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Assessment of Aquaculture Knowledge and Identification of Training Needs of the Fish Farmers in Bangladesh

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Abstract: The present study was carried out to determine the knowledge and training needs of the fish farmers on aquaculture practices and to explore the relationship between the selected characteristics of the fish farmers and their knowledge and training needs. Five villages, namely sutiakhali, vabokhali, boyra, gouripur and mirzapur under Bangladesh Agricultural University Extension Centre (BAUEC) command area were the locale of the study. Fifty fish farmers, 10 from each village were randomly selected as a sample of the study. Data were collected from the sampled fish farmers by using a pre-tested and finally refined structured interview schedule through the personal interview method. Pearson's Product Moment Correlation Coefficient (r) was computed to explore the relationship between the selected characteristics of the respondents and their knowledge and training needs on aquaculture practices. Aquaculture knowledge and training needs of the fish farmers were the focus variable and selected ten characteristics of the respondents constituted the explanatory variables of the study. About 10% of respondents had high aquaculture knowledge, 22% had medium knowledge, 52 had average knowledge and 16% of respondents had low knowledge of carp polyculture. The average knowledge score of the surveyed fish farmers stood at 2.43 which imply that the BAUC fish farmers have low aquaculture knowledge needing immediate training and extension support to continue fish culture operations on a profitable basis. The training needs for 'stocking densities', ranked first, 'species selection' was second, ' sampling and growth monitoring' was third, 'pond biology', was fourth and Fish production planning' was fifth. Correlation analyses indicated that five characteristics of the fish farmers, namely household size, farm size, annual income, organizational participation and training received had significant positive relationships with their knowledge and training needs on aquaculture. The age, years of schooling and communication exposure showed no significant relationships with their aquaculture knowledge and training needs and showed a negative trend.

Key words: Fish Farming · Training Needs · Aquaculture · Bangladesh

INTRODUCTION

Bangladesh ranked 3rd in freshwater fish production, 5th in aquaculture production and 11th in marine fish production in 2018 [1]. Bangladesh is now self-sufficient in fish production and has begun to gain global recognition as one of the top fish-producing countries [2]. This fisheries sector plays an important role in the agro-based economy of Bangladesh, by providing food and nutrition, alleviating poverty, creating employment opportunities and earning foreign currency [3]. It has around 4.69 million hectares of inland water bodies comprising rivers, ponds, beels, boar, Kaptai Lake, floodplains, etc. [4]. Fisheries resources in Bangladesh include inland open-water bodies of 3910053 ha and inland closed-water bodies of 4699354 ha [2, 5]. During 2013-14 the total fisheries production in Bangladesh was 3548115 MT with which inland fisheries and marine fisheries comprising 2952730 MT and 595385 MT accounted for 83.22% and 16.78% of the total production respectively [5].

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Self-sufficiency in food production is of paramount importance for Bangladesh, as many small farmers cannot grow enough to sustain themselves around the year. Raising fish offers a solution to these problems. Most of the fish farmers in our country do not get actual benefits from polyculture, due to a lack of proper knowledge in ponds site selection, water quality management, aquatic weed control, predators control, fish health management and adequate feed supply in a pond. In these circumstances, fish farmers are not able to maximize their total production due to the continuous changing of fisheries technologies. Adequate fish production skills and competencies are needed for use of those technologies by the fishers. For this reason, time demands to arrange training programs to improve the knowledge and skills of the fish farmers in different aspects of improved polyculture. Before planning and conducting training, it is necessary to determine the training needs of the fish farmers so that an appropriate course curriculum and syllabus could be prepared for the need-based training on carp polyculture and allied fields.

Generally, training is the process of improving knowledge and skills and changing the attitude of an incumbent toward doing a specific job properly [6]. Well-trained fish farmers can augment fish production and make efficient use of available resources. Training is the singular factor affecting individuals' attitudes, productivity, improvement and minimization of risks. So, adequate training is essential for the fish farmers on polyculture fish farming. Consequently successful practice for polyculture also greatly depends on appropriate training.

Considering the enormous importance of fish farmers as producers of quality food and nourishers of the rural economy, the present study has been undertaken to determine the aquaculture knowledge and training needs of the fish farmers on polyculture with some socio-economic attributes such as age, year of schooling, household size, farm size, annual income, organizational participation, communication exposure and training received on aquaculture. And explore the relationship between the selected characteristics of the fish farmers and their extent of knowledge and training needs in aquaculture.

