Dhaka Univ. J. Biol. Sci. **31**(2): 257-271, 2022 (July) DOI: https://doi.org/10.3329/dujbs.v31i2.60884

AQUACULTURE STATUS IN SOUTHERN BANGLADESH WITH SPECIAL EMPHASIS ON DISEASE INDUCED LOSS

MD. INJA-MAMUN HAQUE, TAPAN MAZUMDER[1], RANAJIT KUMAR[2], A.F.M. NAZMUS SALEHIN[3], SANJAYA DEBNATH[4], RIPON KUMAR GHOSH[5] AND SHANKAR CHANDRA MANDAL*

Department of Fisheries, University of Dhaka, Dhaka-1000, Bangladesh

Key words: Aquaculture production cost, Expected profit, Production loss, Disease

Abstract

Culture fisheries contributes a major share of fisheries production of Bangladesh which is the accumulation of aquaculture production of every fish farms of the country. However, the actual production of cultured fish (finfish and shellfish) and cost-benefit of the farms are not well documented. Moreover, the farms must overcome a lot of constrains for sustainable production. The present study was thus designed to determine the present aquaculture status in some parts of Bangladesh and to identify the problems for the loss of aquaculture production through questionnaire survey between July 2019 and January 2020. The study areas included Bhola, Rangamati, Khulna, Satkhira, Jashore and Madaripur upazila. In the study area, the relationship between different aspects of aquaculture was determined where pond size and production cost per hectare; pond size and profit per hectare and per unit production cost and profit were found to be significantly and positively correlated. The production and production cost per hectare were also determined which were 3.52 ± 0.40 metric tons and 6260 ± 987 USD, respectively. The fish farmers reported some degrees of reduction of profits compare to the profit obtained during 2018-2019. The reduction of expected profit in different regions ranged between 10 and 33%. The major causes of the production loss in the survey regions were related to disease, seed and feed. Among different diseases viral, bacterial and parasitic diseases were reported where diseases were identified based on the symptoms. Findings of the present study suggest that incorporation of management, modern technology and economic aspects for steady growth of aquaculture sector is needed in Bangladesh.

Introduction

Aquaculture has been contributing for the rural development by humanizing the standard of living and creating opportunity to escape from poverty for the poorer people in the rural areas familiarized in developing countries especially in Asia and Africa(1). It

*Author for correspondence: <shankar@du.ac.bd>. [1]Upazilla Fisheries Office, Madaripur Sadar, Madaripur, Bangladesh. [2]Upazilla Fisheries Office, Phultala, Khulna, Bangladesh. [3]Upazilla Fisheries Office, Borhanuddin, Bhola, Bangladesh. [4]Upazilla Fisheries Office, Kaptai, Rangamati, Bangladesh. [5]Upazilla Fisheries Office, Manirampur, Jashore, Bangladesh.

progresses as a lucrative and imperative element for the development of rural livelihood due to amassed population pressures, environmental degradation or reduced catches from wild fisheries which subsequently reduces the income of rural people[2]. The nutritionally susceptible groups in rural communities, such as pregnant and lactating women, infants and pre-school children get best quality animal protein and indispensable nutrients from aquaculture. The child malnutrition causes death around three million young lives every year in the world which can be lessen by providing sufficient nutrition found in the fish[3]. Aquaculture provides the opportunity to the poorer segment of rural community to get fish at affordable price. Moreover, seed suppling networks, marketing chains and manufacturing/repairing supporting facility provide income opportunities which upholds the livelihood of the rural society.

Aquaculture continues impressive growth in the supply of fish for human consumption and contributes 47% of global fish production which first sale value is 232 billion USD[4]. In addition to food supply, the aquaculture industry plays a dynamic role in improving community advancement, employment prospects and poverty mitigation and rural development. Nearly 59.6 million global populations are engaged (on a full-time, part-time or occasional basis) in fisheries (40.3 million) and aquaculture (19.3 million) sector of which 85% is from Asia. Around 35% of global fish production entered international trade which first sale value is 143 billion USD[4]. More than half of the global farmed food fish come from inland aquaculture (fin fish farming 92.5%) where the rest is dominated by marine and coastal aquaculture (mollusks 58.8%, fin fish and crustaceans 39.9%). Asia accounts for 89% of global aquaculture production for over two decades for the major producers China, India, Indonesia, Viet Nam, and Bangladesh[4]. Bangladesh is one of the top fish producing countries (ranked 5th in world aquaculture production) where aquaculture production contributes approximately 57% of its total fish production[5]. Over 11% of the total population of the country directly or indirectly depend on the fisheries and aquaculture sector for their livelihoods. This sector contributes 3.57% of the national GDP and 1.50% to the export earnings to the country[5].

