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Mehady Islam
Product Executive, Agro-Vet Division, Square Pharmaceuticals Ltd., Mymensingh, Bangladesh

Rumana Yasmin
Scientific Officer, Bangladesh Fisheries Research Institute, Freshwater Station, Mymensingh, Bangladesh

Correspondence
Mehady Islam
Product Executive, Agro-Vet Division, Square Pharmaceuticals Ltd., Mymensingh, Bangladesh

Impact of Aquaculture and Contemporary environmental issues in Bangladesh

Mehady Islam and Rumana Yasmin

Abstract
Environmental issues are ignored in Bangladesh while considering aquaculture practices but unfortunately the environment suffers the most because of over exploitation. The stress of aquaculture over environment starts with the collection of fish seed, because the natural water body is till now the prime source of aquaculture stocking materials. In aquaculture plenty of tons of water and exchange of that is needed periodically but in our country we have a very little or in most of the cases don't have any waste water treatment facility in hatcheries or culture farms and that's why recycle of waste water or treat water before discharge to the nature is not possible till now. In most cases, the used water or wastage of aquaculture is being released to the natural waterbody or main river stream without any treatment which leads to the disease outbreak, invasion of undesired species or foreign species, imbalance in biodiversity and ecosystem. Besides in our aquaculture a plenty of chemicals are being used and then these chemicals get discharged into the environment it also have adverse impact over the environment and its biodiversity. The above mentioned factors are creating stress over the environment and resulting adversely. The most credible solution is properly following the HACCP (Hazard Analysis and Critical Control Point) and GAP (Good Aquaculture Practice) guidelines. Only then we can expect that our aquaculture practices will not hamper or degrade the environmental balance rather, it would enhance the possibility of environmental sustainability over long run.

Keywords: Aquaculture, Environment, Ecosystem, Waste Water, Biodiversity, Good Aquaculture Practice.

1. Introduction
Fish and fisheries play an imperative part in the socioeconomic expansion, accomplishing the demand of animal protein, prospect for employment, poverty mitigation of huge number of population and making foreign exchange [21]. It adds 3.69 percent of the country's GDP and its portion in the entire export earnings is around 4660.60 Crore BDT/Yr and characterizes the second prevalent export product with noteworthy contribution to current GNP fish worth [20]. It is usually appraised that around 12 million individuals of the country are supported by fisheries and its associated actions, in which more than 1.3 million people are directly involved with fisheries sector[18]. There are near 0.26 million ha land for freshwater fish culture [19] and yearly fish production is around 2.0 million mt [20] (Table. 1). Along with likely water possessions the country is similarly rich in the diversity of numerous fish species. These immense and diverse aquatic resources support artisanal and commercial fisheries besides offer chances for aquaculture expansion. Fish production from inland open water has been declining because of innumerable reasons and existing fish production cannot contend with the quickly increasing demand. Yet, input from inland culture fishery has amplified in two folds. Increased production is being accomplished by the enlargement of areas of land and water under culture and the use contemporary farming skills. Aquaculture affords rational cash pay to the people along with it pays to the nutrition of family members. Certain of the outdated customs and applies have endorsed the culture of certain species of fish particularly Indian major carps. Consequently, the carp farming has established in this part of the country to encounter the social and cultural necessities of the local population. Accordingly farm may cogitate as source of environmental pollution if appropriate management method is not monitored. All arrangements of aquaculture practices may affect the environment. Some of these may be considered advantageous, while others are not reliable with long-standing conservation of natural ecosystems.

2. Approaches and Methodology

Aquaculture in Bangladesh context is still in its juvenile stage, new techniques needs to be addressed in order to increase the fish production. Environmental studies have been inadequate mostly to determining optimal circumstances essential in the culture farms and not to appraising the effect of farming on the exterior environment. Consequently it is essential to give courtesy for sustainable aquaculture development in Bangladesh. Sustainable expansion of aquaculture is not conceivable without apposite management of the environment and recognizing the problems precisely. Knowing the prevalent situations of dissimilar farming condition through a comprehensive study can recognize the difficulties and the required actions needed to be taken to overcome this complexity.

