USE OF FISH FARMING PRACTICES BY THE FISH FARMERS

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A B S T R A C T

The main purpose of the study was to determine the extent of use of fish farming practices by the fish farmers. This study was conducted at three unions named Hapania, Kirtipur, and Tilakpur of Naogaon Sadar upazilla under Naogaon district. Ninety-two (92) fish farmers were randomly selected as sample from an updated list of 120 fish farmers. Data were collected by a pre-tested interview schedule during 20th September to 20th October 2020. Simple and direct questions with different appropriate scales were used to obtain information. Descriptive statistics and multiple regression analysis was used for the present study. Slightly above half (53.3 percent) of the fish farmers had medium use of fish farming practices, while 42.4 percent fish farmers had high use of fish farming practices, and only 4.3 percent fish farmers had low use of fish farming practices. Thus, overwhelming majority (95.7 percent) of the fish farmers had medium to high use of fish farming practices. Pond size, fish farming experience, cosmopoliteness, and extension contacts of the respondents had significant positive contribution with their use of fish farming practices. Coefficients of other selected variables namely age, education, family size, annual income, and knowledge on fish farming didn't have any significant contribution with their use of fish farming practices. 'Lack of government support' emerged as the 1st ranked problem as per opinion given by the fish farmers (77.17 percent). The least problem as per opinion given by the fish farmers was 'High labor cost'.

INTRODUCTION

Fisheries sector play an important role in develop the socioeconomic condition of an agriculturally based country, like Bangladesh. Contribution in fisheries sector of Bangladesh is now well recognized in the world (DoF, 2015). The lives of the Bangladeshi people centre around and depend upon fish, fisheries and water. Bangladesh is a transitional zone of many different flora and fauna because of the geographical distribution and climatic characteristics. The mighty Padma, Meghna, and Jamuna rivers flow through the land and the presence of numerous haor, baor, marsh, swamp, pond, lake make the region suitable place for dwelling huge number of aquatic flora and fauna. The areas of closed and open water resources are 0.79 and 3.91 million ha, respectively (DoF, 2017). There are 260 freshwater fish species in addition to the 23 exotic species and many other vertebrates and invertebrates in the inland waters of Bangladesh (Rahman, 2005). Bangladesh is one of the world's leading fish producing countries with a total production of 42.77 lakh MT in FY 2017-18, where aquaculture production contributes 56.24 percent of the total fish production. Average growth performance of this sector is 5.26 percent for last 10 years whereas inland open water (capture) contributes 28.1 5percent (121.6 lakh MT) and inland closed water (culture) contributes 56.24 percent (24.04 lakh MT) to total production (DoF, 2018).

Bangladesh is one of the 15 leading fish producing countries in the world achieving the 3rd in inland open water capture production and 5th in world aquaculture production (DoF, 2018). Per capita annual fish consumption in Bangladesh is about 19.71 kg, whereas the recommended minimum requirement is 21.90 kg, which indicates the necessity of increasing fish production in the country (DoF, 2016). Freshwater fisheries play a significant role in the livelihoods of rural and poor people in Bangladesh (Mazid, 2002). Fish farming has been proved a profitable and attractive business comparing to the rice or other agricultural cultivations. Therefore, many rice farmers are converting their fields into fish culture ponds (Islam *et al.*, 2002; Islam *et al.,* 2017). A large number of people have improved their socioeconomic conditions through fish farming activities in Bangladesh (Ara, 2005). Fish is the primary source of animal protein for Bangladeshi population, especially poor rural households. About 60 percent animal protein comes from fish (BER, 2015). Pond culture represents the mainstay of aquaculture in Bangladesh, accounting for 85.8 percent of total recorded production and 57.7 percent of the area under culture (DoF, 2010). Aquaculture is one of the fastest growing food producing industries in the world over the last 25 years, and the growth rates were between 6 and 14 percent during the last 10 years (Chan *et al.*, 2017). The sector has the potentials of improving human dietary standards by supplementing protein rich food, contributing to 60 percent of protein of animal sources at present in Bangladesh, and diversifying rural production and aquaculture potential (Dhawan *et al.*, 1998; Toppo, 2016).

The aquaculture sector is growing very fast in Bangladesh due to increase in demand for fish and heading towards intensification (DoF, 2017). On the contrary, production is declining in the capture fisheries because of water pollution, over fishing, high population, habitat destruction, sedimentation, tidal control projects, large scale reclamation of rivers, crop production in haors, beels and other depression areas, construction of barrage and water diversion etc. (Aguero, 1989; Flowra *et al.*, 2011). Therefore, the necessity of increasing fish production in closed waters by aquaculture is increasing day by day. Department of Fisheries (DoF) is trying to disseminate fisheries innovation to the fish farmers. On these considerations, the present researcher felt necessity to conduct this research on "Use of fish farming practices by the fish farmers". The study was conducted with the following objectives; i) to describe some selected characteristics of the fish farmers; ii) to determine the extent of use of fish farming practices by the fish farmers; iii) to explore the contributions of the selected characteristics of the fish farmers with their use of fish farming practices; and iv) To identify the problems faced by the fish farmer in fish farming.

