INTRODUCTION

Fisheries and aquaculture have emerged a blessing for economic nourishment of Bangladesh. About 165 million people of Bangladesh (12% of population) depend on fisheries and aquaculture related activities on full time and part time basis for their livelihoods. In 2018-19, fisheries sector contributes 3.50% to the national GDP (DoF, 2019). The country is stepped into a new era through embracing aquaculture to meet domestic and export demand.

Shrimp are the most commonly consumed seafood around the world and being one of the major exportable commodities of Bangladesh. Shrimp are exported to more than 50 countries including European Union (EU), USA, Japan, Russia, China etc. The most prominent culturable shrimp species in Bangladesh are *Penaeus monodon* (locally known as Bagda) and *Macrobrachium rosenbergii* (locally known as Golda). The coastal belt of Bangladesh is favorable for shrimp farming. The leading shrimp creating regions are Bagerhat, Satkhira, Khulna, Cox's Bazar and Chattogram. The land utilized for shrimp cultivation in the country has raised from around 20,000 ha in 1980's to about 258,553 ha in 2019 for its vast international market demand and high export value. Total shrimp and prawn production including capture has also been increased from 1.60 lakh MT in 2002-03 to 2.58 lakh MT in 2018-19 and growth rate is 1.44%. Bangladesh exported 33,362 MT shrimp worth 3088.85 crore TK in 2018-19, the country earned 4118.8 crore TK by exporting 47,635 MT of shrimp in 2013-14 when annual production was 223,788 MT. It shows the quantity of shrimp production has risen but the export has declined by a significant margin in terms of quantity and value both.

In spite of having very good climatic condition, the production efficiencies are low due to high PL mortality, poor management techniques, lack of extension services and poor infrastructure in the coastal areas (Nurruzzaman, 2006). The productivity estimated 483 kg/ha which is relatively lower compare to the top shrimp exporting countries in the world.

Shrimp farming has long been causing severe threats to ecological systems of Bangladesh such as deterioration of soil and water quality, depletion of mangrove forest, decrease of local variety of fish and shellfish, saline water intrusion in ground

water, local water pollution and change of local hydrology (Kabir and Iva, 2014). There have been several reviews on the relations between shrimp culture and the environment (Macintosh and Phillips 1992, Primavera 1993).

The consequence of environmental impacts of shrimp culture is not properly understood in Bangladesh. The creation of a set of requirements for responsible aquaculture products can be the best solution. A standard can also provide aquaculture industry stakeholders with the tools to demonstrate to consumers and major buyers the real cost of production, which could help to ensure that farmers are appropriately compensated for their products (ASC shrimp standard 1.0).

Seafood Choice Alliance found in 2003 that, 72% of respondents stated that they would be more likely to buy seafood bearing an environmentally responsible label. UNEP stated that, consumers are interested in the social and environmental conditions under which their purchases are produced.

Considering the above views, the study was carried out to investigate the environmental impact of shrimp culture and to find out a better shrimp culture practice which is economically viable as well as socially and ecologically responsible.

Therefore, the specific objectives of the study were as follows

1. To detect the overall resource use and environmental impacts caused by shrimp farming.
2. To identify intended shrimp farming activities that ensure the consumers' food safety.

REVIEW OF LITERATURE

The shrimp aquaculture industry is a large international business being farmed in 50 countries globally however the growth of shrimp aquaculture has also led to a range of sustainability related impacts. First, shrimp aquaculture practices have contributed to environmental degradation through the misuse of chemicals and antibiotics, overextraction of wild brood stock, and increasing waste flows to ambient ecosystems. (Kanduri and Eckhardt, 2008; Clayton et al., 1999; Little et al., 2016). Second, negative impacts have also emerged from the expansion of pond areas leading to mangrove loss (Hamilton, 2013), as well as the conversion of agricultural land, and the salinization of water supplies and nearby agricultural land (Samerwong, 2012). Third, food safety concerns are linked to the misuse of pharmaceutical inputs (Nguyen et al., 2019)

Conditions for shrimp farming are optimal where mangrove forests occur due to climate, hypersaline environment, and occurrence of wild populations of shrimp larvae (Tenorio et. al., 2015) and construction of shrimp farms in mangrove forest environments results in high production and high profitability with low costs (Islam and Wahab, 2005; Tenorio et. al., 2015). Mangrove ecosystem is crucially important to support the diverse aquatic species of the region (Islam and Wahab, 2005). The Environmental Justice Foundation (EJF, 2014) linked shrimp farming with significant environmental damage, including the large-scale conversion of ecologically sensitive and important wetland areas and farmland. Destruction of mangroves for shrimp farming has been publicly condemned by the United Nations Environment Programme (UNEP, 2010), which stated that “Vast tracts of mangroves have been cleared for shrimp aquaculture, allowing fast profits but leaving long-term debts and poverty which are hard to reverse”.

Since most of the world’s shrimp supply comes from developing countries, methods of shrimp farming, as well as their impacts, are an important area of focus (Joffre et. al., 2015; Kelly, 2012). It is estimated that only five percent of global aquaculture production is currently certified (Sustainable Seafood, 2019). While this still amounts to 5.4 million tonnes of aquaculture products, the rate of expansion of certified production remains lower than the overall growth of global production (FAO, 2020).

The development and adoption of closed-system farming which controls interactions between pond systems and the wider ecosystem (Joffre et al., 2018; Lebel et al., 2002; Nguyen et al., 2019). According to a new study conducted by World Wildlife Fund in Vietnam and Thailand (Fletcher, 2017) more intensive, shrimp farming can yield better environmental and economic results than its alternative extensive or improved extensive systems. Contrarily, researchers have found that in exchange culture systems these wastes can be easily eliminated (Nguyen T.A.T. et. al. 2019). A study in Vietnam and Thailand showed that, in most cases, intensive operations used land much more efficiently, yielding at least eight additional tons per hectare. They also reduced the costs of land use by more than 90% per kilogram of shrimp. The most intensive farms made more, efficient use of energy as well, with energy costs that were 74% to 89% lower than the least intensive operations (Engle C.R. et. al., 2017)

By producing more shrimp per hectare of land, farmers can increase production to meet growing demand for shrimp without increasing pressure on the region's natural resources (Otoshi et. al., 2007). A 20% increase in survival was capable of decreasing production costs by 0.80 USD per kg. Some of the problematic biological issues include poor growth rate, an inability to maintain adequate pH, likely due to high rates of microbial respiration, high CO_2 concentration, and bacterial infections in animals (Browdy et. al., 2006)

EU, USA and Japan are the main importers of Bangladesh shrimp and they are more concerned about some conditions including freezer requirement, hygienic wrapping and packaging, high degree of personnel hygiene, training requirement of the personnel, traceability and food safety, quality assurance, labeling requirements, HACCP aspects, environment and human rights issues and concerned labor rules, etc. (SSOQ, 2008; FAO/NACA, 1995).

Significant innovations in production and processing in those countries have increased the value added associated with their exports and the market share that they command (Raux and Bailly, 2002). Several researches highlight that quality is a major concern in the shrimp export industry (Dubay et al., 2010; Freitas et al., 2009; Loc, 2003; Sangho et al., 2011). There are a number of quality measurements that are specific to the shrimp industry (Loc, 2003).

Impact assessment is such a process, which can be used to ensure that necessary measures needed to protect biodiversity and its sustainable use are applied in the process of development planning (IAIA, 2005).

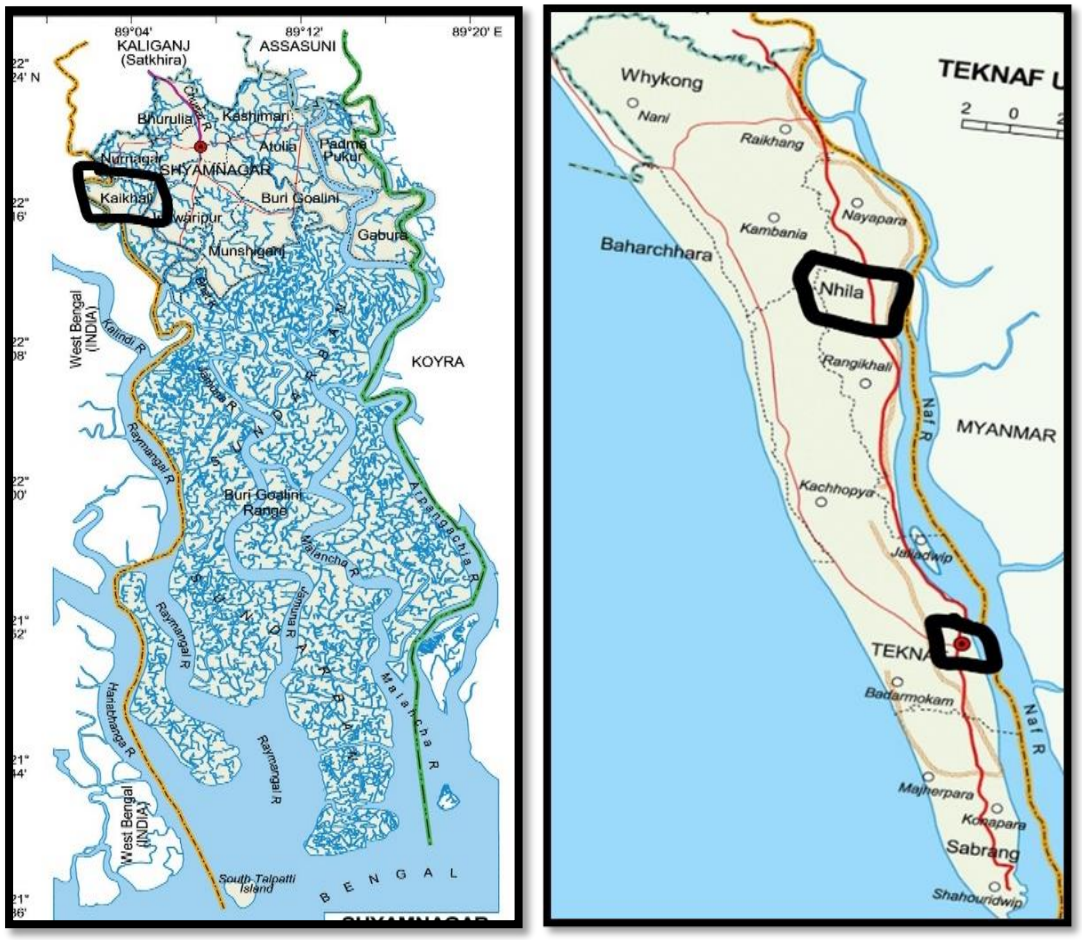
The IAIA (1999) define an Environmental Impact Assessment as: “The process of identifying, predicting, evaluating and mitigating the biophysical, social and other relevant effects of development proposals prior to major decisions being taken and commitments made.”

