Article

Aqua medicines, drugs and chemicals (AMDC) used in freshwater aquaculture of South-Eastern Bangladesh

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Received: 07 July 2021/Accepted: 28 August 2021/ Published: 31 August 2021

Abstract: A broad variety of aquaculture-related medications, drugs, and chemicals (AMDC) are extensively used in the aquaculture industry in South-Eastern Bangladesh. Fish farmers are worried about the quality of their final product, and disease outbreaks must be stopped at all costs. Farmers are sometimes one ahead of the curve when it comes to producing healthy final products by including probiotics, vitamins, and minerals into their aquaculture setups to promote early and disease-free output. However, the current study was carried out in south eastern Bangladesh, specifically in the highly dense aquaculture regions of Chandpur, Cumilla, and Feni district (17 upazilas), from November 2016 to January 2018. Questions were asked through interviews and a Focus Group Discussion (FGD) was held to gather primary data. The major target groups were aquaculture farmers, AMDC shops, pharmaceutical company employees, and hatchery owners. In this three-county area, according to the findings from the thorough research, there are a total of 33 companies that advertise 330 generics brand products via their own distributional channels. Among the available AMDC products in the study area, growth promoters were mostly abundant products among all categories while other products such as predator removal products, insecticides and ectoparasiticides, water quality and pond management, plankton producer, plankton bloom cleaner, disinfectant and disease treatment, toxic gas reducer, pH controller, oxygen supply, stress reducer, growth promoter, probiotics and antibiotics were most selling products to the farmers. The present study revealed 19 generic of antibiotics were available and prescribed by the AMDC vendors or aquaculture disease consultants (ADC) around the regions. Additionally, the research also included the dosages of AMDC and the method of administration in the aquaculture pond, which will assist both the farmers and the ADC in selecting and suggesting the appropriate medications or treatments that may be beneficial to the farmers in the long run.

Keywords: aquaculture; disease; treatments; antibiotics; probiotics; AMDC

1. Introduction

Despite the fact that it is the fastest-growing food-producing industry on the planet, aquaculture has surpassed all other animal-based food-producing industries in terms of growth (Froehlich et al., 2018; Leung and Bates, 2013). The fishery and aquaculture industries are critical to developing economy of Bangladesh, as they provide...
millions of jobs and generate constant worldwide export revenues for the country (Sunny et al., 2021). Bangladesh was the fifth-largest global producer of aquaculture products in 2018, and the aquaculture industry of Bangladesh is expected to grow in the next years (Shamsuzzaman et al., 2020, 2017). Agriculture in Bangladesh has evolved technologically and risen in size and scope over the last few decades, diversifying, intensifying, and diversifying further (Hinchliffe et al., 2021; Naylor et al., 2021; Toufique and Belton, 2014). In Bangladesh, freshwater aquaculture generally consists of pond aquaculture, particularly polyculture of both local and exotic species, whereas coastal aquaculture primarily consists of shrimp farming (Bostock et al., 2010; Boyd et al., 2020; Rahman et al., 2021). In recent years, there has been a considerable expansion of aquaculture in Bangladesh, even the mariculture is considering one of the major industries in upcoming years (AftabUddin et al., 2021; Al-Asif et al., 2021; Khan et al., 2021).

Aqua medicine, drugs and chemicals (AMDC) are increasingly being used in aquatic animal health management in Bangladesh as aquaculture expands (Al-Asif et al., 2021; Alam and Haque, 2021; Diana et al., 2013; Shamsuzzaman and Biswas, 2012). Much of this development has been focused on districts like Cumilla, Feni, Chandpur, Noakhali, where commercial Tilapia and carp polyculture culture is gaining momentum (Adhikary et al., 2018a; Bayazid, 2016; Hossain et al., 2013; Islam et al., 2019; Pravakar et al., 2013; Ullah et al., 2020a). Muhuri is the largest fish farming project in Feni district, encompassing the districts of Feni Sadar, Sonagazi, Chhagalnaiya, and Parshuram in Feni and Mirersarai in Chittagong. With the increase in aquaculture practices leading to enhanced fish production, aquatic animals have come across a series of health menaces due to environmental stress, the incursion of infectious pathogens and increased incidence of fish disease outbreaks (Assefa and Abunna, 2018; Biswas et al., 2018; Chowdhury et al., 2015; Kotob et al., 2016; Lafferty et al., 2015; Ullah et al., 2020a).

In Bangladesh and other Asian nations, many bacterial, viral, fungal, and parasite diseases have been observed in aquaculture (Adhikary et al., 2018b; Ahmed et al., 2007; Faruk et al., 2004; Hasan et al., 2014; Majumder et al., 2001; Shabuj et al., 2016; Sharif and Al-Asif, 2015; Siddique et al., 2021; Vaumik et al., 2017). A large number of aquaculture medicines and chemicals are currently being utilized to prevent production loss as a consequence of this phenomenon (Al-Asif et al., 2021; Chowdhury et al., 2015; Rahman et al., 2019; Ullah et al., 2020).

Besides the control of fish health, aqua medicines and chemicals are required for pond preparation, soil and water management, natural aquatic production improvement, feed formulation, and fish growth (Al-Asif et al., 2021; Chowdhury et al., 2015; Faruk et al., 2021; Hossain et al., 2014; Ullah et al., 2020a). Around 1484 aqua medicines generics are being found and commercialized by 100 pharmaceutical businesses over Bangladesh in past decade (Al-Asif et al., 2021). Many aquaculture consultants, representatives from pharmaceutical and feed companies, and chemical sellers are involved in the marketing chain for distributing such products to end-users (Al-Asif et al., 2021; Sharker et al., 2014). Lime, disinfection, rotenone, various inorganic and organic fertilizers, phostoxin, salt, dipterex, antimicrobials, potassium permanganate, copper sulphate, formalin, sumithion, melathion, and other chemicals are frequently employed in aquaculture of Bangladesh (Adhikary et al., 2018b; Al-Asif et al., 2021; Biswas et al., 2018; Chowdhury et al., 2015; Faruk et al., 2004; Rahman et al., 2019; Ullah et al., 2020a). The use of these chemicals in fish aquaculture units is currently being supported by a number of pharmaceutical companies and other chemical sellers, despite the fact that most farmers are completely unaware of the stability of drugs and effectiveness (Al-Asif et al., 2021; Lulijwa et al., 2020). In recent years, a number of international and national organizations have voiced significant concern about the overuse or abuse of these drugs, which has often led in the development of Antimicrobial Resistance (AMR), presenting a serious threat to public health (Cabello et al., 2013; Hoque et al., 2020; Lulijwa et al., 2020; Neela et al., 2015; Rasul and Majumdar, 2017; Thornber et al., 2019; Watts et al., 2017).

Fishermen are compelled to use a variety of aqua medicines and chemicals in a sequential manner, according to the effects of each drug or chemical. It is up to them to determine the dosage of chemicals based on their own expertise, product instructions on the bottle, or discussions with chemical suppliers or farmers (Al-Asif et al., 2021; Hasan et al., 2015). Consequently, appropriate doses of these aqua medicines and antibiotics are regularly ignored, presenting a danger to aquaculture as well as to the general public (Hinchliffe et al., 2018; Hoque et al., 2020; Liu et al., 2021; Reverter et al., 2020; Schar et al., 2021). Over the past decade, there has been a significant increase in the amount of information accessible regarding aquaculture drug use and its implications for human health, environmental protection, and the sector’s long-term sustainability (Lulijwa et al., 2020).

As aquaculture grows in this area, more pesticides, antibiotics, and aqua medicine are required to keep it running well (Al-Asif et al., 2021). The area, on the other hand, has not had a comprehensive study of the marketing and availability of different aquaculture medicines, pharmaceuticals, and chemicals performed in order to determine their availability (Al-Asif et al., 2021; Rahman et al., 2019; Ullah et al., 2020a). As a
consequence, the present study investigated the market availability and use patterns of different aqua-medicines, pharmaceuticals, chemicals, and formulations in the major aquaculture zones of Bangladesh.

2. Materials and methods

2.1. Study area and periods

The data were collected from three districts of south east Bangladesh namely, Cumilla, Chandpur, and Feni district (Figure 1). A total 17 upazilas (sub-district) were selected for conducting the survey from November 2016 to January 2018. The study covered nine upazila, namely Comilla Sadar, Comilla Sadar Dakkhin, Daudkandi, Muradnagar, Brahmanpara, Burichang, Chaudogram, Laksam and Barura upazilla from Cumilla district; four upazila viz. Chandpur Sadar, Hajigonj, Faridganj and Matlab Uttar upazila from Chandpur district, while four upazila were considered from Feni district such as, Feni sadar, Sonagazi, Parshuram, and Daganbhuiyan (Figure 1).

Figure 1. The study covered three south eastern districts of Bangladesh.

2.2. Data collection

Data were collected from fish farms, feed shops, aqua shops and medical representative of Pharmaceuticals companies at their offices. Both primary and secondary data were used to finalize the study process. Several survey techniques were adopted for gathering data, such as face-to-face interview, focus group discussion (FGD), Participatory Rural Appraisal (PRA) and so on to gather the aqua medicines, drugs and chemicals (AMDC) status in the market, fish disease in the farms, business strategies by the AMDC companies and their representatives.

2.2.1. Primary data collection

First-hand information was gathered through questionnaire interviews with representatives from culture farms, chemical merchants, and medical representatives from pharmaceutical companies. During the visit to the nurseries and culture pond, the following aspects of chemicals and fish toxicants were considered important: the purpose of using chemicals or toxicants, variations in application methods, effectiveness of chemicals or toxicants, and toxicants, variation in applied dose of chemicals or toxicants, or toxicants by the government and availability of the chemicals, specific toxicity of the chemicals, and specific toxicity of the toxicants.
2.2.1.1. Questionnaire interviews
The questionnaire form was filled in by interviewing from 157 farmers, 105 chemical sellers and 33 medical representatives of Pharmaceuticals Company directly from the study area.