So as to accomplish the objective this study was carried out by paying an overall evaluation of literature on outcome of aquaculture on environment and natural ecosystem and the outcomes of precise research lately conducted and the general methodology dealing with a number of phases: a. congregation prevailing literature on climate change subjects for fisheries and aquaculture sector, existing together nationally and internationally, to the extent plausible; b. digging into prevailing literature to find out and accumulate significant outcomes there (taking into consideration methodological rigour that had been applied to reach an inference); and c. concisely highlighting on the ground adaptation and extenuation practices as stated in literature. Consequence of the paper could be used as a significant tool for activities in environmental/ecological conservation and management in context of consequence of aquaculture there by the government of Bangladesh.

3. Results and discussions

The foremost environmental effects of aquaculture occur because of sedimentation and obstacle of water flows, waste releases, hyper-nutrification and eutrophication, chemical remains lack of low cost quality feeds, excessive stocking density, over use of meshed feed, excessive use of medication (e.g. Antibiotics, disinfectants, pesticides etc.), use of low quality materials while producing feed, lack of proper inlet and outlet drainage systems, not following HACCP and GAP protocols, lack of waste water treatment facilities and most prominently lack of sound technical knowledge and strategies. Likely contrary consequences of altering wetlands into aquaculture farm are consequently major considerations to be addressed furthermore with abstraction, retention and drainage of water. The indiscriminate introduction of exotic species with native varieties into the identical environment can have divergent consequence.

Moreover predation and competition with indigenous fauna is another thing to be taken under consideration. Besides, there are hazards of hybridization and reduction of genetic diversity. The unintended introduction of pathogens and diseases carried by the exotics is a predominantly serious jeopardy, if acceptable precautions are not taken on time.

Table 1: Frequently cultured fish species in Bangladesh

Name of the fish (Local name)	Scientific names
Pangus	*Pangasius hypophthalmous*
Tilapia (GIFT)	*Oreochromis nilotica*
Koi	*Anabas testudineus*
Silver carp	*Hypophthalmichthys molitrix*
Grass carp	*Ctenopharyngodon idella*
Big head carp	*Aristichthys nobilis*
Black carp	*Mylopharyngodon piceus*
Rui	*Labeo rohita*
Catla	*Catla catla*
Mrigal	*Chirhinous cirrhosus*
Shingi	*Heteropneustes fossilis*
Magur	*Clarias garipineus*
Sar punti	*Barbodes sarana*
Gulsha	*Mystus sp.*
Giant tiger shrimp	*Paeneus monodon*
Crab	*Scylla olivicea*
Bhetki/ Coral	*Lates calcarifer*
Parse	*Chelon subviridis*
Brakish water catfish	*Mystus gulio*

3.1 Specific Impacts of aquaculture on environment

We need to address some influences of aquaculture systems that are very common with most severe consequence on environment for instance

- Huge bycatch
- Stress on ground water (Absence of recycling)
- Destruction of natural Habitat
- Depletion and Salinization of Potable Water; Salinization of Agricultural Land.
- Nutrient Pollution
- Disease and Parasitic Infestations
- Changes in the receiving water or area (due to discharge of farm effluents)
- Loss of genetic diversity of Brood Stock

3.1.1 Huge bycatch

Aquaculture still depends on wild for fish and shell fish seed. It is well established that many wild resources are declining, but it is difficult to quantify the relative impact of over fishing, habitat loss, and coastal pollution. From numerous studies it has been stated that about 2000 fry and larvae of fin fishes are discarded while catching a single shrimp post-larvae. 10 kg of fish fry and shrimp post-larvae are damaged while collecting every 1 kg of shrimp in the Sundarbans region[39],Up to 5000 fry may be destroyed for every 10 marketable shrimp fry collection [10] which eventually endangering finfish biodiversity enormously.