The benefits of environmental impact assessment to shrimp farmers are that they will obtain a deeper understanding of the importance of the local ecosystem to the sustainability and success of their operation and will be able to identify which elements of their surrounding ecosystem are important. Farmers will also be able to determine which ecosystem elements need to be maintained to reduce risks of conflict with wider societal stakeholders and be able to demonstrate good practice (ASC Shrimp Standard 1.0).

MATERIALS AND METHODS

3.1 Selection of the study area

The experiment was conducted in Mendinagar village under the Shymnagar Upazila of Satkhira (a) district in January to February 2019 and Teknaf upazilla of Cox's Bazar (b) district from January to February 2020 (Study areas are shown in Figure-1). The areas are opted on the basis of certain sets of criteria such as: these areas are very promising for freshwater prawn; the areas having semi-intensive as well as extensive shrimp culture and shrimp is the main crop and major share of income of the farmers of these areas



a) Shyamangar Upazila b) Teknaf Upazila

Figure 1: Study Areas

3.2 Description of the Study Area

Farisa Agro Farm's Limited (Latitude 22º27´776´´ Longitude 89º03´923) is located in the Mendinagar, Paranpur village, in the Shyamnagar sub-district under the Satkhira district. Farm is established in March 2017.The total farm area is 15.33 ha. The East and North side of farm are used by the traditional extensive shrimp farmer. A men made canal named 'Hatkata Khal' is flowing to the West and in the South side of the farm there are some crop lands and residence.

Aqua Shrimp Farm Limited (Latitude: 20°88'063 & Longitude. 92°3014671) is placed in Netong Para, Teknaf Sadar upazila just at the bank of Naf River (Figure 2). The farm comes to operation in April, 2018. The total property of farm is 50 acre having 20 production ponds.

Farisa Agro Farm's Limited (Shyamnagar)

Aqua Shrimp Farm Limited (Teknaf)

MK Aquaculture (Teknaf)

Figure 2: Satellite view of farms

MK Aquaculture (20°59'13.7303 N and Long: 92°15' 24.996 E) is situated in Nhila under the Teknaf upazila. The farm is very close to the Naf river and Bangladesh-Myanmar border. The 27 acre property area of farm established in 2017 (Figure 2**)**. The total description of the is given in table-1.

Table 1: Description of farms

Farm' Name	Farisa Agro Farm Limited	Aqua Shrimp Farm Limited	Mk Aquaculture
Coordinates	Latitude 22º27´776´´ Longitude 89º03´923	Latitude 20°88'063 Longitude 92°30’146	Latitude 20°59’13 Longitude: 92°15' 24
Address	Village: Mendinagar Upazila: Shyamnagar District: Satkhira Division: Khulna	Area: Netong Para Upazila: Teknaf District: Cox’s Bazar Division: Chattogram	Area: Nhila Upazila: Teknaf District: Cox’s Bazar Division: Chattogram
Establishment Period	March, 2017	April, 2018	2017
Property Area	37.88 Acre	50 Acre	27 Acre
Number of Ponds	17	20	18
Types of Ponds	Production pond-17 Reservoir pond- 2 Sedimentation pond-1	Production Pond-20 Reservoir Pond - 2 Sedimentation Pond-0	Production Pond - 18 Reservoir Pond -4 Sedimentation Pond-0
Shrimp Stocking Density	Direct Stocking: 15 p/m2 Nursing: 100p/m2	Direct Stocking: 10-15p/m Nursing: 95p/m	Direct Stocking :10-15p/m Nursing :95p/m
Water Source	Kalindi River	Naf River	Naf River
Pump	3	14	7
Production Cycle Number	1 (May-November)	1 (March- August)	1 (May-October)
Production	45 Ton	60 Ton	68 Ton
Number of Workers	26	35	23

3.3 Data collection method

Several data collection methods were applied to find out an effective and transparent assessment of the biodiversity and potential ecological effects of the farm.

3.3.1 Questionnaire Preparation

Questionnaire was prepared based on the objectives of the study. The environmental impact assessment was based on field survey where primary data were collected from individual farmers, farms' staff, village and community people, village representatives and government officers through direct interview.

3.3.2 Focus group discussion (FGD)

Several focus group discussions and meetings were held with different entities to research deeply on the important effect of the farm.

Table 2: List of Focus group discussion with different stakeholder of the farm

Sl. No	Activity	Date of meetings	Documentation
1	Meeting with the manager		Appendix-1
	1. Farisa Agro FarmLimited	08.01.2019	
	2. Aqua Shrimp Farm Limited	13.01.2020	
	3. MK Aquaculture	15.01.2020	
2	Focus group discussion with Farm employee		Appendix-2
	1. Farisa Agro FarmLimited	07.01.2019	
	2. Aqua Shrimp Farm Limited	14.01.2020	
	3. MK Aquaculture	15.01.2020	
3	Focus group discussion with neighbors of Farisa Agro Farm Limited	09.01.2019	Appendix-3
4	Focus group discussion with village people of Mendinagar	10.01.2019	Appendix-4
5	Meeting with community representative of Mendinagar	11.01.2019	Appendix-5
6	Interview with SUFO, Shyamnagar	07.01.2019	Appendix-6
7	Interview with Department of Forestry	07.01.2019	Appendix-7

3.3.3 Transect walk

Couple of transect walk was held to identify the impacts of the farm on village people and identification of natural resource around the farm**.**

3.3.4 Two-step Checking of Information with Key Informant

Wise persons of the village, village representative, Upazila Fisheries Officer, Additional commissioner of Land are the key informants. Multiple interviews were held to find out the actual scenario of the village, positive and negative issues towards shrimps and which impacts should be maximized and minimized to get better yield as well as improvement of livelihood of the village in relation to the country.

3.3.5 Secondary Data Collection

Secondary data was collected from Upazila office, DoF, forestry and environment office and relevant journals and publications were downloaded from internets.

3.3.6 Soil sample collection and analysis

The proposed procedure for measuring chloride or specific conductance in soils is derived from the method used by Boyd et al. (2006) for aquaculture pond soil. It involved taking a 20- gram sample of dry soil and placing it in a glass container, adding 40 milliliters of distilled water and shaking the mixture by hand for five minutes. The specific conductance can be measured directly in the solution or the solution can be filtered and the chloride concentration measured. Multiply measurement-specific conductance values by two to adjust for the dilution (40 milliliters of water for 20 grams of soil). Specific conductance values over 1,500 µmhos per centimeter or chloride concentrations above 300 milligrams per liter indicate that the soil is slightly saline. The greater the specific conductance or chloride concentration values, the more saline the soil.

RESULT

4.1 Impact on national or international protected areas

Farisa Agro Farm's Limited was established in Medndinagar village (latitude: 22º27´776´´and longitude: 89º03´923´´) under the Shyamnagar Upazila in Satkhira district. The nearest protected area was Sundarban West Wildlife Sanctuary (Mangrove forest) (IV), 71,502 ha area (Year of notification: 1996) which was approximately 38 km away from the farm's location managed by the Forestry Department. The farm did not destruct any mangroves during construction. The nearest mangrove vegetation existed in 4 km away from the north side of the farm. This vegetation stood along with the Kalindi River, that connected India with Bangladesh. Ultimately the site was not ecologically rich in according to IUCN criterion and there was no such kind of wild animal available in that area.

Aqua Shrimp Farm Limited (Lat: 20°88'063 & Long. 92°3014671) and MK Aquaculture (Lat. 20°59'13.7303 N and Long: 92°15' 24.996 E) were in close association with Naf river. The nearest protected area, Teknaf Game Reserve (Lat. 21°04'00" N & Long. 92°09'00"E), IUCN Category lV (Habitat) was respectively 7 km & 13 km away, which is the only game reserve of Bangladesh, declared in 1983 under the Bangladesh Wildlife (Preservation) (Amendment) Act, 1974 for it's richness in biodiversity. A 150m width shrubs and small trees of the genus *Tamarix* having small scale like needle-shaped leaves mangrove exists along with the Aqua Shrimp Farm Limited on the east and north eastern side. The Naf was about 200m away from the farm on the eastern side. MK Aquaculture was established in an open area away from locality. The farm was mostly surrounded on three sides by salt gher. The main reason choosing the area was to availability of saline water from Naf river.

4.2 Impact on ecosystem and land uses in studied area

Based on the opinion of the elders of villagers in Mendinagar, it was evident that salt has been intruded since 1988 and people used to create canal or channel from the river Kalindi and stocked water for shrimp farming. With the increase of salinity, agriculture crop production began to decrease as shrimp provided better income. Farisa Agro Farm Limited came up with semi-intensive shrimp farming in 2017 and created new dimension in the Mendinagar village.

From 1996 to 2016-2017, Aqua Shrimp Farm and MK Aquaculture area were used to salt production during the dry season and white fish and shrimp were allowed to come from Naf river with the tide.

Ecosystems besides the Farisa Agro Farm's Limited were aquaculture pond ecosystem, canal ecosystem, paddy field ecosystem and mangrove ecosystem (Figure-3).

