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Research Article

Trends in the Use of Probiotics in Aquaculture of Bangladesh—Present State, Problems, and Prospects

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Aquaculture in Bangladesh has expanded, diversified, and intensified over the last decades. Control of infectious diseases is critical for a successful and sustainable aquaculture. In this study, we examined the extent of use of probiotics in aquaculture of Bangladesh, using a questionnaire. Data were collected from 200 individual respondents from commercial fish farms located at Mymensingh, Rajshahi, Jashore, and Cumilla (50 from each) regions. A total of 88 different probiotics products from 36 companies, mostly imported, are used in the aquaculture in Bangladesh. Although in most cases the purpose of the use of probiotics is not clear for the farm owners, several representatives of different companies suggested the use of their different probiotic products, for different situations. Most of the farm owners responded that they used probiotics to get higher production by promoting the growth of fish. A considerable number of farm owners responded that probiotics reduced mortality as well as reduced gas emissions from the aquaculture ponds. Although the use of commercial probiotics varies from region to region, Pondcare and Safegut, the product of SK + F, are mostly used in aquaculture based on the responses (32% and 21% of respondents, respectively). To safeguard and clarify the value and effectiveness of these goods, the fish feed manufacturers and regulatory authorities should monitor their production, collection, and marketing.

1. Introduction

Aquaculture is expanding in new directions around the world. The main goal of aquaculture is to maximize the production and ultimately, profits. Aquaculture in Bangladesh is keeping pace with the rest of the global aquaculture. Nationwide, aquaculture contributes 57.10% of the total fish production [1]. Bangladesh ranked as the 5th country in the world in terms of aquaculture production and thus it is considered one of the leading nations for fish production. In terms of average growth rate of fish output over the past 10 years, Bangladesh has ascended to the second position [1]. Bangladesh is a self-sufficient country, providing 63 g of fish per person daily, compared to the requirement of approximately 60 g [2]. However, due to the expansion and intensification of aquaculture, antibiotics have been extensively used to control bacterial infections [3–6]. Antibiotics used in aquaculture promote the development and transfer of resistance to other bacteria, including human and fish pathogens, which may be detrimental to the environment and human health [7–10]. Moreover, feed costs account for over 70% of total production expenses, reducing the profitability of this thriving industry [11–14]. Consequently, alternative solutions for modern sustainable aquaculture that include cost-effective feeds, that can

maintain decent farming conditions for optimal production are quite preferable [15]. In this direction, aquaculture industry explores solutions that are as effective as the traditional antibiotics but are environment- and consumer-friendly [16, 17]. Bio-friendly feed additives, including probiotics, prebiotics, and synbiotics, are increasingly popular dietary supplements that have the potential to increase not only growth performance but also immunological response and physiological well-being in fish and crustaceans [18].

Probiotics serve a critical function as bio-friendly agents that can guarantee aquaculture's long-term viability and profitability [18, 19]. Probiotics are usually members of the healthy microbiota associated with the host [20], such as lactic acid bacteria, or various members of the genus *Bacillus* spp., and yeasts, such as *Saccharomyces* spp. They are often utilized to boost fish's growth, digestibility, immunological responses, disease resistance, blood biochemistry, gut health, and overall well-being [9, 21–23]. In addition, they can alter the gut microbiota and thus they affect the availability of various key nutrients through improved breaking down and absorption of various available nutrients [24, 25]. In reproduction, probiotics significantly increase egg production, the fecundity and fertilization rate [26, 27] and can increase the amount of normal fry hatched [28].

Despite the fact that there are very few studies on the use of probiotics in shrimp and fish culture in Bangladesh, farmers there have been intensively cultivating catfish, particularly shing (*Heteropneustes fossilis*), pabda (*Ompok pabda*), and gulsha (*Mystus cavasius*), with probiotics to reduce disease, algal bloom, and improve growth. Probiotics are used for a variety of functions throughout the culture period on about 13%, 59%, and 28% of semi-intensive, extensive (traditional), and enhanced traditional farms in the Satkhira district of Bangladesh [29, 30]. It has been shown that several probiotics have been employed in the farming of tilapia (*Oreochromis niloticus*), rui (*Labeo rohita*), catla (*Catla catla*), mrigal (*Cirrhinus cirrhosis*), and shrimp [31, 32]. According to reports, around 43%, 29%, 17%, 7%, and 4% of probiotics were employed in water, feed, soil, and feed, water, and soil probiotics, respectively [33]. In addition, probiotics have been utilized extensively in the nation's Biofloc Technology to adapt a variety of species [34, 35].