MATERIALS AND METHODS

Selection of the Study Area

This study was conducted at three unions named Hapania, Kirtipur, and Tilakpur of Naogaon Sadar upazilla in Naogaon district.

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Sampling Design

Naogaon Sadar upazilla under Naogaon district is purposively selected where the government of Bangladesh has been implementing National Agricultural Technology Programm- Phase II project (NATP-2) with the help of Ministry of Agriculture (MOA), lead Ministry and Ministry of Fisheries and Livestock (MOFL). Three unions were randomly selected from 12 unions under Naogaon Sadar upazilla. An up-to-date list of 120 fish farmers from three unions was collected from upazilla fisheries office of Naogaon Sadar upazilla under Naogaon district who were beneficiaries under National Agricultural Technology Programm- Phase II project (NATP-2) constitutes the population. Ninety two (92) fish farmers were selected as sample by using following formula (Kothari, 2004):

$$n = \frac{Z^2 \text{P Q N}}{(N-1)e^2 + Z^2 \text{P Q N}}$$

Where,

n= Sample size
Z= 1 the value of the standard normal variable at the chosen (95 percent) confidence level (1.96)
P= Probability (assume .5)
Q = Remaining from probability (1-P)
N = Total population
e = the level of precision (5percent)

A reserved list of 9 fish farmers was prepared who were supposed to be interviewed only when a respondent in the original sample list was unavailable during data collection.

Research Instrument and Data Collection

In order to collect relevant data for the study, a structured interview schedule was prepared keeping the objectives in mind. The questions and statements contained in the schedule were simple, direct and easily understandable by the respondents. The schedule contained closed and open form of questions. A draft interview schedule was prepared in advance before using the same for collection of data. The draft schedule was pre-tested with 10 respondents selected from the study area. This pre-test facilitated the researcher to identify faulty questions in the draft schedule and necessary corrections, addition and adjustment was made afterwards in the schedule on the basis of the pre-test results. Data were collected from the farmer through personal interviewing.

Data Processing and Analysis

First of all, the collected data were coded, summarized and processed for analysis. All possible errors and inconsistencies were eradicated for verification of the data. Then the collected data were analyzed with a computer-based software - SPSS (Statistical Package for Social Sciences) version 22, and tables and graphs were prepared with MS Excel (Microsoft Excel 2010).

Measurement of Variables

The nine selected characteristics of the respondents namely age, education, family size, pond size, annual income, fish farming experience, cosmopoliteness, extension contact and knowledge on fish farming constituted the independent variables of this study. These selected characteristics were measured by appropriate measurement techniques. Use of fish farming practices by the fish farmers was the dependent variable. To operationalize the variable, twelve fish farming practices were identified through field survey, consultation with fish farmers and upazilla fisheries officer of study area. These twelve practices were to measure the extent of use of fish farming practices by the fish farmers. Use of fish farming practices by the fish farmers was measured by a four-point rating scale. The respondents were asked to indicate for each of the practices whether they 'frequently', 'occasionally', 'rarely', and 'not at all' with a corresponding score of 3, 2, 1 and 0 respectively (Islam, 2010). The score against each of these twelve practices were added together to obtain a total practice score. Hence, scores of the respondents could range from 0 to 36; where 0 indicating no use fish farming practices while 36 indicating highest level of use fish farming practices.

