An Assessment of the Existing Organic Shrimp Culture Practices in the Southwest Region of Bangladesh

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Abstract
Shrimp farming has had a great impact on Bangladesh's economy. By the time being several farming approaches has been launched to uplift production as well as the farmer's income. Of the various cultural techniques, organic farming is getting popular owing to its high market value. This survey investigated the present status of organic shrimp farming in south-western Bangladesh. Three districts (Khulna, Bagerhat and Satkhira) comprising 35 traditional shrimp farmers and 87 organic shrimp farmers were chosen, and data were gathered using the direct interview approach. About 41% of farmers were between the ages of 40 and 49. The majority of the farmers had primary schooling while a small number were illiterate. The family size of the 69.23 % farmers was 5-8 members and 35.38% persons had an experience of more than 20 years. Organic farming practices following EU organic Aquaculture Standard Regulation (EC) No 710/2009 was found higher (65%) in Satkhira since many organic shrimp production hubs were established there. About 77% organic shrimp farmers received training on organic farming in Satkhira and many of them used feed during culture. The study revealed that, the productivity of organic shrimp was 485 kg/ha, which is almost 27% higher than traditional (380 kg/ha) farming. The benefit cost ratio (BCR) for organic shrimp farming was 2.08, which indicated that it is quite profitable. The study suggests that institutional support, technical assistance along with proper training could enable Bangladeshi shrimp farmers to adopt organic culture widely that would bring immense socioeconomic and environmental benefits.

Keywords: Organic shrimp, culture, southwest region, productivity, Bangladesh

Introduction

Being a leading shrimp producer Bangladesh ranks 9th in the world with 2.1 percent shrimp exports by producing 0.25 million tonne's shrimp in 2020-21 (DoF, 2022). It is generally believed that Bangladeshi shrimp are almost organic since 98% of production comes from extensive farming practices. The majority of farmers refrain from using hazardous chemicals in their extensive shrimp production, hence Bangladeshi shrimp are still regarded as having premium quality (Hensler, 2012). Yet, a lot of shrimp farmers use synthetic materials. The detrimental use of agrochemicals, antibiotics, disinfectants, chemical fertilizers, and pesticides in conventional shrimp farming has a significant impact on ecosystem biodiversity, soil quality, groundwater quality, and underground water quality (Gräslund *et al.*, 2003).

It is frequently asserted that Bangladeshi shrimp farming was unplanned and resulted in environmental degradation, such as decreased water and soil quality, decreased farm productivity due to decreased land and soil fertility, decreased livestock production due to decreased grazing land, risked human health, and destroyed mangrove forests (Rahman *et al.*, 2013). Shrimp cultivation is contributing to increase salinity by constructing canals and flooding the earlier rice production fields with saline water (generally known as *gher*). This affects not only the soil salinity of the gher but also of the surrounding areas as salt water is channeled through neighboring land (Alam *et al.*, 2017). As soil fertility falls, rice, vegetable, and other crop productivity declines. Shrimp cultivation harms the mangrove ecosystem by transforming wetlands into ponds or ghers for shrimp aquaculture. As water exchange is required in shrimp farming, toxic effluents are frequently released into waterways, resulting in widespread diarrhoea, dysentery, and other water-borne diseases harming humans (Hossain and Hasan, 2017).

Since last few years, organic shrimp aquaculture has been emerged as a new farming venture in the southwest coast of Bangladesh addressing high profitability to alleviate poverty of marginal shrimp farmers and environmental sustainability. In general, no artificial feed is used in organic shrimp farming, chemical use is prohibited, and natural treatment is employed, which reduces the influence of these substances producing environmental contamination as compared to

conventional shrimp farming (Rönnbäck, 2000). However, the foundation of the organic farming system is sustainable agriculture management that takes into account environmental protection and social reasons. Currently through some overseas partners and NGOs entrepreneur's collaborating with domestic shrimp processing industry, organic shrimp farming is getting popular in coastal districts of Bangladesh, particularly in the Satkhira region. As a result, both domestic and international consumers value safe, high-quality shrimp and shrimp products produced organically. Only a few organic shrimp farms exist in Bangladesh due to the increased risk of disease infestation and higher production input costs (Marschke and Wilkings, 2014). According to Paul and Vogl (2012), despite the fact that organic shrimp farming produced high yields in southwest Bangladesh, it was less productive than other shrimp producing countries. Modern organic food production is attracting a positive attention around the world because of the sustainability issues influencing individual and public healthier options, natural and social resources, the economy and food safety (Thøgersen, 2017; Azzurra *et al.*, 2019). Keeping pace with the increasing demand of developed world Bangladeshi farmers transforming to organic shrimp farming. The government also focusing to develop a sustainable organic shrimp farming framework based on an ideal standard.