2.2.1.2. Focus Group Discussion (FGD)
For this study, one of the PRA tool such as Focus Group Discussion (FGD) was conducted in fish farms (n=20), hatcheries or gher owner (n=10), fish farmers, chemical sellers (n=135), and medical representatives (n=50) of Pharmaceuticals Company. In this study, FGD was used to get an overview of particular issues such as the existing problems associated with the use of aquaculture drugs. A total of 10 FGD sessions was conducted where each group size of FGD was 21.5 people. FGD session was held in front of hatchery or gher, representative offices, chemical sellers shop and so on.

2.2.1.3. Crosschecked interviews
After collecting the data through questionnaire interviews and FGD, crosscheck interviews were conducted with Upazila Fisheries Officer, Assistant Fisheries Officer, relevant NGO workers, chemical seller and medical representative of Pharmaceuticals Company at their offices.

2.2.2. Secondary data collection
Secondary source of information consist of published material such as journals (for example, Al-Asif et al., 2021), textbooks, university thesis (up to post-graduate level), newspaper and other sources. Moreover, appropriate government and non-government organizations reports were also taken into consideration for gathering information. The existing problems associated with the use of aquaculture drugs were also collected from the secondary source.

2.3. Data processing and analysis
The data was analyzed using tabular and descriptive statistical techniques. The summary tables were prepared in accordance to the objective of the study. Data collected from various sources was entered into a data base system using Microsoft office Software. The processed data were transferred to a master sheet from which classified tables were prepared revealing the findings of the study. At each stage of survey data sheets were compared with original data sheets to ensure the accuracy of data entered.

3. Results
3.1. Aqua drugs and chemicals producing companies
The current study found, a total 33 companies were either producing or marketing aqua medicines, drugs and chemicals (AMDC) products targeting freshwater aquaculture in South-Eastern part of Bangladesh. ACI Animal Health Ltd., Square Pharmaceuticals Ltd., Acme Laboratories, Novartis Animal Health Ltd., Eon Animal Health., Organic Pharmaceuticals Ltd., Renata Ltd., CP Company, Rals Agro Ltd., and many other companies were noticed that produced, imported and marketed different AMDC products for freshwater aquaculture in that regions (Table 1). The most of the imported products were imported from countries such as India, USA, Thailand, Taiwan, Indonesia, Malaysia and Spain.

Table 1. AMDC producing, importing and marketing companies available in the South-Eastern part of Bangladesh.

| Name of companies | Name of companies |
|-------------------|-------------------|
| Eon Animal Health | VnF Agro Ltd.     |
| Square Agrovet Division | One Pharma Ltd. |
| Novartis Pharmaceuticals Ltd. | NAAFCO Pharma Ltd. |
| ACI Animal Health | Bismillah Enterprise Ltd. |
| SK+F Animal Health. | NutriHealth Ltd. |
| The ACME Laboratories Ltd. | Advanced Agrotech (BD) Ltd. |
| Nature Care Ltd. | Chemical Seller |
| Fishtech (BD) Limited | Promim Agrovet Industries |
| Penta Agrovet Ltd. | PRAN Agro Business Ltd. |
| Organic Pharmaceuticals Ltd. | Univet Ltd. |
| First Care Agro Ltd. | Save and Safe Agroscience Bangladesh |
| Lion Overseas Trading Company | Verno Bio-Splutions Ltd. |
| Catapol Bioscience Ltd. | Agrosol Bangladesh Company |
3.2. Categorization of AMDC products

According to the findings of the current study, the total number of AMDC goods accessible in the study region totaled 330 items, comprising highest number of growth promoters (GP) (total 59 items; 17.88%), followed by disinfectant and disease treatment (DD) (total 49 items; 14.85%), water quality and pond management (WQPM) (total 47 items; 14.24%), oxygen supply (OS) (total 36 items; 14.24%), toxic gas reducer (TGR) (total 30 items; 10.91%) and rest of the products were found to be less than 30 items and 10% of total numbers. However, We found antibiotics contributes 19 items and 5.76% of the total AMDC available in the study area (Figure 2).

![Figure 2. Categorization of AMDC products available in south-eastern part of Bangladesh (Predator removal=PR; insecticides and ectoparasiticides=IE; water quality and pond management=WQPM; plankton producer=PP; plankton bloom cleaner=PBC; disinfectant and disease treatment=DD; toxic gas reducer=TGR; pH controller=PC; oxygen supply=OS; stress reducer=SR; growth promoter=GP; probiotics=PB and antibiotics=AN).](image)

3.2.1. AMDC used as predator removal

Farmers use rotenone powder to remove predator and unwanted fish. Rotenone is provided by different pharmaceutical company. The dose of Rotenone depends on water depth and company’s products. Following rotenone powder was found in the study (Table 2). Mainly Rota Plus, Napko Glod, Hunter, Phostoxine, Aquanone were used to remove predator and unwanted fish.

| Trade Name       | Active Ingredients | Doses/ 3-6 feet water | Sources                          |
|------------------|--------------------|-----------------------|----------------------------------|
| Aquorot gold     | Rotenone 9%        | 35 g decimal-1 ft-1 depth | ACI Animal Health                 |
| T Seed Cake      | Saponin 15-16%     | 800 g decimal-1 ft-1   | ACI Animal Health                 |
| Rota Plus        | Rotenone 9%        | 30 g decimal-1 ft-1    | ACI Animal Health                 |
| Rotenil          | Rotenone 9%        | 1kg/ 100 dec (depth 4-5 ft.) | SK+F Pharmaceuticals Ltd.        |
| Napko Glod       | Rotenone 9%        | 20 g decimal-1 ft-1    | NAAFCO Pharma Ltd.                |
| Hunter           | Rotenone 9%        | 18g decimal-1 ft-1     | Eon Animal Health                 |
| Aquanone         | Rotenone 9 %       | 5-7kg/100 dec         | Square AgroVet Division           |
| Phostoxine       | Almonomin phosphide| 2-3 Tablets decimal-1  | Fishtech (BD) Limited             |
| Raj-fume 56%     | Almonomin phosphide| 2 Tablets decimal-1    | Aquaculture International Co. BD   |
| Aquanone         | Rotenone 9 %       | 5-7 kg/100 dec        | Square AgroVet Division           |
| Fewmitix 56%     | Almonomin Fosfide  | 5 tablet/ decimal/ depth 5 ft.) | One Pharm Animal Health           |
| Rotenone         | Rotenone 9 %       | 6-7 kg/100 dec        | First Care Agro Ltd.              |
3.2.2. AMDC used as insecticides and ectoparasiticides

Wide ranges of chemicals or formulations are being used by the fish farmers for the treatment of parasitic infestations caused by fish louse (Argulus sp.), gill flukes (Dactylogyrus sp.), Myxobolus sp., ich (Ichthyophthirius sp.) and gill maggot (Ergasilus sp.) (Table 3).

Table 3. AMDC use for controlling insects and ecto-parasites.

| Trade Name       | Active Ingredients | Doses/ 3-6 feet water | Sources                     |
|------------------|--------------------|-----------------------|-----------------------------|
| Argulex          | Trichlorofon-40%   | 12-13 ml/dec/3 ft depth | Eon Animal Health           |
| Sumithion        |                    | 5-8 ml/dec/3 ft depth  | Setu Corporation Ltd.       |
| Engreb           | Cypermethrine 10%  | 7 ml/33 dec/ft depth   | Eon Animal Health           |
| Parastics        | Sumithione 10%     | 100 ml/100 dec, 3 ft depth | Advanced Agrotech (BD) Ltd.|
| Acemec 1% Oral Solution | Ibermehrine     | 300 ml/100 dec, 5 ft depth | ACI Animal Health          |
| Deletix          | Deltametrin-1.75%  | 50 ml/100 dec, 4 ft depth | Fishtech (BD) Limited      |
| Deltacin         | Deltametrin-1.75%  | 50 ml/100 dec, 4 ft depth | Save and Safe Agroscience Bangladesh |
| Terminate        | Deltametrin-1.75%  | 50 ml/100 dec, 4 ft depth | Ultimate (bd) Ltd.         |

3.2.3. Water quality and pond management

Pond preparation is critical in order to increase the productivity of the whole system. Again, maintaining optimal water quality is very important in determining the success or failure of fish production to a significant degree. This includes pH, total alkalinity, total hardness, dissolved oxygen (DO), ammonia, and nitrite-nitrate concentrations, among other things. A wide range of chemicals, including Mega Zeo plus Acme's Zeolite, Matrix, Pond Gurd, Aqua Lime, Bio Aqua, Geotox, and others, were frequently employed in the pond preparation process and for the maintenance of optimal water quality in the survey area (Table 4).