The development and expansion of global aquaculture has been significantly exaggerated by the incidence of diverse diseases which portends the progress of this industry. In Bangladesh, the most common aquaculture diseases are caused by bacteria, fungi, virus and parasites[6-7] which subsidized country's total economic loss more than 1000 USD per year per hectare between 2010 and 2013[8] where global economic loss due to diseases in finfish aquaculture has been estimated as 1.05 to 9.58 billion USD per year[9]. A global assessment of disease damages to aquaculture of 3 billion USD per annum has been reported by the World Bank in 1997[10]. More than 7% loss of net profit in carp hatcheries and nurseries of southeastern and southwestern districts of Bangladesh has been reported by Hasan and Ahmed[11]. The losses due to mortality and cessation of growth of fish in ponds of West Bengal during an epidemic infection has been

reported[12]. Qi[13] has reported that about 10% cultured zone is distress by disease, with yearly damages of fish production nearby at 15% in China. The gross national losses due to shrimp diseases in India was assessed more than 48 thousand metric ton (MT) of shrimp during 2005-2008[14]. The fish disease study in Bangladesh is confined to diagnosis, characterize and control of pathogen as well as socio-economic aspects of developing fish culture[15-16].

Disease is one of the prime reasons for mass mortalities and poor growth of fishes reducing the yield, quality and marketability[8]. There are lots of different reasons of aquaculture diseases including poor quality of water, feed, and seed. Poor aquaculture management including high stocking density, lack of water exchange facilities, predatory birds carrying parasites can also play a significant roles in spreading diseases[17]. The introduction of exotic species always creates a risk of pathogen transfer, disease intrusion and subsequent epidemics of infection in the prevailing aquaculture systems[7]. Diagnosis of aquaculture diseases is a difficult task which needs expertise and knowledge on properties on disease causing agents. Most of the rural farmers of Bangladesh do not have expertise on disease identification and fish health management and cannot take initiatives to prevent fish and shellfish diseases. The farmers must suffer from financial loss due to fish diseases which in turns affect the livelihood of the farmers and their reliant through loss of earnings, production and assets as well as other social consequences.

The incidences of diseases cannot be identified by most of the rural farmers. In addition, traditional fish farmers do not keep proper documentation of their operations. Therefore, the estimation of the economic impact of the disease is handicapped by the deficiency or insufficient information on the morbidity, mortality, and other expenses in fish production. The data on the disease prevalence and economic consequences in Bangladesh are insufficient and somewhat outdated. Thus, a study on the present aquaculture status including aquaculture production, production cost and profit or loss due to diseases and other factors were conducted in some selected regions of Bangladesh.

Materials and Methods

Survey area: The study was carried out in six districts of Bangladesh namely Madaripur, Jashore, Khulna, Bhola, Satkhira and Rangamati. The regions together contribute nearly 20% of total aquaculture production of Bangladesh[5], however, limited research activities covering these areas encouraged to conduct a study on the aquaculture production status and the existing problems causing losses to aquaculture production.

Data collection: The data were collected by using a combination of participatory, qualitative, and quantitative methods between July 2019 and January 2020. A total of 65 farms were sampled from Bhola (n=11), Rangamati (n=10), Khulna (n=14), Satkhira (n=8), Jashore (n=10) and Madaripur (n=12). To collect data, both active and passive surveillance

was conducted. For passive surveillance data on disease incidence and production loss were recorded from fish farmers, Upazilla (sub-district of Bangladesh) fisheries officers in respective areas while for active surveillance were made by direct observation of disease occurrence. For both purposes, questionnaire was developed for specific information such as culture species of fin fish and shellfish, frequency of disease outbreaks, disease symptoms, preventive measures taken, loss in the previous year, predicted loss in the current year, expected production, production cost etc. Questionnaire development and survey were conducted based on Cameron[18]. Simple random sampling framework was used to conduct this interview-based field survey which drew a total of 65 shrimp and fish farms. The data were collected in the local unit to lessen the error and later transformed into standard unit. Focus group discussion with the farmers and cross-check interviews with key informants (District Fisheries Officer, Upazilla Fisheries Officer, local fisherman leader and NGO employee working with aquaculture) were done by semi-structured questionnaire.