MATERIALS AND METHODS

Study Area: The study was conducted in Bangladesh Agricultural University Extension Center (BAUEC) command area. BAUEC command area has 1382 members and 43 societies. From among the BAUEC command area, Sutiakhali, Vabokhali, Boyra, Gouripur and Mirzapur villages were purposively selected for the study.

The Rationale for the Research Site: These villages were purposively selected because; aquaculture activities were more intensified in these villages than in other areas of BAUEC. The selection was made based on suggestions made by BAUEC field staff and other relevant officials of Mymensingh Sadar.

Sampling Design: The total number of farmers in the BAUEC command area stands at 1382. But a very small proportion of them have a fish pond. A list of all fish farmers in the selected villages was prepared to make it a sample frame. In the second step, 10 fish farmers from each of the five villages were selected through random sampling. Only 50 fish farmers were selected in this way which constituted the sample for this study.

Research Instrument: A structured interview schedule was carefully prepared to keep the objectives of the study in mind. The questions and statements contained in the schedule were simple, direct and easily understandable by the respondents. The schedule contained mainly closed-form questions. Scales were included in the schedule, wherever necessary. It was pre-tested by some fish farmers. Based on the pre-test necessary corrections were made to the final interview schedule.

Methods and Procedure of Data Collection

The Survey: In the survey, two trained enumerators along with the researcher himself collected data from 50 fish farmers through personal interviewing. The researcher first established rapport with the respondents and clearly explained the objectives of the study using the local language as far as possible. As a result, the respondents furnished proper responses to the questions without any hesitation. The questions were clarified whenever any respondent had difficulties in understanding. Excellent cooperation was received from the respondents and other people in the study area. No serious difficulty was faced by the researcher in collecting data.

Processing of the Primary Data: Collected primary data were coded, recorded and transferred into SPSS (Statistical Package for Social Science) software package (16.0 Version). This package helps to perform a wide range of statistical analyses.

Processing of the Secondary Data: To develop the conceptual basis of the study, the researcher collected information from different relevant sources, such as books, journals, thesis, abstracts, reports and the internet. The researcher also collected documents from various organizations like Bangladesh Fisheries Research Institute (BFRI), Bangladesh Agricultural University Extension Centre and District Fisheries Office, Mymensingh.

Measurement of the Variables

Measurement of Explanatory Variables: The explanatory variables of this study were 8 selected characteristics of the fish farmers. These were age, years of schooling, household size, farm size, annual income, organizational participation, communication exposure, social mobility, credit received and training received. The procedures followed in measuring these variables are briefly discussed below.

Age: The age of a respondent was measured in terms of actual complete years from his birth to the time of the interview. A score of one was assigned for each year of age.

Years of Schooling: Education was measured in terms of one's year of schooling. One score was given for passing each level in an educational institution [7]. For example, if a respondent passed the degree examination, the educational score was given as 16. If a respondent did not know how to read and write, his educational score was given as 0.

Household Size: The household size of a fish farmer was determined by the total number of members in his/her family including the dependent members. The total number of family members was considered as the family size score of a respondent. For example, if a respondent has 4 members in his/her family, his/her family size score was 4.

Farm Size: The farm size of a respondent referred to the total area of land on which his/her family carried out farming operations, the area being in terms of full benefit to the family.

Annual Income: Annual family income was the total financial return of a family from cereals crops, vegetables, cash crops, poultry, cattle, fisheries, services, business and others in one year. The earnings from these sources were added together for the computation of the annual family income score.

Table 1: Organizational participation scoring system

Nature of participation	Score assigned
Participation as a poor member	1
Participation as an ordinary member	2
Participation as an executive member	3
Participation as president/secretary	4

Organizational Participation: The organizational participation of a respondent was measured by computing an organizational participation score according to his nature and duration of participation in seven (7) selected different organizations up to the time of the interview (Table 1). The organizational participation score of a respondent was measured by using the following formula:

$$\text{Organizational participation score} = P \times D$$

where
P = Participation score
D = Duration score

The participation score was computed in the following manner

The organizational participation score was assigned as 1 for each year of subject to a maximum of 10 for participation for 10 years or more in an organization. The organizational participation score of a respondent was obtained by multiplying his/her participation score and his/her duration of participation score and then adding his scores for all the organizations he/she participated. This score could range from 1 to 28, where, one (1) indicated poor organizational participation and 28 indicated the highest level of organizational participation.