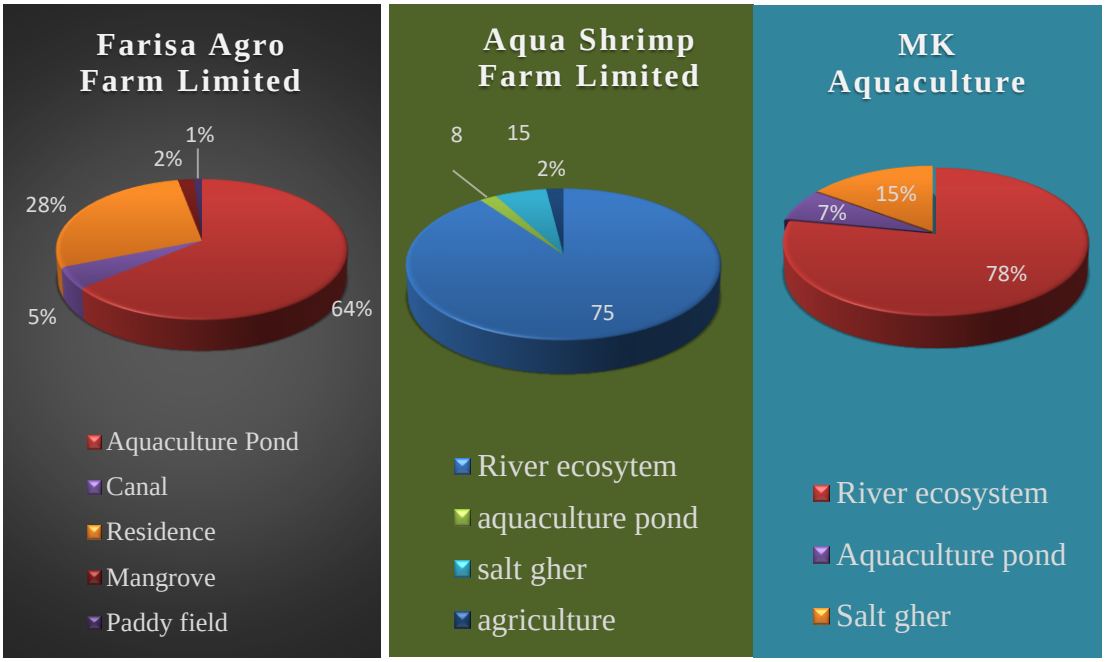


Figure- 3: Ecosystem and Land uses

4.3. Impact on natural habitat of terrestrial and aquatic animals

Based on the physical observation the farms of study areas did not occupy any kind of endangered species both in context of flora and fauna in their farm area. Observed floral and faunal species in the nearby ecosystem are given in table 3;

Table 3: Floral and Faunal biodiversity in studied area

Local/English Name of species	Scientific name	Biodiversity status
Flora		
Gewa	*Excoecaria agallocha*	Least Concern
Keora	*Sonneratia apetala*	Least Concern
Kankra	*Bruguiera gymnorhiza*	Least Concern

Dhundul	*Xylocarpus granatum*	Least Concern
Golpata	*Nypa fruticans*	Least Concern
Goran	*Ceriops decandra*	Near Threatened
Passur	*Xylocarpus mekongenesis*	Near Threatened
Banana tree	*Musa acuminate*	Least Concern
Date palm	*Phoenix dactylifera*	Least Concern
Papaya tree	*Carica papaya*	Least Concern
Fauna		
Phasa	*Setipinna phasa*	Least Concern
Coral	*Lates calcarifer*	Least Concern
Tengra	*Mystus tengara*	Least Concern
Sorpunti	*Puntius sarana*	Least Concern
Bata	*Labeo bata*	Least Concern
Datina	*Acanthopargus berda*	Least Concern

4.4 Impact on water environment

The impacts of shrimp farming on the surrounding waterbodies were assessed by considering presence of ecological buffer zones between farms and the waterbodies, discharge of farm's saline water into adjacent natural water bodies and usage of natural groundwater in shrimp ponds.

4.4.1 Salinization in adjacent waterbody

Water salinity in Kalindi river was recorded 15ppt in winter season and the adjacent waterbody close at the disposal area of Farisa Agro Farm "Sarkar canal" was recorded 17 ppt at. Salinity found in Aqua Shrimp Farm area was 24 ppt and in MK Aquaculture area salinity was recorded 22 ppt.

4.4.2 Salinization of ground water

Farms of both regions were not used to extract groundwaters for dilution of shrimp pond. At the same time both the areas were occupied by saline water ecosystem not less than 3 ppt.

4.4.3 Buffer zones

In Farisa Agro Farm's Limited, distance between natural buffer zone and nearby waterbody kalindi river was 540 m (Figure-4). There was presence of several mangrove tress in that buffer area (Figure-5). The observed species were Gewa (*Excoecaria agallocha*), Golpata (*Nypa fruticans*) and Keora (*Sonneratia apetela).* These vegetation acted to intercept sediment, nutrients and other materials in surface runoff and reduce the risk of erosion. Similarly, natural buffer zone existed around 125 m away between the Naf and the Aqua Shrimp Farm Limited. Keora (*Sonneratia apetala),* Narikel (*Cocos nucifera*), Bain tree (*Avicennia officinali*) were the most dominant tree available there (Figure-4). Riparian zone between MK Aquaculture and Naf river subsisted around 210 m away where Keora (*Sonneratia apetala),* Bain tree (*Avicennia officinali*) were dominant(Figure-4).

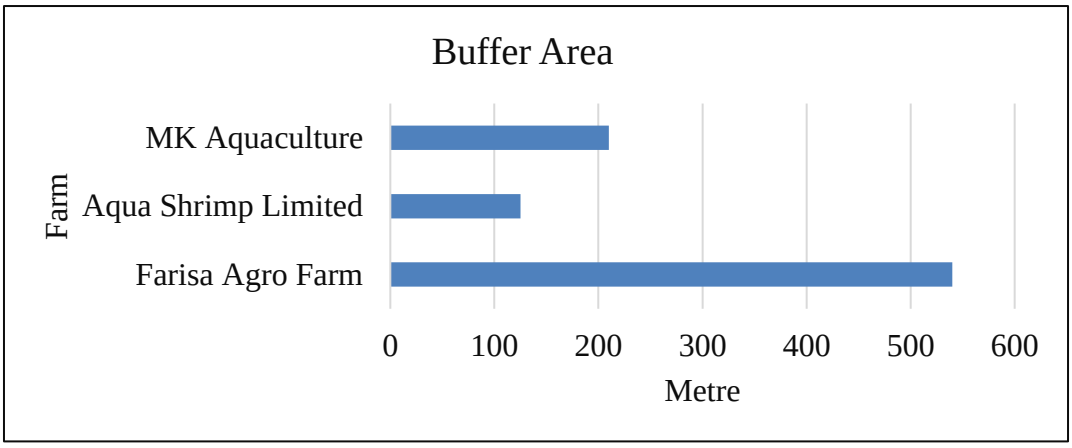


Figure 4: Distance between farms and buffer area

Figure 5: Buffer Area

4.5 Impact on soil environment

The recorded chloride conductance found in disposal area of Farisa Agro Farm was 5.65 dS/m, where adjacent agricultural field it was found 4.49 dS/m. In Aqua Shrimp Farm Limited and MK Aquaculture chloride conductance were recorded respectively 6.68 dS/m and 7.14 dS/m. Conductance found on adjacent field of both farms were 6.12 dS/m and 6.70 dS/m respectively (figure-6).

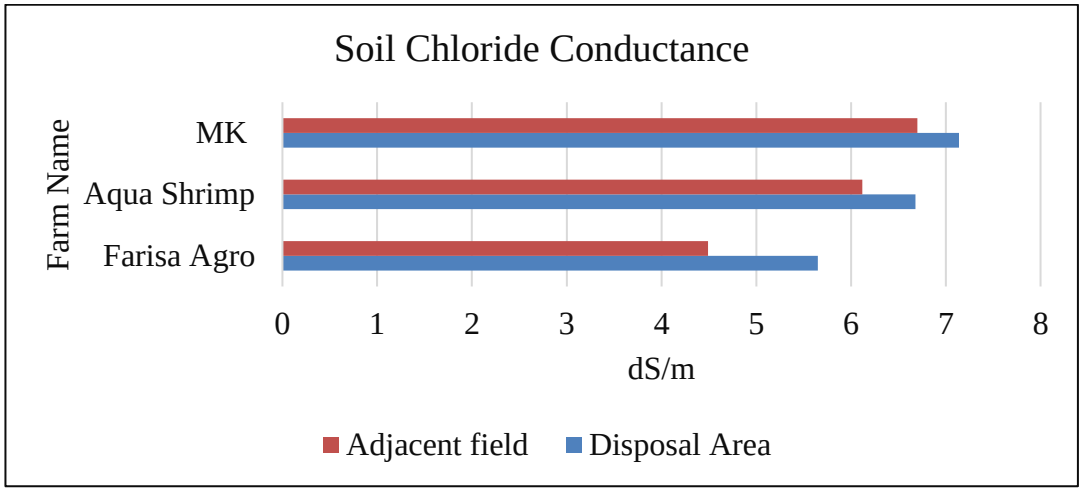


Figure 6: Comparison of soil chloride conductance among the farms

4.6 Shrimp health management

Lack of training in disease diagnosis and laboratory facilities indicated poor capacity of farmers to maintain shrimp health management protocol accurately. But farms adopted some initiative to minimize the impacts of disease outbreak and disease appearance symptom.

4.6.1 Chemicals compounds use in health management

Liming was applied by all studied farms. Farms applied limes to the water or sediment to balance pH, and to kill pathogens and pest. Zeolites and branded probiotics, Molasse were used by farms to reduce turbidity in the water and to improve phytoplankton growth. Sodium thiosulfate was used by the farms to treat disease. Antibiotics group named chlortetracycline, oxytetracycline, doxycycline were not found to be used by the farms.

4.6.2 Probiotics

Different types of probiotics were found to use in farms to control disease from being appeared and to improve water quality (Figure-7).

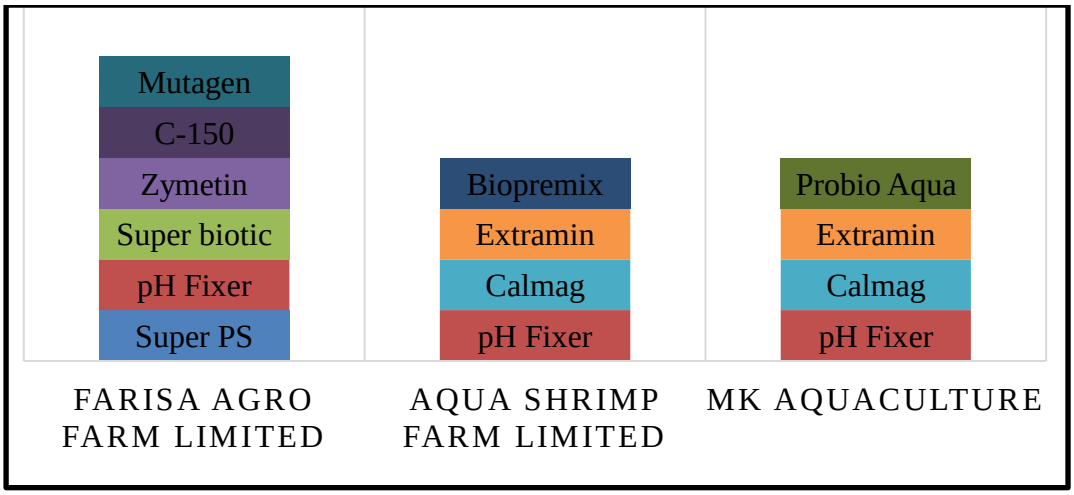


Figure 7: List of probiotics (Brand names) used in farms

Bacillus sp. was the main component of pH Fixure that was used to improve water quality and control pH. Mutagen was a major vitamin and minerals that was used for better health of the shrimp. *Rodobacter sp., Rodococcus sp* were the main component of Super PS that improved soil quality and reduce toxic gas from bottom. *S. faecalis* was the main component of Zymetine that inhibited pathogenic bacteria. C-150 was a coated Vit-C that was used to control vibriosis and luminescent bacteria.