3.1.2 Stress on ground water

Recirculating aquaculture system (RAS) is being popular in developed countries where water for aquaculture is a limitation. But absence of recycling may lead to wastage of ground water which results in shortage of water for aquaculture. Pumping large volumes of underground water to achieve brackish water salinity led to the lowering of

groundwater levels, emptying of aquifers [23].Recently in Bangladesh only one Recirculating aquaculture system project is running its endeavor at Mymensingh.

3.1.3 Destruction of natural Habitat
Establishment of ponds for aquaculture has initiated the obliteration of thousands of hectares of mangroves, coastal and inland wetlands. Substantial losses of natural habitat have occurred in Bangladesh. Integrity of natural habitat and ecosystem is most imperative since they act as a territory of several species, assist to defend wild stock and crucial in the sustenance of many fish species. Ecological wetlands function as a breeding, nursery and feeding grounds for all fish species, counting commercially significant fish, and their devastation may initiate substantial losses for commercial fisheries [2].

3.1.4 Depletion and Salinization of Potable Water; Salinization of Agricultural Land
Pumping of groundwater to supply freshwater to fish farms, leads to decrease in water level and occasionally salinization of local water supplies arises which instigating water deficiencies for local communities. Losses of Crops occur when agricultural land becomes salinized by effluent of aquaculture as pumped out from fish farms to land [1].

3.1.5 Nutrient Pollution
Organic trashes from fish or crustacean farming comprise uneaten food, body wastes and dead fish. Nutrient pollution has also been found to originate the amplified growth of certain species of phytoplankton (microscopic algae), with some which are known to cause detrimental algal blooms and increase fouling [5].

3.1.6 Diseases and Parasitic Infestation
Diseases and Parasitic infestation is a mutual difficult in aquaculture. When wild fishes' migration ways pass nearly fish farms, wild fish can become infested with parasites and ultimately leads to fish loss. Unless accomplishment is reserved it is forecasted that wild populations of fish in affected extents might become extinct [6].

3.1.7 Changes in the receiving water or area (Due to Discharge of Farm Effluents)
Numerous alterations were perceived because of the expulsion of farm emissions in the receiving water or area. It was perceived that most of the farms were involved to upturn the productivity of unloading area, involved to escalation turbidity, intricate to amplified mud, algal bloom and odor [7].

3.1.8 Loss of genetic diversity of Brood Stock
Escape of cultivated fish and incursion of alien species in immense numbers and efficacious breeding with their wild counterparts can cause harm of genetic diversity may modify the gene pool and cause in damage of clarity of brood stock with an intensification in hybrid stock and may leads to annihilation [8].

3.2 Reasons behind adversities
Causes of adversities are as follows-

- Ignorance and lack of proper technical knowledge and guidelines
- Lack of low cost quality feed and low quality raw materials in producing feed
- Excessive Stocking Density
- Occurrence of Disease Outbreak
- Extraneous use of Chemotherapeutics to Control Diseases such as Antibiotics, Sanitizers/ Disinfectants, Pesticides
- Shortage of proper drainage system and absence of waste water treatment facilities
- Collection of Wild Juveniles as Stock
- Escapees Threats to Wild Fish leads to Invasion of species and Genetic pollution
- Predator Control
- Feeding Fish with Fish
- Effluent release
- Use of Excessive fertilizers in aquaculture
- Organic products
- Ignoring international standard protocols

3.2.1 Ignorance and Lack of proper technical knowledge and guidelines
Ignorance, illiteracy of farmers and lack of proper technical knowledge about Organic Aquaculture and lack of proper technical guidelines on HACCP and FAO code of conduct implementation, GAP and BAP (Best Aquaculture Practices) practicing are the major causal issues of impact of aquaculture on environment, ecosystem and natural habitat and fish stock.