Some distinctive studies have so far been performed on organic shrimp farming sustainability and economics, transforming shrimp farming to organic, production status (Ahmed *et al.*, 2018; Sarkar *et al.*, 2019; Dhar *et al.*, 2020). Before giving any policy direction towards increasing organic shrimp production, it is imperative to know the information on existing organic shrimp culture standard, production status, management strategies and economics. Through this comprehensive survey study, we attempted to explore the detailed scenario of above features along with existing organic shrimp production hub and shortcoming regarding this new farming technologies for its further development and dissemination.

Materials and Methods:

Study area

The survey work was carried out to assess the present status of organic shrimp (*P. monodon*) farming in the districts of Bagerhat, Khulna, and Satkhira from July to December 2022. To find out the actual scenario of organic shrimp farming in the coastal areas, 4 upazilas of Bagerhat, 6 upazilas of Khulna, 5 upazilas of Satkhira were selected to survey where shrimp culture was widely practiced.

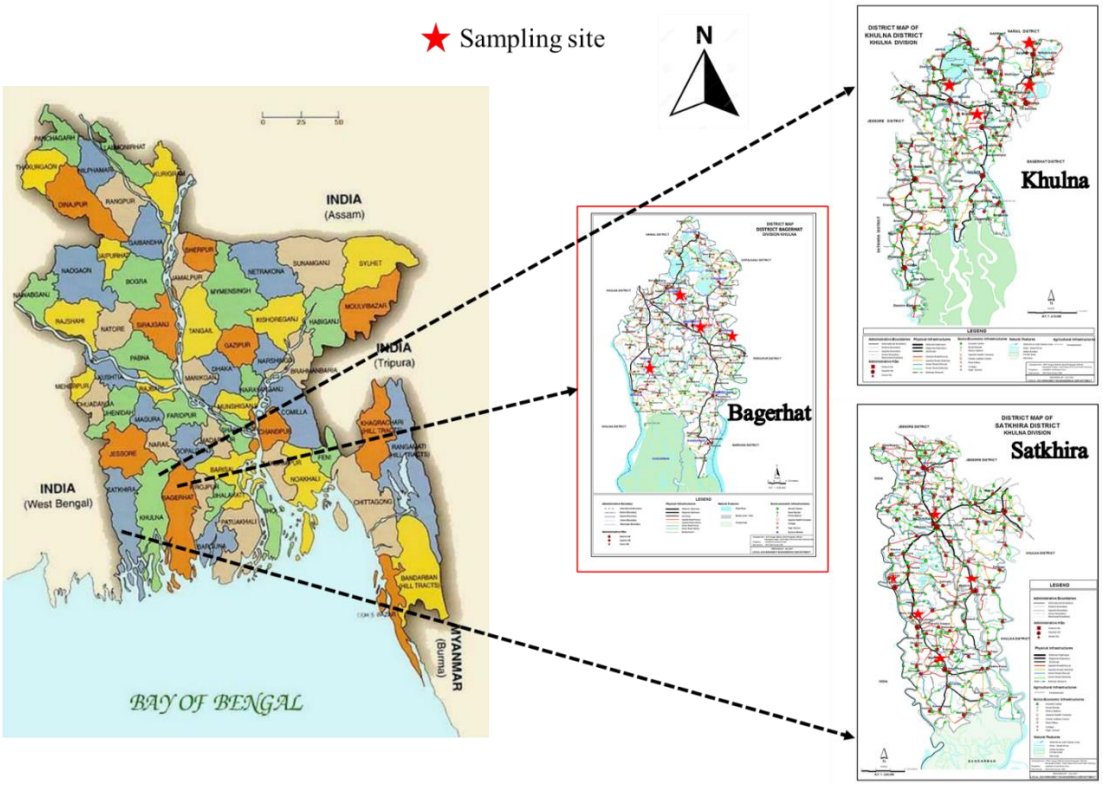

Figure 1. Geographical presentation of the study area.