Communication Exposure: Communication exposure of a respondent was measured by the total scores of extension media contact based on his/her nature of contact with 12 selected extension media. Each respondent was asked to indicate the frequency of his/her contact with each of the 12 selected extension media (Table 2). Weights were assigned to his/her response to all the media in the following way.

The extension media contact score of a respondent was determined by summing the weights of all the extension media. The extension media contact scores of the respondent could range from 1 to 48, where 1 (one) indicated poor extension media contact at all and 48 indicated the highest level of extension media contact.

Table 2: Communication exposure

Sl.No.	Name of the media	Scoring unit
A. Personal media contact		
1.	Upazila Fisheries Officer (UFO) (per year)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
2.	Local Extension Agent for Fisheries (LEAF) (per month)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
3.	NGO field workers (per month)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
4.	Local/village leaders (per month)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
5.	Local/village leaders (per month)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
B. Group media contact		
6.	Result demonstration (meeting per year) (times/3 months)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
7.	Method demonstration (meeting per year)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
8.	Group discussion (meeting per three months)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
C. Mass media contact		
9.	Listening to agricultural programs on the radio (per week)	1time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
10.	Viewing agricultural programs on television (per week)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
11.	Reading daily newspaper (per week)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4
12.	Bulletin/leaflet (per year)	1 time = 1 1-2 times = 2 3-4 times = 3 5 or more times = 4

Table 3: Scores and knowledge grading system of fish farmers

Sl No.	Range of score	Grading system	Knowledge category
1	75-100% correct answer	3.5- 4.0	High knowledge
2	50-74% correct answer	3.0- 3.4	Medium knowledge
3	35-49% correct answer	2.0- 2.9	Average knowledge
4	20- 34% correct answer	1.0-1.9	Low knowledge

Training Received: Training received was measured by the total number of days a respondent attended different training programs in her/him life from different organizations [8].

Measurement of Aquaculture Knowledge and Training Needs: Knowledge and Training needs of the fish farmers on pond aquaculture practices were the focus variable of the present study. To measure the training needs of the fish farmer on Carp polyculture, 10 dimensions of fish culture were included. A similar methodology was used for the polyculture of carp by Begum [9].

Aquaculture knowledge of the selected fish farmers was assessed by asking them a set of six questions on each of the 10 components of aquaculture. Here, knowledge is measured by the incumbent's expressed response on Remembering, Understanding, Applying, Analyzing, Evaluating and Creating capabilities of a selective topic which is collectively recognized as cognitive behavior. Fish farmer's knowledge was arbitrarily graded into 4 categories as High knowledge (3.5-4.0), Medium knowledge (3.0- 3.4), Average knowledge (2.0-2.9) and Low knowledge (1.0-1.9) as per the following criteria (Table 3):

The selected dimensions of pond fish farming were measured on a four-point rating scale. Scores were assigned as 4, 3, 2 and 1 for 'high', 'medium', 'average' and 'low knowledge and training needs, respectively. The scores of all items of each dimension were added to obtain the total score of a single dimension. Finally, scores of all 10 dimensions formed the total score of the training needs on aquaculture of fish farmers for each respondent. Thus, the total score of each respondent for 10 components collectively could range from 10 to 240, where 10 indicated 'poor knowledge and 240 indicated 'high knowledge.

Training Needs Assessment (TNA): Training need was assessed based on the gap between the desired level of the farmer's knowledge and the present level of knowledge of the incumbent. Low aquaculture knowledge is indicative of high training needs. More aquaculture knowledge less is the training need as per the following criteria (Table 4):

Table 4: Training needs assessment criteria

Sl No.	Knowledge category	The extent of training need
1	High knowledge (Score: 3.5-4.0)	No training need
2	Medium knowledge (Score:3.0-3.4)	Low training need
3	Average knowledge (Score: 2.0-2.9)	Medium training need
4	Low knowledge (Score: 1.0- 1.9)	High training need

Data Analysis: The collected data were coded, complied with, tabulated and analyzed following the objectives of the study. Qualitative data were converted into quantitative data utilizing suitable scoring wherever necessary. Descriptive statistics such as range, mean and standard deviation were used for describing the variables of the study. Pearson's Product Moment Correlation Co-efficient was used to explore the relationships between any two concerned variables. The analysis of data was performed by using SPSS (Statistical Package for Social Sciences) computer program. Throughout the study, at least five percent (0.05) level of probability was used as a basis for rejecting a null hypothesis.