Data analysis: The collected data from the questionnaire survey were assembled and categorized conferring to different areas and fish farms and analyzed by using tabular and descriptive statistical techniques. The difference between expected profit and actual profit per unit area per year was calculated to estimate the economic loss. To investigate the correlation between these parameters, production, production cost and profit data were collected by questionnaire survey. Data were plotted to check whether there is any significant correlation between two parameters. Any significant difference was calculated using SPSS version 20.0 employing multiple comparison at $p < 0.05$. Normality test was done using D'Agostino & Pearson test, Shapiro-Wilk test and Kolmogorov-Smirnov test at $p < 0.05$[19].

Results and Discussion

Age group of the pond owners, culture system and pond size of the surveyed regions: Overall, most of the fish farm owners were between the age of 26 and 35 years or above 46 years (Fig. 1A). Nearly half of the fish farms were cultured in semi-intensive culture system followed by improved extensive and extensive culture systems (Fig. 1B). However, in Rangamati all the fish farms surveyed were found to be cultured by semi-intensive culture system while in Satkhira all the surveyed farms practiced improved extensive culture system (Fig. 1C).

The area of the fish farms was also noted by questionnaire survey where the ponds were categorized as <0.3 ha, 0.3-0.5 ha and >0.5 ha. Around 43% of the farm area >0.5 ha while around 37% farms were <0.3 ha (Fig. 1D). Region-wise distribution showed that farm size at Bhola, Rangamati and Madaripur were <0.3 ha while at Satkhira, Khulna and Jashore the farm size was >0.5 ha. Pond ownership types were categorized as owned, leased and mixed type (partially leased and partially owned). At Madaripur, Jashore,

Bhola and Rangamati more than half of farms were owned by the farmers while at Satkhira 50% farms were found to be mixed ownership type (Fig. 1F).

Fish and shellfish species cultured in the survey regions: The fish species commonly cultured were carps including rohu (*Labeo rohita*), catla (*Catla catla*), common carp (*Cyprinus carpio*), and other species included pangas (*Pangasius hypophthalmus*), mrigal (*Cirrhinus mrigella*), olive barb (*Puntius sarana*), tilapia (*Oreochromis niloticus*) etc. while shellfish species included freshwater prawn (*Macrobrachium rosenbergii*) tiger shrimp (*Peneaus monodon*) and crab (*Scylla serrata*). In Khulna and Jashore regions, prawn culture was found to be practiced while shrimp culture in Satkhira. In other regions, only finfish species were found to be cultured.

