Present status, problems and prospect of fish farming at Gazipur Sadar upazila in Bangladesh

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Abstract

The present study was conducted to reveal the present scenario, problems and the prospect of fish farming of Gazipur Sadar upazila Bangladesh. The primary data were collected through field survey, questionnaire interview and focus group discussion from the fish farmers of several villages and urban areas of the upazila. Secondary data were collected from the Department of Fisheries and aquaculture extension section. Gazipur Sadar upazila has 14462.42 ha potential fisheries resources of which floodplains, seasonal water bodies, and ponds comprise 71.01%, 13.04%, and 8.57%, respectively. The total fish production of the upazila in 2016-17 was 14492.7 MT, 27% of the Gazipur district. The highest fish production of 5436 MT and 4.39 MT/ha/year came from the pond sector. Among different pond culture systems, the semi-intensive system had the highest fish production output (2826 MT). Exotic carps were the highest produced fish in the ponds. However, in spite of comprising a huge proportion of seasonal floodplains the fish production from this sector was only 0.42 MT/ha/year in 2016-2017. This indicates the poor utilization of inland open water resources for fish production in the study area. The major areas were identified to improve the existing pond fish farming situation were access to low-interest loan, quality seed, supply of advanced technologies, need-based training, and marketing facilities. Along with improving the pond fish farming, community-based fisheries management and some aquaculture initiatives on private own seasonal floodplains should be taken on a priority basis to improve open water management and to flourish inland fish production in the study area.

Key words: Fish farming, Gazipur Sadar, resources, production, problems

Introduction

Bangladesh is a land of water resources bestowed with rivers, beel, khal, floodplains, canals and thousands of small wetlands and ponds. Majority of those water bodies are suitable for the freshwater fish culture. Total fish production of Bangladesh in 2016-17 was 41.34 lakh MT where aquaculture contributes 56.44% (DoF, 2017). Bangladesh is now ranked 5th in world aquaculture production (FAOSTAT, 2016). Fisheries sector contributes 3.65% of total GDP and 23.81% of the agricultural GDP (DoF, 2016). 18.5 million people have involved in this sector in which numbers of fish farmers are around 13.86 million. Total pond area of Bangladesh in 2016-17 was 1.83 million ha and annual production was 4.77 MT/ha (DoF, 2017). 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). 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 (Ellis, 2000; Hasan et al., 2012). Gazipur is one of the most important districts for aquaculture and fish culture propagation in the division of Dhaka, Bangladesh. Gazipur Sadar upazila is one of the five upazilas of Gazipur district surrounded with the area of 446.38 km², located in between 23°53' and 24°11' north latitudes and in between 90°20' and 92°30' east longitudes. Based on the location it could be one of the ideal fish production areas of Bangladesh. Although the involvement of large numbers of people in fish farming with available huge fisheries resources surprisingly, no study of present fish farming status, available fisheries resources, and emerging problems in that area is reported yet. Therefore, the present study was carried out to assess the present fisheries resources, fish farming conditions, livelihood status of fish farmers and major constraints faced in the fisheries sector in the Gazipur Sadar upazila, Bangladesh.

Materials and Methods

Study area

The present study was conducted at Gazipur Sadar upazila of Gazipur district, Bangladesh (Figure 1). Several types of waterbodies and fish farms located in different villages and urban areas were selected and monitored.

Data collection

The study was conducted by collecting some primary and secondary data. Primary data were collected through the survey, monitoring, participatory rural appraisal (PRA) tool such as focus group discussion (FGD), and consultation among the resource users and stakeholders. A set of preplanned questionnaire was prepared to address several issues of fish farms, fish culture, production, farmers’ socioeconomic conditions and problems related to fish culture. The fish farmers having several ponds that they utilize for sustenance and livelihood were selected randomly and interviewed at home or farming sites. In a given day approximately five to six interviews were performed. FGD was done with a group of 10-14 fish farmers. In addition, some secondary data of fisheries resources and fish production were collected from Department of Fisheries (DoF) and other extension departments.

Data analysis

All the collected data were carefully scrutinized, recorded and analyzed using Microsoft Excel with the simple statistical method and presented in both graphical and tabular form for ease of understanding. Outline of the methodological approach is presented in Figure 2.