Table 4. AMDC use for pond preparation and water quality management.

| Trade Name       | Active Ingredients | Doses/ 3-6 feet water | Sources                     |
|------------------|--------------------|-----------------------|-----------------------------|
| JV Zeolite       | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, K₂O, Mn, P | 5-7 kg/33 dec | Eon Animal Health           |
| Matrix           | SiO₂, Al₂O₃, Fe₂O₃, CaO, | 6-10 kg/100 dec | Eon Animal Health           |
| Super Zeolite    | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, LoI, K₂O | 20-30 kg/100 dec | Avon Animal Health          |
| Raw Lime         | CaCO₃, Ca(OH)₂     | 1-2 kg/dec           | Chemical Seller             |
| Mega Zeo Plus    | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O | 20-25 kg/100 dec | ACI Animal Health           |
| Mega Zeo Gold    | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O + O₂ | 20 kg/100 dec | ACI Animal Health           |
| Zeoren           | Aluminum sodium silicate-75% | 20-30/100 dec | Renata Animal Health        |
| Zeo Prime        | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, LoI, K₂O | 20-24 kg/100 dec | SK+F Animal Health          |
| Quality Zeolite  | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, | 20-25 kg/100 dec | Quality Fish Feed Ltd.      |
| Aalo Zeolite     | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Ti₂O₅, MnO₃, K₂O, Fe₂O₃, pH | 15-20 kg/100 dec | PRAN Agro Business Ltd.     |
| Pure Lime        | CaCO₃              | 1 kg/dec             | PRAN Agro Business Ltd      |
| Vernolite plus   | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, | Na₂O, K₂O, C, E, C = 400 | Verno Bio-Solutions Ltd.    |
| Zeo Pel          | No label found     | 5-10 kg/100 dec/100 dec | SK+F Pharmaceuticals Ltd.   |
| Geo Rich         | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, K₂O | 15-25 kg/100 dec | Opsonin Agro vet Division   |
| Nap Zeo          | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O | 10-16 kg/100 dec | NAAFCO Pharma Ltd.          |
| Pond Gurd        | Al₂O₃, Yucca, Probitics | 10-20 kg/100 dec | ACI Animal Health           |
| Pond Life        | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, Probitics | 20-25 kg/100 dec | ACI Animal Health           |
| Geotox           | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O | 20-25 kg/100 dec | Novartis Pharmaceuticals Ltd.|
| One Zeolite      | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, K₂O, MnO₃, P₂O₅ | 25-30 kg/100 dec | One Pharm Animal Health     |
| Aqua magic       | No label found     | 05-08 kg/100 dec     | Fishtech (BD) Limited       |
| Aqua-Zeo Plus    | SiO₂, Al₂O₃, Fe₂O₃, CaO, MgO, Na₂O, K₂O | 8 kg/33 dec | Advanced Agro Ltd.          |
| Miracol lime mila| No label found     | 100 gm/dec           | The ACME Laboratories Ltd.  |
Chemical were used for growing phytoplankton to boost output beyond natural fertility of ponds, fertilizers also help to improve crop yields. Many aquaculture farmers, on the other hand, have shifted to feed-based aquaculture in order to boost output beyond what is feasible with conventional fertilizers. Different types of chemical were used for growing phytoplankton and Zooplankton in the study area (Table 5).

### Table 5. AMDC used for plankton enhancer in the aquacultures setup in the study area.

| Trade name         | Active ingredient                                      | Doses/3-6 ft water | Sources                                |
|--------------------|--------------------------------------------------------|--------------------|----------------------------------------|
| Plankton Grow      | N, P, K, Ca, Mg, others                                | 1.5 kg/33dec       | ACI Animal Health                      |
| Benthods           | Compost Urea, Vitamin, Mineral, Ammonium silicate      | 150 gm/dec.        | ACI Animal Health                      |
| Vita Plakton       | N, P, K, Ca, Mg                                       | 2 kg/100 dec       | ACI Animal Health                      |
| Pond Ferti         | Organic Fertilizer                                    |                    | ACI Animal Health                      |
| Aqua Green G       | Sea-weed Extract, Enzyme precursors, Micronutrients    | 4 kg/100 dec       | Square AgroVet Division                |
| Bio Pond           | Vitamin, Mineral, Probiotics and Micronutrients        | No recommendation found | SK+F Pharmaceuticals Ltd. |
| Aqua cal           | Ca-22% and Sulper-17%                                  | 5 kg/33dec         | ACI Animal Health                      |
| Green Food         | Dicalcium phosphate, and all mineral                   | 4-5 kg/100 dec     | Ultimate (bd) Ltd.                     |

### 3.2.4. AMDC as plankton producer

The primary constituent of the aquaculture food web, phytoplankton, is found in abundance in natural waters, but the natural quantity of phytoplankton is insufficient to support desired levels of shrimp and fish production. In addition to increasing the natural fertility of ponds, fertilizers also help to improve crop yields. Many aquaculture farmers, on the other hand, have shifted to feed-based aquaculture in order to boost output beyond what is feasible with conventional fertilizers. Different types of chemical were used for growing phytoplankton and Zooplankton in the study area (Table 5).
composition
Aqua Food Fulvic acid, minerals, organic complex, plant growth stimulator 600-700 gm/100 dec Ultimate (bd) Ltd.
Well Bloom Silicon, Plankton Growth promoter 4 liter/100 dec First Care Agro Ltd.
Greenmix Aqua CaCO₃, Phosphorous, Humus, Probiotics 1-2 kg/100 dec Advanced Agrotech (BD) Ltd.
Live Food Multivitamin, Multimineral, Dicalcium Phosphate 5-6 kg/100 dec Advanced Agrotech (BD) Ltd.
Nugel Growth promoter 3 liter/100 dec NAAFCO Pharma Ltd.
All plankkot- L Minerals with probiotics 2.5 ml/100 dec One Pharm Animal Health
Promim Aqua MgSO₄, *Ca* (PO₄)₂, CoSO₄, S, B 12 kg/ 100 dec Promim Agro vet Industries
Verno Bloom Plus Essential Macro and Micro Nutrients with growth promoter 4 kg/100 dec Verno Bio-Solutions Ltd

3.2.5. AMDC as plankton bloom cleaner
This rapid growth and dense buildup of algae causes deoxygenation of the water and the production of poisonous chemicals known as phycotoxins, which are detrimental to both aquatic and human life. Different types of AMDC were used for removing or controlling the toxic algae and phytoplankton growth in the study area (Table 6).

Table 6. List of plankton bloom cleaner.

| Trade name | Active ingredient | Doses/3-6 ft water | Sources |
|------------|-------------------|-------------------|---------|
| No Alage   | Chlro-alkali finale urea concentrated-4% | 1 liter /100 dec | ACI Animal Health |
| Fytonil    | Copper, EDTA, Copper citrate, Inert ingredients | 3-4 litter/100 dec | Agrosol Bangladesh Company |
| Killmax Plus | Copper-50 gm, Inter Composition | 3-5 liter/acer | Save & Safe Agroscience Bangladesh |
| Met Alage  | Alimental copper-10%, Ethylene Diamin-32%, Natural Fungicide-58% | 2-4 litter/100 dec | Univet Ltd. |
| Droper     | Chlro-alkali finale urea concentrated-9% | 0.500-1 liter /100 dec | Univet Ltd. |
| Faito Alage | No label found | 2 liter /100 dec | No label found |
| Kill Alage | No label found | 1 litter /100 dec | No label found |
| Cupper Sulphet | CuSO₄ | | Chemical |
| Promim Algae Clear Plus | CuSO₄, *C₆H₅COONa*, EDTA, BKC | 1 liter/100 dec | Promim Agro vet Industries |
| Promim Aqua Solution Plus | NaOH, CuSO₄, *C₆H₅COONa*, EDTA, BKC | 3 liter/100 dec | Promim Agro vet Industries |
| Verno Drop | No label found | 100 ml/ 33 dec | Verno Bio-Solutions Ltd |

3.2.6. AMDC used as disinfectant and disease treatment
In aquaculture, a variety of chemicals are available for use as disinfectants and as a measure of better health management. The active components in a wide range of antimicrobial disinfectants or sanitizers typically used for fish health management in the study area. Timsen, pathonit, Virex, Aquakleen, Pathocide, BKC (Benzalkonium chloride), potassium permanganate, copper sulphate, Bactisal, Virusnip, and Polgard plus are some of the regularly used chemical preparations for disease control. Spa can be used to heal diseases as well as encourage growth. BKC is used to control bacterial illness while formalin is used to control protozoan parasite infestation (Table 7).
Table 7. AMDC used as disinfectant and disease treatment.