In this study, a survey was conducted to examine the overall performance of probiotics in commercial fish farming in Bangladesh. We compiled current data on commonly used probiotics in aquaculture of Bangladesh noting the supplier companies, their active ingredients, and concentrations, the used doses, with special emphasis on their actual impacts on fish production, feed utilization, water quality management, and disease resistance.

2. Materials and Methods

2.1. Study Area and Period. Based on the top fish-producing districts, we divided the whole country into four centers such as Mymensingh, Rajshahi, Jashore, and Cumilla (Figure 1). These districts are considered important aquaculture centers in Bangladesh as the meteorological conditions and geography are more suitable for fish production. We collected data over 6 months, from January to June 2021.

2.2. Questionnaire Preparation and Survey. A questionnaire interview procedure was designed for the collection of data. A draft interview schedule was first created, in order to obtain a complete picture and fulfill the study's objectives. A set of questionnaires was included like as farmer's identity, physical facilities of the farm commonly used probiotics along with company name, price, extent, and dose, the performance of probiotics in the pond before and after uses of probiotics, problems, and possibilities of probiotics, etc. A total of 200 commercial fish farms were visited to gather information about the selected regions in the country.

2.3. Data Collection. Data were collected from 200 individual respondents of commercial fish farms located at Mymensingh, Rajshahi, Jashore, and Cumilla (50 from each). Both primary and secondary sources were explored when gathering information. The researchers collected primary data through questionnaire interviews and as participatory rural appraisal (PRA) tools like cross-check interviews with key information, focus group discussion (FGD), and large group discussion (LGD) from commercial fish farmers and fish medicine shops personally to have a brief outline of the present status of probiotics in Bangladesh. Secondary information was gleaned from resource persons such as; the districts fisheries officer (DFO), upazila fisheries officer (UFO), and local extension agent for fisheries (LEAF) of government organizations. Some information was documented from representatives of the different pharmaceuticals companies. The Journals, theses, reports, and government documents were also used to collect secondary information.

2.4. Data Processing and Analysis. The gathered information was carefully compiled, reviewed, organized, and summarized. Then the information was analyzed and interpreted in accordance with the objectives and specifications. Collected data were processed using Excel 2010. The information was therefore represented in text, tabulated, and graphic representations to make the current outcomes easier to read and understand.

3. Results

3.1. Major Commercial Probiotics Used in Aquaculture of Bangladesh. Probiotics were mostly available in powder form in the market with different names according to companies. Some liquid probiotics were also available in the market. A total of 88 different probiotics products from 36 companies are used in the aquaculture of Bangladesh (Table 1). Although we found 88 probiotics from 36 companies with different trade names from the survey, not all few probiotics are used extensively by the farm owners. The biochemical composition, concentration, doses, and functions vary from probiotics to probiotics (Table 2). Most probiotics are mixed with prebiotics to enhance the functionality of probiotics. *Bacillus* spp., *Lactobacillus* spp., and *Nitrosomonas* spp. are most abundant for most probiotics with special purposes. We summarized the mostly available probiotics with their content and doses with the specific functions.

FIGURE 1: Map of Bangladesh showing the study areas (Mymensingh, Rajshahi, Jashore, and cumilla).

3.2. Most Commonly Used Probiotics on the Basis of Farmers' Perception. Although the use of commercial probiotics is varied from region to region, the Pondcare and Safegut, product of SK + F, are mostly used in aquaculture as per the perception of 32% and 21% of respondents, respectively (Figure 2).