4.6.3 Disinfectants

Farisa Agro Farm Limited treated river water with 5 ppm potassium permanganate for 24 to 48 hours and bleaching were used by Aqua Shrimp Farm Limited and MK Aquaculture before depositing water into their production pond.

4.6.4 Biosecurity

Different sets of biosecurity tools were used to evaluate the degree of quality of different aquaculture systems. Farisa Agro Farm brought water from Kalindi river through a canal named Sarker canal. The water went to one-hundred-micron mesh size netting filtration system to prohibit all kinds of unwanted animals, insects etc (Figure-7). A wooden sluice gate was placed to stop entrance of all types of animals at initial stage. Aqua Shrimp Farm used five-hundred-micron mesh size net at the inlet

point. Moreover three-hundred-micron mesh size net was used in three sides of the farm so there is no chance of entering any kinds of animals, human as well. In MK Aquaculture, there was a presence of salt gher on almost three sides around the farm except east-southern part where an open area lies to allow movement of local people. Use of Iron fencing around the farm prohibited all kinds of entrance. On the other side Aqua Shrimp farm Limited used 12 feet long wall and iron fencing to secure farm from all kinds of entrance.

Figure 8: Corridor

4.6.5 Predator management

Farms were found not to use any kind of lead shot and harmful chemicals that has been found to have negative tropic and environmental impacts. Proper netting facility were used to prevent entering of domestic animals such as duck, goat, rodents, and local indigenous species like snake, crab, kuchia (*Monopterus cuchia*) etc. Farisa Agro Farm also provided 'curved net' inside the farm to give extra protection from the predator. The farm set wooden plate in the mouth of farm's canal to escape all kinds of animal from entrance during water intake. Authority of Farisa Agro Farm did not allow to kill any species inside the farm. Moreover, bell sound system and bird fencing were used by Farisa Agro Farm farm set for extra protection which was environmentally friendly.

DISSCUSSION

5.1 Zones, protected areas and standard rules for responsible shrimp farming

Shrimp farms have been constructed on a variety of coastal lands, including salt pans, agricultural lands, abandoned and marginal lands, and wetlands, including ecologically important mangroves and marshes (Phillips, 1995). Conversion of land to shrimp farming has been reported to lead to adverse ecological impacts or conflicts with other users (Primavera, 1992). Inappropriate and unplanned siting of shrimp farms has the potential to result in production failures, ecological degradation, land use conflicts and social injustice (FAO, 2006). According to ASC principle 2.1 and 2.2 Shrimp farms should not allow to construct in Protected Areas (PA) (listed by IUCN), mangrove ecosystem, natural wetlands and other areas of ecologically importance determined by national respective authority.

Farisa Agro Farm Limited, Satkhira was established in an open where traditional shrimp farming has been practicing since 1980's, to maximize the production by using same property farm started semi-intensive farming system. The land did not adopt any kind of ecological interest. The farm is surrounded by seasonal agricultural land, traditional shrimp pond and men made canal. The analysis view of ecosystem and land uses found in Farisa Agro Farm Limited, Satkhira suggested that the adjacent lands are widely used for aquaculture production and there is minimal presence of mangrove vegetation which may act as buffer zone between the farm and Kalindi river.

Similarly, MK Aquaculture and Aqua Shrimp Farm Limited, Teknaf are also sited on open area relatively away from the human residence. From the ecosystem and land uses view these lands are using for salt and aquaculture production (mostly dominated by shrimp and salt tolerant fish species). Both of the farms are very much close to the Naf river which is the source of water for the farms and the same time habitat of many species and contribute a large portion of people through livelihood and nutrition activity. There is presence of mangrove vegetation of around 200m width between the Aqua Shrimp Farm Limited and Naf. Small portion of mangrove vegetation also exists between the MK Aquaculture and Naf.

After analyzing the site selection criteria, we can say that the three semi-intensive farms of Satkhira and Teknaf are established in a proper way where water source are available and farms did not decline any biological resource in respective area by its operation.

5.2 Conservation and maintenance of habitat of endangered species

A large number of local varieties of fish have disappeared and nutrient content of the soil has diminished, resulting in drastic reductions of land productivity. Viral contamination in shrimp farms has also brought about tremendous losses not only to the shrimp, but also to the biodiversity in areas under cultivation by semi-intensive methods (Masum, 2008). Many shrimp farmers very often kill mammals and reptiles considering them harmful for the shrimp i.e., the animals could eat shrimp and share the foods of shrimp. Many of those animals have been almost abolished from shrimp producing localities (Manju, 2000). The ASC Shrimp Standard seeks to identify and protect critical habitats for species at risk in areas where shrimp farms are located. According to ASC principle 2.3, farm should investigate and monitor types of species are on their site and classify them based on national or international importance before construction. If there is presence of such kind of species or habitat exists, they need to restore it in a proper way.

Sundarban West Wildlife Sanctuary IUCN Category lV (Mangrove forest), protected area of Bangladesh is approximately 38 km away from the Farisa but Mendinagar, Shyamnagar is free from endangered species since last 10 to 15 years and dominated by local domestic animal and mangrove plants.

Teknaf Game Reserve IUCN Category lV (Habitat), the only game reserve of Bangladesh is respectively 7 km & 13 km away from Aqua Shrimp Farm Limited and MK Aquaculture. Based on the physical observation the farms do not possess any kind of endangered species both in context of flora and fauna in their farm area. Domestic animal and some mangrove plants have been seen in the adjacent area.

From the above points it is evident that farms did not destruct any types of the mangroves or habitats of ecological interests and farms.

5.3 Ecological buffer, barrier and corridors

Protection from wind, waves, tides, and storms has great socio-economic benefits (Alongi, 2008, Islam and Wahab, 2005, Kathiresan and Bingham, 2001, Kelly, 2012, Lee et. al., 2014, McKee, 2007). Coastal community and infrastructures are protected by coastal barrier. Mendinagar, Shyamnagar is protected by a 20-feet long and 10 feet width strong cemented barrier that keeps farm safe and sustainable. Aqua Shrimp Farm Limited is located in the center of Teknaf sadar just bank of the Naf river. The area is protected by 12 feet long cemented boundary. MK Aquaculture is situated in Nhila, Teknaf near to shore of Naf, protected by 10 feet soiled barrier.

From the above discussion on the placement of coastal barrier, we come to the point that Farisa is relatively secured, Aqua Shrimp Farm Limited is moderate secured and MK Aquaculture is less secured.

Haylor and Bland (2001) stated, Coastal mangrove buffers are regularly from 100 meters to two kilometers in width and may be much wider. Boyd pointed out mangroves also stabilize soil against erosion and filter runoff entering coastal water from rivers. ASC shrimp standard requires for vegetation must be dominated by tree/forest/vegetation cover consistent with natural endemic riparian zones within <5m of the farm in question (ASC shrimp standard 1.0)

There is significant existence of natural vegetation like mangrove trees and shrubs in Farisa, Aqua Shrimp Farm and MK Aquaculture within 200 meter and width not less than 100m. These features indicate the effluent water is filtered out before dump into natural waterbodies like Kalindi and Naf river.

Corridors are beneficial ecological features that allow the movement of organisms within a landscape. Maintaining the potential for organisms to move freely and within the safety of appropriate habitat is essential for the maintenance of essential functions such as foraging and breeding.

The north and east side of the farm is surrounded by traditional shrimp pond. An agricultural land is placed on the south side of the farm and the local road is situated in west side of the farm. The farm use mesh size of 100 micron net in three sides of the farm so there is no chance of entering any kinds of animals, human as well. In Aqua Shrimp Farm Limited mangrove and Naf river lies on the north and east side of

the farm. There is no presence of wild animals near the farm site. To prevent the entrance of domestic animals such as goat, dog, cat etc, farm use 500 micron mesh size netting. MK Aquaculture has taken the same initiative of 500 micron mesh size netting to prevent the entrance of domestic animals. As farms do not occupy any ecologically important habitat its' relatively need not to have corridors inside to allow movement.

5.4 Salinity intrusion and effluent management system

The discharge of saltwater from shrimp farms also causes salinization in adjoining rice and other agricultural lands. In the southwestern part of Bangladesh, the saltwater intrusion has caused freshwater crisis and related gastrointestinal disease, loss of diversified crops, poultry and fodders (Ali, 2006). According to ASC principle 2.5 farm are not allowed to discharge saline water to natural ecosystem and also ASC do not permit to use natural fresh groundwater to dilute salinity of farm. The Standard requires monitoring of chloride concentration or specific conductance levels in soil (including sediment disposal sites), surface water and groundwater near shrimp farms after every six months, as an increase will indicate salinization has taken place.

Shrimp farms in Bangladesh normally do not pay much attention to the salinity intrusion effect. The farms of both regions are also the same, there is no developed protocol existed by how they can estimate net salinity increase after every operation. From onsite observation it was found wastes, faces, operational waters and other effluents were released to the nearby canal or river that is totally unethical and detrimental to the ecosystem. According to SRDI, Salinity range above 13 dS/m indicates the soil contains higher salinity and totally impotent for agricultural production and range between 5-12 dS/m indicates soil is moderately saline an 2-4 dS/m indicates soil is law in salinity.