| Trade name | Active ingredients | Doses /3-6 ft water | Sources |
|------------|--------------------|---------------------|---------|
| Timsen     | n-Alkyl dimethyl benzyl ammonium chloride-40%, stabilized urea-60% | 20 g/33 dec. (for prevention), 80 g/33 dec. (for treatment) | Eon Animal Health |
| Pathonil   | n-Alkyl dimethyl benzyl ammonium chloride-80% | 200 ml/33 dec. | ACI Animal Health |
| Acidin     | Iodine             |                     | ACI Animal Health |
| Germnil    | BKC-50% + Glutaraldehyde | No recommendation found | NAAFCO Pharma Ltd. |
| Bleaching powder | Clorine  | 0.1-1 ppm | Chemical Seller |
| Eon CTC    | Efinol             | 5–8 gm/liter water | Eon Animal Health |
| Emsen      | n-Alkyl dimethyl benzyl ammonium chloride + stabilized urea | 80 gm/33 dec | SK+F Pharmaceuticals Ltd. |
| Aquoxide Plus | Alkyl dimethyl benzyl ammonium chloride + Glutaraldehyde | 500-750 ml/100 dec | Advanced Agrotech (BD) Ltd. |
| Virokill Aqua | Alkyl dimethyl benzyl ammonium chloride-80% | 500-750 ml/100 dec | Advanced Agrotech (BD) Ltd |
| Onesol P   | n-Alkyl dimethyl benzyl ammonium chloride-40%, stabilized urea-60% | 5 gm/dec | One Pharm Animal Health |
| Onesol L   | Tetradyile Trimethylene Ammonium Bromide-6.7% + Alkyl dimethyl benzyl ammonium chloride-83% | 5-10 ml/dec | One Pharm Animal Health |
| BKC        | n-Alkyl dimethyl benzyl ammonium chloride-80% | 500-600 ml/100 dec | VnF Agro Ltd. |
| BKC-800    | Benzal konium chloride- 80% | 500 ml/100 dec | First Care Agro Ltd. |
| Protector Plus | Alkyl dimethyl benzyl ammonium chloride + Glutaraldehyde | 350-500 ml/100 dec | Ultimate (bd) Ltd. |
| Topper Aqua | Alkyl dimethyl benzyl ammonium chloride-80% | 350-500 ml/100 dec | Ultimate (bd) Ltd. |
| Mector BKC | Alkyl dimethyl benzyl ammonium chloride-80% + Acetic acid- 10% Glutaraldehyde -5% | 300-500 ml/100 dec | Univet Ltd. |
| Oxykol     | Per acetic acid-90 gm/kg | 250-500 gm/100 dec | Univet Ltd. |
| Aqua Guard | Alkyl dimethyl benzyl ammonium chloride-80% + Teradecyl trimethyl ammonium bromide-6.7% | 300-600 ml/100 dec | PRAN Agro Business Ltd |
| Aquasen    | Alkyl dimethyl benzyl ammonium chloride-40% + Alkyl dimethyl benzyl ammonium chloride-60% | 100 gm/100 dec. (for prevention), 250 gm/33 dec (for treatment) | PRAN Agro Business Ltd |
| Superio    | Iodofour           | 500 ml/100 dec     | Verno Bio-Splutions Ltd |
| Bromi-5    | Bromine 5%         | 5-10 ml/dec        | VnF Agro Ltd. |
| Promim Anti-virus | Alkyl dimethyl benzyl ammonium chloride + ISO Propanol Methyleneblue | 500ml/ 33 dec. | Promim Agro vet Industries |
| Promim Qripus Aqua | CaCo3, KMnO4, P, Mn C3H27N2Na2O2S 3, P, NaCl, C6H4COONa | 2kg/ 33 dce | Promim Agro vet Industries |
| Formalin   | 38% Formaldehyde   | 1–3 ppm            | Chemical Seller |
| Lenocide   | Ankul benzyl dimethyl ammonium chloride + poly-2 | 500–1000 ml/100 dec | Nature care |
| Chemical Name                | Active Ingredients                                                                 | Concentration            | Supplier                          |
|------------------------------|--------------------------------------------------------------------------------------|--------------------------|-----------------------------------|
| Omicide                      | Benzyl ammonium chloride + urea                                                     | 200 ml/33 dec.          | Lion overseas trading company     |
| Virex                        | Potassium Peroxymono sulphate 50%                                                   | 100-200/33 dec.         | ACI Animal Health                 |
| EDTA                         | Sodium thiosulphate                                                                 | 0.1-1 ppm                | Chemical seller                   |
| Water clear 300/L.           | Sodium thiosulphate                                                                 | 2-3 L/100 dec.          | Organic pharmaceuticals Ltd.     |
| Aquakleen                    | Tetradesail Tri-methyl Amonium bromid, BKC                                           | 0.5-1 L/100 dec         | Square AgroVet Division           |
| Microbite                    | Benzal konium chloride + providin Iodine                                             | 100-150 ml/ 33 dec      | Nutrihealth Ltd.                  |
| Albez                        | Doxycyclin, colistine sulphate + vitamin premix + mineral                            | No recommendation found | Syngenta pharmaceuticals Ltd     |
| BKC                          | Benzal konium chloride                                                               | Spread with water, 0.5 ppm | Chemical seller                   |
| Polgard plus                 | 3-Methyl and 4-Methyl two chain brominated compound                                  | 500 ml/100 dec          | Fishtech (BD) Limited             |
| Farmsafe                     | Didisyle Dimethyl Ammonium chloride + Ethylalcohol +Yucca                          | 250-300 ml/100 dec      | Catapal Bioscience Ltd.           |
| Bioxide                      | Alkyl dimethyl benzyl amonium chloride-80% + Glutaraldehyde -50%                    | 350-500 ml/100 dec      | Save and Safe Agroscience Bangladesh |
| Virocin                      | Dichlor Ammonium chloride-1% + Iodine-3% + Dimethyl blue                              | 200-300 gm/100 dec      | Agrosol Bangladesh Company        |
| Bactisal-80                  | Ankul benzyl dimethyl ammonium chloride                                            | 350 ml/ 100 dec         | First Care Agro Ltd.              |
| Well Guard                   | Bromine- 5%                                                                          | 500 ml/ 100 dec         | First Care Agro Ltd.              |
| Lenocide                     | Ankul benzyl dimethyl ammonium chloride + poly-2 deoxy-2 amino glucose              | 500 ml/ 100 dec         | Nature care Ltd.                  |
| Virusnip                     | Potassium per oxymonosulphate 50%, Sodium dichloroisocyanurate 5%, Excipients 45%   | 300-400g/ 100 dec       | Novartis Animal Health            |
| Germclean                    | Alkyl dimethyl benzyl ammonium chloride                                             | 1-1.5 litter/100 dec    | Uttara Tread bd.                  |
| Auqa Fair                    | C<sub>17</sub>H<sub>30</sub>CIN-40%, CH<sub>3</sub>COON-10%, HCHO-5%, 3CHO-5%, OHCCCHO-5% | 400-600 gm/ 100 dec     | Uttara Tread bd.                  |
| Potash                       | KMnO<sub>4</sub>                                                                      | 5-15 mg/ 100 dec        | Chemical seller                   |
| Salt                         | NaCl                                                                                  | 500-1000g/ 100 dec      | Chemical seller                   |
| Malachite green              | C<sub>2</sub>H<sub>12</sub>O<sub>4</sub>                                              | 1ppm; 1min; dip         | Chemical seller                   |
| Melethion                    | Active melathon                                                                      | 500g/ 100 dec           | Chemical seller                   |
| Methylene blue               | C<sub>10</sub>H<sub>13</sub>CIN<sub>3</sub>SxH<sub>2</sub>O                           | 2-3ppm bath for 1h/10-20 mg/L for 15 min. | Chemical seller                   |
| Copper Sulphate              | CuSO<sub>4</sub>                                                                      | 15-25 mg decimal        | Chemical seller                   |

### 3.2.7. AMDC used as toxic gas reducer

Farmers have been observed adding a gas removal agent to their culture ponds in order to remove organic and inorganic wastes that are generating gas. Some of the probiotics utilised in feed included MI Plus, Yuka, Ammonil, Gas check, Aqua Pure Powder, Gasonil, Pond Kleen, Bio-Aqua-50, Gasonex plus, Gas kit, and Gasonex plus plus, among other things (Table 8).
**Table 8. List of available AMDC used as toxic gas reducer in the study area.**

| Trade Name          | Active ingredients                                                                 | Doses/3-6 ft water | Sources                                |
|---------------------|-------------------------------------------------------------------------------------|--------------------|----------------------------------------|
| MI Plus             | *Bacillus subtilis, Bacillus licheniformis, Bacillus megaterim, Bacillus pumilus, Bacillus amyloliquefaciens* | 40-50 tablet/ 100 dec | ACI Animal Health                      |
| Yuka                | Yucca plant extract, Saponin Components Glyco components                            | 300 ml/ 100 dec    | Opsonin Agrovet Division               |
| Bio-Aqua-50         | Yucca plant extract, Saponin Components Glyco components                            | 60-70 ml /33 dec   | Eon Animal Health                      |
| Bio- Aqua liquid    | Yucca plant extract                                                                | 200-300 ml/ 100 dec | Nutrihealth Ltd.                       |
| Faast               | Yucca plant extract, Saponin Components Glyco                                      | 100 gm/33 dec      | Nutrihealth Ltd.                       |
| Gaskleen Aqua       | Natural element, Beneficial Microorganism, Digestive Enzyme                         | 200-400 gm/ 100 dec| Advanced Agrotech (BD) Ltd             |
| Ammonil             | Yucca plant extract, *Bacillus subtilis, candida utilis*                           | 100-200 g/ 100 dec | Noverties Pharmaceuticals Co. Ltd.     |
| Gas stop            | *Bacillus subtilis Al2O3 SiO2*                                                     | 500 mg/100 dec, 3 weeks | Organic pharmaceuticals Co. Ltd.(BD) |
| Gasonil             | *Bacillus subtilis*                                                                | SK+F Animal Health  |                                        |
| Pond Kleen          | Yucca plant extract, Saponin and Glyco components                                  | 300 ml / 100 dec   | ACI Animal Health                      |
| ACI Yucca Plus      | Yucca plant extract, *Bacillus subtilis, Rhodoseudomonas*                          | 300 ml / 100 dec   | ACI Animal Health                      |
| Victor Aqua         | Yucca plant extract                                                                | 300-400 gm/ 100 dec| Ultimate (bd) Ltd.                    |
| Gass free aqua      | Yucca plant extract, Saponin and Glyco components                                  | 0.500-1kg/ 100 dec | Renata Animal Health                   |
| Ammorid             | Nitirifying and Denitrifying Bacteria                                              | 0.500-litter/ 100 dec | Renata Animal Health                   |
| First Yucca         | Yucca plant extract                                                                | 200-300ml/ 100 dec | First Care Agro Ltd.                   |
| First Pro Yucca     | Yucca plant extract, Probiotics                                                   | 175-200 gm/ 100 dec| First Care Agro Ltd.                   |
| Bio Cure            | Yucca plant extract, Probiotics                                                   | 10-12 kg/ 100 dec  | First Care Agro Ltd.                   |
| Ammosol Liquid      | Natura Yucca plant extract 1 Biochemical compounds                                 | 200-400 ml/ 100 dec| Save and Safe Agroscience Bangladesh  |
| Gas Killer          | Yucca plant extract with pro biotics                                              | 200-400/ 100 dec   | PRAN Agro Business Ltd                 |
| Gastrap             | Lactic acid *Bacillus sp. Bacillus subtilis Cellulase, Hemicellulase, amylase       | 200 mg/ 100 dec    | Square Agrovet Division                |
| Biomax Power        | Maximum consortium of probiotics bio-fixed on a calcareous matrix                  | 4-5 kg/ 100 dec    | Square Agrovet Division                |
| Aqua Pure Powder    | Hydrate sodium alumino silicate with natural adsorbing and deodorizing agent       | 8-10 kg/ 100 dec   | Square Agrovet Division                |
| AMOVER Remover      | Essential Bacteria, Yeast, Enzyme, Nitrogen Factor, catalyst, Oxygen               | 300-400 gm/ 100 dec| VnF Agro Ltd.                         |
| Aqua Magic          | Azotabactor chorococcum, *Bacillus subtilis, candida utilis*                       | 400g/ 100 dec      | Fishtech (BD) Limited                  |
| Pond D tox          | Pracoccus pantotrophus                                                            | 4 ppm              | Fishtech (BD) Limited                  |
| Gas Check Plus      | Tetra acetyl ethylene diamin                                                       | 200 g/ 100 dec     | First Care Agro Ltd.                   |
| Gas kit             |                                                                                   | 200-300 g/ 100 dec | Catapol Bioscience ltd.                |
| Gasonex plus        | Nal-lorile ether sulphate                                                          | 200-400 mg/kg, Zeolite | Fishtech (BD) Limited                  |
| Gas Clean           | Probiotics and enzyme                                                             | 200 gm/ acer       | Uttara Tread bd.                       |
| Metox_GR Pro        | Yucca plant extract, Probiotics, enzyme                                            | 200 gm/ 100 dec    | Univet Ltd.                           |
3.2.8. AMDC as pH controller

The pH of freshwater environments may vary significantly across daily and seasonal timescales, and most freshwater species have evolved to withstand a rather wide pH range. Animals, on the other hand, can get stressed or perish when subjected to pH extremes or fast pH shifts, even if the change occurs within a pH range that is typically tolerated. We found two pH controller products were available in the market of the south eastern Bangladesh (Table 9).