3.3. Farmers' Perception of the Purpose of Use of Probiotics in Bangladesh. The purpose of the use of probiotics is not clear for the farm owners in most cases. However, when they face any problem, several representatives of different companies provided suggestions to use their different probiotics products. Most of the farm owners responded that they used probiotics to get higher production by promoting the growth of fish (Figure 3). A considerable number of farm owners responded that probiotics reduced mortality, improved water quality, as well as reduced gas from the aquaculture ponds.

4. Discussion

This study provides a foundation to assess the actual scenario of probiotics used in the aquaculture of Bangladesh. The results also would release new avenues for research in the case of commercially imported probiotics. Although the application of probiotics is both empirical and scientific, most commercial farmers do not concern about its use in aquaculture. The function of probiotics is confusing yet for the farmers. However, some farmers are very much interested in using the probiotics as they know probiotics are crucial catalysts for boosting growth, decreasing pathogens, and maintaining an eco-friendly culture environment. Farmers would thereby experience increased output and financial gain.

As probiotics play a key role in aquaculture, their application in the aquatic environment enhances water quality parameters such as alkalinity, pH, COD, DO, BOD, TDS,

Table 1: A checklist of different probiotics with their companies used in different regions of Bangladesh.

SL no	Name of companies	Name of the probiotics	Working areas	Probiotics availability in selected regions			
				Mymensingh	Cumilla	Rajshahi	Jashore
1	SK + F	Pondcare	Gut, Water	√	√	√	√
		Gasonil	Water	√	√	√	
		Safegut	Gut	√	√	√	√
		Biopond	Water	√	√		
		Biogrow	Water				
		Nutrigel	Gut				
		Aqua 4	Water	√	√		
2	EON	Profs	Water	√		√	√
		pH care	Water			√	√
		Procid	Gut	√		√	√
		Noxcare	Water			√	√
		Biosurf	Water			√	√
		Bio-aqua	Water	√			
		Energy mix aqua		√			
3	Opsonin	IKI–IKI	Water	√	√	√	√
		GPA	Gut	√	√	√	√
		Ecorich	Water	√	√	√	√
4	ACI	Yucca Plus	Water	√		√	
		Aqua Photo	Water			√	
		Ariake	Water			√	
		MI Plus	Water				
		Pond Guard	Water, gut				
		Pond Life	Water				
		Aci Fish Premix	Gut				
		GP Fish Gel	Gut				
		Navio Plus	Gut			√	√
		Power Lac	Gut			√	√
		Bioplus			√		
5	Square	Biomax	Water, soil	√	√	√	
		Probio-aqua	Soil, water	√	√	√	
		Gastrap	Water				
		Square Aquamix	Gut	√			
6	Navana	Aquavit plus	Gut	√			√
		Fepromix	Gut	√			√
		Dynablend	Water	√			√
		Pondlite Pro	Soil, water	√			√
		Plankto grow	Water	√			√

Table 1: Continued.

SL no	Name of companies	Name of the probiotics	Working areas	Probiotics availability in selected regions			
				Mymensingh	Cumilla	Rajshahi	Jashore
		Ecotoxnil	Water			√	√
		Pond health	Water			√	
		Aqua Magic Plus	Water	√			
7	Fishtech	Gasonex Plus	Water	√			
		BactoGrow	Water	√			
		SoilGerow	Soil				
		Biocult	Water				
		AquaStar Pond	Water	√	√	√	
8	Renata	Aquastar Growout	Gut			√	
		Biomin Aquaboost			√		
9	ACME	Prozime		√		√	
		M-lime	Water	√			
		Promax-Aqua	Soil, water			√	√
10	RIMS BD	Enzimax	Gut				
		Maxilyte	Water				
11	Elanco	Biofav-Aqua	Water	√			
		Amoline	Water		√		
12	CP	pH Fixer	Water		√		
		Super Biotic	Water		√		
13	Novartis	Biofab Aqua	Water		√		
14	Quality Feed	Quality Gold	Gut		√		
		SI Bio-zeo fish	Water	√	√		
15	Pharma & Firm	SI Grow Fish	Water		√		
		SI Royal Pro	Water		√		
16	Catapol	Good Earth	Water		√		
17	SK + D	Bio Grow	Water		√		
		Aqua Gold	Water		√		
18	Organic Pharma	Ecomax	Water		√		
		Ecomarine	Water		√		
19	Bio Pharma	Biozyme Aqua	Gut		√		
20	Growel	Gasonex-y	Water	√	√		
21	Vemedim	Antistress	Water		√		
22	Univer	Golden Bac			√		
23	Aqua Green Bio	Green Aqua	Water	√			
		Projen max	Water, soil	√			
24	Jonik	Mita-Yuca	Water	√			
25	Fish World	Vivo-prob	Water	√			
		Pro-life Aqua	Water				
26	Anvet Pharma	SI-Proclean	Water	√			