3.2.2 Impact of Feed related issues
Lack of low cost quality feed and use of low quality raw materials in producing feed can cause faster degradation of feed which cause excessive waste production which will eventually lead to higher BOD (Bio-Chemical oxygen demand) and COD (Chemical oxygen demand) level, higher rate of decomposition results higher level of organic pollution. Overuse of meshed feed in aquaculture farms causes faster leaching of feed materials may lead to algal bloom, Eutrophication and so on.

3.2.3 Excessive Stocking Density
Practice of Excessive Stocking Density in fish farming may cause use of excessive ground water. Amount of aquaculture wastage and effluent may increase from the traditional culture practice which may lead to higher BOD and COD level, higher rate of decomposition results higher level of organic, chemical disease pollution. Disease infestation and use chemicals and therapeutics may subsequently increase.

3.2.4 Occurrence of Disease Outbreak
Disease occurrence in different farms is utmost common in aquaculture uppermost percentage of farms affected by Epizootic Ulcerative Syndrome (EUS), tail and fin rot disease, oxygen deficiency and agrulosis, parasitic diseases, gas bubble disease and nutritional insufficiency disease (Table 2). Contagious diseases and parasitic infestation enforcemenace to wild fishes through aquaculture occurs due to water release and escape of cultivated fish.

3.2.5 Chemicals used to Control Diseases
Fish culture in Bangladesh depends greatly on the contribution of artificially formulated feed and the application of agrochemicals, antibiotics and disinfectants and are expected detrimental to the adjacent environment when waters are discharged (Table 2). Overuse of lime, salt, $KMnO_4$, sumithion, dipterex, copper sulphate, formalin, methylene blue, malachite green, calcium hypochlorite and antibiotics for instance tetracyclin, chloramphecal, ciprocin, erythomycine etc. consequences in too much antibiotics remains in the aquaculture products,

Table 2: Health Management in Aquaculture

Disease Name	Host	Pathogen	Remedies
Saproleigniasis/EUS	Common white fishes	Fungi/Parasite	Water Quality improvement & antibiotic
Trychodeniasis & Chylodenelliasis	Common white fishes	Single celled parasite	Water Quality improvement & antibiotic
Ichthyophthiriasis	Carp species	Single celled parasite	Water Quality improvement & antibiotic
Gyrodactylosis	Indigenous spp.	Skin fluke	Water Quality improvement
Dactylogyrosis	Indigenous spp.	Gill fluke	Water Quality improvement
Columnaris	Indian major carps	Bacteria	Water Quality improvement & antibiotic
White Spot syndrome	Black Tiger Shrimp	WSSV	No remedy
Yellow head disease	Black Tiger Shrimp	YHV	No remedy
Black Gill Disease	Bagda/Galda	H_2S gas	Water Quality improvement & antibiotic
Antenna Rotten Disease	Bagda/Galda	Bacteria	Water Quality improvement, antibiotic & Probiotics
External fowling	Bagda/Galda	Nutritional deficiency	Water Quality improvement & Vit-min-enriched diet feeding

which leads to not only the reduction in the immunity of the aquaculture products, but also the diminution in the disease resistance of consumers and the intensification in the likelihood of contaminating the disease [26, 28, 12, 40, 38]. These chemicals may be categorized as therapeutants, disinfectants, water and soil treatment compounds, algaecides and pesticides, plankton growth inducers (fertilizers and minerals) and feed additives. Unnecessary and undesirable use of such chemicals outcomes in complications allied to toxicity to non-target species (cultured species, human consumers and wild biota), expansion of antibiotic resistance and accretion of remains [37].

3.2.6 Shortage of proper drainage system and Absence of waste water treatment facilities

Shortage of proper drainage system and absence of waste water treatment facilities also one of the main reasons of adversities of environment caused by aquaculture. Release of waste water without proper or no treatment in the natural waterbodies, is the main source of pollutant such as chemicals, hormones, pathogens, parasites, organic wastes etc. which may pose a greater threat to the wild ecosystem and may lead to the extinction of vulnerable fish species.

