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Comparative performances of exotic and indigenous fish species with commercial culture systems of Mymensingh district in Bangladesh

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Abstract

An experiment was conducted to assess the relative performances of indigenous and exotic fish species under commercial culture system at Muktagacha and Trishal upazila in Mymensingh district. Six exotic fish species namely Thai koi (*Anabas testudineus*), Thai pangus (*Pangusius hypophthalmus*), Silver carp (*Hypophthalmichthys molitrix*), Vietnam koi (*Anabas testudineus*), Big head carp (*Aristichthys nobilis*) and Tilapia (*Oreochromis niloticus*) and nine indigenous fish species namely Rui (*Labeo rohita*), Shing (*Heteropneustes fossilis*), Sar punti (*Puntius sarana*), Gulsha (*Mystus bleekeri*), Koi (*Anabas testudineus*), Mrigal (*Cirrhinus cirrhosus*), Kalibaush (*Labeo calbasu*), Catla (*Catla catla*) and Magur (*Clarias batrachus*) were selected in Muktagacha while exotic Big head carp and indigenous Gulsha, Koi and Magur were lacking for observation in Trishal upazila. Results revealed that the production of exotic Thai pangus was comparatively higher in Muktagacha (5810.81 kg/acre) than Trishal (4521.74 kg/acre) upazila. In contrast, silver carp and tilapia production were 3063.04 kg/acre and 1008.26 kg/acre in Trishal, respectively which were higher than Muktagacha. Average selling price of tilapia, Vietnam koi and silver carp was also comparatively higher in Muktagacha than Trishal upazila. Similar observation was also obtained in respect of indigenous fish species. On the other hand, average selling price of shing was found highest (BDT. 333.33 per kg) in Muktagacha than Trishal while other fish species were sold at similar price. Gross income was also significantly higher with the exotic fishes in Muktagacha accounted for BDT. 858,716/acre/cycle while the highest gross income obtained with the indigenous fishes was in Trishal upazila, valued BDT. 121,5987/acre/cycle. It can be concluded that, both indigenous and exotic fish farming has spread in the area because of easy to adopt culture system, availability of fry, feed, good profit and high demand in the market. Some limitations of the ongoing practices have been identified that need to be addressed properly by the concerned authority.

Key words: Exotic, indigenous, fish, production, economic potentiality

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Introduction

Bangladesh, formed by a deltaic plain, has extensive water resources in the form of ponds, haors, beels, huge floodplains, lakes, canals, rivers and estuaries covering an area of 4.56 million ha which have tremendous scope for fisheries (DoF, 2011). In Bangladesh, the total annual fish production was estimated at 41.34 lakh MT in 2016-17, of which 23.33 lakh MT (56.44 %) were obtained from inland aquaculture, 11.63 lakh MT (28.14%) from inland capture fisheries and 6.37 lakh MT (15.42 %) from marine fisheries (DoF, 2017). Bangladesh is now one of the world leading fish producing country and fisheries sector contributes 3.61% to GDP and 24.41% to agricultural GDP where Mymensingh is one of the