Table 1: Continued.

SL no	Name of companies	Name of the probiotics	Working areas	Probiotics availability in selected regions			
				Mymensingh	Cumilla	Rajshahi	Jashore
27	Hanvet	Green-procare	Gut	√			
28	Vivo-Bio science + KRF Agrocare	Eco-charger	Water	√			
29	Avasta	VC-7	Water	√			
30	Anova	Aqua clear-S	Gut	√			
		Biotics	Water	√			
31	RALS Agro	Humigard	Water	√			
32	Naphavet Co.	Aqua Life-S				√	
33	Safety Health	Biotic Hi Boost	Gut			√	
34	Doctors Co.	Protox				√	
35	Fast Ecogreen Agrovet	Prosave					√
		Progreen					√
36	Agro Private Co.	Natura 360	Soil, water				√

Table 2: Commonly used probiotics with composition, concentrations, doses, and functions mentioned on the label of the packet.

Trade name	Composition	Concentrations (cfu/g)	Doses (g/dec)	Functions
Pondcare	*Bacillus subtills Bacillus licheniformis Bacillus polymyxa Bacillus pumillus Bacillus megaterium Bacillus coagulans Bacillus amyloliqefaciens* *Aspergillus niger Aspergillus oryzae*	$2–4 \times 10^7$ $1–2 \times 10^7$	1–2	Most effective and highest potency of facultative probiotics, reduce water hardness, increase DO, and control multiplication of plankton and reduce turbidity, no need to change pond water, *Bacillus* spp. is the food for zooplankton and aquatic larvae
Safegut	Nonantibiotic eco-friendly bioproduct, probiotics, vitamins and enzymes		2	Used as growth promoter
GPA	*Bacillus subtills* *Lactobacillus* spp. *Saccharomyces cerevisiae* Lipase Protease Amylase	3×10^9	0.5	Improves gut health, inhibits the growth of harmful bacteria, prevents growth of detrimental microorganisms, helps in digestion of organic waste, improve survival and growth rate, reduce FCR, improve immunity of fish, shrimp, crab, etc.
PROFS	*Bacillus subtills* *Pediococcus* Enzyme: protease, lipase, amylase, bitagalactosilase, pectinases		1.5	Increases the production of beneficial bacteria and inhibits the growth of harmful bacteria, breakdown of complex components, fertility of water and soil, helps in digestion of organic waste, converts waste into micronutrients and reduce toxic gases, reduces turbidity
IKI–IKI	*Bacillus subtills Bacillus licheniformis Bacillus amyloliqefaciens*	1×10^8 1×10^7 1×10^7	1–2	Prevents growth of detrimental microorganisms, enhance denitrification, breakdown of biological debris
Gasonil	*Bacillus Subtills* *Bacillus licheniformis* *Bacillus polymyxa* *Bacillus megaterium* *Bacillus coagulans* Yucca 30%	8×10^9	1.5–2	Prevents growth of detrimental microorganisms, used as growth promoter, increase disease resistance, prevent bacterial and viral disease of fish, remove stress and ammonia and act as a buffering agent to control pH, improve immunity of fish, shrimp and crab, etc.
Gasonex Plus	*Bacillus subtills Bacillus megaterium Pseudomonas florecium Nitrococcus* sp. *Thiothrix* sp. *Rhodospirilium* sp.	1×10^9 8×10^8 1×10^9 4×10^8 6×10^8 8×10^8	0.8–1.6 with 4 g zeolite gold	Quick removal of toxic gases from ponds, fast growth of fish and shrimp, keeps fish safe from suffocation, helps to remove black gill, blue gill and gulping of fish
Aqua-Star Pond	*Bacillus Subtilis Enterococcus faecium Thiobacillus denitrificans Paracoccus pantotrophus*	8×10^7	2	Enhance denitrification, breakdown of biological debris.
pH Fixer	*Vibrio maintain*		10	Maintain optimum pond water quality and natural food, inhibits the growth of pathogenic bacteria.
Biozyme Aqua	*Bacillus polymyxa Bacillus pumillus Bacillus megaterium*		500g/100 kg feed	Improve performance and prevent pathogenic, bacterial and viral disease of fish, improve survival and growth rate, reduce FCR
Eco Marine	*Enterococcus faecium Paracoccus pantotrophus Bacillus* spp.		2–3 tab/acre	Helps in digestion of organic waste, converts waste into micronutrients and reduce toxic gases
Probio-Aqua LQ	*Rhodopseudomonas palustris*		25 ml/dec	Increases the production of beneficial bacteria, inhibits the growth of harmful bacteria, compatible with fresh and marine water, able to work in rainy season and cloudy conditions