RESULTS

In this chapter, the findings of the study and their interpretations have been conveniently presented according to the objectives of the study. Results have been discussed concerning other similar studies whenever applied. The chapter has been divided into three sections. The first section dealt with the selected characteristics of the fish farmers. The dependent variable of the study has been discussed in the second section and in the third section; the relationship between the dependent and independent variables of the study.

Characteristics of the Fish Farmers: Some of the selected characteristics of the fish farmers had a pronounced influence on their aquaculture knowledge and training needs. In the present study, 8 characteristics of the fish farmers were selected as independent variables, which included age, years of schooling, household size, farm size, annual income, organizational participation, communication exposure and training received.

Age: The age of the fish farmers ranged from 20 to 70 years with an average of 46.76 years and a standard deviation of 11.20 years. Based on their age, the fish farmers were classified into three categories young (up to 40), middle age (40-60) and old aged (>60) are presented in Table 5. Data contained in Table 5 revealed that (68.0%) of the fish farmers were middle-aged, 22.0% of them belonged to the young age category and 10.0% of the fish farmers belonged to the old age category having an age above 60 years.

It is expected that middle-aged and young fish farmers (90.0%) were more active, energetic and enthusiastic in fish culture. They were the pioneer to adopt new ideas and technologies but old people are difficult to be motivated for the adoption of improved cultural practices. Since the majority of the fish farmers were young to middle-aged, so there is a possibility of using improved management practices in aquaculture.

Years of Schooling: Years of schooling of the fish farmers ranged from 0 to 16 years of schooling with an average of 5.44 and a standard deviation of 4.56 based on their level of education, the fish farmers were classified into five categories as no (0) primary (1-5), secondary (6-10), higher secondary (11-12) and degree (12-16) are presented in Table 5. Data revealed that 76.0% of the fish farmers had a level of education between 6 to 10 years of schooling, whereas 8% of them had no level of education and 16% of them had a higher secondary level of education. So, most of the respondents were literate. It might help to improve their knowledge of aquaculture.

Household Size: The household size of the respondents ranged from 2 to 12 members, with an average of 5.18 and a standard deviation of 1.53. Based on their household size, the respondents were classified into three categories small (up to 4), medium (5 to 6) and large (>6) size family is shown in Table 5. Data reveal that 64.0% of the respondents possessed medium size family, 22.0% had a small family and 14.0% had a large family. It is assumed that the respondents having a medium family can spend more time in aquaculture after completion of household activities.

Farm Size: Among the farmers, the smallest farm size was found to be 27 decimals and the largest was 200 decimals with an average of 66.3 decimals and a standard deviation of 52.16. Based on farm size, the respondents were classified into three categories following the classification and shown in Table 5. Data indicated that the proportion (16.0%) of the farmers belonged to the marginal farm size category compared to 56.0% having small farm size and only 28.0% having medium farm size. It was found that most of the respondents were in the small farm-size category. The farm size of the people is being decreased day by day to land fragmentation from generation to