Figure 1. Map of the study area of Gazipur Sadar upazila.
Table 1. Fisheries resources of Gazipur Sadar upazila

| Type of Resources                  | No. | Area (ha) | Area (%) |
|-----------------------------------|-----|-----------|----------|
| **Inland Open Water (Capture)**   |     |           |          |
| River                             | 07  | 158       | 1.09     |
| Floodplain                        | 91  | 10270     | 71.01    |
| - Natural                         | -   | 10120     | -        |
| - Fry released program            | -   | 150       | -        |
| Beel                              | 07  | 668.01    | 4.62     |
| **Inland Closed Water (Culture)** |     |           |          |
| Khal                              | 09  | 52.91     | 0.37     |
| Pond                              | -   | 1239      | 8.57     |
| - Extensive                       | -   | -         |          |
| - Semi-intensive                  | 1748| 987       |          |
| - Intensive                       | 346 | 211       |          |
| Highly Intensive                  | 47  | 41        |          |
| Seasonal water body (Paddy field and Boropit) | - | 1886 | 13.04 |
| Pen culture                       | 65  | 143       | 0.99     |
| Private commercial fish farm      | 15  | 45.50     | 0.31     |
| **Total**                         | 2335| 14462.42  |          |
| **Others and Manpower**           |     |           |          |
| Fish hatchery                     | 02  |           |          |
| Fish nursery                      | 31  |           |          |
| Fish market                       | 57  |           |          |
| Fish feed industry                | 14  |           |          |
| Fish farmers                      | 2575|           |          |
| Fisherman                         | 2083|           |          |

Source: Department of Fisheries (DoF), Gazipur Sadar, Bangladesh.

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**Results and Discussion**

**Fisheries resources and prospect of fish culture**

Gazipur Sadar upazila has vast fisheries resources including both open and closed water bodies. The large number of open and closed water-bodies and human resources present in Gazipur Sadar Upazila, of which most of the water resources are suitable for fish culture (BBS, 2012). Among the five upazilas in Gazipur district, total fisheries resource area in Gazipur Sadar was 14462.42 ha, which was about 30.61% of Gazipur district (47250.76 ha) in 2016-17. In Gazipur Sadar 71.01% water area was occupied by the floodplains while seasonal waterbodies, ponds, beel, river, and khal comprises 13.04%, 8.57%, 4.62%, 1.09% and 0.37% area, respectively. The sector-wise varieties of fisheries resources are summarized in Table 1. Among the seven rivers, the major rivers flow in this area is Turag, Balu, Labandaha, and Salda. The beels, floodplains, and ponds are highly potential water resources for aquaculture in Gazipur Sadar (Halim et al., 2017).
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Fish production

From the data, it is obvious that fish production of Gazipur Sadar had increased over the past three years (Table 2 and Figure 3). The production has increased from 14309.0 MT in 2014-15 to 14492.7 MT in 2016-17. In the year 20016-17, pond fish production had the highest production rate of 4.39 MT/ha/year, followed by seasonal water bodies (2.19 MT/ha/year), beels (0.83 MT/ha/year), floodplains (0.42 MT/ha/year) and rivers (0.15 MT/ha/year).

Table 2. Sector-wise three years fisheries production in Gazipur Sadar and Gazipur district (Unit: Metric Ton)

| Sectors           | 2014-2015 | 2015-2016 | 2016-2017 |
|-------------------|-----------|-----------|-----------|
|                   | GD        | GS        | GD        | GS        | GD        | GS        |
| River             | 171       | 26        | 224       | 25.9      | 380       | 25.2      |
| Floodplain        | 16136     | 4327      | 16397     | 4338.1    | 16764     | 4341      |
| Beel              | 1189      | 545       | 1218      | 548       | 1245      | 552       |
| Seasonal water    | 7994      | 3748      | 8296      | 3751.1    | 8623      | 3760.0    |
| Pen culture       | 656       | 353       | 1233      | 365       | 1058      | 378       |
| Khal              | -         | -         | -         | -         | -         | -         |
| Haor              | -         | -         | -         | -         | -         | -         |
| Pond              | 23481     | 5310      | 21909     | 5340      | 25588     | 5436      |
| Extensive         | 10        | -         | 7         | -         | 9         | -         |
| Semi-intensive    | 11456     | 2852      | 8852      | 2838      | 9176      | 2826      |
| Intensive         | 7467      | 1690      | 7306      | 1725      | 10612     | 1858      |
| Highly Intensive  | 4548      | 768       | 5745      | 777       | 5791      | 752       |
| Total             | 50179     | 14309.0   | 49277     | 14368.1   | 53658     | 14492.7   |