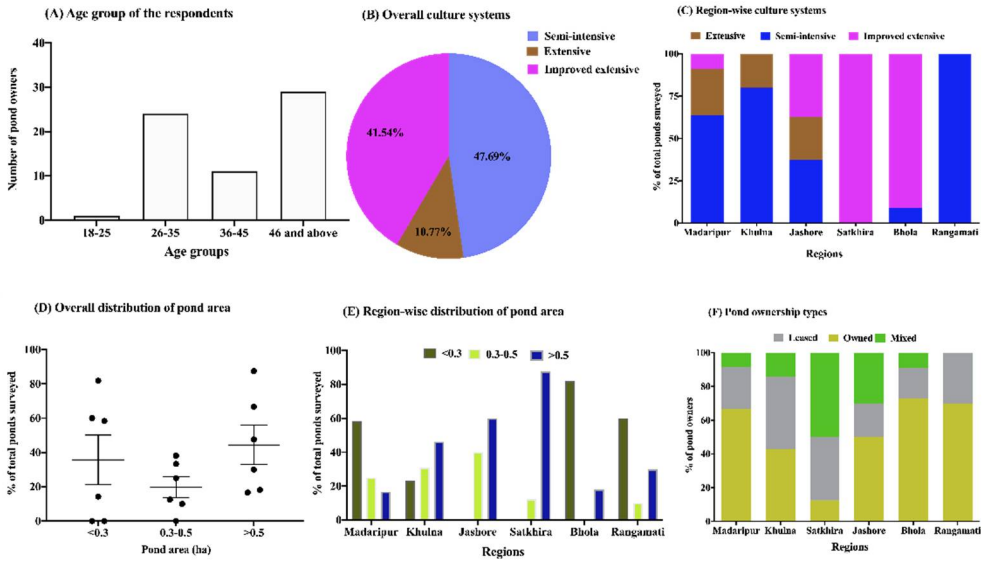

Fig. 1. Information of the study areas. (A) Overall age group of the respondents in different surveyed regions, (B) overall culture system and (C) region-wise culture systems in percentage, frequency (%) of ponds surveyed according to the area of the ponds: (E) overall distribution and (F) distribution in different regions; and (F) types of pond ownership (%) in different areas.

Correlation between pond area, production rate, production cost and profit: No correlation existed between pond area and production per hectare ($p > 0.05$, Fig. 2A). However, significant correlation was found between production cost per hectare and pond area ($p < 0.01$, Fig. 2B). No significant correlation was found between pond area and profit per hectare ($p > 0.05$, Fig. 2C). A significantly positive correlation was also found between per unit production cost and profit ($p < 0.001$, Fig. 2D) meaning that higher investment per unit area (ha) provided higher production and profit as well. However, no significant correlation was found between production per hectare and profit per hectare ($p > 0.05$, Fig. 2E) and per unit production and production cost ($p > 0.05$, Fig. 2F).

Production, production cost and yearly profit: Production, production cost and yearly profit per hectare were compared between different regions. Significantly higher production per hectare was found in Satkhira (6.22 ± 1.32 MT/ha) than that of Rangamati (1.35 ± 0.17 MT/ha), Khulna (1.69 ± 0.38 MT/ha) and Jashore (2.34 ± 0.79 MT/ha) (Fig. 3A; $p<0.05$). Moreover, higher production per hectare was also found in Madaripur (5.49 ± 1.07 MT/ha) than that of Rangamati and Khulna ($p < 0.05$).

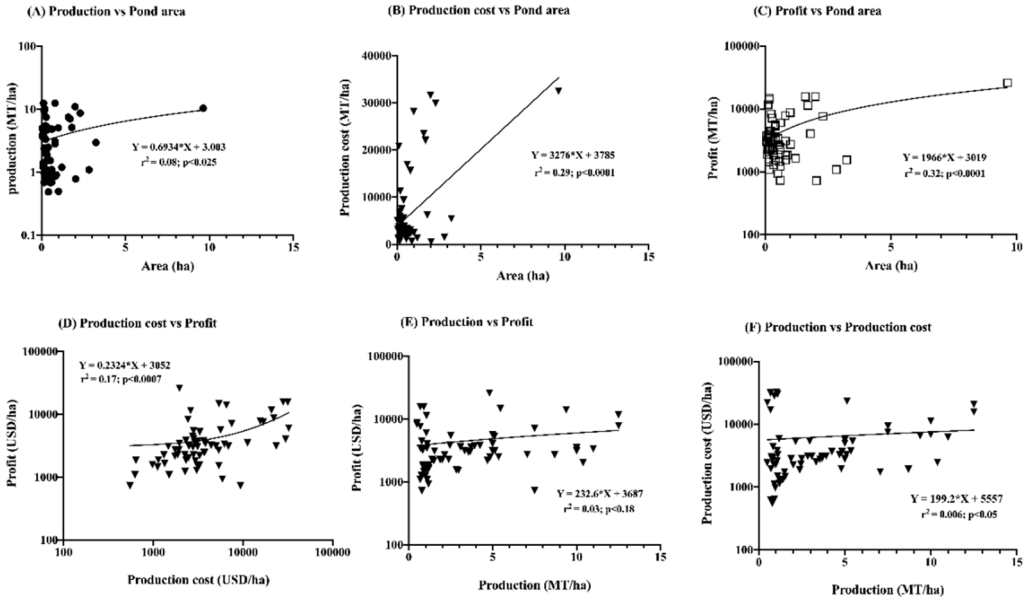

Fig. 2. Correlation between different aspects of fish farming. Correlations were made between (A) pond area and production per hectare, (B) pond area and production cost per hectare, (C) pond area and profit per hectare, (D) production cost per hectare and profit per hectare, (E) production per hectare and profit per hectare; and (F) production per hectare and production cost per hectare with the combined data from different regions where significant correlations were determined at $p < 0.05$.