Table 9. The list of AMDC used as pH controller.

| Trade name | Active ingredient | Doses/3-6 ft water | Sources |
|------------|-------------------|--------------------|---------|
| pH<sup>+</sup> | Organic Acid-15%, Gypsum-25%, Aluminum Silicate-60% | pH: 8-9, used: 6-8 kg/ 100 dec; pH: 9-9.5, used: 8-10 kg/ 100 dec; pH: above 9.5, used: 10-15 kg/ 100 dec | Univet Ltd. |
| Aqua Balance | Sodium humate, Polymerization aluminum potassium sulfate, enzyme | 1 kg/ 100 dec | Ultimate (bd) Ltd. |

3.2.9. AMDC used for oxygen supply

To boost the amount of dissolved oxygen in an aquaculture pond, many types of chemicals were applied in the farms of the study area. The most important active constituents in those chemicals are oxidizing agents such as hydrogen peroxide and sodium carbonates (Table 10).

Table 10. AMDC list of chemicals used for oxygen supply.

| Trade name | Active ingredient | Doses/3-6 ft water | Sources |
|------------|-------------------|--------------------|---------|
| Oxymax | H<sub>2</sub>O<sub>2</sub> 10% | 250-500 gm/ 100 dec (1 m deep water body) | Eon Animal Health |
| Aci-OX | Sodium carbonate, H<sub>2</sub>O<sub>2</sub> 10% | General dose 300–400 gm/ 100 dec. In case of high deficiency 500–700 gm/100 dec | ACI Animal Health |
| Bio-OX | Sodium carbonate, H<sub>2</sub>O<sub>2</sub> | General dose 300–400 gm/ 100 dec. In case of high deficiency 500–700 gm/100 dec | ACI Animal Health |
| Oxy more | Sodium carbonate per- oxyhydrate | General dose 250–500 gm/ 100 dec. In case of high deficiency 750–1000 gm/100 dec | SK+F Pharmaceuticals Ltd. |
| Oxy top | Sodium Per carbonate | 250-500 gm/ 100 dec | Nutrihealth Ltd. |
| Han-ox | Sodium Per carbonate-14.5% | General dose 250–500 gm/ 100 dec. In case of high deficiency 750–1000 gm/ 100 dec | Ultimate (bd) Ltd. |
| First Oxy | Sodium Per carbonate | 500–700 gm/100 dec | First Care Agro Ltd. |
| Oxy Aqua | Sodium Per carbonate | General dose 500–600 gm/ 100 dec. In case of high deficiency 1000–1200 gm/ 100 dec | PRAN Agro Business Ltd |
| Verno Ox | Sodium per carbonate | 500 1000 gm/ 100 dec | Verno Bio-Solutions Ltd |
| Oxy Sos | Sodium per carbonate Peroxide | 300 – 500 gm/ 100 dec | Advanced Agrotech (BD) Ltd |
| Oxy Rich | Sodium per carbonate | General dose 500 gm/ 100 dec. In case of high deficiency 1000 gm/ 100 dec | Opsonin Agrovet Division |
| Oxyren | Sodium per carbonate | 1kg/100 dec | Renata Animal Health |
| O<sub>2</sub> marine | H<sub>2</sub>O<sub>2</sub> 10% | 66–90 tablet/33 dec. | Organic pharmaceuticals ltd. |
| O-plus | O<sub>2</sub> promoter (H<sub>2</sub>O<sub>2</sub>/Ca2O2) | 500 gm/ 100 dec | Nature care Ltd. |
| Oxy gold | Sodium percarbonate | 250 g/ 100 dec | Fishtech (BD) Limited |
| Oxy-plus | O<sub>2</sub> promoter (H<sub>2</sub>O<sub>2</sub>/Ca2O2) | 500gm/ 100 dec | Penta Agrovet ltd. |
| Oxylife | Sodium carbonate 13% | 400g/ 100 dec | Square Agrovet Division |
| Product          | Formula  | Description                                                                 | Dose                        | Company                      |
|------------------|----------|-----------------------------------------------------------------------------|-----------------------------|------------------------------|
| Quick oxygen     | Sodium percarbonate + free oxygen | In case of high deficiency 500 gm/100 dec in same water body | Organic pharmaceuticals Ltd. |
| Oxy-A            | Sodium percarbonate | General dose 300–400 gm/100 dec. In case of high deficiency 500-700 gm/100 dec          | The Acme Laboratories Ltd.   |
| Oxy flow         | H₂O₂10%  | General dose 250–350 gm/100 dec. In case of high deficiency 500 gm/100 dec in same water body | Novartis Pharmaceuticals Ltd. |
| Oxygen plus      | O₂ promoter (H₂O₂/Ca₂O₂) | General dose 250–500 gm/100 dec. In case of high deficiency 750–1000 gm/100 dec | Avon Animal Health           |
| Miracle O₂       | Sodium carbonate-13.5% | General dose 200–250 gm/100 dec. In case of high deficiency 400–500 gm/100 dec | One Pharm Animal Health      |
| V-Oxy TAB        | Sodium carbonate | General dose 500–700 gm/100 dec. In case of high deficiency 1–1.2 kg/100 dec | VnF Agro Ltd.                |
| Oxymix           | Sodium peroxid-14% carbonate | General dose 250–500 gm/100 dec. In case of high deficiency 750–1kg/100 dec | Save & Safe Agroscience Bangladesh |
| Oxy Pol          | Sodium Peroxide-13.5% + H₂O₂ | 250-500 / 100 dec | Catapal Bioscience Ltd.     |
| Pure oxy         | H₂O₂     | 1 kg/ 100 dec | Al Madina                   |
| Oxygrow          | O₂ promoter (H₂O₂/Ca₂O₂) | 500 gm/ 100 dec | Century Agro Ltd.           |
| Oxy gold         | Sodium Percarbonate | 250-500 / 100 dec | Fishtech (BD) Limited       |
| Oxysun           | Sodium peroxide, peroxide, magnesium oxide | 500 gm/ 100 dec | Rals Agro Ltd., Bangladesh |
| Best oxygen      | Sodium percarbonate | 250–500 g/100 dec | Univet Ltd.                 |
| Fish care powder | Oxide of Ca, P, S, Mn, Mg, Cu, N | 1 kg/33 dec. | S.S.S Agro care ltd.        |
| Fish curepas     | Oxide of Ca, P, S, Mn, Mg, Cu, N | 1 kg/33 dec. | M.R. Food and Protein Industries |
| Oxywell          | Sodium percarbonate, Tetra acetyl ethylene diamine | 150-200g/4046.86m² | First Care Agro Ltd.        |
| Metoxy Tab       | Sodium percarbonate: 99% and oxygen release: 13.60% | General dose 500 gm/100 dec. In case of high deficiency 1 kg/100 dec | Univet Ltd.                 |
| Oxy Ton          | Sodium percarbonate-90% and others 10% | General dose 200–250 gm/100 dec. In case of high deficiency 400–500 gm/100 dec | Agrosol Bangladesh Company |
| U-Oxy            | Sodium percarbonate-17% | General dose 250–500 gm/100 dec. In case of high deficiency 500–800 gm/100 dec | Uttara Tread bd |

### 3.2.10. AMDC used as stress reducer

The available stress reducer were Ossi-C, Charger gel, Biomin Pondlife, Profis, Eskavit-C, Vitamin C –Soul, Energy plus, Osmosaline, Vita X-CK etc. The active ingredients of such medicines were mainly vitamin-C, betain, glucan, polyssceharides, beta-glucans, oxolinic acid bitaglucan (Table 11).
3.2.11. AMDC used as growth promoter

All of the growth promoters are essential for the rapid increase of the fish population. Some of these chemicals, such as aqua boost, fish vita plus, Aqua savour, Eon fish grower, Aqua gel, Panvit aqua, Charger gel, Vitamin F aqua, Acimix super fish, and others, help to improve the disease-prevention abilities of fish. Aqua boost is a type of growth promoter that is being used to boost the immune system of fish. Megavit aqua also helps to boost the hatching rate, and Aquamin is beneficial in the development of fishes' bones. Aqua savour and Grow quick type of growth promoter that is being used to boost the immune system of fish. Megavit aqua also helps to boost the disease prevention abilities of fish. Butamin is used as growth promoter.