Table 2: Continued.

Trade name	Composition	Concentrations (cfu/g)	Doses (g/dec)	Functions
Good Earth	*Microbacter* sp. *Rhodopseudomonas* sp. *Saccharomyces* sp.	1×10^{7} 1×10^{7}		Breakdown of biological detritus to provide nutrition, fertility of water and soil, *Rhodopseudomonas* sp. contains rich of nutrient such as protien, carotenoid, vitamin B.12, etc. Thus *Rhodopseudomonas* sp. is the food for zooplankton and aquatic larvae
NoxCare	*Bacillus megaterium* *Bacillus amyloliquefaciens* *Bacillus subtilus* *Bacillus licheniformis* Yucca extra (sarsaponin, reserveratol, yuccaols)	8×10^{4}	1–1.5	Acts as an ammonia reducer, increases digestibility and FCR of shrimp and fish, balances nutritional status in water
Procid	*Bacillus* spp. *Lactobacillus* spp. *Saccharomyces* sp.		5g/kg feed	Assists for molting, hardening of shrimp, develops immunity and early maturity of fish and shrimp, improves shiny appearance of scale, and inhibits the erosion of scale
Biosurf	Probiotics enzyme	5.5×10^{7}	2.5–3	Prevents diseases of fish and shrimp, enhance denitrification, breakdown of biological debris, reduces black soil from pond bottom, reduce toxic gases
ACI Yucca Plus	Yucca extract (saponin, glycocomponent) *Rhodopseudomonas* spp. *Bacillus subtilis*		3ml/dec	Protected the culture from the adverse effect of noxious gases, inhibits growth of harmful bacteria, reduces mortality and improves FCR of shrimp and fish, increases natural productivity of pond
Aqua Photo	*Rhodopseudomonas* sp. *Bacillus subtilis*		70ml/dec	Removes noxious gases and increases water quality
Ariake 3	*Bacillus amyloliquefaciens* *Bacillus licheniformis* *Bacillus pumilus* Starch Calcium carbonate	1×10^{10} 1×10^{11} 1×10^{10}	0.75	Breakdown of complex components, inhabits the growth of harmful bacteria and fungus, improves survivability and growth of fish and shrimp
MI Plus	*Bacillus subtilis* *Bacillus licheniformis* *Bacillus megaterium* *Bacillus pumilus* *Bacillus amyloliquefaciens*	1×10^{12} 1×10^{12} 1×10^{12} 1×10^{12} 1×10^{12}	1.2	Removes noxious gases, inhabits the growth of harmful bacteria, improves immunity and growth of fish and shrimp
Pond Guard	*Bacillus subtilis Bacillus licheniformis Nitrosomonas* spp. *Nitrobacter* spp. *Aerobactor* spp. Zeolite Yucca extract		70–80	Inhabits growth of pathogenic bacteria, improves digestibility and FCR of shrimp and fish, and removes noxious gases, equilibrium conditions of pH level
Pond Life	*Bacillus subtilis* *Bacillus licheniformis* *Nitrosomonas* spp. *Nitrobacter* spp. *Rhodococcus* Zeolite	2×10^{8} 2×10^{8} 2×10^{8} 2×10^{8} 2×10^{8}	100	Removes noxious gases, inhabits growth of pathogenic bacteria, improves growth of shrimp and fish through the enrichment of plankton, increases oxygen production
ACI Fish Premix	Vitamin, minerals, probiotics, growth promotant, and attractant		1 g/kg feed	Increase body length and body weight very rapidly, increase reproduction capability, increase disease prevention capability, improve FCR, improve immunity