leading areas for the production and culture of indigenous and exotic fish (DoF, 2017; BER, 2017). Both fisheries and aquaculture in Bangladesh play a major role in alleviating protein deficiency and malnutrition; about 63% animal protein of our meal comes from fisheries resources (Ahmed, 2005). Fish flesh also provides well balanced essential amino acids and minerals consisting of potassium, sodium, calcium, magnesium and zinc (Sandhu, 2005). So, the fisheries sector has high potential for the economic development of Bangladesh. Besides, many rice farmers are converting their fields into fish culture ponds (Islam *et al*., 2017). A large number of people have improved their socioeconomic conditions through fish farming activities in Bangladesh and earns a considerable amount of foreign currencies by exporting fish, shrimps and other fisheries products (Das *et al*., 2018; Salam and Sarker, 2018). So, aquaculture practice has the potentiality to achieve self-sufficiency in the food sector and to reduce poverty in Bangladesh (Al-Amin *et al*., 2012). Proper planning and development in any production sector need up to date information on available resources, prospect, current states, and problems. The implementation of the developmental program often turns to unsuccessful due to the lack of proper information and socio-economic data (Hasan *et al*., 2012). Now-a-days, indigenous freshwater carps (22%) and exotic carps (10%) from both the farming and capture sectors are the primary contributors to total production (Azim *et al*., 2002). Exotic fish species are that species of foreign origin and introduced to Bangladesh to augment fish production to serve various purposes (Rahman, 2005). In Bangladesh, a total of 92 varieties of exotic fishes under 53 species, 17 families and 5 orders have been found (Galib and Mohsin, 2011). History shows that the silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), bighead carp (*Aristichthys nobilis*), black carp (*Mylopharyngodon piceus*) and the common carp (*Cyprinus carpio*) are the major exotic fishes that have been introduced during the last few decades while tilapia *(Oreochromis mossambicus)* introduced in 1954, was the first exotic fish in Bangladesh. Among the pond fish, grass carp *(C. idella)* was officially introduced in 1966, while the silver carp *(H. molitrix)* was introduced in 1967 from Hong Kong. Thai sharputi (*Barbodes gonionotus*) also known as rajpunti, Thai pangus (*Pangusianodon hypophthalmus*) and Thai koi (*Anabas testudineus*) has been introduced from Thailand during 1977, 1990 and 2002, respectively. Department of Fisheries (DoF) targeted 22 districts for dissemination of improved fish culture practices for extend the fish production and enhance the socio–economic status through various development projects in collaboration with DoF (Bakhtiar 2011). Besides, government of Bangladesh interested to increase fish production with the culture of both exotic and indigenous fish in pond polyculture system. The use of artificial feed in aquaculture practices offers best means of larger fish production within shortest possible time. From the above points of view, the present study was conducted to address the production and economic variability of both exotic and indigenous fish species at Muktagacha and Trishal upazila in Mymensingh.

Materials and Methods

***Selection of the study area*:** The study was conducted to determine the comparative production and economic performances of indigenous and exotic fish species in commercial culture systems at both Muktagacha and Trishal sadar upazila in Mymensingh District of Bangladesh during July 2015 to December 2015 (Figure 1). This area was selected considering the following factors:

a. Large number of pond farms in this area.
b. Fish culture is a rising trend in this area.
c. There is an easy communication facility.
d. The study area was not far away and thus it was less expensive as well as easier for data collection for the researcher.
e. Social norms and common believes were well known by the researcher; and
f. No research was conducted in this respect.

Figure 1. Geographical location (highlighted with yellow shadow) of the study area (Source: Google Maps).

***Collection of data*:** Data were purposively collected from 30 fish farm owners/managers along the selected area (Table 1). It was not possible to include all the farms under the study because of limitation of time and resources. Fish farmers of the selected area constitute population of this study.

Table 1. Distribution of farms according to upazila.

Name of upazila	Number of farms	
	Indigenous	Exotic
Muktagacha	8	7
Trishal	8	7
Total	30	

Samples were purposively selected in order to meet the objectives of the study. Thus, a total of 30 fishermen were purposively selected for face to face questionnaire interviews for collecting the primary data. During the study, six exotic fish species namely Thai koi, Thai pangus, Silver carp, Vietnam koi, Big head carp and Tilapia and nine indigenous fish species namely Rui, Shing, Sar punti, Gulsha, Koi, Mrigal, Kalibaush, Catla and Magur were selected for observation and data collection from the selected fish farmers. However, exotic Big head carp and indigenous Gulsha, Koi and Magur were lacking for observation in Trishal upazila. Importantly, the respondent farmers are those who have started fish culture within 2009 to 2013.

Data were collected by direct interviews. With a set of interview schedule designed for this study, each respondent was given of brief information about the nature and purpose of the study during the interview. Besides, the researchers asked the questions in a very systematic manner with explanations wherever it was felt necessary and the information were recorded.

Questionnaire was prepared consulting with the supervisor as well as reviewing literature. The first draft questionnaire was used for preliminary survey. Much attention was given to gather all the information from the farmers, which was not designed to be asked but was important and informative towards the objectives. Finally a well-defined complete questionnaire was developed through the experiences gained from the pilot survey. Data were collected on average weight, production and average sale of both exotic and indigenous fish species along with the socio-economic status of the farmers.

***Problems encountered during data collection*:** During data collection, the researcher faced the following methodological problems:

1. Most of the farmers in the community had no concept about research work and it was, therefore very difficult to explain the purpose of the study.
2. Most of the farmers hesitated to give the answer of the questions since they thought that the investigator might use the information against their interest.
3. Usually most of the respondents do not keep records of their activities. Hence it was very difficult to collect actual data and researcher had to rely on memory of the respondents.