Table 11. AMDC used as stress reducer.

| Trade name         | Active ingredients          | Doses/3-6 ft water | Sources                          |
|--------------------|-----------------------------|--------------------|----------------------------------|
| Glucovet Premix    | Ascorbic acid (Vit-C)       | 1-2 g L-1          | ACME Pharmaceuticals Co. Ltd.    |
| Ossi-C             | Oxolonic Acid, Beta glucan, | 4-5g/ Kg feed      | Fishtech (BD) Limited           |
| Osmosaline         | Betain                      | 5-10g/100 Litre    | Eon Animal Health               |
| Cevit Aqua         | L-ascorbic acid (Vit-C)     | 2-3 gm/ kg feed    | Square AgroVet Division         |
| Vita X-CX          | Vit-C, K                    | 1 gm/3 kg feed     | Eon Animal Health               |
| Eskavit-C          | Vit-C 100%                  | 1 g kg-1 feed      | SK+F Pharmaceuticals Ltd.       |
| Vitamin C–Soul     | Vit-C 100%                  | 3 g/Feed           | Eon Animal Health               |
| C-Aqua             | Vit-C 100%                  | 2-4 g/Feed         | ACI Animal Health               |
| Oralyte            | Vita A with Electrolyte Premis | 1 gm/ liter water | Opsonin Agrovet Division       |
| Energy plus        | Vita C + Glucose            | 1-2 gm/ liter water| ACI Animal Health               |
| Vitamin C-Sol      | Vita C-99%                  | 2-3 gm/feed        | Advanced Agrotech (BD) Ltd      |
| Stress remover saline | NaHCO₃, NaCl, KCl, Vit A, ZnSO₄ | 0.5-1 gm/litter | VnF Agro Ltd.                   |
| Gluco-c Power      | Vita C + Glucose            | 0.5-1 gm/ton       | VnF Agro Ltd.                   |
| Vita Fast          | Ascorbic acid               | 1-2 gm/ Feed       | VnF Agro Ltd.                   |
| Verno C            | Vita-C                      | 0.5-1 gm/feed      | Verno Bio-Solutions Ltd.         |
| Renalyte-F         | NaHCO₃, NaCl, KCl, Dextrose | 3 kg/acere         | Renata Animal Health            |
| Aqualyte           | NaHCO₃, Al₂O₃, CaO          | 3-5 kg/100 dec     | Agrosol Bangladesh Company      |
| Fish Saline        | NaHCO₃, NaCl, KCl, Vitamin, | 0.5-1 gm/litter    | Uttara Tread bd.                |
|                    | Glucose                     |                    |                                  |
| Vitamix C Plus     | Vitamin-C                   | 1gm/litter         | Uttara Tread bd.                |

3.2.11. AMDC used as growth promoter

All of the growth promoters are essential for the rapid increase of the fish population. Some of these chemicals, such as aqua boost, fish vita plus, Aqua savour, Eon fish grower, Aqua gel, Panvit aqua, Charger gel, Vitamin F aqua, Acimix super fish, and others, help to improve the disease-prevention abilities of fish. Aqua boost is a type of growth promoter that is being used to boost the immune system of fish. Megavit aqua also helps to boost the hatching rate, and Aquamin is beneficial in the development of fishes' bones. Aqua savour and Grow quick both aid in the recovery of malnourished fishes as well as the improvement of their physical condition in general (Table 12).

Table 12. AMDC used as growth promoter.

| Trade name          | Active ingredients            | Doses | Sources                          |
|---------------------|--------------------------------|-------|----------------------------------|
| Eon Fish Grower     | Vitamin + Mineral premix       | 1.5-3 gm/kg feed | Eon Animal Health                 |
| Aqua savor          | Amino acid premix              | 2–3 kg/MT feed   | Eon Animal Health                 |
| Spa                 | Protein, Cholesterol 116arotenoid, Vit-D, Ca | 10-15 ml/kg feed | Eon Animal Health                 |
| Fish Gel            | Vitamin + Mineral premix       | 7–10 ml/kg feed  | ACI Animal Health                 |
| Aquamin             | Mineral premix + Herbal growth factor | 2-4 ml/kg feed | ACI Animal Health                 |
| ACI Fish Premix     | Vitamin + Mineral + Ammonium acid+ Calcium and probiotics | 1 kg/ ton Feed | ACI Animal Health                 |
| Acimix super-fish   | Vitamin, mineral + antioxidant | 1 kg/ton Feed  | ACI Animal Health                 |
| Krill Meal          | Crude-Protein, Fat, Moisture, Ash, Fiber, CHO, Ca, and P | 1-2 gm/ kg feed | ACI Animal Health                 |
| Vita Health Plus    | Multivitamin, Nicotinamide, Biotin, Lysine, Fol acidETC | 1ml/ kg feed | Ultimate (bd) Ltd.               |
| Han-Vita            | Vita-C, E, B1, K3, Sorbitol, Multienzyme | 2-3 gm/ kg feed | Ultimate (bd) Ltd.               |
| Aqua Live Care      | Liver extract, Yeast Amino acid, protein, biotin, extract, sorbitol, vita-B₁₂ | 2-3 ml/ kg feed | Advanced Agrotech (BD) Ltd       |
| Growth Gel          | Essential vitamins, lysine, Methionine and herbs | 7-10 ml/ kg feed | Advanced Agrotech (BD) Ltd       |
| Multi Grow          | Multivitamin, Multimineral, Biotin, Folic acid, Taurine, Inositol | 2-3 gm/ kg feed | Advanced Agrotech (BD) Ltd       |
| Butamin             | Cyanocobalamin, Methyl Hydroxybenzoat | 5 ml/ kg feed  | Advanced Agrotech (BD) Ltd       |
| Product Name                | Ingredients                                      | Feed Rate/ Contents          | Company                      |
|----------------------------|--------------------------------------------------|------------------------------|------------------------------|
| Methylethyl-phosphonic acid | Mutivitamin, Multienzyme, Multimineral, amino acid | 3-5 gm/kg feed              | Agrosol Bangladesh Company   |
| AVM- Aquamix                | Mutivitamin, Multienzyme, Multimineral, amino acid | 3-5 gm/kg feed              | Agrosol Bangladesh Company   |
| Verno Vit Aqua              | Vitamin Premix                                    | 2.5-5 kg/ton feed           | Verno Bio-Solutions Ltd.     |
| Saltose plus                | Probiotics and Enzyme                            | 250-500 ton Feed            | Opsonin Agrovet Division     |
| Biomin Boost Aquamix        | Amino acid, Immune component,                     | 3-5 gm/kg feed              | Reneta Animal Health         |
| Fish Probiotics             | Bacillus subtilis, Nitro fire, photosynthetic bacteria | 1000-1500 gm/100 dec       | VnF Agro Ltd.                |
| V-F. GEL                    | Vit B12, lysine, DL Methionine, Collin chloride, Biotin | 0.5-10 ml/kg feed          | VnF Agro Ltd.                |
| Verno Boost                 | Growth promoter                                   | 1-2 gm/kg feed              | Verno Bio-Solutions Ltd.     |
| Multisol-G                  | Multivitamins and Multiminerals                   | 1-1.5 gm/kg feed            | Univet Ltd.                  |
| Chelamin Plus               | Chelate Ca, Mn, K, Zn, Fe, Cu, Cr, Co             | 10 ml/kg feed               | Univet Ltd.                  |
| Panvit Liquid               | Vit A, D3, B1, B2, B6, Nicotinamide and Vit-C    | 0.5-10 ml/kg feed           | Square Agrovet Division      |
| Aqua GEL gel                | Amino acids, ω3, ω6 fatty acid and Minerals       | 10-15 gm/kg feed            | Square Agrovet Division      |
| Square Aquamix Powder       | Vitamins, Amino acids, Minerals, Prebiotic and Antioxidant | 1 gm/kg feed               | Square Agrovet Division      |
| Provit gel                  | Vitamin A, B1,B2,B6, C, D, Niacinamide, Calcium pentothenate, Folic acid , Inositol, Lysine, Methionine, Protein hydrolyzate | 10g/kg feed                | First care Agro. Ltd.        |
| Fibosoel.                   | β-Glucan and mannos polymer                       | 200–300 g/MT feed           | Eton Animal Health           |
| Aquumin                     | Cu, Co, Mg, Fe, Zn, I, Ca, P, D, L, Mithiolin, L-lysin HCl | 1gm/kg feed                | ACI Animal Health            |
| Grow Fast                   | High protein, Fat and Mineral                     | 5-10% of body weight       | ACI Animal Health            |
| Ayumin powder               | Mineral and herbs                                 | 5–10 kg/ton feed            | ACI Animal Health            |
| Eskavit                     | Vitamins, Minerals and Premix                     | 2.5 kg /ton feed            | SK+F Pharmaceuticals Ltd.    |
| Aqua boost                  | Organic acid, β-glucan                           | 500 g/ ton feed             | Novartis pharmaceuticals ltd.|
| Fish vita plus              | Vitamin, mineral and amino acid supplement        | 200-300 ml/100 kg feed      | Rals Agro Ltd.               |
| Grow fast                   | Vitamin, mineral and amino acid supplement        | 200-300 ml/100 kg feed      | Rals Agro Ltd.               |
| Growmax                     | Vit + mineral + amino acid                        | 2.5 kg/ton feed             | Penta Agrovet Ltd.           |
| Megavit Aqua                | Vitamin, mineral and amino acid supplement        | 100 g/100 kg feed           | Novartis pharmaceuticals ltd.|
| Nature aqua GP              | Vit + mineral + amino acid                        | 2.5 kg/ton feed             | Nature care ltd.             |
| Orgavit aqua                | Vitamin, mineral and amino acid supplement        | 100 g/100 kg feed           | Organic pharmaceuticals ltd. |
| Safe Gurd                   | Vitamin, Enzyme and Probiotics                   | No recommendation found     | SK+F Pharmaceuticals Ltd.    |
| NutriGel                    | Vitamin, mineral and Probiotics                  | No recommendation found     | SK+F Pharmaceuticals Ltd.    |
| Esklina                     | 100 % organic Sprolina                            | No recommendation found     | SK+F Pharmaceuticals Ltd.    |
| Acilina                     | 100 % natural Sprolina                            | No recommendation found     | SK+F Pharmaceuticals Ltd.    |
| Rena Fish                   | Vit A, B, C, D3, E, K, Cu, Mn, Fe, Co etc.       | 1 Kg/ton feed               | Reneta Animal Health         |
| Charger Gel                 | 1-3 D-Glucan, Polysaccharides, Btain, Beta Glucan | 6-8 g/kg feed               | Fishtech (BD) Limited        |
| Square Aquamix              | Vitamin, Amino acid, Minaral, Probiotic,         | 1 g/kg feed                 | Square Pharmaceuticals Ltd.  |
3.2.12. Probiotics used in fish culture
Probiotics work by supplying nutrients, enzymes for improved digestion, regulating the immune system, and boosting the immunological response to harmful microorganisms. Lactic acid bacteria such as *Lactobacillus* sp., *Bacillus* sp., *Enterococcus* sp., and yeast *Saccharomyces cerevisiae* are the most often utilized probiotics in aquaculture. The study area included 21 probiotics items that were commonly used by farmers (Table 13).