Table 5: Salient features of the selected characteristics of the respondents

Characteristics (Measurement units)	Scoring system	Range		Respondents			
		Possible	Observed	Category	Percent (N=50)	Mean	SD
Age	Actual Year	Unknown	20-70	Young (up to 40)	22. 0		
				Middle-aged (40-60)	68.0		
				Old (>60)	10.0	46.76	11.20
Years of schooling	Years of schooling	Unknown	0-16	No	8.0		
				Primary (1-5)	60.0		
				Secondary (6-10)	16.0		
				Higher Secondary (11-12)	12.0		
				Degree (12-16)	4.0	5.44	4.56
Household size	No. of members	Unknown	2-12	Small (up to 4)	22.0		
				Medium (5-6)	64.0		
				Larger (> 6)	14.0	5.18	1.53
Farm size	Decimal	Unknown	25-200	Marginal (1-27)	16.0		
				Small (28-60)	56.0		
				Medium (>61)	28.0	66.3	52.16
Annual income	Tk. '000'	Unknown	60-200	Low (up to 90)	02.0		
				Medium (91-150)	20.0		
				High (>150)	78.0	180.36	58.95
Organizational participation	Scale score	1-28	1-15	Low (up to 8)	88.0		
				Moderate (9-15)	12.0	5.32	3.28
Communication exposure	Scale score	1-48	7-40	Low (up to 14)	30.0		
				Medium (15-29)	62.0		
				High (>29)	08.0	18.28	8.61
Training received	No. of days	Unknown	0-20	Short-term (up to7)	82.0		
				Mid-term (8-15)	16.0		
				Long-term (>15)	4.0	4.38	4.36

generation. Despite the scarcity of available land, the fish farmers of the study might have an interest in aquaculture for increasing fish production.

Annual Income: The annual income of the respondents ranged from TK. 6000 to TK. 200000 with an average of 18000 and a standard deviation of 58.95 thousand. Based on annual income, the respondents were divided into three categories as low (up to 90), medium (91-150) and high (>150). The distribution of the annual income of the fish farmers is presented in Table 5. Data revealed that 20.0% had medium annual income, 78.0% had high family income and 2.0% of them had low annual income. Findings indicate that all (98.0%) the fish farmers had medium to high family income. Since most of the respondents had medium to large family sizes, more earning members in the family and small to medium farm sizes, the family income tended to be medium to high.

Organizational Participation: The organizational participation score of the respondents ranged from 1 to 15 with an average of 5.32 and a standard deviation of 3.28. Based on organizational participation the respondents were divided into two categories as low (up to 8) and moderate (9-15) were presented in Table 5. Data furnished in Table 5 indicate that none of the fish farmers had high participation, while 12.0% had moderate participation and 88.0% had low participation in aquaculture organizations. Findings show that the highest 88.0% of the fish farmers were found to have low involvement in organizations for a short period; it implies that their mobility and participation in development activities are limited to a greater extent. This is not good for the adoption of improved cultural practices for aquaculture.

Communication Exposure: The communication exposure score of the respondents ranged from 6 to 40 with an average of 18.28 and a standard deviation of 8.61. Based on their communication exposure, the fish farmers were classified into three categories as low (up to 14), medium (15-29) and high (>29) are presented in Table 5. Data contained in Table 5 indicate that 62.0% of the fish farmers had medium communication exposure compared with 30.0% having low communication exposure and 8.0 % having high exposure. The findings indicated that the fish farmers had moderate contact with various extension teaching methods.

Table 6: Aquaculture knowledge of the fish farmers on 10 selected components of pond fish culture (n=50)

Components	Rem.	Und.	Apl.	Ana.	Eva.	Creat.	Total Av. score	Remarks
Pond biology	3.0	2.1	1.9	1.8	1.0	1.0	1.80	Low
Pond preparation	3.3	3.0	3.5	3.2	2.3	3.1	3.06	Medium
Species selection	2.1	2.0	2.0	1.1	1.5	1.0	1.62	Low
Stocking densities	1.0	2.1	1.2	2.1	1.52	1.3	1.53	Low
Pond fertilization	3.2	2.7	2.6	2.7	2.5	3.2	2.81	Average
Fish feeding	3.0	3.1	2.7	2.3	2.9	2.8	2.80	Average
Sampling for growth monitoring	2.1	2.0	1.7	1.5	1.0	2.0	1.72	Low
Prevention and control of fish disease	3.5	3.1	3.2	3.4	3.1	3.0	3.21	Medium
Fish harvesting & marketing	3.7	3.1	3.1	3.2	3.2	3.4	3.22	Medium
Fish production planning	3.1	3.0	2.2	2.0	1.9	3.3	2.52	Average
Average score	2.93	2.66	2.36	2.30	2.12	1.94	2.43	Average

Rem. = Remembering, Und.= Understanding. Apl. = Applying, Ana.= Analyzing
Eva.= Evaluating, Cre.= Creating

Table 7: Distribution of farmers according to their aquaculture knowledge score (n=50)