Studies found that a settling basin can improve the quality of effluents from intensive farms. Although settling basins are not effective in removing plankton, detritus or colloidal clay particles from water, they are effective in removing larger particles (Boyd and Queiroz, 2001; Ozbay and Boyd, 2004).

Farisa Agro Farm Limited developed a harvest basin where effluents are coming via outlet and treat with bleaching before release into natural resource. Aqua Shrimp

Farm Limited and MK Aquaculture hampers the Naf river ecosystem by releasing operational waters and effluents directly without undergoing any types of treatment. It is found that in last 20 to 25 years soil chemistry in Mendinagar, Syamnagar has changed dramatically and decreased plant growth. In Teknaf, salt gher is widely practiced so salinity has been intruded from earlier. The extent of salinity in groundwater will also be flourishing in future if proper waste disposal system is not setting up by the farms.

5.5 Disease management and treatment

Health management of fish and crustacean are recognized internationally as useful parts of sustainable aquaculture management, often in the form of formally laid-out "Better Management Practices" (Belton et al. 2011). It is claimed that shrimp diseases occurred more frequently in extensive or improved extensive shrimp farming than intensive or super-intensive shrimp farming due to exposure to climatic events **(**Nguyen et. al., 2019). Research suggested that climate change events such as flooding, saltwater intrusion, changes in temperature and acidification affected all types of shrimp farming systems (Quach, 2018). ASC Shrimp Standard also emphasizes the importance of implementing biosecurity measures at the farm, regional, national and international levels and ensures a health plan including identification of potential disease risks, appropriate screening and disease prevention measures, dispose of dead shrimp in a sanitary way and effective adaptive measures and pathways to continuous improvement to reduce the risk of spreading pathogens (ASC Shrimp Standard 1.0).

Farisa Agro Farm Limited are using three layers inlet filtration system including a wooden gate that remains open only at the time of water intake, one-hundred-micron mesh size net is using that entraps all sorts of disease carriers such as snakes, rodents and finally an iron fencing that provides final protection from predators and other harmful elements to come. Aqua shrimp Farm Limited and MK Aquaculture practice five-hundred-micron mesh size net that is relatively bigger in mesh size than Farisa Agro Farm Limited to keep out disease carriers.

Farms of both regions do not have laboratory facility as laboratory facilities is compulsory to diagnosis various pathogenic disease. Viral disease is the most severe disease that are almost impossible to treat. Intake of polluted water can cause different

water borne disease in the shrimp pond. So proper treatment of water with Potassium permanganate and chlorine agent before stocking can be an ideal solution to prevent different water borne disease and to reduce the chance of fish from being affected in future. Potassium permanganate is a strong oxidizing agent used to treat fungal infections and a common and popular disinfectant.

Shrimp disease treatment is more complex but it can be prevented with effective hatchery sanitary and hygiene protocol, proper PL screening, appropriate stocking density, good quality feed and strict feeding rate. Farisa Agro Farm Limited and Aqua Shrimp Farm Limited use hand and foot dip, set up at the entrance point of every pond to cease spreading of cross contamination from one pond to another. Installment of hand and foot deep is under processed in MK Aquaculture. At the same time visitors' entrance are completely restricted. Different types of probiotics are also used to boost up shrimp immunity.

5.6 Chemicals and drugs

There has been considerable discussion about the effects on the environment of chemotherapeutants used in shrimp ponds to disinfect, prevent or treat diseases, to condition soil and water, to kill pests, and as feed additives. Antibiotics and several others of these compounds are potential threats to human health and the environment, as well as to shrimp health and product quality. chemicals from shrimp culture are likely to have a smaller environmental impact than the agricultural chemicals used in most countries in the region (FAO-NACA, 1994). Misuse of antibiotics is a direct threat to shrimp farming because of the emergence of antibiotic-resistant pathogens. The spread of resistant strains of bacteria in Southeast Asia has probably been made easier by the frequent intermixing of effluent and influent water in congested culture areas. Moreover, there is concern that transfer of such resistance to human pathogens could have serious repercussions on human health (Brown, 1989).

The proper maintenance of water parameters is obligatory to improve the production of shrimp. Farms are claimed they use traditional compound such as lime, tea seed cake, zeolite, bleaching during pond preparation and water treatment and do not use any kinds of antibiotics in their feed or other operational purposes. Toxic gases and pathogens become controlled or trapped by these compounds. Different sorts of fertilizer also increase the pond productivity. Lime controls shrimp from being

affected by diseases. The benefits of applying these chemicals are to balancing water pH, control of water color, reduce turbidity of water, increase primary productivity and reduce toxic gas from the aquatic environment.

From the above discussion it is evident that farmers of both regions are mostly rely on simple and environmentally friendly chemicals that ensures the safety of products to the consumer levels.

5.7 Predator management

Predator control is an important issue in intensive shrimp culture. Shrimp farm can be affected by predator in both horizontal and vertical ways. The ASC Shrimp Standard determined that the intentional killing or harassment of protected, threatened or endangered animals that prey on cultured shrimp is inappropriate for farms certified under this standard. Use of netting and bird fencing keep most unwanted predators out from farms. Farms do not allow use of toxic, poisonous chemicals or any kinds of destructive method. Removing dead bodies from pond or any unwanted predators are buried outside the farm that keep environment fresh and healthy.

CONCLUSION

In this paper, current shrimp farming situation was assessed against quality standard developed by Aquaculture Stewardship Council. From the assessment it was found that there is no net loss of biodiversity in the both regions of semi-intensive farms. It was also evident that farms of both regions did not have well drainage and effluent management system. Shrimp is one of the demandable and expensive global food items. The economic returns of shrimp farming especially foreign exchange earnings and provision of employment, are highly important to the economy of Bangladesh. At the same time Bangladeshi exporters face strong competition from the top exporter country like India, Vietnam, Ecuador, Indonesia. The sector also besets with numerous challenges. To compete in the international market, various types of initiatives should be taken to boost up Bangladesh's ability in export. Firstly, Bangladesh requires strengthen their production system. Extensive shrimp pond and gher should be converted into semi-intensive shrimp farming system to utilize the land properly and to maximize the shrimp production in relation to the country. High yield with high quality shrimp can only bring sustainable export success. Secondly, Effective traceability mechanism is must needed to ensure standard compliance. Others top exporter countries have already given emphasis on quality as buyers demand shrimp must be produced and handled in an environment-friendly and socially responsible manner and in compliance with labour rules, and effective traceability regulations. Thirdly, more research must be conducted to find out the consumer preference in foreign markets and create new markets for our shrimps. At the same time most importantly, environmental costs should be calculated and need to address properly. A sustainable, environmentally responsible shrimp farming should be promoted for better outcomes in future.

RECOMMENDATION

1. Continuous monitoring of shrimp farm impacts on biodiversity and ecosystem.
2. Improvement of farm's effluent management system.
3. Regular assessment of the status of natural wetlands and resource.
4. Development of effective disease surveillance, notification and control system.
5. Enforcing national standards to ensure compliance with international standards.
6. Training facilities should be strengthened.
7. Develop the interaction with all levels stakeholders to address on-going conflicts.
8. Traceability system must be implemented in every step of shrimp production, processing and exportation.

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Appendix 1 (a)

Meeting with Manager, Farisa Agro Farm Limited, Shymnagar, Satkhira

Date: 08.01.2019
Time: 10 am
Place: Office Building
Email: majabber1986@yahoo.com
Contact number: +8801708924634

Site description:

- Total property area: 15.33 ha
- Production area: 48600m^2
- Area of buildings: 6600m^2
- Production pond number: 17
- Sedimentation Pond: 2
- Reservoir pond: 2
- Power house: 3

Adjacent Water bodies:

A canal locally named 'Hatkata Khal' is flowing beside the farm which is about 3km long; originated from the Kalindi River which is 4km far away from farm.

Sedimentation pond and reservoir pond:

There are two sedimentation ponds in the farm with 5000m^2 and 4800 m^2. Farm also uses two reservoir ponds for stocking of the clean water.

Operations:

- Operation techniques: Semi-intensive farming
- Species: *Penaeus monodon*
- Stocking density: 15pieces/m^2
- Production cycle: 2crops/year
- Harvest basin: Fish feed wastage and excreta are removed by using harvest basin. It is also used for harvesting of the shrimp.
- Waste disposal system: Farm has ETS pond but not well developed
- Permanent worker: 26 Permanent employees are working in the farm's operations.
- **Production**: 45 ton (last year-2018)

Appendix 1 (b)

Meeting with Manager, Aqua Shrimp Farm Limited, Teknaf

Date: 13.01.2020
Time: 9 pm- 10.30 pm
Place: Office Building
Email: irashedul766@gmail.com
Contact number: +8801708429480

Site description:

- Total property area: 21 Hectare
- Production area: 10.75 hectare
- Area of buildings: 0.8 Hactare
- Production pond number: 20
- Sedimentation Pond: No
- Reservoir pond: 2
- Power house: 4

Adjacent Water bodies:

A canal locally named 'Hochkar Khal' is flowing beside the farm originated from the Naf River.