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RESULTS AND DISCUSSION

Selected Characteristics of the Fish Farmers

Age

In the study area, majority (43.4 percent) of the fish farmers were middle aged, 19.6 percent of them belonged to young age category and 37.0 percent of the fish farmers belonged to the old age category (Figure 1). This means that fish farming in the study area is being managed by comparatively younger fish farmers. The age of fish farmers has a vital impact on labor and also on their opinions of the future. Jahan *et al.,* (2018) observed that more than half of the farmers (55.80 percent) were found in the 41-60 years age group, while 16.70 and 27.50 percent of farmers were fell into the age groups 20-40 and above 60 years, respectively. The causes of differential participation of farmers of various age-groups in aquaculture are likely to be personal choice, ease of operation, physical capabilities, social interactions etc. (Mia *et al.*, 2015).
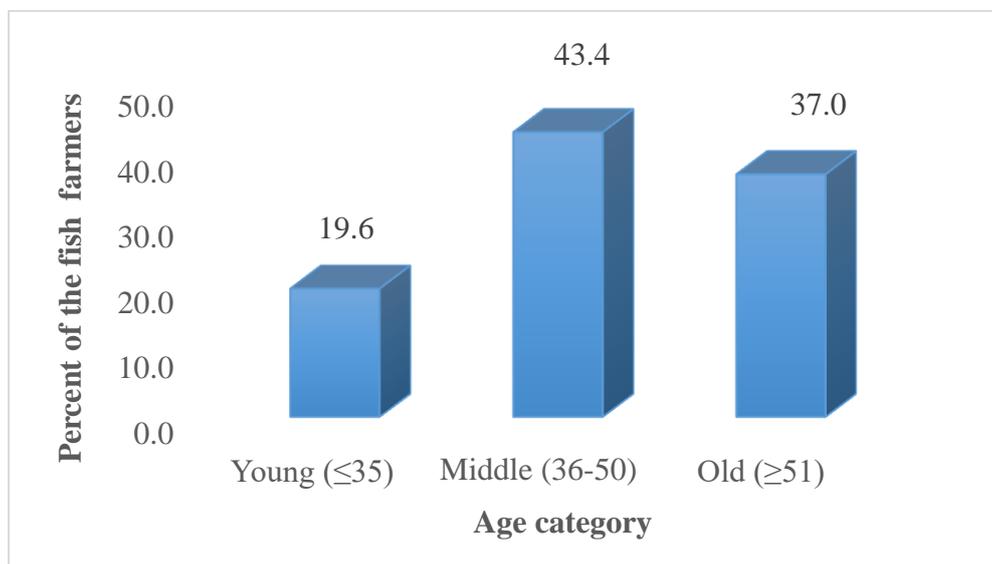

Figure 1. Distribution of the respondents according to their age

Education

Data revealed that majority (46.7 percent) of the fish farmers had secondary level, where 21.7 percent of them having primary level of education, 17.4 percent of them having percent can sign only and only 14.2 percent of them having above secondary level of education. so, most of the respondents were in only secondary level education (Table 1). It indicates that educated persons, even graduates, are being involved in fish aquaculture in the recent time as aquaculture is a profitable business (Jahan *et al.,* 2018).

Table 1. Distribution of the respondents according to their education

Observed range	Education category	Respondents	
		Number	**Percent**
0.5-17	Can sign only (0.5)	16	17.4
	Primary level (1-5)	20	21.7
	Secondary level (6-10)	43	46.7
	Above secondary level (≥11)	13	14.2

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Family size

Data reveal that majority (45.7 percent) of the respondents possessed both small and medium family size and 8.6 percent had large family. However, majority (91.4 percent) of the respondents had small to medium family size (Table 2). The family size is closely related to income. The size of the family has a direct control on the expenditure and income patterns of the family. At the same time as the fish production is a labor-intensive activity hence family size influences the fish production (Jahan *et al.,* 2018).

Table 2. Distribution of the respondents according to their family size

Observed range	Family size category	Respondents	
		Number	**Percent**
	Small family (1-4)	42	45.7
3-9	Medium family (5-6)	42	45.7
	Large family (≥7)	8	8.6

Pond size

Data presented in Figure 2 reveal that slightly above half (54.3 percent) of the fish farmers had medium ponds while 31.5 percent of them had small ponds and 14.2 percent had large ponds. Thus, Overwhelming majority (85.8 percent) of the fish farmers had small to medium ponds. Jahan *et al.,* (2018) and Abdullah (2013) support this result. Thus, Overwhelming majority (84.6 percent) of the fish farmers had small to medium ponds. Decisions regarding the use of fish farming practices in study area are, therefore, anticipated to be considerably motivated by the small and medium size fish farmers.
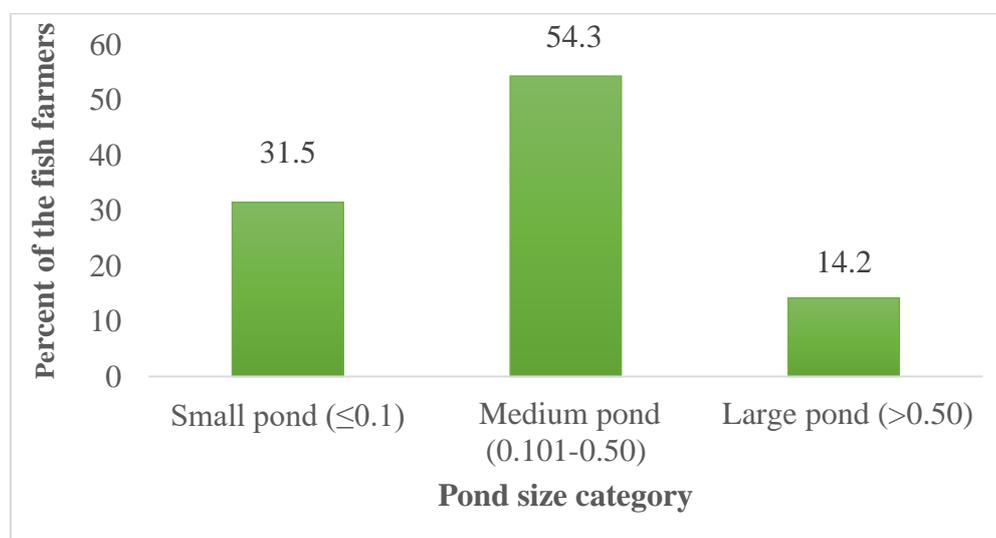