The collection of data

Primary Sources

The primary data were collected through a field survey in the study area utilizing a structured questionnaire. Throughout the culture period, data on farming operations were obtained by direct physical observation as well as interviews with farmers along the pond's edge. Changes in socioeconomic and environmental issues were obtained through standardized questionnaires administered to respondents involved in shrimp farming and those who were not involved in shrimp

farming. One hundred and twenty-two respondents were interviewed for this purpose. According our survey, it was found that the number of organic farmer and traditional farmers are 87 and 35 respectively. Farmers were chosen using a simple random selection procedure. Age, gender, education, family size, average gher size, major profession, water source, water depth, source of PL, feed ingredients used in organic farming, lime and medicine, transportation, annual income, and credit source were considered. Organic shrimp production hub and organic shrimp processing industry were also visited to realize the actual scenario (Table 1).

Table 1. An overview of the procedures used to collect empirical data.

Criteria	Satkhira	Khulna	Bagerhat
Total no. of farmers interviewed	62	28	32
No. of upazila surveyed	5	6	4
No. of FGD	3	-	1
No. of Organic shrimp production Hub visited	6	-	-
No. of organic shrimp processing industry visited	1	-	-

Source: Author survey, 2022

Secondary Sources

Further relevant information of organic shrimp (*P. monodon)* farming on socio-economy and environment were collected from Upazila fisheries office, NGOs like Mostofa organic shrimp products Ltd. in Satkhira, research journals, reports and web pages available on the internet.

Data Analysis

After gathering the essential data and information, it was categorized, revised, and coded. All collected data were analyzed using "Microsoft Excel 2019". The results were shown in descriptive tabular and graphical presentation. GraphPad Prism 8.0.2 was used to create various graphs to demonstrate the outcome. Descriptive statistics (i.e., sum, average, percentage, etc.) with tables and figures were utilized to document the socioeconomic standing and farming inputs of organic shrimp farmers.

Results and Discussions

Demographic features of organic shrimp producers

Age structure

The age distribution and educational status of the respondents are illustrated in Figure 2. Maximum (41.26%) population were in older age class which was from 40-49 years. Only 1.06% of the population was found below 18 years. Other 31.74% of the population were in between 30-39 years, 23.83% in between over then 50 years age and 2.11% in 18-29 years (Figure 2).

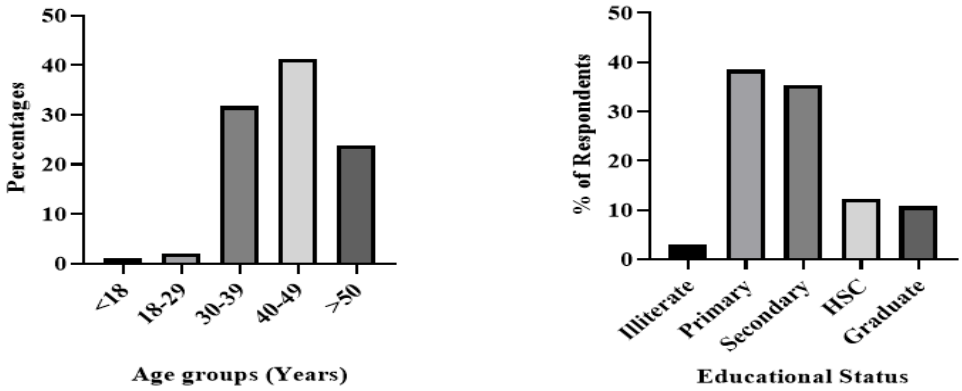

Figure 2. Age distribution and educational status of the respondent

Educational status

The educational status of the respondents was classified into five categories (illiterate, primary, secondary, HSC and graduate). Among the organic shrimp farmers, maximum respondents (38.46%) had an education level of class I to V, while only 3.07% respondents were illiterate (Figure 2). This perspective has found to be changed over the time greatly compared to early decades as because government are taking intensive program to eradicate illiteracy from the society.