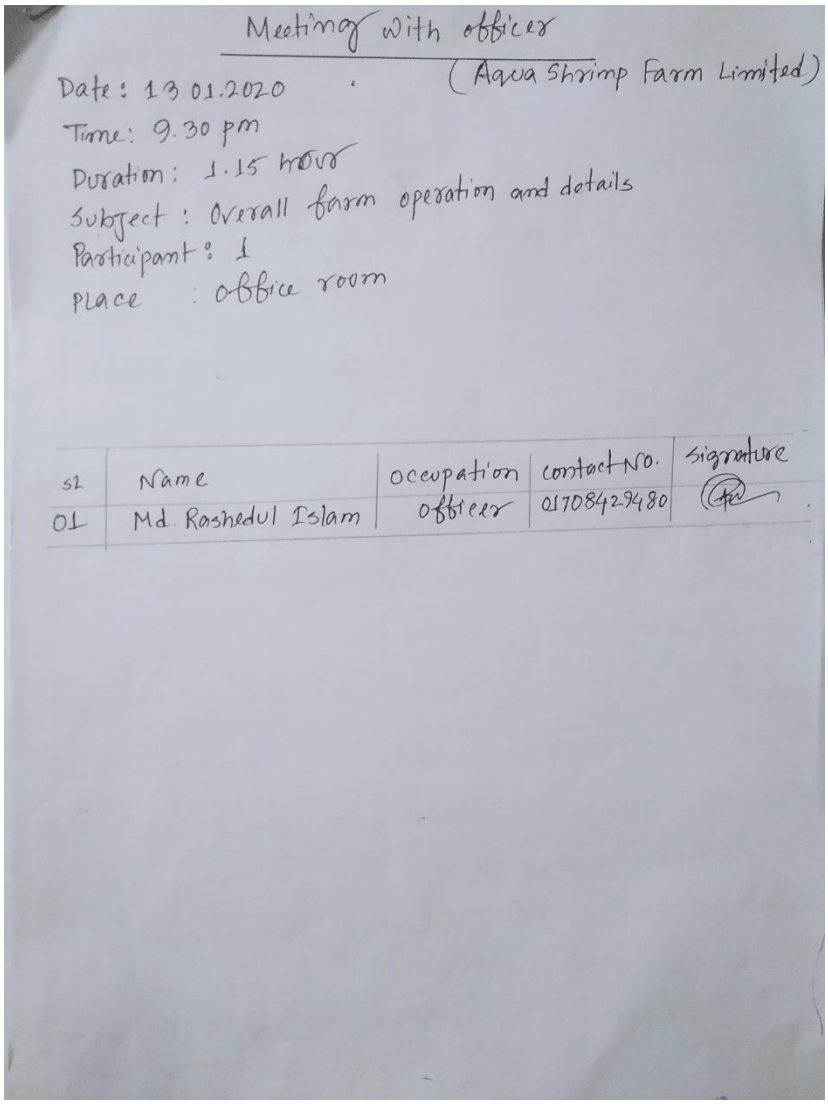
Sedimentation pond and reservoir pond:

There are no sedimentation ponds and two reservoir ponds in the farm. Farm use two reservoir ponds for stocking of the clean water for immediate use and continuous use.

Operations:

- Operation techniques: Semi-intensive farming
- Species: *Penaeus monodon*
- Stocking density: 15pieces/m^2
- Production cycle: 2crops/year
- Harvest basin: Harvest basin is on the way to construct
- Waste disposal system: Farm has no sedimentation pond and waste disposal unit.
- Permanent worker: 36 Permanent employees are working in the farm's operations.

Production: 60 ton (last year-2019)



Meeting with officer

(Aqua Shrimp Farm Limited)

Date : 13.01.2020
Time : 9.30 pm
Duration : 1.15 hour
Subject : Overall farm operation and details
Participant : 1
Place : office room

sl	Name	occupation	contact No.	Signature
01	Md. Rashedul Islam	officer	01708429480	

Attendance of the manager, Aqua Shrimp Farm Limited

Appendix 1 (c)

Meeting with Manager, MK Aquaculture, Nhila, Teknaf

Date: 15.01.2020
Time: 6.10 pm
Place: Office Building
Email: -
Contact number: +8801836537419

Site description:

- Total property area: 12.14 hectare
- Production area: 8.9 hectare
- Area of buildings: 1.2 hectare
- Production pond number: 14
- Sedimentation Pond: No
- Reservoir pond: 2
- Power house: 4

Adjacent Water bodies:

A canal locally named 'Hada Khal' is flowing beside the farm originated from the Naf River.

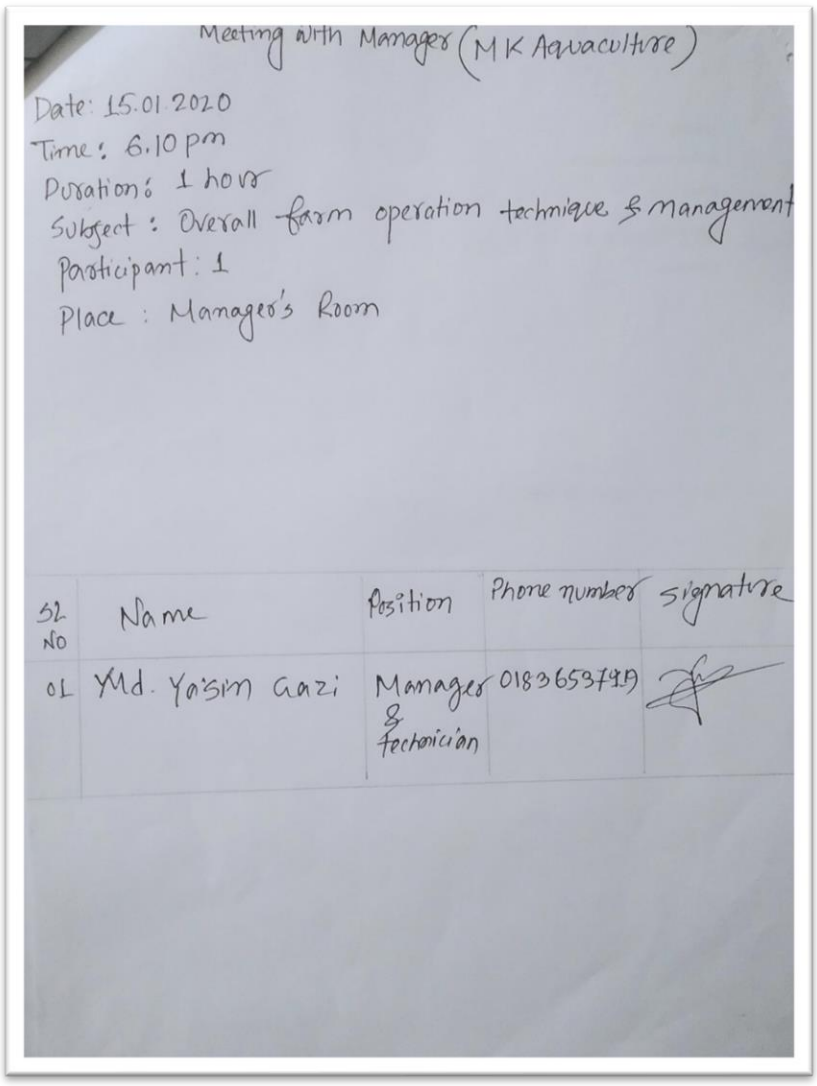
Sedimentation pond and reservoir pond:

There are no sedimentation ponds and two reservoir ponds in the farm. Farm use two reservoir ponds for stocking of the clean water for immediate use and continuous use

Operations:

- Operation techniques: Semi-intensive farming
- Species: *Penaeus monodon*
- Stocking density: 15pieces/m^2
- Production cycle: 2crops/year
- Harvest basin: No harvest basin.
- Waste disposal system: Farm has no structured sedimentation pond and waste disposal unit.
- Permanent worker: 23 Permanent employees are working in the farm's operations.

Production: 68 ton (last year-2019)



Meeting with Manager (MK Aquaculture)

Date: 15.01.2020
Time: 6.10 pm
Duration: 1 hour
Subject: Overall farm operation technique & management
Participant: 1
Place: Manager's Room

SL No	Name	Position	Phone number	signature
01	Md. Yasin Gazi	Manager & Technician	01836537419	

Attendance of the manager, MK Aquaculture

Appendix 2 (a)

Focus group discussion with the employee of the Farisa Agro Farm Limited

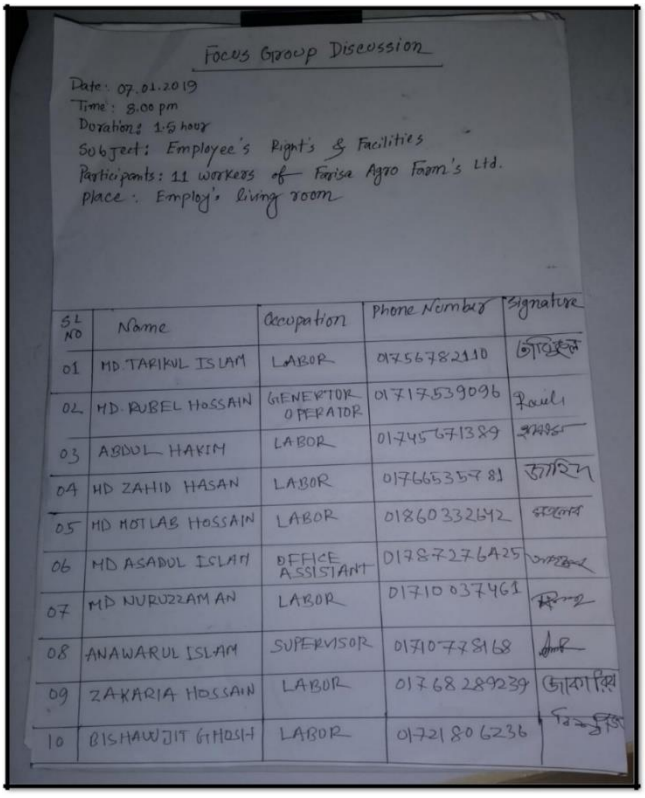
Date: 07.01.2019

Time: 8.00 pm

Place: Employee living room.

Participants: 10 employees of the Farisa Agro Farm's Limited.

A focus group discussion was held in the living room of employees. The main purpose of this discussion was to know the different facilities and restrictions adopted by the workers and to get an idea of the working environment of the farm. In this meeting employees presented their duty towards the farm and what was their recruitment system and if they satisfied or not to the farm current facilities was discussed spontaneously. The employees also mentioned their family condition in this meeting.