Characteristics (Knowledge score)	Fish farmers		Mean ± SD
	Nos.	(%)	
Low knowledge (1.0- 1.9)	8	16	2.43
Average knowledge (2.0- 2.9)	26	52	
Medium knowledge (3.0- 3.4))	11	22	
High knowledge (3.5- 4.0)	5	10	

Training Received: Training received by the respondents in the study area ranged from 0 to 20 with an average of 4.38 and a standard deviation of 4.36. Based on the training received, the respondents were classified into three categories as short-term training (up to 7), mid-term (8-15) training received and long-term (>15) training received are presented in Table 5. Data revealed that 82% of the respondent received short-term training, 2.0% received long-term training and 16% of them had received mid-term training. The majority of the fish farmers (82%) had short-term training experience. This endeavor is not enough for practicing modern aquaculture by fish farmers.

Aquaculture Knowledge and Training Needs of the Fish Farmers: The component-wise average aquaculture knowledge score of the respondents is presented in Table 6 and Table 7. As per our scoring system, the score of a fish farmer under each of six sub-levels of the cognitive domain such as remembering, understanding, applying, analyzing, evaluating and creating aspects could vary from 0 to 4. As there were 6 sub-levels, so a respondent could obtain a total score of 0 to 24 in each component of carp polyculture practices. It could be seen from the data in Table 6 that the average scores of the surveyed fish farmers covering all six aspects of cognitive domain against pond biology, pond preparation, species selection, stocking density, pond fertilization, fish feeding, sampling for growth monitoring, prevention and control of disease, fish harvesting and marketing and fish production planning averaged 1.80, 3.06, 1.62, 1.53, 2.83, 2.80, 1.72, 3.21, 3.22 and 2.52, respectively. When all these scores are added together and divided by the number of components (10 components), then the final average score stands at 2.43 which is considered to average level of aquaculture knowledge. This level of knowledge score (2.43) indicated that the surveyed farmers possessed 60.75% of the total possible score out of 100. Data contained in Table 7 showed that fish farmers had low knowledge of pond biology (1.80), species selection (1.62), stocking densities (1.53) and sampling for monthly growth monitoring (1.72). Farmers were found to have average knowledge of pond fertilization (2.83), fish feeding (2.80) and fish production planning (2.52). Farmers' medium knowledge was found to be mostly concentrated on pond preparation, prevention and control of fish diseases and fish harvesting and marketing only.

Relationship Between the Selected Characteristics of the Respondents and Their Knowledge of Fish Culture: In this section, the relationship between the 8 selected characteristics of the farmers with their knowledge of fish culture is explored. Since either a parametric or non-parametric test was used, the test of hypothesis by the coefficient of correlation is shown. The age of the fish farmers had no relationship with farmers' fish culture knowledge. In this way, it can be summarized that farmers' knowledge of fish culture does not depend on their religious affiliation, family size and total income. The aquaculture training experience, extension media contact, education and major profession of the fish farmers were observed to be significant and positively related. Based on this, it appears that aquaculture training

experience, extension media contact, education and major profession are the important characteristics of the fish farmers which influence them to attain and increase aquaculture knowledge. In the present study, the term 'training needs' referred to the necessity of acquiring further knowledge on a specific topic(s) on a selected dimension of pond fish culture which arises from existing deficiency or gap due to lack of the required level of expertise for performing the intended task. Knowledge and training needs of the fish farmers on pond fish farming were the main focus of the present research work. Ten personal attributes of fish farmers in line with six sub-levels of cognitive behavior were selected to measure the knowledge and training needs of the fish farmers on aquaculture. Sixty statements on 10 dimensions of aquaculture each covering six sub-levels of cognitive behavior such as remembering, understanding, applying, analyzing, evaluating and creating aspects were formulated to assess the aquaculture knowledge and training needs of the fish farmers. The 'species selection' and 'stocking densities' were the 2 top most priority areas where all the fish farmers need comprehensive training to remove their misconception about stocking too many species (6-7) and much greater number (80-120) of fish fingerlings. Most of the respondents believed that stocking around 100 fish fingerlings per decimal of pond space would more profitable to them which is wrong and unscientific. 'Fish production planning is another area where the majority of the fish farmers require clear understanding and adequate training to better manage their fish culture operations on a sustainable basis. Monthly fish sampling is important for the determination of the growth performances as well as the health condition of cultured fishes. A great majority of the fish farmers in the studied areas are not aware of the necessity of this important task. As such their knowledge score was very low (Score 1.72 against 4.00) which demands immediate training to boost up knowledge and change their attitude towards scientific methods and management of pond fish farming.