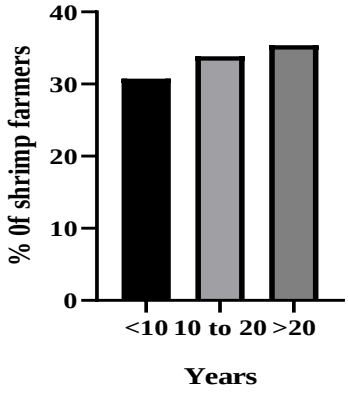

Figure 3. Shrimp farming experience year.

Family size
The family size of the respondents (61+17+9= 87 families) was found to vary from 4 to 11 members in the study area. Maximum 69.23% shrimp farmers had a family of 5-8 persons. About 3.07% of the farmers had a family size of above 8 persons. The rest 27.69% shrimp farmers had a family size of 4 persons.

Experience in shrimp farming
Among the shrimp farmers, 35.38% persons had an experience of more than 20 years. While only 30.76% farmers had farming experience of less than 10 years. The rest 33.84% farmers had 10-20 years' experience in shrimp farming (Figure 3).

The size and water depth of shrimp farms
The size of the (57.73%) surveyed shrimp farms varied between 1.01 and 2.99 ha. However, most of the farms (39.20%) had a size less than 1 ha. Another 3.07% of the farms had a land size between 3.00 ha and above. The depth of surveyed shrimp farms varied from 3-7m. Most of the farms (46.15%) had 3m depth. Others 40%, 12.30% shrimp farms had 4m and 5m depth and rest 1.53% had a water depth of 7m.

Source of PL
Quality PL was essential for the profitable production of organic shrimp. About 47% of river PL was widely used in organic farming systems. 31% organic hatchery PL and 22% other shrimp hatchery PL were also used in organic farming systems.

Feeds and Feeding
Out of 122 farmers both traditional and organic farming system, 46% farmers never used any supplemental feed. About 54% farmers used to apply handmade feed (rice bran, rice polish, wheat flour etc.) as supplemental feed on their farms. They used handmade feed at a rate of 20-30 and > 30 kg/ha respectively. From the field survey information, it was found that feed had been widely used in the organic farming system in Satkhira than the others studied districts (Figure 4). As the feed price was high, the organic shrimp farming system was needed more investment than traditional one but organic farmers did not get any financial aid from Government and NGOs. So, farmers did not show interest in organic farming.

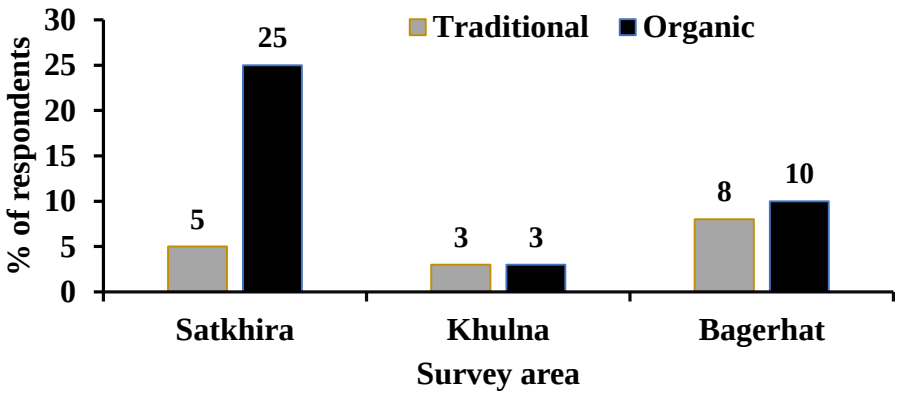

Figure 4. Feed used in the culture system.

Organic standard

The field survey information demonstrated that, 65% of organic shrimp farmers in the Satkhira district followed the standard of EU organic Aquaculture Standard Regulation (EC) No 710/2009. Few numbers of farmers followed the organic standard in the Khulna region (Figure 5). All organic farms partially followed most of the Standard EU Organic Aquaculture Standards, but shrimp health and water quality in the production ponds were not examined on a regular basis (Table 2).