4. In response to the question about output some farmers provides dubious figure. The reason behind such answers perhaps might have been the fear of imposition of a levy or taxes by government.
5. On some occasions farmers were not available at home and in such cases the researcher had to give extra effort to collect information from them.

***Data processing and analysis*:** The collected data were scrutinized and summarized carefully before the tabulation. Some data were collected into local units and those were converted into international units. Then the data were tabulated into a preliminary data sheet of a Microsoft excel. After data entry, the data were analyzed with Microsoft Excel software and DMRT (Duncans' Multiple Range Test) analysis was done to ascertain to impact of different culture practices. Finally, data were presented graphical and tabular forms for better understanding.

Results and Discussion

***Scenario of ongoing fish culture strategies*:** Majority of the fish farmers (87%) in the study area started their fish farming activities within the year of 2009-2013 and the trend is increasing day by day. The maximum (87%) farm size ranged from 0.5-0.8 acre in Muktagacha while 60% ranged from 0.5-0.8 acre in Trishal upazila. Throughout the area, most of the fish farmers had cultivable lands (73%) of their own. Whereas, farmers of Muktagacha and Trishal upazila had 4% and 6% lease land in their position, respectively. It was found that Trishal upazila farmers' homestead land was 44%, whereas Muktagacha farmers had smaller area in their homestead (23%). Rahman *et al.* (2012) found in fishers community of Nijhumdwip under Hatiyaupazila of Noakhali district that average homestead area of that fishers was 8.75 decimal, a few had agricultural land which was about 29.17% and most of the fishers (54%) were living in *khas* land which was owned by the government, was also opposite findings with the present study due to the geographical variation. Ground water (tube-well) has been used as the main source of aquaculture water in Muktagacha (60%), although majority of the Trishal farmers used rain water (53%) for the purpose. Similarly, AL-Mamun (2012) along the Gomoti riverside found that about 30% had own tube-well and rest (70%) used neighbors' tube-well. Regarding the soil type, majority of the pond soil in Muktagacha (73%) and Trishal (66%) upazila were clay loam which is suitable for aquaculture (Ali and Rahman, 1986). Besides, 27% clay soil was found in the participant's pond in Muktagacha but in Trishal it was 27% sandy loam and 7% clay soil. It was found that majority of the farmers re-excavated their ponds in every 2 years interval in Trishal (67%) and Muktagacha (47%). Moreover, 20% and 33% farmers of Muktagacha re-excavate their pond yearly and at 3 years interval, whereas, the figure is 13% and 20% in Trishal upazila. A large portion of the farmers of Muktagacha and Trishal upazila (73%) used commercial formulated feeds to feed their fish. Floating feeds are most commonly used in Trishal (89%) and Muktagacha (57%). In Trishal (66%) and Muktagacha (34%) upazila, majority of the fish farmers invested their own money in fish farming. Other sources of money were bank loan (13%), NGOs (27%), dadon from aratdar (13%) and friends or relatives (13%) in Muktagacha. On the other hand in Trishal, farmers borrowed money from NGOs (7%), Friends or relatives (20%) and dadon from aratdar (7%). Regarding the fish marketing channel, it was found that 67% and 57% farmers in Muktagacha and Trishal upazila sold their fish directly to the aratdar respectively, whereas 33%farmers of Muktagacha sold their fish to bepari. In contrast, farmers of Trishal upazila sold fish to the bepari (22%) and paiker (21%).

***Comparison of exotic and indigenous fish culture in terms of production and profitability*:** Among the exotic fishes, the highest average weight (480 gm) of Thai pangus was found in Trishal whereas it was 466.67 gm in Muktagacha. Besides, Vietnam koi and thai koi obtained lower in Trishal (42.2 gm and 44.33 gm respectively) than Muktagacha upazila (46.5 gm and

48.33 gm respectively). Bighead carp was found in Muktagacha only and its average weight was 250 gm (Figure 2).

Production of Thai pangus was comparatively higher in Muktagacha (5810.81 kg/acre) than Trishal (4521.74 kg/acre) upazila. On the other hand, silver carp and tilapia production was 3063.04 kg and 1008.26 kg per acre in Trishal which was higher than Muktagacha upazila (Figure 2).

Average selling price of tilapia, Vietnam koi and silver carp was comparatively higher in Muktagacha at BDT. 110, 107.5, and 85 per kg respectively than Trishal upazila (BDT. 108.75, 106, and 80 per kg respectively), though, no difference was found with the price of Thai koi in both upazila (Figure 2).