Focus Group Discussion

Date: 07.01.2019
Time: 8.00 pm
Duration: 1.5 hour
Subject: Employee's Right's & Facilities
Participants: 11 workers of Farisa Agro Farm's Ltd.
place: Employ's living room

Sl NO	Name	Occupation	Phone Number	Signature
01	MD TARIKUL ISLAM	LABOR	01756782110	
02	MD RUBEL HOSSAIN	GENERTOR OPERATOR	01717539096	
03	ABDUL HAKIM	LABOR	01745671389	
04	MD ZAHID HASAN	LABOR	01766535781	
05	MD MOTLAB HOSSAIN	LABOR	01860332642	
06	MD ASADUL ISLAM	OFFICE ASSISTANT	01787276425	
07	MD NURUZZAMAN	LABOR	01710037461	
08	ANAWARUL ISLAM	SUPERVISOR	01710778168	
09	ZAKARIA HOSSAIN	LABOR	01768289239	
10	BISHAWJIT GHOSH	LABOR	01721806236	

Attendance of the employee

Appendix 2 (b):

Focus group discussion with the employee of the Aqua Shrimp Farm Limited

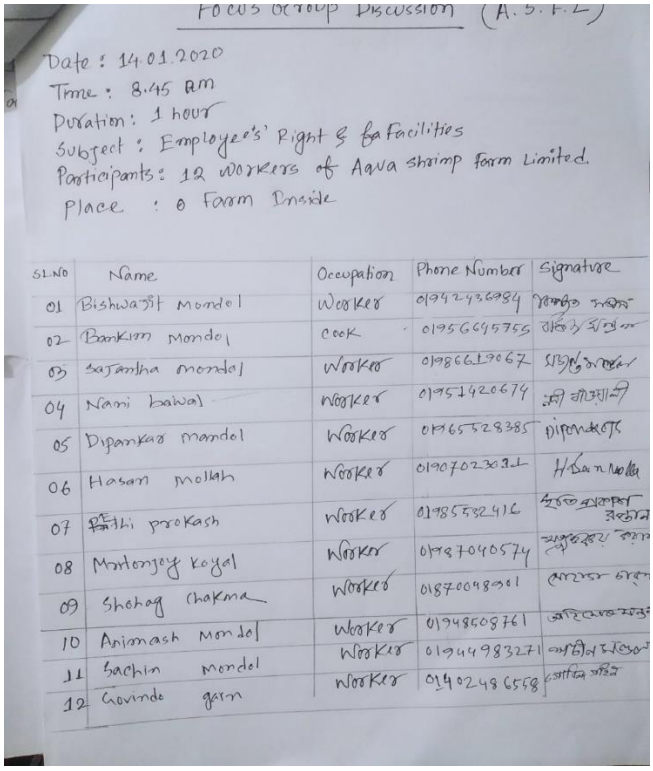
Date: 14.01.2020

Time: 8.45

Place: Inside farm.

Participants: 12 employees of the Aqua Shrimp Farm's Limited.

A focus group discussion was held inside farm with the employees. The main purpose of this discussion was to know the different facilities and restrictions adopted by the workers and to get an idea of the working environment of the farm. In this meeting employees presented their duty towards the farm and what was their recruitment system and if they satisfied or not to the farm current facilities was discussed spontaneously. The employees also mentioned their family condition in this meeting.



Focus Group Discussion (A.S.F.L)

Date : 14.01.2020
Time : 8.45 AM
Duration : 1 hour
Subject : Employee's' Right & Facilities
Participants : 12 Workers of Aqua shrimp farm Limited.
Place : @ Farm Inside

Sl.No	Name	Occupation	Phone Number	Signature
01	Bishwajit Mondol	Worker	01942436984	
02	Bankim Mondol	Cook	01956695755	
03	Sajantha mondal	Worker	01986619067	
04	Nani baiwal	Worker	01951420674	
05	Dipankar mandol	Worker	01965528385	
06	Hasan mollah	Worker	01907022021	
07	Prithi prokash	Worker	01985582416	
08	Montonjoy koyal	Worker	01987040574	
09	Shohag chakma	Worker	01870048981	
10	Animash Mondol	Worker	01948508761	
11	Sachin Mondol	Worker	01944983271	
12	Govinde garn	Worker	01902486558	

Attendance of the employee

Appendix 2 (c)

Focus group discussion with the employee of the MK Aquaculture

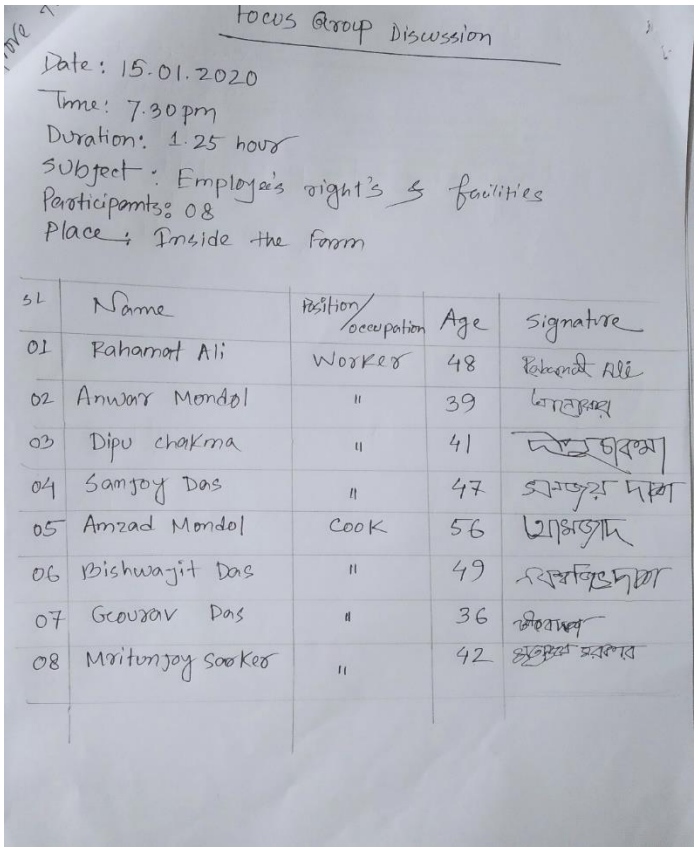
Date: 15.01.2020

Time: 7.30 pm

Place: Inside farm.

Participants: 8 employees of the MK Aquaculture.

A focus group discussion was held inside the farm with the employees of MK Aquaculture. The main purpose of this discussion was to know the different facilities and restrictions adopted by the workers and to get an idea of the working environment of the farm. In this meeting employees presented their duty towards the farm and what was their recruitment system and if they satisfied or not to the farm current facilities was discussed spontaneously. The employees also mentioned their family condition in this meeting.



Focus Group Discussion

Date: 15.01.2020
Time: 7.30pm
Duration: 1.25 hour
Subject: Employee's right's & facilities
Participants: 08
Place: Inside the farm

Sl	Name	Position/occupation	Age	Signature
01	Rahamat Ali	Worker	48	Rahamat Ali
02	Anwarr Mondol	"	39	
03	Dipu chakma	"	41	
04	Samjoy Das	"	47	
05	Amzad Mondol	Cook	56	
06	Bishwajit Das	"	49	
07	Gouzav Das	"	36	
08	Mritunjoy Sooker	"	42	

Attendance of the employee

Appendix 3

Meeting with neighboring people of Farisa Agro Farm Limited

Date: 09.01.2019

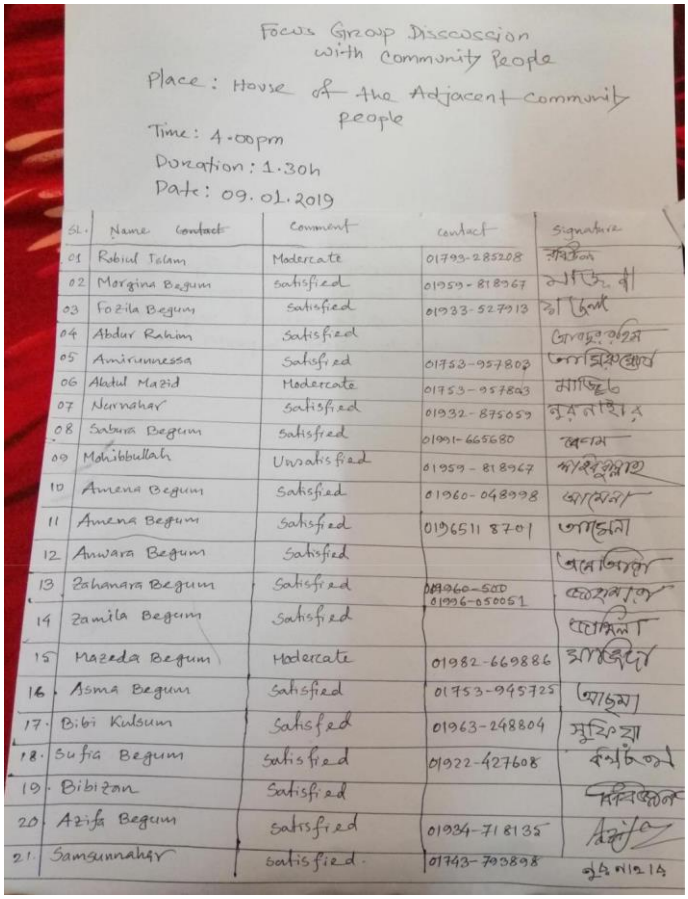
Place: Robiul Islam House (Neighbor)

Duration: 1hour 20 minutes

Number of participants: 21

Questions:

1. Do they face any problems in their activities due to farm operations?
2. Do they have any complaints about the farm?
3. Does farm play any role in their employment?
4. Do farms create any problem in their communication?
5. Which types of benefits they got from the farm?
6. Are they satisfied about farms developments and operations?



Focus Group Discussion with Community People

Place: House of the Adjacent Community people

Time: 4.00pm

Duration: 1.30h

Date: 09.01.2019

Sl.	Name Contact	Comment	contact	Signature
01	Robiul Islam	Modercate	01793-285208	
02	Morgina Begum	Satisfied	01959-818967	
03	Fozila Begum	Satisfied	01933-527913	
04	Abdur Rahim	Satisfied		
05	Amirunnessa	Satisfied	01753-957803	
06	Abdul Mazid	Modercate	01753-957843	
07	Nurnahar	Satisfied	01932-875059	
08	Sabura Begum	Satisfied	01991-665680	
09	Mohibbullah	Unsatisfied	01959-818967	
10	Amena Begum	Satisfied	01960-048998	
11	Amena Begum	Satisfied	0196511 8701	
12	Anwara Begum	Satisfied		
13	Zahanara Begum	Satisfied	01960-500 01996-050051	
14	Zamila Begum	Satisfied		
15	Mazeda Begum	Modercate	01982-669886	
16	Asma Begum	Satisfied	01753-945725	
17	Bibi Kulsum	Satisfied	01963-248804	
18	Sufia Begum	Satisfied	01922-427608	
19	Bibizan	Satisfied		
20	Azifa Begum	Satisfied	01934-718135	
21	Samsunnahar	Satisfied	01743-703898	