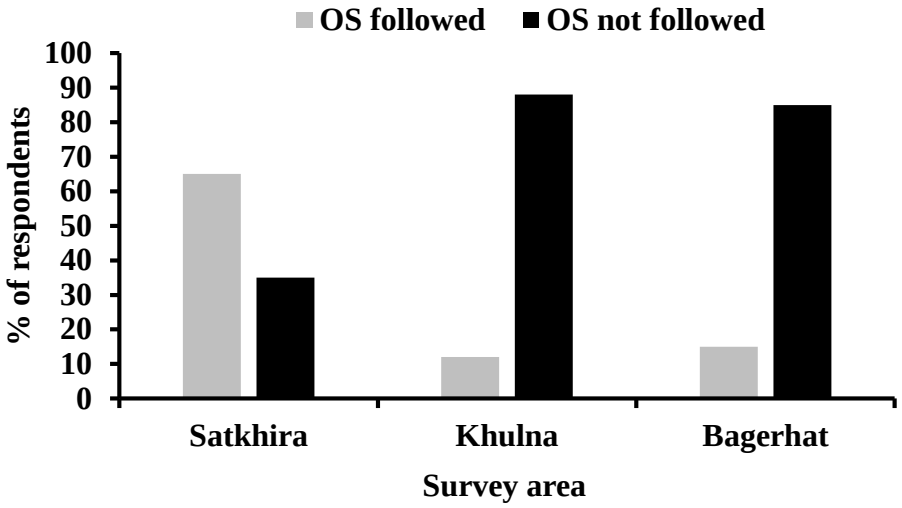

Figure 5. The Percentage of farmers following organic standard

Table 2: Few major criteria of EU Organic Aquaculture Standard followed by the farmer's

Standard EU Organic Aquaculture Criteria	Strictly follow	Partially follow	Not follow
1. Water sources shall be without risk from hazardous substances and other contamination	-	√	-
2. Stocking density of fry shall not exceed 15 fry/m^3	-	√	-
3. Restoring biodiversity	-	√	-
4. Pets shall not be allowed to enter the production site		√	-
5. Application of organically formulated feed	-	√	-
6. Shrimp health and water quality in the production pond shall be regularly checked	-	-	√
7. Fry should be organic	-	√	-
8. No use of prohibited chemotherapeutants and antibiotics, Urea, synthetic appetizers, materials and the product derived from GMO	-	√	-

Trained Organic farmers

To spread technology and information among farmers and enhance farming performance, training is vital. The smaller number of farmers had received organic shrimp farming training in the coastal districts of Bangladesh. Most of the organic farmers (77%) had gotten training on organic farming practices in the Satkhira region but in Khulna and Bagerhat a smaller number of farmers had gotten training (Table 3).

Table 3. Trained organic farmers in the area surveyed

Organic Shrimp Farmer	Districts		
	Satkhira	Khulna	Bagerhat
Trained	77%	3%	4%
Not Trained	23%	97%	96%

Source: Author survey, 2022

Productivity and profitability of different farming practices

From the survey, the production of organic shrimp farming was 27% higher than the traditional shrimp farming systems (Figure 6).