Figure 2. Distribution of the fish farmers according to their pond size

Annual income

Data presented in Figure 3 showed that the majority (76.0 percent) of the fish farmers had medium income compared to 12.0 percent of them having both high income and low income. Rahaman (2010) also found close findings in his study. Thus, the huge majority (88.0 percent) of the fish farmers had medium to high income indicating that fish farming is usually practiced by the fish farmers of comparatively medium economic standings.
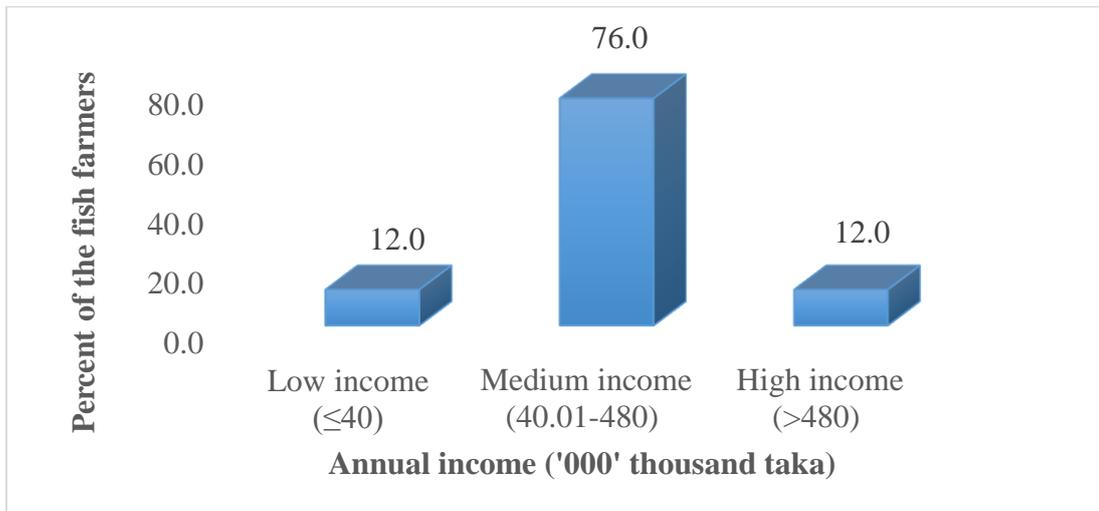
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Figure 3. Distribution of the respondents according to their family income

Fish farming experience

Data reveal that slightly above three-fifth (77.2 percent) of the fish farmers had medium experience while 14.1 percent of the fish farmers had high fish farming experience and lowest proportion (8.7 percent) of the respondents had low fish farming experience (Figure 4). Thus, the huge majority (91.3 percent) of the fish farmers had medium to high fish farming experience. Haque (2014) found similar findings in his studies.
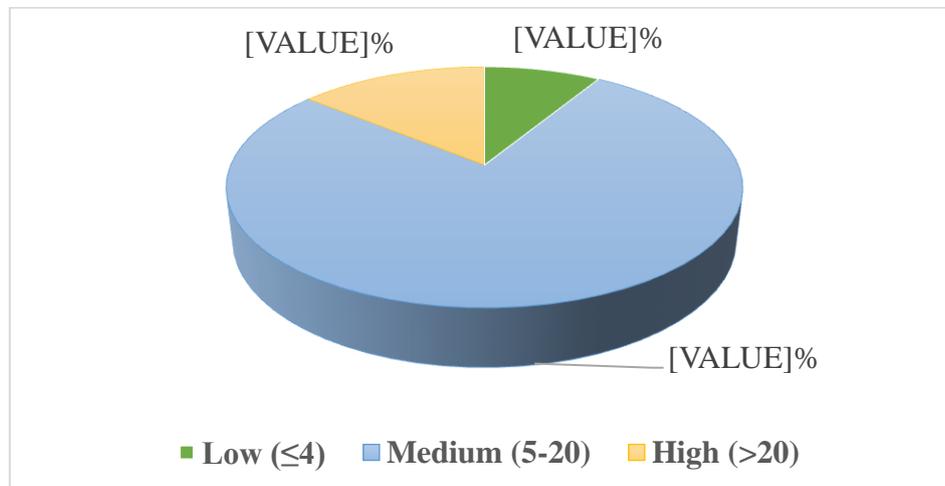

Figure 4. Distribution of the respondents according to their fish farming experience

Cosmopoliteness

Data contained in the Table 3 shows that majority (67.4 percent) of the total respondents had medium cosmopoliteness as compared to 27.2 percent having low and only 5.4 percent had high cosmopoliteness. Rahaman (2010) also found similar findings in his study. Data also revealed that overwhelming majority (94.6 percent) of the respondents were under low to medium cosmopoliteness. It implies that their cosmopoliteness in development activities is limited to a greater extent. However, which is not promising for adoption of improved fish farming practices.