Among the indigenous species, highest average weight found for rui and mrigel counted as 550gm and 433.33gm respectively in Trishal but production was higher in Muktagacha. On the other hand, average selling price of shing was found highest (BDT. 333.33 per kg) in Muktagacha. However, average selling price of kalibaush followed by sharpunti, catla was found to be BDT. 130, 114, and 112.5 per kg correspondingly, that was higher in Muktagacha than Trishal (Figure 3).

During the study period, it was found that, indigenous fish farming system was more profitable than exotic fish farming in Muktagacha (67%) than Trishal upazila (53%). By contrast, exotic fish farming was comparatively profitable in Trishal (47%) than Muktagacha upazila (33%). As because, it was found that exotic fish farming system required more feed and labor in Muktagacha (80%) than Trishal upazila (60%). On the other hand, indigenous fish farming system required more feed and labor in Trishal (20%) than Muktagacha upazila (13%). Profitability of aquafarming was hampered with disease prevalence in both exotic and indigenous fish culture in the study area. Exotic fish farmers (93%) of both the upazila experienced disease occurrence in their farm whereas only 7% of indigenous fish farms were affected with disease.

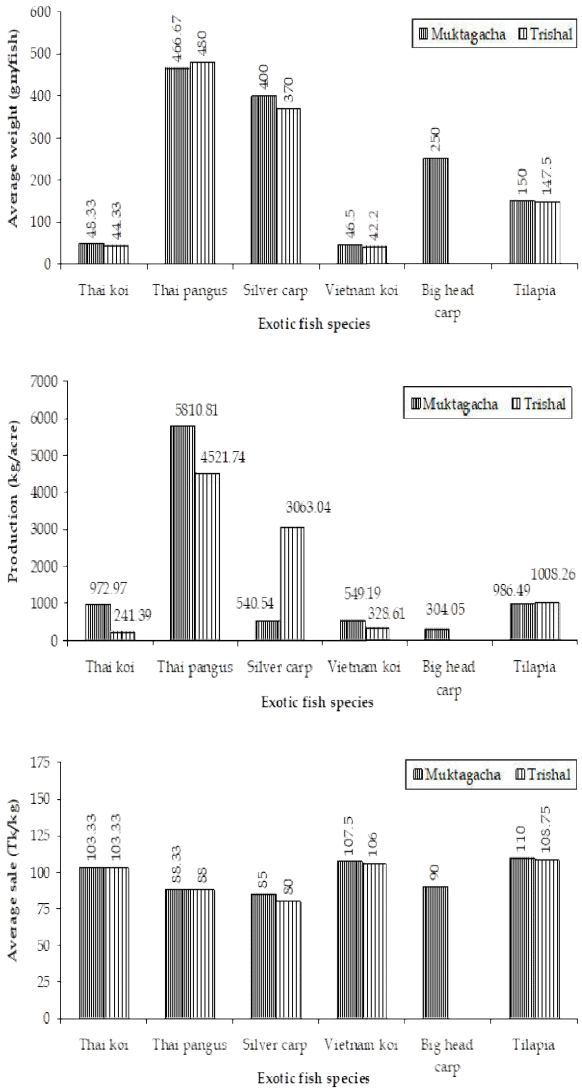

Figure 2. Average weight (up), production (middle) and average sale (below) of exotic fish species in Muktagacha and Trishal Upazila of Mymensingh.

Among the exotic species, highest average cost of fry (BDT. 1, 347,823/acre) was recorded in Trishal while average feed cost obtained highest (BDT. 647,568/acre) in Muktagacha. However, transportation and harvesting cost were found lower in Trishal than Muktagacha. For indigenous species, reverse trend was achieved with the average cost of fry and feed and similar trend was found with average cost of transportation and harvesting. Moreover, total average cost for indigenous species