Table 2: Continued.

Trade name	Composition	Concentrations (cfu/g)	Doses (g/dec)	Functions
GP Fish Gel	Probiotics, amino acid, growth promoter, multiprotein, fish oil, taste enhancer, liquid glucose, vitamin		10 ml/kg feed	Faster growth rate, digestibility, new cell formation, reduces FCR and develops shiny appearances of fish, acts as a stress reducer and instant energy supplier
NAVIO Plus	*Bacillus subtilis Bacillus licheniformis Bacillus megaterium Lactobacillus acidophilis Lactobacillus plantarum* Yeast	1×10^{9}	4–5g/kg feed	Enhances water quality, stun the growth of pathogenic bacteria in gut of fish and shrimp, improves growth and FCR
Power Lac	*Lactobacillus lactis*	1×10^{11}	3–5 g/kg feed	Increases immunity; reduces stress; increases survivability, growth and digestibility of fish and shrimp; improves FCR
Enzimax	Probiotics enzyme		0.25–0.5	Improves FCR and digestibility, increases growth and immunity, improves functionality of beneficial bacteria
Maxilyte-P	*Bacillus subtilis Bacillus licheniformis Nitrosomonas* spp. *Nitrobacter* spp. *Aerobacter* spp. Hydrogen sodium calcium aluminosilicate		40	Removes bad odor from water and soil, equilibrium conditions of pH level, removes noxious gases, improves growth of beneficial plankton, enriches DO of water, and reduces mortality of fish and shrimp
Promaz Aqua	Probiotics and enzymes		1.6–2.4	Removes noxious gases, enriches DO of water, improves growth of beneficial plankton, removes bad odor from water and soil
Aquavit Plus	Probiotics Vitamin Mineral Amino acid		1–2 g/kg feed	Reduces mortality and improves production of fish and shrimp, improves functionality of beneficial bacteria and reduces density of harmful bacteria, increases immunity, increases capability of shrimp for molting, increases fecundity of fish and hatchability of fertilized eggs, improves FCR and shiny appearance of fish and shrimp
FEPROMIX	*Bacillus subtilis* *Saccharomyces* spp. *Lactobacillus* spp. *Bifidobacterium* spp. *Streptococcus* spp.	2×10^{9}	2–2.5 g/kg feed	Inhabits the growth of harmful bacteria, creates the favorable condition of beneficial bacteria in the gut, improves FCR and growth of fish and shrimp. Increases immunity and digestibility and reduces mortality of fish and shrimp
DYNABLED	*Bacillus subtilis* *Bacillus licheniformis* *Bacillus megaterium* *Bacillus mesentricus* *Nitrosomonas* spp. *Nitrobacter* spp. *Aerobacter* spp. *Saccharomyces cerevisiae* *Saccharomyces boulardi* Enzymes (protease, xylanase, lipase, betaglucanase, amylase and cellulase), yucca extract (30%)	2×10^{9}	2	Removes noxious gases and bad odor from water and soil, inhabits the growth of harmful bacteria, increases digestibility and growth of fish and shrimp, breakdown of biological debris
Pondlight Pro	*Bacillus subtilis* *Bacillus licheniformis* *Bacillus polymyxa* Silicon dioxide Aluminum oxide Ferric oxide Calcium oxide	2×10^{8} 2×10^{8} 2×10^{8} 75–85% 5–10% 0.5–1% 2–4%	32–40	Maintains equilibrium conditions of pH level, improves the conditions of water and soil, removes noxious gases and bad odor from water and soil, increases the productivity of pond

Table 2: Continued.