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Table 3. Distribution of the respondents according to their cosmopoliteness

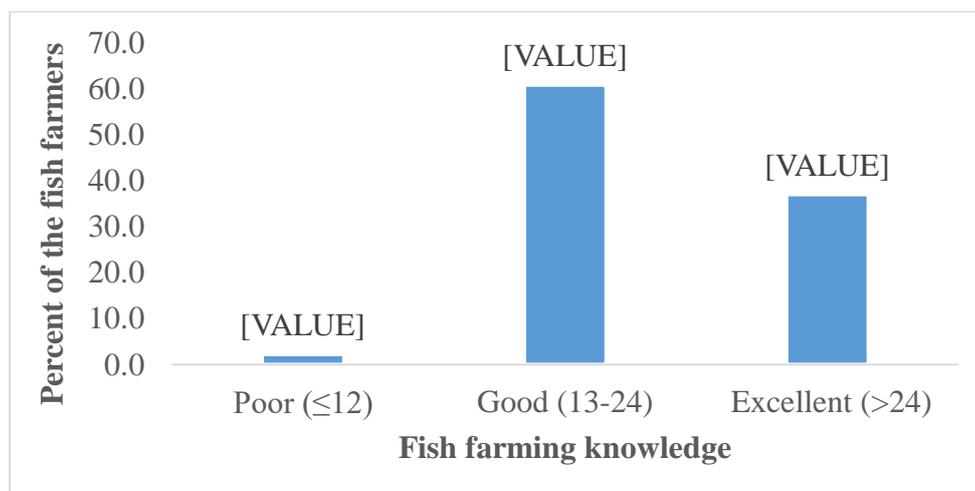| Observed range	Categories	Respondents	
		Number	**Percent**
3-16	Low (≤6)	25	27.2
	Medium (7-12)	62	67.4
	High (>12)	5	5.4

Extension contacts

Data contained in Table 4 indicated that the highest proportion (65.2 percent) of the fish farmers had medium extension contact as compared to 27.2 and only 7.6 percent having low and high extension contact respectively. Abdullah (2013) and Rahaman (2010) also found close findings in their study. Thus, huge majority (92.4 percent) of the fish farmers had low to medium extension contact. Extension contact is a very effective and powerful source of receiving information about various new and modem technologies. The status of no or having low and very low contacts might have significant impacts on the practice of the fish farmers.

Table 4. Distribution of the respondents according to their extension contact

Observed range	Categories	Respondents	
		Number	Percent
6-28	Low (≤11)	25	27.2
	Medium (12-22)	60	65.2
	High (>22)	7	7.6

Fish farming knowledge

Data contained in Figure 5 indicated that slightly above three-fifth (60.8 percent) of the fish farmers had good fish farming knowledge as compared to 37.0 and only 2.2 percent having excellent and fish poor farming knowledge respectively. Haque (2014) found close findings in his studies. Thus, huge majority (97.8 percent) of the fish farmers had good to excellent fish farming knowledge. It can be concluded that though fish farmers are aware of routine and general practices, they lack adequate knowledge on scientific fish farming. The reason may be low education and poor communication characteristics.

Figure 5. Distribution of the fish farmers according to their fish farming knowledge

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Use of Fish Farming Practices by the Fish Farmers