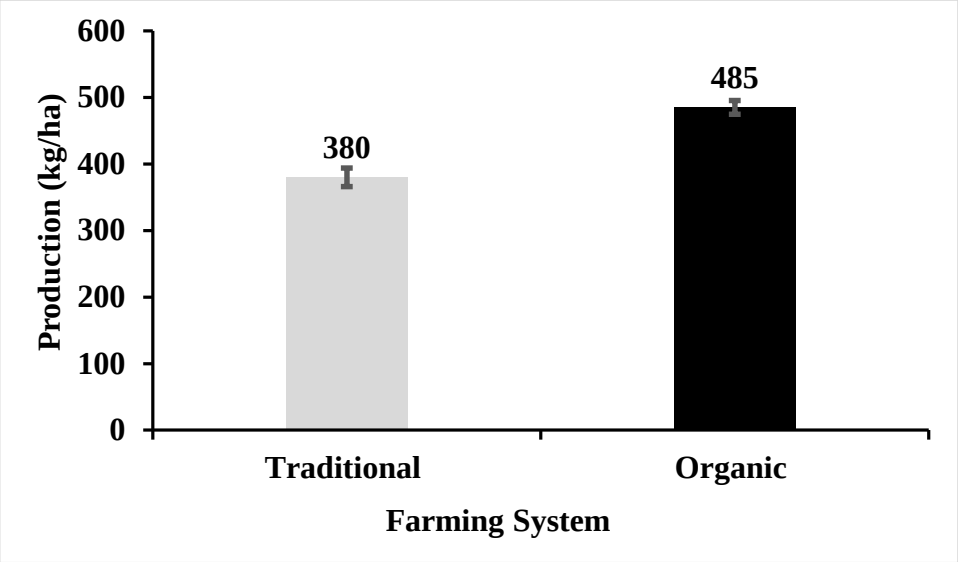

Figure 6. Shrimp production in different farming practices

Since the primary goal of a producer is to maximize profit, determining financial success is crucial for every agricultural business. Shrimp productivity was calculated as the total production produced per unit of land. For the purpose of determining profitability, GR, TC, NR, and BCR were calculated **(Table 4).**

Table 4. Analysis of traditional and organic shrimp farming's financial profitability

Type of farming	Production (kg/ha)	Average price/kg	Gross return (GR)	Total cost (TC)	Net return (NR)	BCR
Traditional	380	600	228000	165395	62605	1.37
Organic	485	800	388000	185768	202232	2.08

Source: Author survey, 2022

Organic shrimp farming hub

Shrimp production hub refers to a small group of farmers working together under a company. In these production hubs, shrimp fry (PL) was collected from their organic PL hatchery which supplied good quality and virus free shrimp fry. Then, through their Collection Center (CC), the production hub provided this shrimp fry to their chosen farmers and also provided virus-free ice (Figure 7). Then, utilizing the necessary inputs for an organic system, the farmer produced good-quality organic shrimp. The company subsequently obtained shrimp from the farmer who was producing them through one of their CC members, and processed the shrimp it had obtained. After organically processing the gathered shrimp, the company exports its goods to other countries with its chosen buyers.

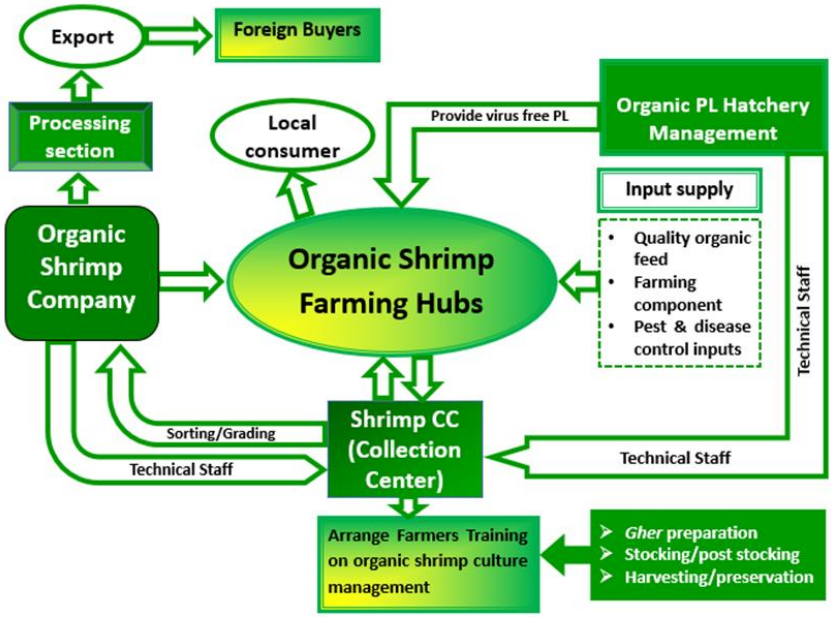

Figure 7. Organic shrimp farming hub in Satkhira.

Source: Depicted by own according to the field observation

Discussion

To keep pace with global demand organic farming is being popular also in Bangladesh. This study assessed the current scenario of organic shrimp practices in the southwest region of Bangladesh. The present study revealed that above 70% farmers had been included in the age group 30-49 years. Ahmmed *et al.* 2021 also found 68% of the respondents were between the ages of 26 and 50, and 17% were older respondents (above the age of 50). The fact that the younger generation showed no interest in shrimp farming is crucial to note (Paul *et al.*, 2018), which suggests that if the current situation persists, troubles are about to come. Previous research has showed that the 16-30 age group had most involvement (45%) in shrimp farming of Botiaghata upazila under Khulna district (Das *et al.*, 2015).