Trade name	Composition	Concentrations (cfu/g)	Doses (g/dec)	Functions
PLANKTO-GROW	*Bacillus* spp. *Nitrosomonas* spp. *Nitrobacter* spp.	1.875×10^8	0.16	Removes noxious gases and bad odor from water and soil, inhabits the growth of harmful bacteria and increases the phytoplankton productivity of pond, converts nitrogenous substances into protein
pH Care	*Bacillus licheniformis*	12×10^9	5–7	Maintain equilibrium conditions of pH level, removes toxic gases, increases functionality, and load of beneficial bacteria, retains natural color of water, increases phytoplankton production
AQUA 4	Probiotics *Rhodopseudomonas* spp. zeolite	1×10^6 1×10^7	5–6	Creation of favorable conditions in the water body, breakdown of complex components
Ecorich	Zeolite, probiotics, yucca		60–90	Increases the production of plankton, balances soil and water pH, inhibits the growth of harmful microorganisms, reduce toxic gases
Biopond	Probiotics, zeolite, minerals	1×10^7	15–20	Reduce toxic gases, enhance denitrification, breakdown of biological detritus
Biogrow	Probiotics, prebiotic, vitamin, minerals	5×10^{11}	20–30	Increases the production of plankton, supplies of available vitamin and minerals for fish and shrimp
Nutrigel	Vitamin Minerals Probiotics		5–10 ml/kg feed	Acts as a mixer with drug and other ingredients, helps for quick growth of fish, increases functionality of feed
Square Aquamix	Vitamin, mineral, amino acid, prebiotic		1g/kg feed	Improves growth, survivability, resistance against diseases, improves spawning performances, FCR, yield, molting, and postmolting performance of shrimp
Biomax	Maximum consortium of probiotics biofixed on a calcareous matrix.		12–16	Clean pond bottom, prevents formation of noxious gases like ammonia, hydrogen sulfide, etc., maintains proper plankton bloom, builds ideal water and soil parameters for aquaculture, promotes excellent growth rate, and improved yield
Gastrap	*Lactic acid bacillus* *Bacillus subtillis* *Saccharomyces cereviceae* Xylanase, amylase, protease, cellulase, hemicellulase, phytase, betaglucanase, lipase aminonitrogen in a fortified base	3×10^{10} 3×10^9 2.5×10^{10}	0.2	Adsorbs the noxious gases from the pond bottom, contains active bioscavengers, deodorizes, and purifies the pond environment, protected the culture from the adverse effect of noxious gases, provides ample oxygen, improves the yield of a high-density stocking

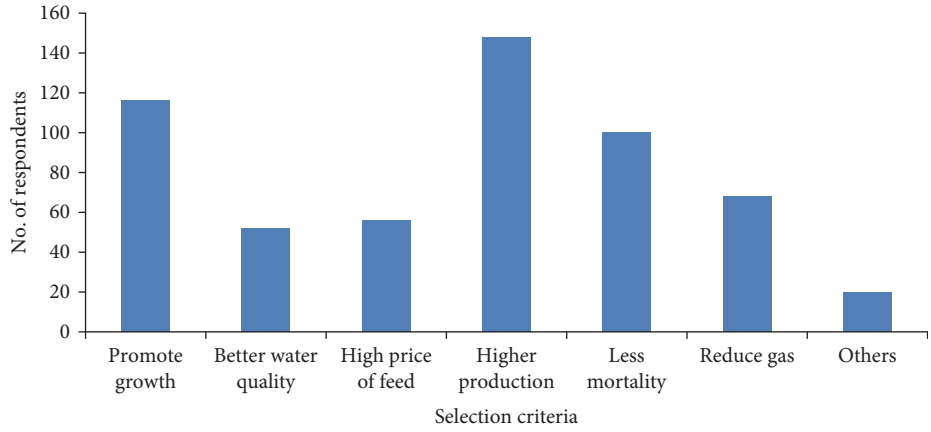

Figure 2: Most commonly used probiotics on the basis of farmers' perception.