Slightly above half (53.3 percent) of the fish farmers had medium use of fish farming practices, while 42.4 percent fish farmers had had high use of fish farming practices, and only 4.3 percent fish farmers had low use of fish farming practices. Abdullah (2013) also found similar result in his studies. Thus, a proportion of 95.7 percent of the fish farmers had medium to high use of fish farming practices (Figure 6). The result showed a vast opportunuity for fish farmer in use of fish farming practices. If majority of the fish farmers would be more involved in fish farming practices, they could contribute great role in our domestioc economy through fish production. They might also economically solvent through use of modern fish farming practices.
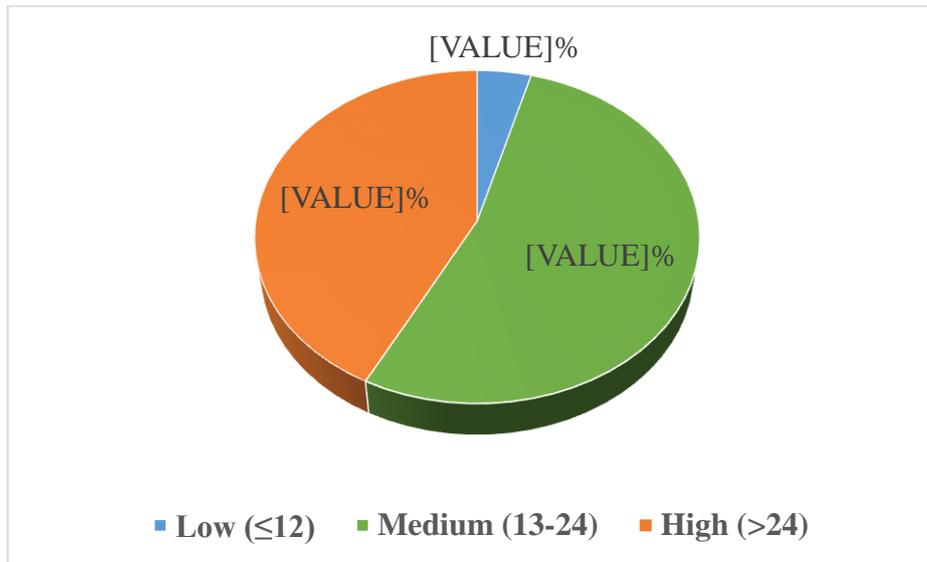

Figure 6. Distribution of the fish farmers according to their use of fish farming practices

Data contained in Table 5 indicated that mean score obtained by fish farmers regarding use of fish farming practices. It is clearly depicted that mean score of twelve (12) fish farming practices were ranged from 1.55 to 2.42. The fish farming practices in which the fish farmers having higher mean score than the overall mean was use of the good quality and healthy seed, as it received first rank. This is due to that only in very recent years fish farmers began to realize the importance of quality seed (e.g., uniform sized seed, pathogen-free seed) to the success of a crop. Production of quality seed should be examined from two perspectives, i.e., existing seed production systems and new seed production systems. Existing seed production systems have mastered the hatchery technology for most of the widely cultivated species (carps, catfish, tilapia), but the industry is yet to perfect the art of producing seed of desired quality (Mohan, 2007). The 2nd two rank jointly maintenance of proper ration of fish species and use of balanced fertilizer. In fish farming, it is necessary to maintain proper ration of fish species for fish production. Balanced fertilizer application in pond is critical to successful fish farming. Fish fertilizers are a source of nitrogen, phosphorus and potassium. Fertilization of aquaculture ponds increases productivity of phytoplankton which is the food base of zooplankton and benthic animals. Plankton, remains of plankton (detritus) and benthos are food for fish and crustaceans (Mischke, 2012). The fish farming practices in which the fish farmers having lower mean score than the overall mean was maintenance of water temperature, followed by soil and water treatment and drainage management.

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Table 5. Mean score of use of fish farming practices by the Fish Farmers

Sl. No.	Name of fish farming practices	Mean	Rank
1.	Soil and water treatment	1.51	11th
2.	Maintenance of pond water depth	1.71	9th
3.	Maintenance of proper ration of fish species	2.02	2.5nd
4.	Maintenance of water temperature	1.55	12th
5.	Use of quality supplementary feed	1.96	5th
6.	Drainage management	1.69	10th
7.	Liming in the pond	2.00	4th
8.	Partial harvesting	1.77	8th
9.	Use of balanced fertilizer	2.02	2.5nd
10.	Use of the good quality and healthy seed	2.42	1st
11.	Disease management	1.78	6.5th
12.	Fish health management	1.78	6.5th

The Contribution of the Selected Characteristics of the Fish Farmers with their Use of Fish Farming Practices

In order to estimate the use of fish farming practices, the multiple regression analysis was used which is shown in the Table 6. Table 6 shows that pond size, fish farming experience, cosmopoliteness, and extension contacts of the respondents had significant positive contribution with their use of fish farming practices. Of these, fish farming experience and extension contacts were most important contributing factors (significant at the 1 percent level of significant) and pond size and cosmopoliteness of the respondents were less important contributing factors (significant at 5 percent level of significant). Rashed (2018) found that extension contact of respondents had significant contribution with their use of best management practices. Abdullah (2013) revealed that pond size of fish farmers had significant positive relationship with their practice on pond fish farming. Islam (2010) found that pond size, extension media contact and cosmopoliteness of fish farmers had significant positive relationship with their use of selected polyculture practices. Rahaman (2010) also found that cosmopoliteness had significant positive relationship with the extent of participation of rural youth in fish farming activities. Coefficients of other selected variables don't have any contribution with their use of fish farming practices. Rashed (2018) found that age and annual family income of respondents had no significant contribution with their use of best management practices. The value of R^2 is a measure of how of the variability in the dependent variable is accounted by the independent variables. So, the value of $R^2 = 0.48$ means that independent variables account for 48 percent of the variation with their use of fish farming practices. The F ratio is 8.50 which is highly significant (p<0).