*Extensive <1.5 MT/ha, Semi-intensive 1.5-4 MT/ha, Intensive 4> MT/ha, Highly Intensive 10.0>MT/ha, (GD: Gazipur District; GS: Gazipur Sadar). Source: Department of Fisheries (DoF), Gazipur Sadar, Bangladesh.

The annual pond fish production in the study area was lower than the Gazipur district (6.39 MT/ha) but about similar to national pond fish production (4.77 MT/ha) (BBS, 2016). The share of pond fish production in the total fish production of Gazipur Sadar was 37.69% in 2016-17. Khaled (2008) also reported that the share of pond fish production of Gazipur district was less than 40%.

In the year of 2014-2015, pond fish production in Gazipur Sadar was 5310 MT which was 22.61% of Gazipur district. In 2015-2016, it increased by 24.37% and then slightly decreased to 21.24% in the following year. Pond fish cultures in this area are mainly conducted by the extensive, semi-intensive, intensive and highly intensive system. Semi-intensive culture contributed more than 50% (2852 MT) of the fish production of total pond sector. The extensive ponds’ productions were done mainly for the home consumption and were not recorded in this study. The overall fish production of Gazipur district slightly decreased by 902 MT from 2015 to 2016 and then rose by 4381 MT in 2017. Among the total fish production of Gazipur district, about 27% came from Gazipur.
Sadarpur upazila in 2016-17. Most of the open water bodies are hugely affected by agricultural, industrial and municipal waste in Bangladesh. However, similar to our study the closed water or pond fishery production in Bangladesh is increasing gradually (Ahmed, 2010).

![Graph showing fish production in Gazipur Sadar_Upazila and Gazipur District from 2014-15 to 2016-17](image)

**Figure 3.** Comparative figure of three years fish production in Gazipur Sadar upazila and Gazipur district

Farmers were found to culture various types of fish species including exotic carps, tilapia, Indian major carps, pungsus, koi, small indigenous species, catfishes etc. From the species-wise fisheries production at 2016-17, it was recorded that exotic carps: silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), bighead carp (*Hypophthalmichthys nobilis*), common carp (*Cyprinus carpio*) and Indian major craps: catla (*Catla catla*), rohu (*Labeo rohita*), mrigal (*Cirrhinus cirrhosus*) contributed 22.89% (3318.10 MT) and 16.47% (2387.0 MT), respectively of total fish production of that area (Table 3). On the other hand, other varieties of wild caught species including small indigenous species mainly came from the floodplains comprised 28.80%.

The monoculture production of tilapia reached 19.31% then followed by pungsus (*Pangasius hypophthalmus*) 6.02%, catfishes (*Heteropneustes fossilis* and *Clarias batrachus*) 3.88%, and koi (*Anabas testudineus*) 2.62%. Catfishes had very lower production rate compared to the carps. There was no commercial production of freshwater prawn observed in the study area.

| Types of fish       | River | Beel | Floodplain | Pond | Seasonal water | Total (MT) | % in Gazipur district |
|---------------------|-------|------|------------|------|----------------|------------|-----------------------|
| Indian major Carp   | 3     | 15   | 18         | 1337 | 1014           | 2387       | 16.47                 |
| Exotic Carp         | 0.1   | 3    | 11         | 2212 | 1092           | 3318.10    | 22.89                 |
| Pungsus             | 0.5   | 3    | 11         | 682  | 190            | 872.50     | 6.02                  |
| Tilapia             | -     | -    | 20         | 1178 | 1600           | 2798       | 19.31                 |
| Koi                 | -     | 49   | 331        | -    | -              | 380        | 2.62                  |
| Shing-Magur         | 79    | 482  | 2          | -    | -              | 563        | 3.88                  |
| Others Inland Fish  | 22.1  | 406  | 3479       | 25   | 242            | 4174.10    | 28.80                 |
| Total               | 25.7  | 552  | 4341       | 5436 | 4138           | -          | -                     |
| Production          | 0.15  | 0.83 | 0.42       | 4.39 | 2.19           | -          | -                     |

Source: Department of Fisheries (DoF), Gazipur Sadar, Bangladesh.
Demographic profile of fish farmers

In the present study, different socio-economic indicators of the farmers have been studied (Table 4). In the area, 52.72% of the farmers were old aged whereas 34.54% and 12.72% fish farmers were middle and young aged respectively.