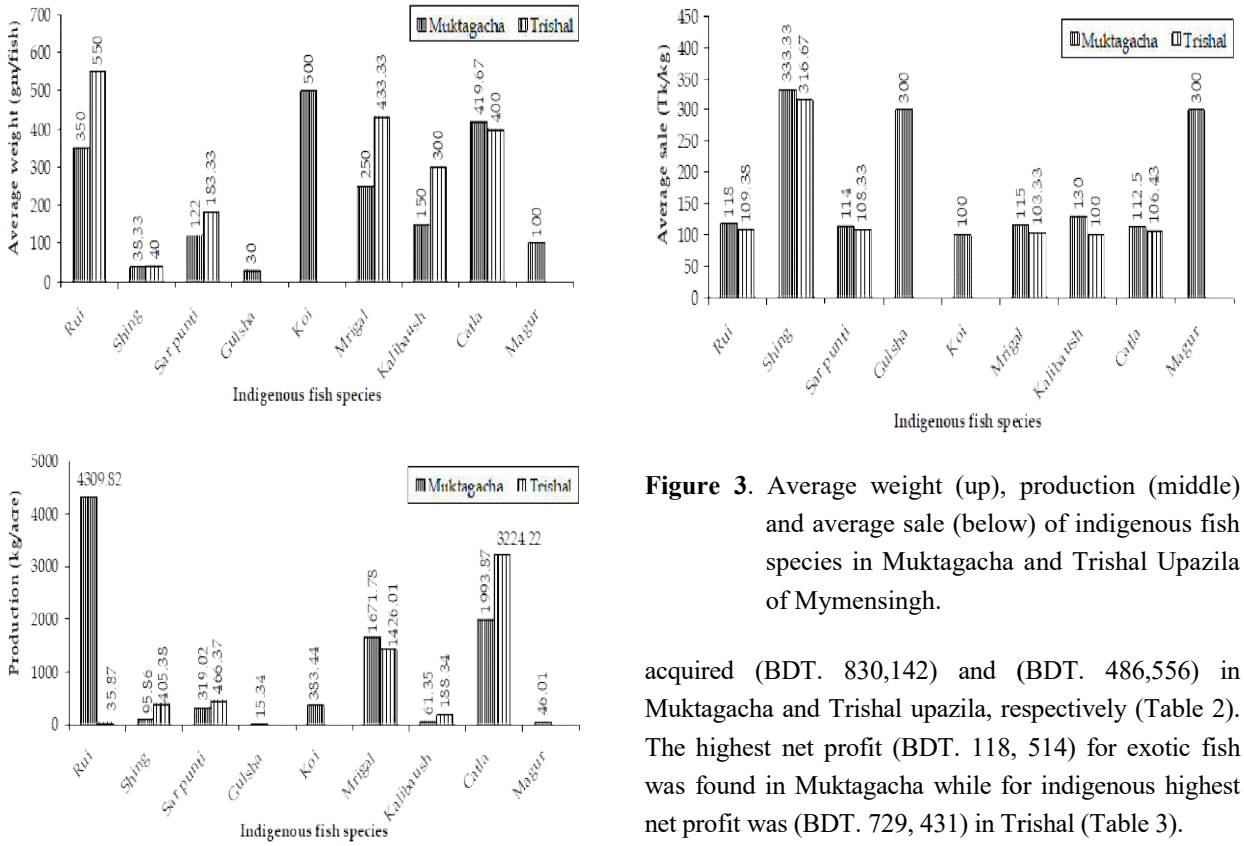

Figure 3. Average weight (up), production (middle) and average sale (below) of indigenous fish species in Muktagacha and Trishal Upazila of Mymensingh.

acquired (BDT. 830,142) and (BDT. 486,556) in Muktagacha and Trishal upazila, respectively (Table 2). The highest net profit (BDT. 118, 514) for exotic fish was found in Muktagacha while for indigenous highest net profit was (BDT. 729, 431) in Trishal (Table 3).

Table 2. Main operating costs of exotic and indigenous fish species in both Muktagacha and Trishal upazila.

Cost item	Muktagacha						Trishal					
	Total cost (BDT)		Avg. cost (BDT/acre)		Cost (%)		Total cost (BDT)		Avg. cost (BDT/acre)		Cost (%)	
	Ex	ID	Ex	ID	Ex	ID	Ex	ID	Ex	ID	Ex	ID
Fry	318,750	130,1825	86149	199,666	11.64	23.9	23.9	23.9	23.9	23.9	23.9	23.9
Feed	239,6000	384,8000	647,568	590,184	87.49	70.64	70.64	70.64	70.64	70.64	70.64	70.64
Fertilizer	5600	17000	1514	2607	0.2	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Electricity	2500	670,00	675.67	10276	0.09	1.23	1.23	1.23	1.23	1.23	1.23	1.23
Labour	5500	102500	1486.48	15720.43	0.2	1.89	1.89	1.89	1.89	1.89	1.89	1.89
Medicine	2200	7100	594.59	1088.96	0.08	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Fry transportation	1900	18100	513.51	2776.07	0.07	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Fish Transportation	1800	13000	486.48	1993.87	0.07	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Harvesting	3500	20000	945.94	3067.48	0.13	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Other	1000	18000	270.27	2760.74	0.04	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Total	273,8750	541,2525	740,2023	830,142	100	100	100	100	100	100	100	100