Dimension-wise Training Needs of the Fish Farmers on Aquaculture: Ten dimensions of fish culture were selected to assess the knowledge and training needs of the fish farmers on aquaculture. The computed Training needs an index on aquaculture values of all the dimensions. Data presented in Table 8 indicated that the knowledge and training needs of the fish farmers in aquaculture

Table 8: Dimension-wise knowledge and training needs of the fish farmers on aquaculture

Dimensions on aquaculture	Knowledge score	Training need index	Rank
Stocking densities	1.53	High	1
Species selection and species combinations	1.62	High	2
Sampling and growth monitoring	1.72	High	3
Pond biology	1.80	High	4
Fish production planning	2.52	Moderate	5

Table 9. Relationship between the focus and explanatory variables

Focus variable	Explanatory variables	'r' value with 48 df
Training needs of the fish farmers on carp aquaculture	Age	-0.042
	Years of schooling	-0.031*
	Household size	0.012
	Farm size	0.030
	Annual income	0.144
	Organizational participation	-0.102**
	Communication exposure	-0.114*
	Training received	0.217**

Here, ** Significant at 0.01 level of probability ;* Significant at 0.05 level of probability

Data furnished in Table 8 indicated that the 'knowledge and training needs on stocking density' ranked first followed by 'training needs on species selection and species combination, 'training needs on sampling and growth monitoring were third. Sequentially, 'pond biology was fourth, 'training needs on fish production planning was fifth. It can be mentioned here that all the surveyed fish farmers require re-training on all aspects of pond fish farming. A good number of farmers had expressed their felt need that they wanted to culture Stinging catfish i.e., Shinghi because of its high price, palatable taste and high consumer demands.

Relationship Between the Selected Characteristics of the Fish Farmers and Their Aquaculture Knowledge and Training Needs: The relationship between the focus and explanatory variables has been presented in Table 9. However, the correlation matrix of the variables has been presented to have a clear exploration of the inter-correlation and multi-colinearity among the variables.

Age and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (-0.042) value was no relationship between age and their knowledge training needs on fish culture and followed a negative trend. Hence, the concerned null hypothesis could not be rejected.

Years of Schooling and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (-0.031) value as shown in Table 9 the relationship between the level of education of the fish farmers and their knowledge and training needs on aquaculture was significant at 0.01 level of probability and followed a negative trend. The findings indicated that there was a significant and negative relationship between years of schooling and their knowledge and training needs on aquaculture. There is a negative relationship between years of schooling and the extent of training needs because most of the fish farmers had an educational level of primary to secondary. Education broadens the outlook of people and leads them to explore new ideas to solve problems. It is assumed that respondents having higher education are more progressive and innovative than those illiterate and they could perform better in aquaculture. Thus, it could be said that years of schooling of the fish farmers could play a significant role in extent of training needed on fish culture.

Household Size and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (0.012) value as shown in Table 9 there was no relationship between household size and their knowledge and training needs on aquaculture and followed a positive trend. Hence, the concerned null hypothesis could not be rejected.

Farm Size and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (0.030) value as shown in Table 9 there was no relationship between farm size and their knowledge and training needs on aquaculture and followed a positive trend. Hence, the concerned null hypothesis could not be rejected. The findings indicate that the farm size of the fish farmers had no relationship with their extent of training needs on aquaculture.

Annual Income and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (0.144) value as shown in Table 9 there was no relationship between annual income and their knowledge and training needs on aquaculture and followed a positive trend. Hence, the concerned null hypothesis could not be rejected. The findings indicate that the annual income of the fish farmers had no relationship with their extent of training needs on aquaculture.

Organizational Participation and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (-0.102) value as shown in Table 9 the relationship between organizational participation and their knowledge and training needs on aquaculture was significant at 0.01 level of probability and followed a negative trend. Hence, the concerned null hypothesis could be rejected. The findings indicated that the organizational participation of the fish farmers had a significant relationship with their knowledge and training needs on fish culture.