Table 4. Socio-economic and educational profile of fish farmers (n = 110)

| Category                        | No. | Percentage |
|---------------------------------|-----|------------|
| **Age group (Average age)**     |     |            |
| Young                           | 14  | 12.72      |
| Middle                          | 38  | 34.54      |
| Old                             | 58  | 52.72      |
| **Family Type**                 |     |            |
| Nuclear                         | 75  | 68.18      |
| Joint                           | 35  | 31.82      |
| **Family Size**                 |     |            |
| Small family (<5 members)       | 82  | 74.55      |
| Large Family (>5 members)       | 28  | 25.45      |
| **Education level of farmer**   |     |            |
| No formal education             | 14  | 12.72      |
| Primary (I-V)                   | 21  | 19.09      |
| Secondary (VI-X)                | 56  | 50.90      |
| Higher Secondary (XI-XII)       | 10  | 9.09       |
| Graduation                      | 9   | 8.18       |
| **Investment in fish culture**  |     |            |
| Own                             | 91  | 82.73      |
| Bank Loan                       | 14  | 12.73      |
| Others                          | 5   | 4.55       |
| **Training on fish culture**    |     |            |
| No formal training              | 88  | 80         |
| Training from GO                | 14  | 12.73      |
| Training from NGO               | 8   | 7.27       |

Source: Field survey, 2017

However, most of the farmers have other job involvement such as agriculture, livestock, business, service etc. The farmers at Mirergao area were observed conducting fish culture commercially at very large scale especially in the beel area. The higher involvement of old people in fish farming indicates that the young people are moving to other occupations. The higher percentage of the nuclear family (68.18%) was evidenced than the joint family (31.82%). The family size usually has a considerable influence on the income and expenditure of the family. In both family types, 74.55% family had more than five members. The study sketched that majority of the farmers (82.73%) were invested their own money in fish culture. A few of them, who were not economically solvent, took loan from the bank (12.73%). Rest of them managed the amount of investment from friends or neighbors. Most of the fish farmers of Bangladesh culture fish with their own money (Quddus et al., 2000).

Level of education

According to the present study, 12.72% farmers were illiterate whereas 19.09%, 50.90%, and 8.18% had primary, secondary and graduation level of education respectively. However, the literacy rate (87.28%) in the surveyed area was higher than the national literacy level (72.3%) of Bangladesh (BBS, 2016). Pravakar et al. (2013) illustrated about the similar educational status of the fish farmers in Shahrasti, Chandpur of Bangladesh. Level of education of farmers hugely affects the utilization of pond and fish production (Khan, 1986).

Training on fish culture

During the study, it was observed that most of the farmers (80%) do not get any kind of scientific fish culture training. Only 12.73% farmers got training from DoF and 7.27% farmers got training from different Non-Govt. Organizations (NGO). Very little initiatives to conduct training are arranged by the DoF of Bangladesh (Khatun et al., 2013; Rahman et al., 2015). In most cases, farmers adopted fish culture techniques from their ancestors and neighbors that are not the scientific approach.

Pond characteristics and ownership

From the study, it was observed that majority of the cultured ponds (60%) were smaller (1-4 Decimal) whereas only 17.27% ponds were comparatively large.
(>8 Decimal) in size (Table 5). In addition, more than half of the ponds had a lower depth between 1-2 m (53.64%) which is desirable for fish culture. In addition, 79.09% and 20.91% ponds were seasonal and perennial respectively. Khan (1986) stated that fish culture efficiency depends on the size and the depth of ponds. 74.56% farmers were recorded culture fish in their own pond while in contrast, 20% ponds had multiple ownership. Multiple pond ownership is one of the major constraints for the pond aquaculture (Hossain et al., 2002).