However, each predictor may explain some of the variance in respondents their use of fish farming practices simply by chanced. The adjusted R^2 value penalizes the addition of extraneous predictors in the model, but value 0.43 is still show that variance is fish farmers their use of fish farming practices can be attributed to the predictor variables rather than by chanced (Table 6). In summary, the models suggest that the respective authority should be considers the pond size, fish farming experience, extension contacts, and fish farming knowledge on their use of fish farming practices.

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Table 6. Multiple regression coefficients of the contributing variables related to use of fish farming practices

Dependent variable	Independent Variables	β	P	R^2	Adj. R^2	F
Use of fish farming practices	Age	-0.096	0.255			
	Education	0.050	0.595			
	Family size	-0.097	0.235			
	Pond size	0.248	0.035*			
	Annual income	-0.125	0.307	0.48	0.43	8.50
	Fish farming experience	0.287	0.006**			
	Cosmopoliteness	0.238	0.026*			
	Extension contacts	0.305	0.003**			
	Fish farming knowledge	-0.084	0.354			

** Significant at $p<0.01$; *Significant at $p<0.05$

Problems Faced in Fish Farming

Fish farmers usually face several problems in fish farming. The researcher made an attempt to identify the various problems in fish farming. For easy understanding of the problems faced by the fish farmers are listed in this section with their number of citations, percent and rank order. It is noted from the data contained in the Table 7 that 'Lack of government support' emerged as the 1st ranked problem opined by the fish farmers (77.17 percent). Government has an important role to maintain a favorable atmosphere for all types of entrepreneurship. Respondent fish farmers mentioned that it was so strong a constraint for pond fish culture entrepreneurship. 'Lack of marketing facilities' was the second most problem mentioned by the farmers (70.65 percent). It was observed that there was no established fish market in the study area. The quality of fish transported to distant places often gets deteriorated and damaged.

Table 7. Rank order of problems faced by the fish farmers in fish farming

Suggestions	No. of citation	Percent (%)	Rank order
Lack of government support	71	77.17	1st
Lack of marketing facilities	65	70.65	2nd
Water crisis in dry season	51	55.43	3rd
Lack of extension facilities	48	52.17	4th
High price of fertilizer, feed and other inputs	42	45.65	5th
High labor cost	37	40.21	6th

'High labor cost' was the last problems (40.21 percent) in the rank table as opined by the farmers. For the smooth running of a fish culture enterprise, the need for labour support is inevitable. Due to increasing trend of labour migration from agricultural sector to non-farm sector, fish farmers are enforced to face great adversity in need for labour support.

CONCLUSION

Slightly above half (53.3 percent) of the fish farmers had medium use of fish farming practices. Use of fish farming practices by the fish farmers is also not up to mark. It may be concluded that the production of fish will not be possible to improve to a significant extent unless the concerned authorities take proper steps to improve fish farmers use of overall practices regarding fish farming. Pond size of the respondents had significant positive contribution with their use of fish farming practices. Fish farmers having large pond size

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had more opportunity of using fish farming practices by them. The use of fish farming practices was mostly limited to the fish farmers having larger pond size. Thus, the policymakers and extension service providers need special attention to this issue in popularizing fish farming practices. Cosmopoliteness of the respondents had significant positive contribution with their use of fish farming practices. Therefore, it can be concluded that increase of cosmopoliteness of fish farmers would increase the knowledge area about fish farming and ultimately enhance increase the use of fish farming practices by them. Among the fish farmers highest proportion (65.2 percent) of the fish farmers had medium extension contact and extension contacts of the respondents had significant positive contribution with their medium use of fish farming practices. So, there is a need to take initiative to improve the extension contact of the farmers with various organization for increasing the practice of fish farming. 'Lack of government support' emerged as the 1st ranked problem opined by the fish farmers (77.17 percent). It is therefore, recommended that concerned authorities (DoF, DAE and other organizations) should take necessary steps to improve their service for fish farmers.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

1. Abdullah MM, 2013. Farmers' Knowledge and Practice on Pond Fish Farming. M.S. (AEIS) Thesis, Department of Agricultural Extension and Information System, Sher-E-Bangla Agricultural University, Dhaka.

2. Aguero M, 1989. Inland Fisheries in Bangladesh: Management Options and National Interventions, Proceedings of the ICLARM/DoF/BCAS Workshop on Experiments in New Approaches to the Improved Management of Open Water Fisheries in Bangladesh, Dhaka, Bangladesh, 1989, 1-13 pp.

3. Ara Y, 2005. Assessment of Small-Scale Fresh Water Fish Farming for Sustainable Livelihoods of the Rural Poor Farmers. An Unpublished M.S. Thesis submitted to The Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh.

4. BER, 2015. Bangladesh Economic Review. Dhaka: Finance Division, Ministry of Finance, Government of the Peoples' Republic of Bangladesh from http:/www.mof.gov.bd/bn.