The findings indicated that the fish farmers were affiliated with different organizations like the school committee, mosque committee, madrasha committee, bazar committee, etc. They become more aware of their training needs. Accordingly, with the increase of the organizational participation of the fish farmers, their training needs on fish culture also increase. Thus, it could be said that the organizational participation of the respondents could play a significant role in the extent of training needs on aquaculture.

Communication Exposure and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (-0.114) value as shown in Table 9 the relationship between communication exposure and the extent of training needs in aquaculture was significant at a 0.05 level of probability and followed a negative trend. Hence, the concerned null hypothesis could be rejected. The findings indicate that communication exposure of the fish farmers had a significant relationship with their extent of training needs on aquaculture.

It is assumed that communication exposure changes their attitude toward the adoption of improved culture practices. Communication exposure enables individuals to come in contact with different kinds of communication media, namely interpersonal, group and mass media. Through increased contact with these information media, the fish farmers are likely to gain more knowledge and skills about aquaculture. Thus, it could be said that the communication exposure of the respondents could play a significant role in their knowledge and training needs on aquaculture.

Training Received and Knowledge and Training Needs on Aquaculture: According to the computed 'r' (0.217) value as shown in Table 9 the relationship between training received and the extent of training needs in aquaculture

was significant at 0.01 level of probability and followed a positive trend. Hence, the concerned null hypothesis could be rejected. The findings indicate that the training received by the fish farmers had a relationship with their extent of training needs on aquaculture.

DISCUSSION

The fish farmers in the studied area were mostly middle-aged (20 to 70 years), having annual incomes ranging from TK. 6000 to TK. 200000. Their education level varied from zero level to degree level, the average being 7 years of schooling. The fish farmers were found to have a total farm size between 25 to 200 decimals with an average holding size of 66.3 decimals. The fish farmers in the studied area had good organizational participation and they had much communication exposure. A similar finding was obtained by Ferdousi, Yesmin, Yeasmin and Hossain [10-13].

The aquaculture knowledge of the respondents was determined based on 10 components of pond fish culture such as Pond Biology, Pond Preparation, Species selection, Stocking densities, Pond fertilization, Feeding, Sampling for growth monitoring, Prevention and control of fish disease, Harvesting and marketing and Fish Production planning. Bloom's taxonomy of education was used to determine the cognitive behavior of the fish farmers which contained 6 sub-levels, such as remembering, understanding, applying, analyzing, evaluating and creating. Four points rating scale was assigned to evaluate the aquaculture knowledge of the incumbent such as high knowledge (3.50-4.0), medium knowledge (3.0-3.49), average knowledge (2.5-2.9) and low knowledge (less than 2.4). The possible score of the fish farmers could vary from 1.0 to 4.0. Similar findings were obtained by Hossain, Sharmin and Sarker [14-16].

The aquaculture knowledge of the fish farmers in the selected areas varied from 1.0 to 4.0 with an average of 2.43 which implies that the fish farmers possessed an average level of fish culture knowledge. Comparatively unsatisfactory knowledge scores of the BAUEC farmers are indicative of the immediate need for further training on all aspects of carp polyculture. As the farmers possessed low knowledge scores on Stocking densities (1.53), Species selection (1.62), Sampling for growth monitoring (1.72), Pond biology (1.80) and Fish production planning (2.52), therefore, it is suggested that BAUEC and Department of Fisheries (DoF) should take concerted efforts to strengthen training and extension support to the BAUEC fish farmers aiming at farmers capacity development to undertake fish culture in a befitting manner. Similar findings were obtained by Gazi, Afique and Bhowmick [17-19].

Correlation analyses indicated that five characteristics of the fish farmers, namely household size, farm size, annual income, organizational participation and training received had positive relationships with their knowledge and training needs on aquaculture. The age, years of schooling, communication exposure and showed relationships with their knowledge and training needs on aquaculture and showed a negative trend. Similar findings were obtained by Rahman and Ahmed [20-28].

CONCLUSION

The fish farmers in the surveyed areas indicated that they need new training on Stinging catfish culture (*Heteropneustes fossilis*) because of its high market demand, lucrative price and good taste. The extension agencies working in the Mymensingh region may come forward to assist the fish farmers to build up their knowledge base and enhance skills to cultivate Shingi catfish in the near future.

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