Table 5. Characteristics and pattern of ownership of ponds at Gazipur Sadar upazila (n=110)

| Pond Area (Dec.) | %  | Pond Depth (m) | %  | Pond type  | %  | Pond Ownership | %  |
|------------------|----|----------------|----|------------|----|----------------|----|
| Small (1-4)      | 60 | Low (1-2)      | 53.64 | Seasonal   | 79.09 | Own            | 74.56 |
| Medium (5-8)     | 22.73 | High (>2)   | 46.36 | Perennial  | 20.91 | Leased         | 5.44 |
| Large (>8)       | 17.27 | -            | -   | -          | -   | Multiple       | 20  |

Source: Field survey, 2017

Pond management

Different pond management practices found in the study area are mentioned in Table 6. In the study area, farmers were found to use organic fertilizers (compost, cow dung and chicken manure) and inorganic fertilizers (urea and TSP). Application of fertilizer is very important for increasing natural food (phytoplankton, zooplankton and benthic organisms), in that way to augment fish production. From the study, it was clear that 49.09% fish farmers applied different kinds of commercial floating and sinking pelleted feed while 31.82% farmers used loose feed (non pelleted feed, rice bran, wheat bran, mustard oilcake etc.) Most of the farmers were not well concern about the use of recommended amount of feed.

Table 6. Percentage of different kind of fertilizers, feed and chemicals (n = 110)

| Fertilizer | %  | Feed            | %  | Chemical     | %  | Gear           | %  |
|------------|----|-----------------|----|--------------|----|----------------|----|
| Organic    | 23.64 | Loose feed     | 31.82 | Lime        | 41.82 | Seine net    | 58.18 |
| Inorganic  | 20   | Commercial pellet feed | 49.09 | Lime and salt | 6.36 | Cast net    | 40  |
| Both       | 56.36 | Both            | 19.09 | Other chemicals | 10  | Hook         | 1.81 |
|            |      |                 |     | No Chemicals | 40.91 | Push net    | 0.91 |

Source: Field survey, 2017

Lime and salt were the most used chemicals in the study area. Other chemicals and drugs used by the farmers include timsen, KMnO₄, oxycol, and renamycin. However, 40.91% farmers did not use any chemicals and drugs. Lime, salt, potassium permanganate, sumithion, malathion, formalin, bleaching powder, methylene blue, zeolite and malachite green are the most commonly used chemicals in Bangladesh (Jilani et al., 2012; Rasul et al., 2017). The use of antibiotics in the intensive farming has led to multiple drug resistance among the
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pathogens and some associated risks (Boyd and Massout, 1999).

In the study area, farmers were found to use different types of fishing gear from those seine net used mostly and then followed by cast net, hooks and push net. Farmers widely use the similar types of harvesting nets in Bangladesh which were found in the study area.

Diseases

In the study area, farmers reported the occurrence of diseases like fungal disease, epizootic ulcerative syndrome (EUS), argulosis, tail and fin rot and gas bubble disease during the culture (Figure 4).

![Figure 4. Season-wise different disease occurrence in the fish farms of Gazipur Sadar upazila.](image)

Fungal diseases (31.82%) were mostly reported disease in that area. Most of the diseases occurred in the winter season while gas bubble disease manifested in the summer season. About one-fourth of the respondent (24.55%) did not report the occurrence of diseases in their ponds. The farmers were found to take some preventative measures such as pond drying, liming, water exchange, removal of aquatic weeds and undesirable fishes to reduce disease outbreak. Fish disease and its management is a big challenge in commercial fish farming in Bangladesh. Along with the reported diseases edwardsielosis, red sopt, gill rot, parasitic disease are the most common freshwater fish diseases in Bangladesh (Aftabuddin et al., 2016).