Production cost per hectare was also significantly higher in Satkhira (20.71 ± 4.42 thousand USD/ha) than that of other regions ($p < 0.0001$; Fig. 3B). Expected and actual profit per hectare per year were also determined where no significant difference between actual and expected profit was observed (Fig. 3C). However, actual profit was lower than expected profit in all the regions except Satkhira. Actual and expected profit in different regions ranged between 1901 USD and 9750 USD; and 2843 USD and 9905 USD, respectively. Percentage reduction of expected profit in different regions were also determined which ranged between 10 and 33% (Fig. 3D). No significant difference in percentage reduction of expected profit was not found. However, the lowest reduction was found in Satkhira (10.18 ± 3.91% USD per hectare per year) and the highest in Madaripur (33.00 ± 8.54% USD per hectare per year).

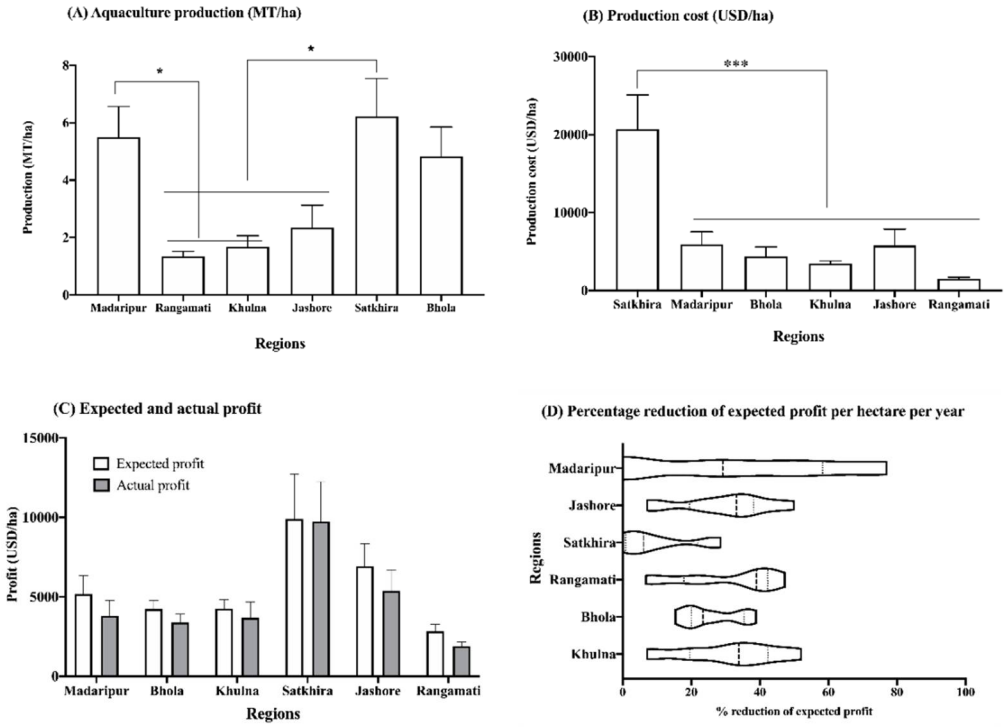

Fig. 3. Bar diagram showing area-wise production (A), production cost (B), expected and actual profit (C). Violin plot showing the percentage loss of expected profit (USD) per hectare in aquaculture in different areas (D). Data were analyzed using SPSS version 22 with the level of significance at P<0.05 using multiple t-test (A-C) and one-way ANOVA (D). The symbol * means P<0.05, *** means P<0.0001.