3.2.7 Collection of Wild Juveniles as Stock

Aquaculture of some species depends on juvenile fish or shellfish being captured from the wild to supply stock, instead of using hatcheries to rear them. Shrimp and crab farms in several parts count on wild-caught juveniles. This has led to overexploitation and scarcities of wild stocks. Additionally, capture of shrimp and crab juveniles also leads to the by-catch of juveniles of copious further species which are slain in the procedure.

3.2.8 Threat of Escaping farmed fish to Wild Fish

Farmed fish can flee in huge quantities and can efficaciously breed with their wild equivalents. Cultivated fish have an inferior genetic variability than wild one and when propagated with wild fish, adaptations to the wild might be misplaced in the descendants who will less appropriate than wild one and a great amount will perish. Inter-breeding of farmed with wild stock possibly will consequently drive previously susceptible populations of wild fish near extinction.

3.2.9 Predator Control

Control of predator in aquaculture is further vital in each kind of aquaculture preparation. For this determination diverse traps, pesticides, algaecides and herbicides, piscicides and dissimilar motorized devices for allowable and non-permissible control of birds, marine mammals, control of crustaceans, control of aquatic weeds, macrophytes and marginal plants, control of predatory and weed fish, chopping of trees on dykes correspondingly.

3.2.10 Feeding Fish with Fish

In aquaculture, it is very customary to deploy trash fishes (by-catches) to fed cultured fish, formulate fish meal, as crude material for feed preparation. To farm carnivores, wild caught fish are widely utilized.

3.2.11 Discharge of untreated Aquaculture Effluent

Effluents allude to either an uninterrupted or recurrent release of a liquid from an aquaculture facility. The arrangement of effluent is dissolved composites such as phosphorus, nitrogen etc., organic matter and sludge (Fecal solid and uneaten feed). Dissolved composites (Phosphorus and Nitrogen) can cause eutrophication, algal blooms, extermination of fish and other benthic creature, modifications in food chains and elimination of oxygen. Organic substance burden can cause enhanced BOD; declines DO in water column and sediments, and modify benthic food chains and ecology, can execute superior life. Nutrients (P, N), and organic matter percolates out or is broken down and eventually converts dissolved composites (Fig. 1).

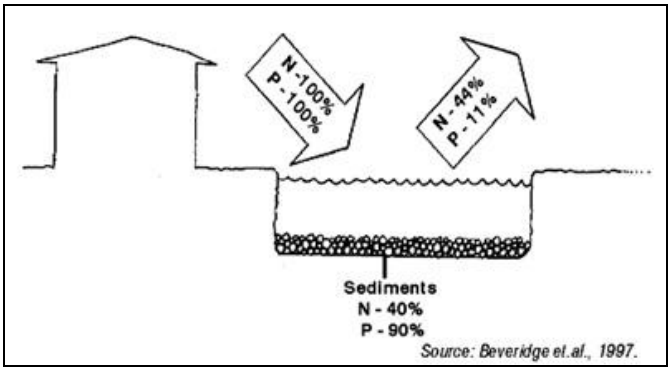

Fig 1: Effluent in aquaculture ponds

3.2.12 Use of Excessive fertilizer in Aquaculture

The utmost frequent products used in shrimp aquaculture are fertilizers for the enrichment of natural feed and liming material for water and soil control. Overdo of lime outcomes in the growing and over profusion of cyanophytes and the preventive of propagation of diatom. Several chemicals used in shrimp farming, such as organotin compounds, copper compounds and toxic remains, are expected to have an adverse impact on the environment [26]. The frequently used sanitizer chlorine is applied to exterminate bacteria and viruses. Additional pesticides are employed in shrimp ponds

to destroy undesirable organisms such as fish, crustaceans, snails, fungi and algae [26].

3.2.13 Organic products
Release of organic products for instance PCBs (Polychlorinated Biphenyls), heavy metals, DDT (Dichloro-diphenyl-trichloroethane), hormones as waste from aquaculture create persistence, bioaccumulation and biomagnifications of those products; carcinogenic nature of those organic products have shattering effect on the environment, ecosystem and natural biota of natural habitat [44, 45].