Present emerging problems

Gazipur Sadar upazila has a huge proportion of inland open water bodies especially floodplains (71.01%). However, the production from this sector comprises only 0.42 MT/ha/year where pond production contributes about 4 times. Only 150 ha area of floodplains was taken under fry release program until the year 2017 while rest of the area (98.54%) solely relies on captured fisheries. A huge area of capture fisheries of common property water-bodies is exposed to open access in Bangladesh, which is a big threat (Hossain et al., 2015). In addition, the open water bodies have no exercise of aquaculture. Seasonal water-bodies also had comparatively low fish production rate (2.19 MT/ha) than the ponds. Open universal access and the indiscriminate use of these resources resulted in overexploitation which reduces fish production and diversity significantly. Seasonal floodplains retain water for 5-6 months/year during the monsoon, which is very rich in nutrients and identified as an excellent feeding, breeding and nursery grounds for the aquatic animals (Graaf, 2003). Floodplains comprise a major portion of our inland open water resources and could enrich national fish production significantly with a little enforcement of management and aquaculture initiatives (Rahman et al., 2012).

In addition, the major problems faced by the pond fish farmers in the study area were low quality seed, insufficient loan facilities, lack of technical knowledge, multiple ownership of pond etc. (Table 7). Though industrial pollution remains in low risk until now rapid growing industries in the study area could lead a serious problem in near future. Similar types of pond farming constraints were found by Mazumder et al. (2013) which are major hinders for the progress of pond fish farming in Bangladesh.
Das et al. (2018), Progressive Agriculture 29 (1): 53-63

Table 7. Problems faced by fish farmers during pond fish farming (n = 110)

| Rank | Problems                                      | Percentage |
|------|-----------------------------------------------|------------|
| 1    | Inadequate supply of quality fish seed        | 90.90      |
| 2    | Lack of technical knowledge                   | 83.64      |
| 3    | Lack of training from DoF and NGO             | 80.90      |
| 4    | Lack of loan facility                         | 74.55      |
| 5    | High cost of commercial fish feed             | 73.64      |
| 6    | Poaching and vandalism                        | 72.73      |
| 7    | Scarcity of culture water in the dry season  | 68.18      |
| 8    | Bad water quality                             | 65.45      |
| 9    | Higher interest on loan                       | 59.09      |
| 10   | Problem of ownership                          | 56.36      |
| 11   | Poor transport facilities                      | 54.55      |
| 12   | Diseases                                      | 45.45      |
| 13   | Political problem                             | 43.63      |
| 14   | Labor shortage                                | 35.45      |
| 15   | Natural calamities                            | 13.64      |
| 16   | Industrial pollution                           | 9.09       |

Recommendations to increase fish production

In the upazila, the total demand for fish was calculated by 15530 MT which is quite high than the production of fish (14492.7 MT) in 2016-17. To boost the fish production rate huge area of floodplains and seasonal water bodies need to take under proper management. WFC (2005) reported that if 25% of seasonal water resources could bring under community-based fisheries management then national fish production will be increased many folds over the existing production. Therefore, to achieve maximum benefits from the inland open water resources in the study area the following suggested actions should be implemented.

- Initiatives to bring private own floodplains under aquaculture program
- Community-based fisheries management program for the sustainable use of common property water-bodies
- Establishment of sanctuaries and harvesting regulations

However, to remove the existent problems in pond fish farming the farmers suggested a number of following initiatives that could be implemented by Government organizations (GO), NGOs, and private organizations.

- Assurance of good quality seeds by increasing the number of hatcheries and nurseries
- Soft loan facilities for the fish farmers with a low-interest rate
- Need-based training on advanced fish culture and adequate supply of technologies
- Regular monitoring of fish farming activities by the skilled manpower from DoF and other extension departments
- Initiatives to proper utilization of derelict water bodies and adoption of integrated culture techniques
- Development of a coactive community and improvement of the transportation system to resolve the marketing problems
- Pollution mitigation especially in the industrial area

Conclusion

From the present study, it is evident that Gazipur Sadar upazila is very rich with versatile aquaculture resources that could make that one of the ideal freshwater fish production areas of Bangladesh. However, this study has revealed very poor utilization of inland open water-bodies and existence of some major constraints in pond fish production in the Gazipur Sadar upazila. The fish production will reach high beyond the fish demand in the study area if the huge area of inland water bodies could bring under proper management and aquaculture technologies and existing pond fish farming production
could be raised. Therefore, Governmental and Non-governmental initiatives are crucial to resolve existing problems and to ensure higher fish production.

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