Attendance list of the meeting with neighbors

Appendix 4

Focus group discussion with Village People of Mendinagar, Shyamnagar,

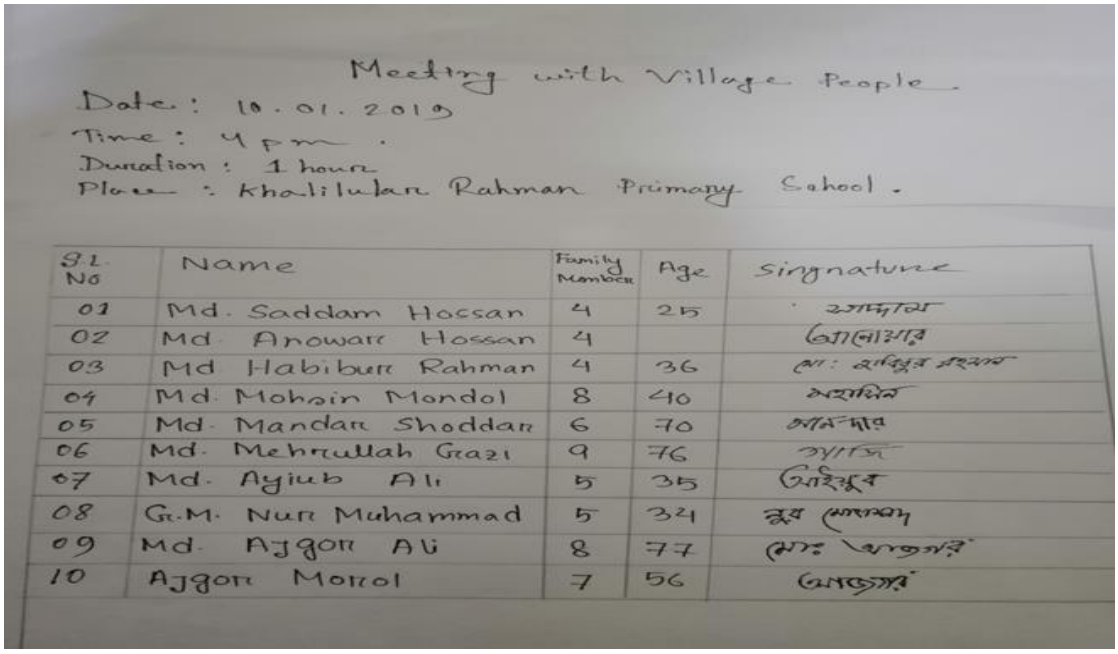
Date: 10.1.2019

Time: 4.00pm

Duration: 1hour

Place: Khalilur Rahman primary school, Mendinagar, Koi-khali, Satkhira

Agenda: A Focus Group Discussion was held in Khalilur Rahman primary school . to identify impacts of the farm in the village where 10 village people were present.



Meeting with Village People.

Date: 10.01.2019
Time: 4 pm.
Duration: 1 hour
Place: Khalilukar Rahman Primary School.

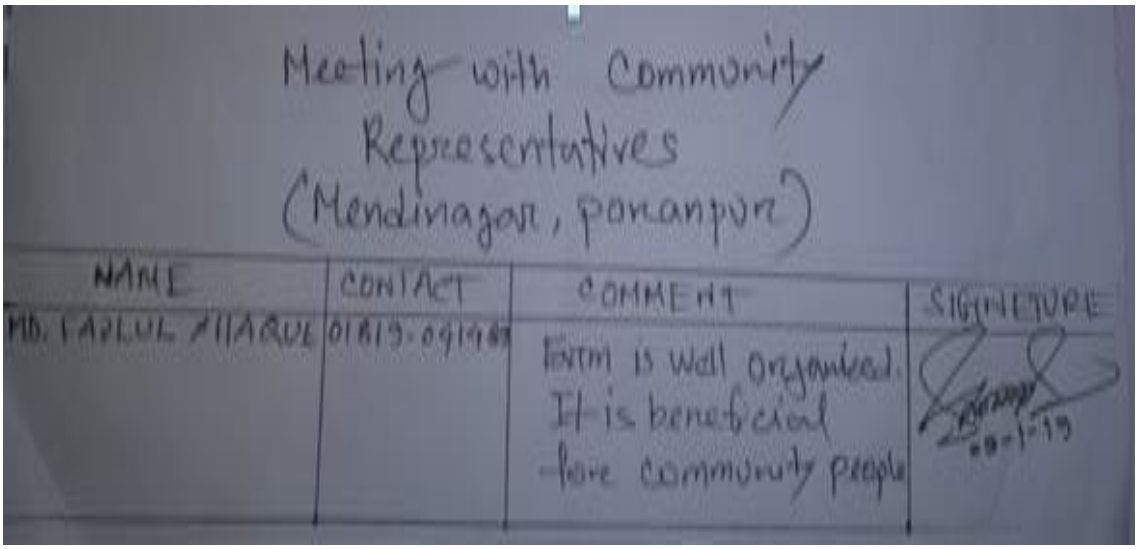
Sl. No	Name	Family Member	Age	Singnature
01	Md. Saddam Hossan	4	25	
02	Md Anowar Hossan	4		
03	Md Habibur Rahman	4	36	
04	Md Mohsin Mondol	8	40	
05	Md. Mandar Shoddar	6	70	
06	Md. Mehrullah Grazi	9	76	
07	Md. Ayiub Ali	5	35	
08	G.M. Nur Muhammad	5	34	
09	Md. Ajgor Ali	8	77	
10	Ajgor Mollol	7	56	

Attendance list of the village people in focus group discussion

Appendix 5

Meeting with Community Representative of Mendinagar, Shyamnagar

A meeting was held with Mr. Abdur Rahim (Chairman of Koi-khali union Porishad) and Mr. Fazlul Haque (Community representative of Mendinagar). It was held at 11 January 2019. The main purpose of the meeting was to identify the effects of the farm on the community and environment.


Meeting with Community Representatives (Mendinagar, panapur)

NAME	CONTACT	COMMENT	SIGNETURE
MD. FAZLUL HAQUE	01813-091403	Farm is well organized. It is beneficial for community people	11-1-19

Attendance of the meeting with Chairman of Koi-khali union Porishad

Appendix 6

Interview with Senior Upazila Fisheries Officer (SUFO) in

Department of Fisheries (DoF)

Date: 07.01.2019

Place: Shyamnagar Upazila Porishad

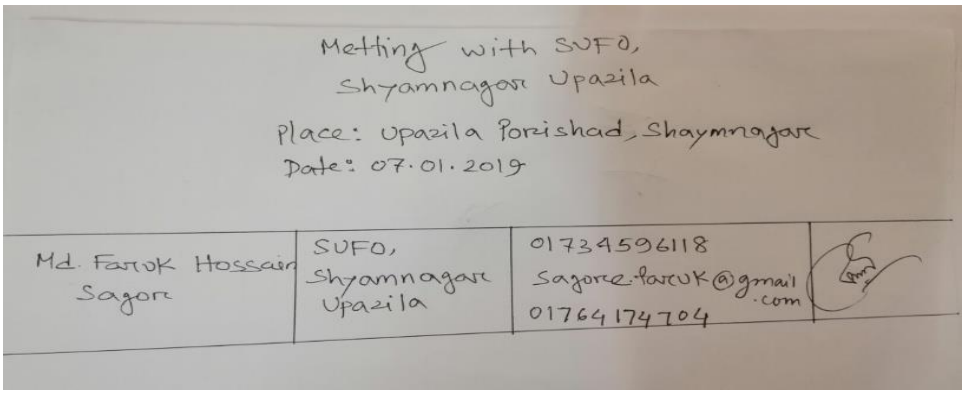
A discussion was held with Mr. Faruk Hossain, Senior Upazilla fisheries officer (SUFO), Shyamnagar, Sathkhira. The conversation focused on the certification project and general role that the DoF can play in this process.

Certification:

SUFO told, about the certification protocol of Department of Fisheries and said that farm has completed all other requirement that need to follow.

Enlisted Semi Intensive Farm:

SUFO showed, there are seven recognized semi intensive farm in the Shyamnagar Upazila and Farisa Agro Farm's Limited is one of them.


Metting with SUFO,
Shyamnagar Upazila
Place: Upazila Porishad, Shaymnagar
Date: 07.01.2019

Md. Faruk Hossain Sagor	SUFO, Shyamnagar Upazila	01734596118 sagore.farUK@gmail.com 01764174704	

Attendance of the meeting with SUFO

Appendix 7

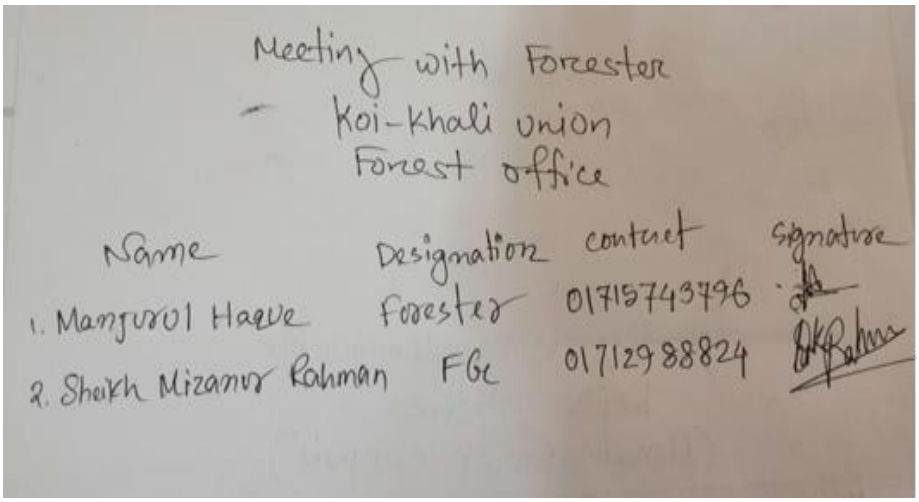
Interview with Department of Forestry

Date: 07.01.2019

Place: Koi-khali forest office

Time: 5.20pm

A meeting was held with Mr. Monjurul Hoque (forester of the Koi-khali union). The nearest mangrove ecosystem is located approximately 17 km away from the farm which a part of a Sundarban Reserve Forest. The main objective of this discussion was to know whether there was any damage to the farm by Farisa Agro Farm's Limited.


Meeting with Forester
Koi-khali union
Forest office

Name	Designation	contact	Signature
1. Manjurul Haque	Forester	01715743796	
2. Shaikh Mizanur Rahman	FGC	01712988824	

Attendance list of the meeting with forester