3.2.14 Ignoring international standard protocols
Ignorance of international standard protocol such as HACCP, GAP, BAP, FAO code of conduct etc. are also liable for adversity caused by aquaculture to the environment and ecosystem which may guide to annihilation, disparity, inconsistency of natural ecosystem.

3.3 Negative Impacts of Different commercially important fish farming Practices on the Environment
3.3.1 Environmental impacts of shrimp farming
Drastic expansion of shrimp farming conveys a sequences of harmful environmental impacts, alike ecological imbalance, environmental pollution and disease outbreaks etc. Therefore, shrimp farming is fronting management-related complications which bring about greater anxieties about its sustainability.

3.3.2 Environmental impacts of Tilapia farming
Apprehension about poorly planned aquaculture expansion of exotic fish (tilapia) is levying intimidations through their associated diseases and parasites, and the environmental pollution will obstruct the exceptional natural fauna and natural habitats too. The farming procedure has noteworthy environmental influences, on native fish populations, bottom biota, water quality with subjects concomitant with leftover feed, feces, antibiotics, hormones and farm operations, incorporating noise, fuel spills, interactions with predatory birds and other influences. Tilapia crosses for commercial culture are continuously evolving and introduction and escape of these hybrids is a genuine distress [42, 43].

3.3.3 Environmental impacts of Pangus farming
Pangas farming is one of the wildest mounting forms of aquaculture in Bangladesh. Likely environmental influences of pangas farming are alteration in land use arrangement, water quality organization and eutrophication, pond waste management, usage of chemicals and antibiotics, and escape of fish. The unutilized feed ration accrued in pangas ponds produces massive pond bottom waste and cause water quality worsening. Furthermore, unselective usage of chemicals and antibiotics had an antagonistic influence on the environment and human health.

3.3.4 Environmental impacts of Carp farming
Carp pond cultivating in an outdated form of aquaculture is closely related with the adjacent environment triggering pollution via extraordinary nutrient input, chemicals, therapeutics, contagious pathogens and parasites etc. into pond ecosystems. The diminution in nutrient concentrations was perceptible in all forms of N and P throughout the growing season; ponds have noteworthy nutrient entrapping aptitude. Conversely, fish farming procedures and water preservation in ponds provided with decent quality river water consequence in the worsening of outflow water quality.

3.3.5 Environmental impacts of farming of other finfish and shell fishes
Along with shrimp, carps, pangus, tilapia and cat fishes, the aquaculture commerce is nowadays farming numerous species of other finfish and shell fishes for instance parse, sea bass, prawn, crab etc. (Table 1) Most are raised in cages in open waters or ponds and ghers. It is, nonetheless, expected that some of the environmental difficulties concomitant with above mentioned fish farming will be repeated with farming of other marine finfish.

3.4 Overall impact of aquaculture on environment
Overall impact of aquaculture on environment can be framed out as follows-

3.4.1 Impact of Aquaculture on open water Ecosystems
Nutrient discharge from cage culture and aquaculture farms in open waters and its probable influence on pelagic ecosystem relies on mass poise using feed use, fish production, nutrients in feed and fish, and digestibility of nutrient constituents, discharge of inorganic nutrients (NH_4 and PO_4), particulate organic nutrients, and dissolved organic nutrients. Pelagic ecosystems are mostly disturbed by the inorganic nutrients with uppermost emanation rates during summer.

3.4.2 Destruction of the mangrove ecosystem
A quantity of shrimp ponds have been established alongside the edge of the Sundarbans mangrove reserve forest expanse owing to the greatest noteworthy ecosystems that have collapsed victim to shrimp pond manufacture, with the enormous annihilation of mangrove forest. The precise rate of mangrove devastation because of the construction of ponds in the south-western parts of Bangladesh is not hitherto comprehended [13].Annihilation of mangroves because of aquaculture extension has been stated by some investigators in diverse portions of the world [36, 17, 27].