Identification of causes of aquaculture production loss: The causes of production loss in aquaculture of the surveyed regions were divided into four groups where the first one was feed related problems which included higher feeding cost, scarcity of feed and poor Feed Conversion Ratio (FCR), while the second problem was seed related including the price and scarcity of good quality seed. The third one was management related which encompassed scarcity of water during the summer months, sudden oxygen depletion and natural disasters. The last and most important one was disease related problems. Disease was reported as the main impediment in the aquaculture production losses reported by more than half of the farmers (55.38%) in the surveyed areas followed by management related problems (20.00%), seed related problems (9.23% each) (Table 1). The disease related problems were highest in Bhola (100%) while it was lowest in Satkhira (25.00%). The farmers of Khulna regions identified the management problems as the prime reasons of production loss (35.71%) while in Rangamati, management problems were regarded as the least (10.00%). Both seed and feed related problems were dominant in Satkhira reported by 37.50% and 25.00% of total farmers respectively.

Table 1. Causes of aquaculture production losses in the survey area.

Causes	Percentage of ponds experienced the problems in different regions						
	Bhola (n=11)	Rangamati (n=10)	Khulna (n=14)	Satkhira (n=8)	Jashore (n=10)	Madaripur (n=12)	Total (n=65)
Feed related problems	-	-	21.42	25.00	10.00	-	9.23
Seed related problems	-	10.00	14.28	37.50	-	-	9.23
Management related problem	27.27	10.00	35.71	12.50	-	25.00	20.00
Disease related problem	100	60.00	28.57	25.00	50.00	66.67	55.38

Category of finfish diseases: The diseases of finfish and shellfish recorded in the surveyed regions were categorized as bacterial, viral, parasitic and other groups (fungal, nutritional etc.). Overall more than 33% of the farms suffered from bacterial diseases (Table 2). However, apart from viral, bacterial and parasitic diseases, other diseases were reported in the nearly half (40%) of the farms surveyed. Moreover, bacterial diseases were more prevalent in the farms at Jashore, Khulna and Rangamati while viral diseases were dominant in Satkhira (50% farms). Parasitic diseases were reported in all the regions.

Table 2. Categories of fin fish diseases causing aquaculture production loss during the survey.

Disease	Percentage of ponds experienced the diseases in different regions						
	Bhola (n=11)	Rangamati (n=10)	Khulna (n=14)	Satkhira (n=8)	Jashore (n=10)	Madaripur (n=12)	Total (n=65)
Bacterial	18.18	40.00	50.00	25.00	60.00	8.33	33.85
Viral	0.00	0.00	07.14	50.00	0.00	25.00	12.31
Parasitic	18.18	10.00	14.29	12.50	10.00	16.67	13.85
others	63.64	50.00	28.57	12.50	30.00	50.00	40.00

More specifically, the diseases that were seen in the farms of the survey regions included Epizootic Ulcerative Syndrome (EUS) (12.30%), dropsy, argulosis, gill rot (10.77% each). Lernea, commonly known as anchor worms, red spot and tail and fin rot (7.69% each) were also reported (Table 3). EUS was the major problems, farmers called it ulcer, in Rangamati and Madaripur regions. Farms at Madaripur also had gill rot disease. Dropsy was predominant at Bhola, Rangamati and Jashore.

Table 3. Fin fish diseases reported in the survey regions.

Disease	Percentage of ponds experienced the diseases in different regions						
	Bhola (n=11)	Rangamati (n=10)	Khulna (n=14)	Satkhira (n=8)	Jashore (n=10)	Madaripur (n=12)	Total (n=65)
EUS	9.09	30.00	-	-	10.00	25.00	12.30
Dropsy	27.27	20.00	-	-	20.00	-	10.77
Argulosis	18.18	-	14.29	12.50	-	16.67	10.77
Learnea	-	20.00	-	-	10.00	16.67	7.69
Tail and fin rot	9.09	10.00	-	-	30.00	-	7.69
Gill rot	18.18		-	-	10.00	33.33	10.77
Red spot	9.09	20.00	-	-	10.00	8.33	7.69

Category of shellfish diseases: As mentioned earlier, only the farms at Khulna and Satkhira regions covered by this survey had shellfish aquaculture mostly shrimp and prawn where 50% of shellfish diseases at Satkhira were found to be occurred by viral pathogens (Table 4).