Table 13. Probiotics used in freshwater aquaculture in south-eastern Bangladesh.

| Trade name | Compositions | Purpose of use | Doses | Source |
|------------|--------------|----------------|-------|--------|
| Profs      | *Bacillus* sp. And *Pediococcus* sp. | Control vibriosis, luminescent bacteria | 50–70 gm/33 dec | Eon Animal Health |
| Aqua photo | *Bacillus subtilis* and *Rhodoseudomonas* | Control unwanted gas, sediment and increase growth of plankton | 50–70 ml/100 dec | ACI Animal Health |
| Navio Plus | *Bacillus subtilis*, *B. licheniformis*, *Bacillus megaterium*, *Lactobacillus Acidophilus*, *Lactobacillus plantarum* | Increase growth rate and disease preventive power | 1-3 gm/Feed | ACI Animal Health |
| Uni ecosense | *B. subtilis*, *B. licheniformis*, *B. polymyxas*, *B. pumils*, *Thioacillus denitrificans*, *Aspergillus oryzae*, *Aspergillus niger*, *Pseudomonas denitrificans*, *Bacillus coagulans* | | | First care |
| Eco Marine | *Bacillus subtilis*, *B. pumilis*, *B. amylolevicfaciens megaterium* | Control vibriosis and luminescent bacteria | 3–4 tablet/100 dec | Organic Pharmaceuticals Ltd. |
| Aqua Gold | *Rhodopseudomonas* sp. | Increase growth rate and disease preventive power | 2 ml/100 dec | Organic Pharmaceuticals Ltd. |
| Product       | Bacteria/ Yeast                                                                 | Function                                                                 | Concentration | Supplier                        |
|--------------|--------------------------------------------------------------------------------|-------------------------------------------------------------------------|---------------|---------------------------------|
| Aqua Magic   | *Azobacter chorococcum*, *Bacillus cereus*, *Bacillus megaterium*, *Bacillus subtilis*, *Candida utilis*, *Lactobacillus fermentus*, *Lactobacillus plantarum*, *Rhodotorulla sp.* | Control unwanted gas, sediment and increase growth of plankton          | 5-6 kg/100 dec | Fish tech (BD) Limited          |
| Aqua Star    | *Bacillus sp.*, *Lactobacillus Enterococcus sp.*, *Pedicoccus sp.*               | Increase beneficial bacteria, increase feed attraction, increase fish weight | 3-5 gm/feed   | Reneta Animal Health            |
| Procon-PS    | *Bacillus sp.*, *Rhodococcus*, and *Rhodobacter*                                | Control unwanted gas, sediment and arrests the pathogens               | 5 L/hac (1 m depth) | Rals Agro Ltd.                  |
| Super Biotic | *Bacillus sp.*                                                                   | Reduce pathogenic bacteria in water                                     | 1-2 kg/100 dec | CP Aquaculture                  |
| Super PS     | *Rodobacter sp.*, *Rodococcus sp.*                                              | Improve soil quality and reduce toxic gas from bottom                   | 4-6 L/100 dec | CP Aquaculture                  |
| Pond care    | *S. faecalis* and other bacteria                                                 | Inhibit pathogenic bacteria                                            | 50 gm/100 dec | SK+F Animal Health              |
| Eco-Life     | *Bacillus subtilis*, *Bacillus megaterium*, *Lactobacillus*, *Nitrosomonas sp*, *Nitrobacter sp*, *Yeast* | Improve soil quality and inhibit pathogenic bacteria                    | 200-300 gm/100 dec | Agrosol Bangladesh Company      |
| First-Ecosafe| *Bacillus subtilis*, *Bacillus Coagulans*, *Bacillus megaterium*, *Lactobacillus acidophil*, *Aspergillus*, *Nitrosomonas sp* | Inhibit pathogenic bacteria like *Salmonella*, *Aeromonas*, *E. Eoli*, *Vibrio* | 200-250 gm/100 dec | First Care Agro Ltd.            |
| PPM          | Probiotics                                                                       | Improve soil quality and reduce toxic gas from bottom                   | 250 gm/100 dec | Verno Bio-Solutions Ltd.         |
| Metprob      | *Nitrosomonas sp*, *Nitrobacter sp*, *Bacillus subtilis*, *Rhodobacter Padiococcus sp*, *Saccharomyces cerevisiae* | Reduce toxic gas from bottom, improve water quality                      | 250-500 gm/100 dec | Univet Ltd.                     |
| Aqua Rich    | *Bacillus subtilis*, Photosynthetic bacteria, Nitrifying bacteria, Nitrobacteria sp, Lactic acid bacteria, Yeast, Enzyme | Reduce toxic gas from bottom, control bloom, remove black Soil          | 500 gm/100 dec | Ultimate (bd) Ltd.              |
| Delight Aqua | *Bacillus subtilis*, *Nitrobacteria*, *Nitrococcus*, Photosynthetic bacteria     | Reduce toxic gas from bottom, control bloom, remove black Soil          | 600 gm/100 dec | Ultimate (bd) Ltd.              |
| Aqua Life S  | *Bacillus subtilis*, *Bacillus megaterium*, *Lactobacillus acidophil*, *Nitrosomonas sp*, *Nitrobacter sp*, *Saccharomyces cerevisiae*, *Yeast* | Reduce toxic gas from bottom, improve water quality, improved biological way | 500 gm/100 dec | Save & Safe Agroscope Bangladesh |
| Aqua Clear S | *Bacillus subtilis*, *Bacillus megaterium*                                      | Reduce toxic gas from bottom, improve water                            | 500 gm/100 dec | Advanced Agrotech (BD) Ltd      |
3.2.13. Antibiotics for disease treatment

While only a few antibiotics have been approved for use in aquaculture, and precise data on their use is difficult to come by, at least two critically important antibiotics, tetracyclines and oxolinic acid, a third generation quinolone, are in routine use in Bangladesh and adjacent regions, respectively, to control specific diseases and bacterial infections in the aquaculture industry. Several antimicrobials, including antibiotics, were proposed for inclusion in fish feed regulations in 2011, and some of these were approved by the Bangladesh government in accordance with acceptable ranges of presence of these substances and the use of antibiotics, as well as the use of antibiotics in fish feed regulations in 2011. The present study found 19 antibiotics in the south eastern Bangladesh (Table 14).

Table 14. List of antibiotics for disease treatment in the study area.

| Trade name            | Active ingredients                                      | Doses                  | Source                  |
|-----------------------|---------------------------------------------------------|------------------------|-------------------------|
| Oxy-D Vet             | Oxytetracycline, Doxycycline 10%                        | 20% 5-10 g/Kg body wt. for 5-7 days | Eon Animal Health       |
| EST-Vet               | Erithromycin, thiocyanate, Sulphadiazine, Trimethoprim | 100-150 gm/1000 kg body wt. for 3-5 days | Eon Animal Health       |
| Ablaze                | Vitamin, Mineral, Antimicrobial agents                 | 150-200 gm/1000 kg body wt. | Eon Animal Health       |
| Bactitab              | Oxytetracycline 20%                                     | 5 gm/kg body weight 5-7 days | ACI Animal Health       |
| Acimox (vet) powder   | Amoxicillin trihydrate                                  | 1 gm/1 kg feed         | ACI Animal Health       |
| Cotrim-vet            | Sulphamethoxazole, trimethoprim                        | 0.5 mg/kg body weight  | Square AgroVet Division.|
| Contrim (vet) bolus    | Cotrimoxazole                                           | 1 bolus/10–12 kg body weight | Square AgroVet Division.|
| Otetra (vet) powder 50| Oxytetracycline                                         | Mixed with feed; 11–16 gm/100 kg body weight | Square AgroVet Division.|
| Oxin WS               | Oxytetracycline 20%                                     | 50 mg/kg body weight   | Navana pharmaceuticals ltd.|
| Oxysentin 20%         | Oxytetracycline HCL BP                                  | 50–100 gm/100 kg feed, 5–7 days (for treatment) | Novartis pharmaceuticals ltd.|
| Ranamox               | Amoxicillin trihydrate                                  | 28–40 gm/100 bd of fish, 10 days continuously | Renata Animal Health.    |
| Renamycin             | Oxytetracycline                                         | 28–42 gm/100 kg feed, 10 days | Renata Animal Health.    |
| Sulphatrim            | Sulphadiazine                                           | 50 gm/kg body weight, 5–7 days | Square AgroVet Division.|
| Aquamycine            | Oxytetracycline HCL 25%                                | 1-2 g/Kg feed for 5-7 days | ACI Animal Health        |
| Chlorstecin           | Chlortetracycline                                       | 200-300 gm/100 kg feed (5–7 days) | Novartis pharmaceuticals ltd.|
| Amoxifish             | Amoxicillin trihydrate                                  | 3-5 gm/kg feed         | Fish tech                |
| Orgacycline 15%       | Chlortetracycline                                       | 200–300 gm/100 kg feed 5–7 days | Organic pharmaceuticals ltd.|
| Fish cure             | Chlortetracycline HCL                                   | 500 gm/1000 kg feed (3–5 days) | Rals agro ltd.           |
| Argulex               | Trichlorofen 40%                                       | 12-13 ml/dec           | Eon Animal Health        |
4. Discussion

Aquaculture generates a great deal of financial activity and transaction in the south-western portion of Bangladesh, and this is mostly owing to both the intensity and the extent of the nature of the aquaculture activity in this region. According to a number of prior studies, aquaculture in these specific locations might contribute to the regional and national demand for animal protein, as well as providing financial assistance to local farmers and, ultimately, to the gross domestic product (GDP) (Al-Asif et al., 2021; Ullah et al., 2020b). While the aquaculture industry has a direct relationship with the social and economic growth of an area, a small-scale and healthy farm may create enough money to support a nuclear family in a comfortable manner (Adhikary et al., 2018c; Adhikary et al., 2018a, 2018b; Al-Asif et al., 2015; Al-Asif and Habib, 2018; Ali et al., 2016; Hossain et al., 2017, 2015; Islam et al., 2017, 2014; Rahman et al., 2017a; Razeim et al., 2017; Sharif et al., 2015; Vaumik et al., 2017).