5. Chan CY, N Tran, CD Dao, TB Sulser, MJ Phillips, and M Batka, 2017. Fish to 2050 in the ASEAN region. Penang, Malaysia: World Fish and Washington DC, USA: International Food Policy Research Institute IFPRI.

6. Dhawan AK, GS Kamaldeep, R Dhaliwal, NS Arora, and AK Dhawan, 1998. Aquaculture: A Tool for Integrated Rural Development. In: Arora GSR, Randhawa NS (Editors), Proceedings of International Conference on Ecological Agriculture: Towards Sustainable Development, Chandigarh, India.

7. DoF, 2010. Fisheries Statistical Yearbook of Bangladesh, Department of Fisheries, Ministry of Fisheries and Livestock, Government of Peoples Republic of Bangladesh, Ramna, Dhaka.

8. DoF, 2015. National Fish Week Compendium (in Bangla). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh.

9. DoF, 2016. National Fish Week Compendium (in Bangla). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh.

10. DoF, 2017. Yearbook of Fisheries Statistics of Bangladesh 2016-17. Fisheries Resources Survey System (FRSS), Department of Fisheries. Bangladesh.

11. DoF, 2018. Yearbook of Fisheries Statistics of Bangladesh 2017-18. Fisheries Resources Survey System (FRSS), Department of Fisheries. Bangladesh.

12. Flowra FA, MA Islam, SN Jahan, MA Samad, and MM Alam, 2011. Status and Decline Cause of Fishing Activities of The Baral River, Natore, Bangladesh. Journal of Science Foundation, 9(1-2): 115-124.

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Res. Agric. Livest. Fish.   **Vol. 7, No. 3, December 2020 : 565-576.**

13. Haque MH, 2014. Use of Communication Media by the Farmers Regarding Fish Farming. M.S. (AEIS) Thesis, Department of Agricultural Extension and Information System, Sher-E-Bangla Agricultural University, Dhaka.

14. Islam MR, MM Haque, and MM Rahman, 2017. Strength and Weakness of Existing Traceability System of Seafood Production in Bangladesh. Progressive Agriculture, 28: 160-162

15. Islam MS, SMM Murshed, M Moniruzzaman, and MA Baree, 2002. Rice-cum Fish Farming in Selected Areas of Mymensingh District. Online Journal Biological Science, 2: 715-718.

16. Islam S, 2010. Use of Selected Polyculture Practices by the fish Farmers of Melandaha Upazila under Jamalpur Districts. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.

17. Jahan H, I Parvez, and ASM Kibria, 2018. Current Aquaculture Practices in Dinajpur District: Special Emphasis on Fish Feeds. International Journal of Fisheries and Aquatic Research, 3(1): 35-42.

18. Kothari CR, 2004. Research Methodology: Methods and Techniques (2nd. ed.) New Age International (p) Limited.

19. Mazid MA, 2002. Development of Fisheries in Bangladesh, Plan and Strategies for Income Generation and Poverty Alleviation. 176 Dhaka: Nasima Mazid, 74 A/2, Kallyanpur Main Road.

20. Mia MS, F Yeasmin, SM Moniruzzaman, MFH Kafi, MI Miah, and MS Haq, 2015. Socio-economic Condition of the Fishers' Community of Meghna River of Ashuganj upazila in Brahmanbaria district, Bangladesh. International Journal of Natural and Social Sciences, 2: 42-47.

21. Mischke CC, 2012. Aquaculture Pond Fertilization: Impacts of Nutrient Input on Production. Wiley Blackwell, Ames, IA, USA.

22. Mohan CV, 2007. Seed Quality in Freshwater Fish Production. pp. 499–517. In: M.G. Bondad-Reantaso (ed.). Assessment of Freshwater Fish Seed Resources for Sustainable Aquaculture. FAO Fisheries Technical Paper. No. 501. Rome, FAO. 2007. 628p.

23. Rahaman MM, 2010. Participation of Rural Youth in Fish Farming Activities. M.S. (Ag. Ext. Ed.) Thesis, Department of Agricultural Extension Education, Bangladesh Agricultural University, Mymensingh, Bangladesh.

24. Rahman AKA, 2005. Freshwater Fishes of Bangladesh, Second edition, Zoological Society of Bangladesh, Department of Zoology, University of Dhaka, Dhaka-1000. 1-263pp.

25. Rashed MAR, 2018. Use of Best Management Practices (BMPs) by the Farmers of Savar Upazila of Bangladesh. M.S. (AEIS) Thesis, Department of Agricultural Extension and Information System, Sher-E-Bangla Agricultural University, Dhaka.

26. Toppo N, 2016. Quality Assessment of Some Farm Made Fish Feeds of Muktagacha and Phulpur upazila in Mymensingh district. MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh.

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