The portion of farmers who got primary education was higher in number (38.46%) and the illiteracy rate was less in number. In a previous study Das *et al.* (2015) found up to 75% illiterate people in a fishing community of Botiaghata upazila under Khulna district. The result may be varied because the present study was conducted in three coastal districts. Rahman, 1994 found that the fishermen were socially, economically, and educationally disadvantaged, and they did not have the financial means to spend in education.

Das *et al.*, 2015 exposed (65%) respondents' family members were 4-6 persons in a study in Khulna district and Dhar *et al.*, 2020 also revealed the average number of respondents' family members of Assasuni upazila under Satkhira district was 6 which was quite similar with the present study. Similarly, Shawon *et al.*, 2018 explored about 65 % medium size family comprising 5-7 members in shrimp farming areas of Khulna.

In the present study, almost all farmers had the previous experience on shrimp farming. Farmers' capacity to adopt new technology such as organic shrimp aquaculture can be hampered by a lack of education, expertise, and income (Paul and Vogl, 2012).

Based on farmer's gher size (1.01-2.99 ha), the survey found that majority (57.73%) of shrimp farmers were in the category of medium class which differed with Dhar *et al.* 2020 wherein highest numbers (67%) was small scale farmers. During the entire production period, the water level was maintained between 0.305 and 1.829 meters (Paul and Vogl, 2013).

It was reported by Mamun *et al.*, 2020 that farmer groups in the south-west of Bangladesh collected PL primarily from hatcheries, 20% from natural sources, and 33.33% from both hatcheries and natural sources. In this study major portion of PL (about 47%) was used from natural source.

Roy, 2018 observed that organic shrimp growers used a variety of additional feeds, including rice bran, wheat bran, pulse bran, and various oil cakes. They used home-supplied feed on occasion. However, extensive shrimp growers employed more commercial feeds to get higher yields. This finding is totally in agreement with the present study.

Training is essential to develop skill in a particular field. Chowdhury and Khairun, 2014 revealed pond management training was received by the shrimp farmers and 75% shrimp farmers got training on disease management and environmental awareness training. In this survey, maximum organic farmers get specific training on organic farming in Satkhira district and organic farming spread in Satkhira because there is developed some organic shrimp farming hub. On the other hand, in Khulna and Bagerhat a smaller number of farmers get training on organic farming and hope it will be changed in coming days. Above 65% farmers in Satkhira region practiced organic standard as because Organic Shrimp Company established many shrimps farming hub in Satkhira region and they assist farmers with different organic input supplies *i.e.*, organic PL, organic feed, fertilizer and other farming components. Moreover, they arrange multiple training for farmers throughout the entire culture period to adopt organic practices.

Organic shrimp farming had the highest productivity than the traditional one (Paul and Vogl, 2012and Sarkar *et al.*, 2020). Paul and Vogl, 2012 found in organic shrimp farmers in the Kaligonj and Shyamnagar under Satkhira district that the average output of organic shrimp was 320 kg/ha/year, with a range of 120 to 711 kg/ha/year which is quite similar with the surveyed production. Sarkar, 2019 reported traditional farming practices produced 275 kg/ha on average which was quite similar with the present study's traditional shrimp production. Organic aquaculture practices have enhanced shrimp productivity, which has influenced Bangladeshi producers to switch from conventional to organic.

Conclusion

This study was conducted to understand the actual scenario of organic shrimp farming practices and the social status of organic farmers. The organic shrimp farmers of Satkhira district were gotten training than the others surveyed districts. Standard EU Organic Aquaculture Criteria Should be followed to ensure the shrimp organically produced and to attract the foreign buyers. According to the survey results, if farmers strictly adhere to organic standards, per unit area productivity and income will improve significantly. So, this study suggesting that, more government and NGOs aid for farmers are warranted to encourage towards organic farming practices.

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Conflict of interest
The author states that they do not have any conflicting research interests.

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