Approximately 33 businesses were found to be either manufacturing or selling aqua medicines, drugs, and chemicals (AMDC) items aimed at freshwater aquaculture in the south-eastern portion of Bangladesh, according to the results of the present study. However, study of Rahman et al. (2017b) suggested 24 companies were established and continuing their business in only Cumilla region and 30 nationwide companies were reported by the study of Al-Asif et al. (2021).

In the booklet of company (provided by the company), they gave in-depth information on the objectives, doses, duration, and mode of application of the substances they were using. The usage and effectiveness of several of the items, on the other hand, were seen differently by farmers. There have been reports of certain businesses providing technical help to the farmers (Al-Asif et al., 2021). As a result, the farmers are subjected to significant pressure from commercial enterprises to utilize a diverse range of products on their fields.

The present study revealed 330 AMDC products were available in the three districts of south eastern region of Bangladesh, while a nationwide investigation from 2011-2020 revealed 1484 items of products from different generic and business names are available around Bangladesh (Al-Asif et al., 2021), which is relevant with the present study.

Several kinds of predatory fish may get access to aquaculture farms via water sources or by being introduced to the farm with seed that has been brought in from outside (Nunny, 2020). The use of water management techniques in farms, such as periodic draining and preparations for the introduction of new stock, provides possibilities for farmers to exert a fair degree of control over predatory fish in their fields which might be costly for the farmers (Biswas et al., 2018; Ledesma, 2019; Otieno, 2019). It is relatively simple to implement control measures in outdoor nursery ponds, where the post-larvae and fry are vulnerable to predation not only by predatory fish, but also by insect larvae, notonectids, and other amphibians such as frogs. For example, spreading oil emulsions to prevent aerial breathing of insect larvae or fencing to prevent entry of frogs are both relatively simple and effective measures. Controlling avian and mammalian predators is more challenging than controlling rodents (Mogi, 2007; Ram Kumar, 2006).

Ectoparasites, which include single-celled protozoa, multi-celled trematodes, crustaceans, and arthropods, are a common infectious agent in freshwater fish and are found in a broad variety of environments. Ectoparasites are a kind of infectious pathogen that may infect freshwater fish and other aquatic organisms (Br uno et al., 2006; Iyaji and Eyo, 2009). There were many insecticides used on arugulas in the study area, including Engreb, Paratics, and Acemec 1 percent Oral Solution, among other things.

The present study suggested that various sort of pond preparation chemical and materials were used in the south eastern part of Bangladesh, including zeolite, lime and sometimes changes in water in a proper manner. While the study of Adhikary et al. (2018c), Chowdhury et al. (2015), Ullah et al. (2020) reported that lime, zeolite, fish toxin, insecticides and different fertilizers were used for the preparation and water quality management in Jashore, Sylhet and Noakhali regions respectively.

The usage of Geotox, Zeolite, Zeocare, lime, Mega Zeo Plus, Bio Aqua, Aquanone, and Zeo prime for pond preparation and water quality management by various farmers in Bangladesh was reported by Rahman et al. (2017b). When it came to fish aquaculture in Bangladesh, lime was by far the most frequently utilised chemical. Plankton is an essential food source for fish and a good indication of the overall productivity of a body of water (Ak ter et al., 2018; Siddika et al., 2013). In a water body, the qualitative and quantitative abundance of phytoplankton indicates whether the water body is oligotrophic or eutrophic, and therefore the productivity of the water body (Ak ter et al., 2018; Sipaulba-Tavares et al., 2011). A comprehensive understanding of phytoplankton quantity and quality in connection to environmental circumstances, both in time and space, has become a requirement for the production of high-quality fish (Chukwu and Afolabi, 2018; Hossain et al., 2019).

The existence of zooplankton production is largely dependent on the availability of primary production (Anton-Pardo and Adámek, 2015; Bhaumik et al., 2006; Korhonen et al., 2011). Many plankton producers’ chemicals
The traditional fertilizers which are used in the agricultural sector as disinfectants are effective at killing bacteria, viruses, and other pests (Ali et al., 2014; Kasai et al., 2002). There are a variety of chemicals that are extensively utilized in the aquaculture sector as disinfectants (Al-Asif et al., 2021; Chowdhury et al., 2015; Rahman et al., 2017). These chemicals are regularly employed in the majority of fish and shrimp hatcheries, grow-out facilities, and processing facilities to eliminate bacteria, viruses, and other pests that may negatively affect production. Depending on the nation, laws regulating the use of disinfectants may vary from being very easy to being quite difficult to understand (Chen et al., 2018; Kim et al., 2008; Pomaranski and Soto, 2020). The current study revealed Timsen and Pahonil were the most popular disinfectant in the aquaculture setup in the south eastern Bangladesh.

Waterborne creatures are particularly vulnerable to hydrogen sulphide (H₂S) and ammonia (NH₃-N), which are poisonous gases in general. Some bacteria use the uneaten feed and organic debris on the pond bottom to produce H₂S gas, which gives the pond a rotten egg smell when it is under anaerobic conditions (Rahman et al., 2015; Sumantri et al., 2020). The study found some toxic gas reducers products along with gas removal probiotics were fairly use in the aquaculture setup. In most of the products the extract of Yucca schidigera plants were the primary ingredients (Dawood et al., 2021; Santacruz-Reyes and Chien, 2012; Yu et al., 2015).

In the fish and shrimp farming industries, aquaculturists are unaware of the magnitude of economic losses that could be avoided if pH levels were maintained at levels that are safe for fish. Controlling pH in water, in conjunction with the adoption of management practices to maintain pH levels at levels that are safe for fish, could help to mitigate these losses (Africa et al., 2017; Grøttum et al., 1997; Pote et al., 1990). The study area comprised of two pH controller chemical products which might helpful to buffer the pH of aquaculture setup. Oxygenating agent are useful while the oxygen level of an aquaculture setup become depleted in a dangerous level (Chowdhury et al., 2015). In the study area we found several companies oxygenating chemical agents which were readily available in the market; while the most of the ingredients of the oxygenating agents are similar but they do marketing with different brand or trade name, including ACI OX, BIO OX, etc.

Vitamins and minerals, particularly vitamin C, have been shown to be stress reducers in aquaculture settings. While certain medications are extremely helpful in acting as growth promoters, farmers that want to obtain their final products as quickly as possible add various minerals and vitamins to the feed, including different vitamins and minerals premix, in order to speed up the process (Al-Asif et al., 2021; Chowdhury et al., 2015; Hasan et al., 2015; Rahman et al., 2017b). The current study revealed that, the highest number of AMDC products were growth promoter (total 59 items; 17.88%) (Refer to, Figure 2).

Probiotics are microbial organisms and yeast preparations that have positive effects on the host body's nutrition consumption, digestion, development, and immunological response by encouraging the growth of beneficial bacteria and yeast (Hai, 2015; Martínez Cruz et al., 2012; Verschueren et al., 2000; Zorriezahra et al., 2016). Bacillus spp., which produce spores and are Gram positive, are the primary components of the vast majority of probiotics used in fish farming (Fijan, 2014; Hlordzi et al., 2020). The use of probiotics as an environmentally acceptable alternative to antibiotics and other medicines has found widespread use in the treatment of illness in aquaculture (Farzanfar, 2006; Jahangiri and Esteban, 2018). A broad variety of beneficial bacteria strains were found in the probiotic formulations. These included Bacillus sp., Lactobacillus sp., Nitrosomonas sp., Aspergillus sp., Pseudomonas sp., Clostridium sp., Rhodococcus sp., Rhodobacter sp., and Saccharomyces cerevisiae (Rahman et al., 2017b; Shefat, 2018). Among others the validity and quality of goods containing various combinations of the probiotic organisms listed above were not confirmed despite a large number of such
products being available on the market and in great demand. But such goods were in great demand across all aquaculture zones, suggesting that they were successful, despite the fact that their usefulness has not yet been scientifically shown.

As a result of the fact that only a few antibiotics have been approved for use in aquaculture and that precise data on their use is difficult to come by, at least two critically important antibiotics, such as the tetracyclines and oxolinic acid (a third generation quinolone), are now being used in routine practise in Bangladesh to control specific diseases and bacterial infections in the aquaculture industry, respectively (Al-Asif et al., 2021). Study of Lulijwa et al. (2020) and Rahman et al. (2017b) both reported at least 19 antibiotics were available in Bangladesh and Cumilla respectively. While the present study support the previous findings with the report of 19 antibiotics from the south eastern region of Bangladesh, comprising three popular aquaculture regions, Chandpur, Cumilla and Feni.

5. Conclusions

The aquaculture medicine drugs and chemicals are widely used by the farmers of south eastern Bangladesh, while the adverse effects of antimicrobial agents are simply neglected by the farmers or other stakeholders. Bioremediation, probiotics, immune-stimulants, immunization, and alternative therapeutics are examples of alternatives that may be utilized instead of antibiotics. For mitigating the harmful effects of antibiotics usage in aquaculture; policymakers, researchers, and scientists should collaborate in order to solve the problems surrounding some adverse AMDC products use in this industry.

Conflict of interest

None to declare.

Authors’ contribution

Conceptualization and execution of study: Amir Hossain and Abdulla-Al-Asif; methods: Amir Hossain and Abdulla-Al-Asif; data collection: Amir Hossain; statistics and presentation: Abdulla-Al-Asif; Map preparation: Abdulla-Al-Asif; writing, original-draft preparation: Amir Hossain and Abdulla-Al-Asif; writing, review and editing: Amir Hossain, Saiful Islam, Abdulla-Al-Asif and Hafzur Rahman. All authors have read and agreed to the published version of the manuscript.

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