3.4.3 Pollution
Poor quality feed is the foremost pollution origin of the farming and its contiguous waters, while the soluble organic matter is the imperative component of water quality of the environment [41]. Feed responds with many components (pH, temperature, osmotic pressure, wave strike and chemical reaction) by resolving, swelling, breaking, pulverization and desquamation etc. Directly discharged wastes can effortlessly pollute the adjacent water and soil quality [14]. The discharging emissions can diminish the dissolved oxygen, generate hyper-nutrification and eutrophication, escalation sedimentation burden, and cause variations in the planktonic and benthic communities [22, 23].

3.4.4 Sedimentation
Water runoff during the rainy season transports sediments from upstream through river tributaries to downstream. When water from estuaries or river channels is deposited in coastal ghers or fresh water fish ponds, the sediments rapidly settle on the bottom as water velocity slackens down [15]. In intensive fish farming, conversely, sediments originate also from the pond bottom and adjacent walls as well as from the sludge that accrues on the pond bottom during each production cycle [11]. Management practices, comprising high

stocking density, feed application, aerator use, liming and fertilizers, etc. also donate to suspension and sediment accretion [25].

3.4.5 Diseases
Some of the diseases that distress the fish farming commerce are directly triggered by environmental difficulties, whereas a number of added diseases are prompted or spread more successfully by the stress persuaded by environmental problems. When physico-chemical issues such as pH, temperature, dissolved oxygen, etc. fluctuate normally, shrimps become prone to stress, leading to diseases[31] such as red colour, soft shell, tail rot and black gill[34, 3](Table 2). High stocking density and unwarranted use of feed drops water quality, which adds to stress and diseases amid shrimp in intensive farming systems [24, 31]. The ingestion of polluted water from neighboring farms often spreads water-borne illnesses from farm to farm [32]. Poor water quality, allied with unplanned and uncontrolled farming, has improved the occurrence of diseases and abridged production [14].

3.4.6 Saltwater intrusion
Shrimp aquaculture has raised severe anxiety about the effect of saltwater intrusion into the adjacent agricultural lands [24, 23]. Ponds are being created for shrimp aquaculture behind the mangrove forests where freshwater wetlands and rice-growing extents still occur[22, 17]. Inundation of land by saline water for long periods advances to its percolation into the contiguous soils, subsequent in reformed soil chemistry. Extended inundation constrains the fixation of free nitrogen and halts mineralization, thus impairing soil fertility inside a few years[29]. In the southwestern parts of Bangladesh, salinization diminishes water supplies not only for agriculture but also for drinking, domestic requirements and irrigation [14, 33].

3.4.7 Introduction of exotic species
Exotic fish is alien species which is not ingenuous and belonging by nature or origin to alternative portion of the world or brought in from overseas or foreign or strange. Exotic fishes are species, subspecies of inferior taxon happening as a consequence of human activity in an expanse or ecosystem. This introducing of alien species lacking quarantine has spread numerous viral and fungal diseases through Bangladesh[14].Besides pathogens and diseases, introductions of aquatic species can bring about habitat changes, disturbances of host communities by competition and predation, and genetic exchanges with native populations. The innate biodiversity of both wild and farm stocks are antagonizing environmental threats owing to the introduction of invasive species and altered genotypes [30, 16].

3.4.8 Loss of natural biodiversity
Several aquaculture farms in Bangladesh stock wild captured juveniles somewhat than hatchery-reared post larvae that reasons forfeiture of biodiversity. While hatchery post-larvae are currently obtainable, wild fry still afford the foremost source of seed in others. For instance, trawl fishermen accumulate mother shrimps as brood stock from the deep sea. This gathering of brood stock and spawn performs a major role in the forfeiture of capture fisheries as the by catch increases[35].Moreover, capture fisheries are used to supply trash fish to formulate fishmeal. When the shrimp industry uses pelagic fish as trash fish to formulate fish meal and eventually to manufacture pellet feed, it reduces the wild fishery reserves [30]. The elevated amount of fish meal in the aquaculture industry has persuaded a forfeiture of wild capture fish stock [35].