Table 4. Categories of shellfish diseases causes aquaculture production loss in the survey areas.

Disease	Percentage of ponds experienced the diseases in different regions					
	Bhola (n=11)	Rangamati (n=10)	Khulna (n=14)	Satkhira (n=8)	Jashore (n=10)	Madaripur (n=12)
Bacterial	No shellfish culture recorded	No shellfish culture recorded	21.43	12.50	No shellfish culture recorded	No shellfish culture recorded
Viral			28.57	50.00		
Parasitic			14.29	12.50		
others			35.71	25.00		

Table 5. Types of viral diseases in shellfish aquaculture found during the survey.

Shellfish diseases	Percentage of ponds experienced the diseases in different regions		
	Khulna (n=14)	Satkhira (n=8)	Total (n=22)
Antennae degeneration/ broken in prawn	21.42	12.50	16.96
Soft shell disease	14.29	12.50	13.40
White spot disease of shrimp	21.42	50.00	35.71
Yellow head disease of Prawn	14.29	0.00	7.15

The most prevalent disease of shellfish reported in the study was white spot disease (35.71%) followed by antennae degeneration/ broken (16.96%), soft shell disease (13.40%) and yellow head disease of prawn (7.15%). Half of the farms from Satkhira had reported white spot disease in shrimp. The most dominant shellfish diseases reported in Khulna were antennae degeneration/ broken in prawn and white spot disease in shrimp (Table 5).

Aquaculture in Bangladesh has a great contribution to the global aquaculture production. The continuous increase of aquaculture production in Bangladesh largely depends on the fisheries management[20]. Moreover, skilled manpower, modern technology and availability of raw materials including fish seed and feed determine the success of this sector[21]. Farmers' perception and adaptability to new technology also play a great role for improved production where age of the farmers is one of the many factors[22]. The farming system is greatly influenced by the demographic dividend of the farmers[23]. Age of most of the fish farmers in the study regions are between 25 and 54 years which is categorized as prime working age group where farmers are more energetic, proficient and capable in resource use with upholding better management practices in fish farming than the others[23-24].

Aquaculture production in the survey areas have followed a steady growth over the last decade as has been reported in the nation statistical year book of Bangladesh[5]. The production rate per hectare in these regions has been found to be related to the area of the ponds and production cost which means that the higher the investment specially for improved technology, quality raw materials and for management the higher the production rate which consequently has provided higher profit. Even though, all the fish farmers have earned profit from the aquaculture production, actual profit was lower than the expected profit which might be because of excessive cost due to diseases.

These losses in aquaculture production mainly occur four types of problems mentioned earlier. The disease has been found to be the vital factor of the loss which includes mortality, reduced growth and treatment cost. Tavares-Dias and Martins[25] have reported an annual loss of about 15% of production in Brazilian freshwater fish farms due to diseases. In the present study, average production damage of farmers of six districts of Bangladesh caused by fish disease was 18.5% of total average yearly income from fish production[26]. Shinn *et al.*[9] have estimated an annual loss of 5.8-16.5% of UK aquaculture production considered all the species in both freshwater and marine aquaculture due to parasitic infection. Bagum *et al.*[8] have reported around 12.9% loss of the production value due to fish diseases. The reduction of expected profit (loss) in the current study was found ranged between 10 and 33% which is similar to the findings of other studies. The feed related problem was prominent in Satkhira and Khulna due to higher feeding cost as well as high FCR which increases the wastage of feed resulting the requirement of more feed. Unavailability of good quality feed also responsible for less

production. The seed related problem was highest in Satkhira due to the scarcity of good quality seed and price. The major shrimp production regions in Bangladesh are Satkhira and Khulna where the shrimp post larvae (PL) produced in cox's bazar are transported for stocking which increases the production cost. Unavailability of disease-free PL is one of the main constraints for continuous shrimp production[27]. Moreover, Khulna region faces the sudden oxygen depletion and scarcity of water during the summer months which are also responsible for production loss while the farmers at Rangamati have reported natural calamities (for example landslide, overflow of the spring water) as one of the reasons for aquaculture production loss (field experiences).