Ex= Exotic and ID= Indigenous

Besides, the lowest average production (8.90 tons/acre) was found with indigenous species in Muktagacha whereas the highest gross income (BDT. 121,5987) was obtained with the same species in Trishal. However, the highest range of pond size for indigenous and exotic species (0.70–1.90 and .90–1.90, respectively) obtained

in Trishal (Table 4). Such the similar observation was also reported by Sheheli *et al.* (2013) who also found variation in production cost due to the variation in price of different materials included within the study area.

This study revealed significant variation in both exotic and indigenous fish production while Muktagacha Upazila was more favorable for getting the higher production than Trishal upazilla.

Table 3. Costs and benefit of fish production per acre per cycle.

Parameters	Muktagacha		Trishal	
	Exotic	Indigenous	Exotic	Indigenous
Total return (BDT.)	858,716[a]	103,1879[b]	809,649[a]	121,5987[c]
Total cost (BDT.)	740,203[b]	830,142[c]	760,739[b]	486,556[a]
Net profit (BDT.)	118,514[b]	201,737[c]	48910[a]	729,431[d]

Values in a row having similar letter (s) do not differ significantly whereas values bearing the dissimilar letter (s) differ significantly as per DMRT at 5% level of probability.

Table 4. Total pond range, total cost, production and gross income of the study area.

Parameters	Muktagacha		Trishal	
	Exotic	Indigenous	Exotic	Indigenous
Range of pond size in acre (average in the parenthesis)	0.50–0.90	0.50–1.00	0.90–1.90	0.70–1.90
Cost involved (BDT./acre)	740,203	835,510	760,739	486,556
Average production/ tons/acre	9.16	8.9	9.16	11.43
Gross income (BDT./acre)	858,716	1,031,879	809,650	1,215,987

This might be due to the variation in soil quality as well as fertility and water pollution of the studied area and also the variation in environment and management strategies which were applied. Such the similar variation was also reported by Kamruzzaman (2011) who also reported that the fish production is high in the study area because of soil fertility, environment, lower water pollution, proper management by the farmer and farmers' own interest on fish farming. Besides, this study also showed that the yield of pangus is much higher than that of other fish species in Muktagacha and Trishal. The observation of the present study was more or less similar with the research findings of Tomal *et al*. (2015). They reported that the estimated tilapia yield of 36128.33 kg/ha is substantially higher than the yield of 23553 kg/ha of pangus than other fish species in Mymensingh District. Comparatively indigenous fish farmers were highest in number than exotic fish farmers in Muktagacha than Trishal upazila.

But gross income obtained with indigenous fishes was highest in Trishal. On the other hand, exotic fish farmers were highest in Trishal than Muktagacha, but gross income obtained with exotic fishes was highest in Muktagacha upazila.

***Problems faced by the fish farmers*:** The involved farmers with the present study claimed some problems which are obstacles to aquaculture development in their localities. They indicated that lack of technical knowledge, scarcity of quality fish seeds, high price of production inputs, poor marketing system, and difficulties in getting aquaculture loan were the big problems in expansion of pond fish farming. Costs of fish farming were also reported by Sheheli *et al*. (2013) to have increased significantly in recent years as a result of increased feed cost and farmers often bought low quality feed because of adulteration. Naser (2009) identified the similar problems of pond fish culture in

Bangladesh. So, the farmers who are involved with the present study requested the researchers to bring these matters into the attention of the government and local administration to find out working solution of the problems.

Conclusions

Aquaculture has intensely been commercialized in Bangladesh over the last few decades. Mymensingh is one of the top fish producing districts of the country. This experiment focused on the current trends of farmers' adaptation to either exotic or indigenous fish culture. Although both the types are important for increased production and keeping fish diversity as well as conserving native strains. Production and profitability of aquaculture either from exotic or indigenous species varied depending on some geographic and demographic factors. Besides farmers experienced some obstacles in boosting their profit from fish culture those are to be addressed properly by concerned authorities. Such base line research should be continued to represent the exact scenario of the fisheries and aquaculture in Bangladesh.

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