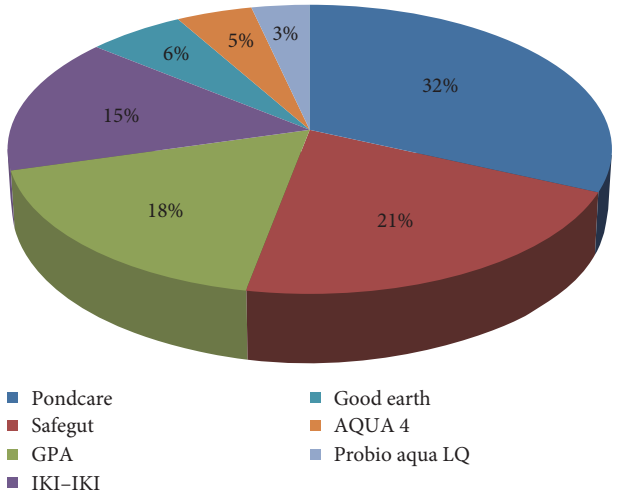

Figure 3: Selection criteria for the use of probiotics on the basis of farmers' perception.

phosphates, nitrogenous species, hardness, transparency, heavy metals, and decrease in the frequency of illnesses. In our survey, we perceived that the DO level of water increases after the use of probiotics. Farmers use probiotics to maintain optimum DO levels in waters for better growth performances. Similarly, probiotics significantly improved DO levels and decreased the ionized and unionized ammonia of water [11, 36, 37]. In our investigation, we ascertained that the pH level increased after using probiotics on the fish farm. It has been reported that ionized and unionized ammonia, level of nitrite and nitrate, as well as the concentration of TAN value, also were drastically reduced after the use of probiotics [13, 36, 38, 39]. Similarly, probiotics changed the water color from light green (high transparency) to dark green (low transparency), as *Bacillus* species have influence on transparency [40, 41].

Although probiotics are a crucial management tool, their effectiveness depends on the environment because most probiotics are imported from other countries, and they are adapted to their environment. So new environment is so challenging for effective functioning, and it is quite difficult to compete with local strains, and their functionality may hamper. Many farmers do not concern about probiotics. Some farmers utilize probiotics as feed additives, but doing so not only adds to costs and requires attention to ensure that new microbial strains are used properly and as effectively as possible. On the other hand, several problems are also associated at the field level, like a lack of technical knowledge of fish farmers about the use of probiotics and the dose and content of probiotics. Sometimes they apply overdose, which may create adverse effects due to the rapid multiplication of microbes in culture systems. Some farmers also claim that probiotics do not work properly due to adulteration in probiotics. Some probiotics have negative side effects, including intestinal cell damage, gill and skin mucus, and intestinal tissue disturbance due to adulteration. In many cases, commercially available probiotics do not properly label the dose, target species to be treated, age, or size.

5. Conclusions

In summary, a considerable number of different probiotics, mostly imported, are used in the aquaculture of Bangladesh. The purpose of the use of probiotics is not clear for the farm owners in most cases. The feed producers and regulatory authorities should therefore keep an eye on their production, collecting, and marketing in order to protect and define the worth and efficacy of these items. More field trials are necessary to validate the dose and application of laboratory findings of probiotics. Also it is undoubtedly an urgent need to develop probiotics using local strains from the environment and organisms of Bangladesh to enhance the efficiency and functionality of probiotics, and raise awareness about the beneficial effects of probiotics among commercial fish farmers.

Data Availability

The data that support the findings of this study are available within the article.

Conflicts of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Authors' Contributions

Md Kabir Hossain collected and analyzed data, and drafting the manuscript. Md Shahjahan conceived, designed, supervised the study, and edited the manuscript. Zulhisyam Abdul Kari and Guillermo Téllez-Isaías involved in the writing–review and editing.

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