3.5 Moving Towards More Sustainable Aquaculture Systems
In sequence for aquaculture processes to shift towards sustainable yield, the industry requires few prerequisites to recognize and address the full spectrum of environmental impacts caused by its operations. Essentially, this means that it will no longer be acceptable for the industry to place burdens of production (such as the disposal of waste) onto the wider environment. Consecutively, this infers moving near closed production systems. Likely solutions to the difficulties of aquaculture on environment will be

- Integrated multi-trophic aqua-culture (IMTA) - in which organic leftover products from the farmed species (finfish or shrimp) are exercised as nutrients or food by other cultivated species.
- Aquaponics - in which effluent leftover for fish farming are exercised as a nutrient source for growing vegetables, herbs and/or flowers.
- Lessening overfeeding can drop costs of food, condense nutrient accumulation and aid in preserving compulsory Dissolved Oxygen levels and raise herbivore fish.
- Closed loop/ Recirculating Aquaculture System (RAS) can discourse water require, drain pollution and must use exclusive and multifaceted filtration systems.
- Overstocking should be alluded to abridge stress, reduce disease/pathogen outbreak, and diminish antibiotic usage, sell and buy nearby, lessen transport footprint.
- Stock native species along with Organic Aquaculture and proper drainage facilities
- HACCP implementation and GAP practicing with
- Producing quality seeds and providing quality feed at a competitive price
- Improve transportation amenities and reduction of usage of chemotherapeutics
- Ensure high quality raw materials while producing meshed feed

3.6 Management Strategies
Management strategies should be reduced environmental impact of aquaculture without decreasing production. Action needs to manage should be

3.6.1 Funding for research
- Improve feed conversion ratio (FCR) –ratio of gain in wet body weight to the amount of feed fed
- Improve organism-specific feeds to increase nutrient retention and improve waste treatment methods
- Research should be conducted to find out appropriate solution for post drainage management for the salt affected or waste water to be drained from a shrimp pond.

3.6.2 Educate Farmers on
- Method benefits and drawbacks
- Integrated aquaculture techniques (e.g. Waste-water-fed mollusk farming can be used to recover excess nutrients)
- Best Management Practices (BMP) plans

3.6.3 Encourage communication between researchers and commercial facilities via conferences and meetings

3.6.4 Strict implementation of the FAO code of conduct [32, 4].

4. Concluding recommendations

Fish cultivation has ecological influence in terms of salinity escalation, mangrove annihilation, pollution, sedimentation, diseases, land degradation, abolishing natural fish species, damage of capture fisheries and biodiversity, salinization of groundwater and consequential difficulties with drinkable water and agriculture.

Apposite management can confirm a sustainable progress and advantage of shrimp cultivation. Fortification and refurbishment of aquatic environment from pollution of shrimp cultivation is the utmost indispensable theme of environmental management. Consequently, appropriate management and arrangement can stretch a sustainable development and benefit to aquaculture. Retaining all these in view, the subsequent recommendation may be procured to defend and manage the environmental impact of shrimp cultivation:

- Ascertain actions for EIA (Environmental Impact Assessment) and observing to lessen the antagonistic ecological alteration and associated social and economic impact resulting from water abstraction, land use, effluent emancipation, usage of drug or chemical and other actions.
- Requisite for improved collaboration and sharing and distribution of information regarding disease prevention and control approaches;
- Fry gathering should be scrutinized recurrently and catching should be barred in areas where there are sufficient hatcheries and in certain ecologically delicate extents such as the Sundarbans and migration courses;
- Shrimp fry gathering by presently used fine meshed nets should be forbidden or as a minimum controlled throughout a licensing system. Mesh sizes for other nets should also be scrutinized.
- Demarcation of shrimp expanses using remote sensing and GIS applications should be commenced.
- Apposite policy concerning shrimp cultivation should be articulated and executed for appropriate management of shrimp farming.

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