In the current study, bacterial and parasitic diseases have been found to cause most of production losses. Similar results have been reported in Brazilian aquaculture[25]. Aquaculture diseases including EUS, dropsy, argulosis, gill rot, red spot, tail and fin rot were reported in Bangladesh previously[8,28]. Symptoms of these diseases were also observed in some areas of the present study, particularly in finfish dominated culture region such as Bhola, Rangamati, Jashore and Madaripur. From the personal discussion with the farmers in some of the study areas, it has been identified that farmers used water from rice field and river/ditch which may be the possible sources of these disease-causing agents. The average disease control loss of around 45 USD per hectare per year in Mymensingh, Sylhet and Rajshahi was assessed by Bagum *et al.*[8]. USD 4.8 million was lost due to epizootic ulcerative syndrome disease reported in Bangladesh during 1988-1989[29]. Economic loss due to different diseases including viral, bacterial and fungal diseases between 2010 and 2013 was also reported as more than 1000 USD per year per hectare in Bangladesh[8].

In the present study, more than 30% of the farms have been found to be infected by bacterial pathogens where fish at around 7.69% of the farms have shown red spot or hemorrhages on skin and at the base of fins. The change of the season (dry to rainy) and flood is are the major environmental causes of these disease as reported by Khoi *et al.*[30]. High stocking densities, environmental pollutants and a large amount of organic mud in the pond have also been reported to favor the bacteria to initiate the diseases[8] which have also been observed in the study areas. The metazoan parasite *Argulus* is another threat to finfish which induces mortality, growth and subsequently economic losses. Hossain *et al.*[31] have demonstrated that carp fingerlings in the nurseries get infected with protozoan and monogenean parasites. Argulosis has also been shown to cost around USD 615 per hectare per year in carp aquaculture in India[32]. The estimated total economic loss of Indian major carp aquaculture in Bangladesh due to parasitic diseases was estimated as USD 444 /ha/year[33].

Among shellfish viruses, WSSV was first detected in Bangladesh in 1994 which caused the loss of shrimp production of 5 MT (14% of expected outputs) costing 25 million USD[34]. The projected annual global loss for WSSV is tens of billion USD per year.

The estimated damage, caused by WSSV in Asia, was 4 billion USD and Bangladesh shrimp industry has to face loss several million USD every year[35]. Early mortality syndrome (EMS) disease caused by a strain of *Vibrio parahaemolyticus* has also been reported in shrimp in Bangladesh[36]. EMS disease has been previously reported to cause more than one billion USD economic destruction in shrimp aquaculture in China, Viet Nam, Thailand, Mexico and Malaysia[37]. Loose shell disease (LSD) causes flaccid spongy abdomen from muscular dystrophy and the development of a loose exoskeletal covering over the abdominal musculature[38]. Loose shell, soft muscle, and a condensed melanized hepatopancreas are the symptoms reported by the respondent of the surveyed area which might be LSD. Approximately 14-23% of shrimp farms in Tamil Nadu during 1998-1999 reported LSD which incurred a loss of ~9.125 million USD in 2006[38-39]. Symptoms of antennae broken (erosion of antennae) and yellow head disease (caused by yellow head virus) were also reported in the surveyed region. The yellowish discoloration under carapace or hepatopancrease is the sign of yellow head disease which caused estimated economic loss of half a billion USD during an outbreak in Thailand in 1991[40].

Conclusions

The prime obstacle for upgrading a small scale fish farm into commercial husbandry is diseases of aquatic species which hinders the future development of fisheries industry of a country. The area of ponds, quality fish feed and seed and strategy to disease identification, control and prevention have been found to correlate with the aquaculture production. In addition, the reduction of expected profit indicated that the disease induced loss hampers the future development of aquaculture industry. The present study recommends a combined effective approach, which includes proper management, state-of-the-art technology and economic feasibility to up rise aquaculture production of Bangladesh.

Acknowledgements

This work was supported by Center for Advanced Studies and Research in Biological Sciences of the University of Dhaka, Bangladesh (2018-2019 fiscal year). All authors would like to thank the LEAF (Local Extension Agent of Fisheries) of the respective survey areas (Madaripur, Bhola, Satkhira, Jashore, Rangamati and Khulna) for their cooperation during the survey.

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(Manuscript received on 21 December, 2021; accepted on 20 June, 2022)