



International Journal of Fisheries and Aquatic Studies

E-ISSN: 2347-5129
P-ISSN: 2394-0506
(ICV-Poland) Impact Value: 5.62
(GIF) Impact Factor: 0.549
IJFAS 2019; 7(1): 28-34
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www.fisheriesjournal.com
Received: 13-11-2018
Accepted: 15-12-2018

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Aqua drugs and antibiotics used in freshwater aquaculture of North Chittagong, Bangladesh

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Abstract

Aquaculture remains a growing, vibrant and important food production sector. Chemicals and drugs are widely used to increase aquaculture production in Bangladesh. A study was carried out to assess the aqua drugs and antibiotics used in aquaculture activities in north Chittagong of Bangladesh. Data were collected through questionnaire interview, personal contact, market survey and participatory rural appraisal like focus group discussion with fish hatchery owners, nursery and culture farmers, and retailers of aqua medicine and representatives of different pharmaceuticals companies. Major aquaculture species in experimental areas were combination of carps, tilapia and catfish (57%). Approximately 80 stakeholders were used to collect data from the selected upazilla of Chittagong and Cox's bazar district. Six categories of aqua drugs and chemicals were found to be used by fish farmers for water quality management, disinfectants, disease treatment, antibiotics and growth promoter. Most commonly used chemicals in this area including Geotox, Acmes Zeolite, Zeofresh, Lime, Zeo prime, Hunter, Vita plankton for the pond preparation and water quality management. 60% farmer use only lime while 22% use commercial zeolite and lime during pond preparation. Bleaching 14%, Potassium permanganate 40%, and 38% farmer use different commercial disinfectant for the treatment of disease. Bio-ox, Oxylife, Oxymax, and Oxymore are the available chemicals for increasing oxygen concentration in the pond. Renamycin, Otetra-vet 20%, Erisen-vet, Cotrim-Vet, AT-vet, Sulprim-vet and Sulfatrim were widely used antibiotics in this area. The study shows that lack of knowledge regarding use of chemicals, appropriate dose, method of application and indiscriminate use of antibiotics. This research finding will help to fish farming community to know the appropriate dose and administration methods for safe and sustainable aquaculture practices.

Keywords: Aquaculture, antibiotics, pharmaceuticals, drugs, fish health management.

1. Introduction

In Bangladesh the production of Aquaculture is increasing day by day through diversification (Mahmud *et al.*, 2012 and Ahmed *et al.*, 2012) [13]. It's a fast growing food production sector and has a positive impact on national economy. Fisheries production contributes 3.57% to GDP and 25.30% to agricultural GDP in Bangladesh. Directly and indirectly involved about 11% of the population and intake 60% of our daily animal protein from fisheries products (DoF 2018) [3]. Throughout the most recent decade aquaculture has extended, diversified, and intensified and mechanically praiseworthy in Bangladesh. Chemicals are in fact a crucial fixing to fruitful aquaculture, which has been utilized within different structures for centuries (Faruk *et al.*, 2008) [6]. Aquaculture drugs and chemicals plays a pivotal role not only in fish health management but also pond construction, soil and water management, enhancement of natural aquatic productivity, feed formulation, manipulation of reproduction, growth promotion and processing and value addition of the final product (GESAMP, 1997; Subasinghe *et al.*, 1996) [7, 8, 17]. A variety of drugs and chemicals are used in aquaculture for fish health management apart from antibiotics. Most commonly used chemicals are sodium chloride, formalin, malachite green, methylene blue, potassium permanganate, hydrogen peroxide and glutaraldehyde (Plumb, 1992) [15]. Different types of disease could be found in farmed aquatic animals in Bangladesh (Karim *et al.*, 1998; BFRI, 1999 and Faruk *et al.*, 2004) [12, 2, 4]. Farmer use different types of chemicals and antibiotics to control the fish disease. Sometimes chemist and representative of different Pharmaceuticals Company influenced the farmer to use their products. Some of the farmers use these chemicals indiscriminately without

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knowing their necessity, effectiveness, proper dose and method of application. Hence, the objectives of the present study were to identify types of chemical and antibiotic used in aquatic animal health management, their purpose, doses and to detect the problems associated with their use.

2. Materials and Methods: The study was conducted in some hatcheries, nurseries, aquaculture farms, drug shops, technical service officer and representatives of different fish feed and pharmaceuticals companies from January to October 2018 located in North-Chittagong of Bangladesh (Fig.1). Total 80 questionnaires interview were selected during the investigation. They were 50 fish farmers, 10 technical service officer of different fish feed and medicine companies and 20 drug shops were also interviewed. Before collecting the primary data a well structure questioners were developed and

pre testing in few farmer in adjacent areas. In the pre testing much attention were given to any useful information for the completeness of the objective. After improving the final questionnaire, primary data were collected through survey of farmer household in selected areas by applying participatory Rural Appraisal tools such as directly interview of the farmer, focus group discussion, crosscheck etc. Relevant secondary data were collected from district and upazila fisheries office. The literatures were also collected from different study (The resources include online publications, books, governmental reports, international reports, scientific journals and news articles that focused on aqua drug and antibiotics used in fresh water aquaculture). All the information of the study then compiled, accumulated and analyzed by MS excel and presented in tabular and graphical forms.

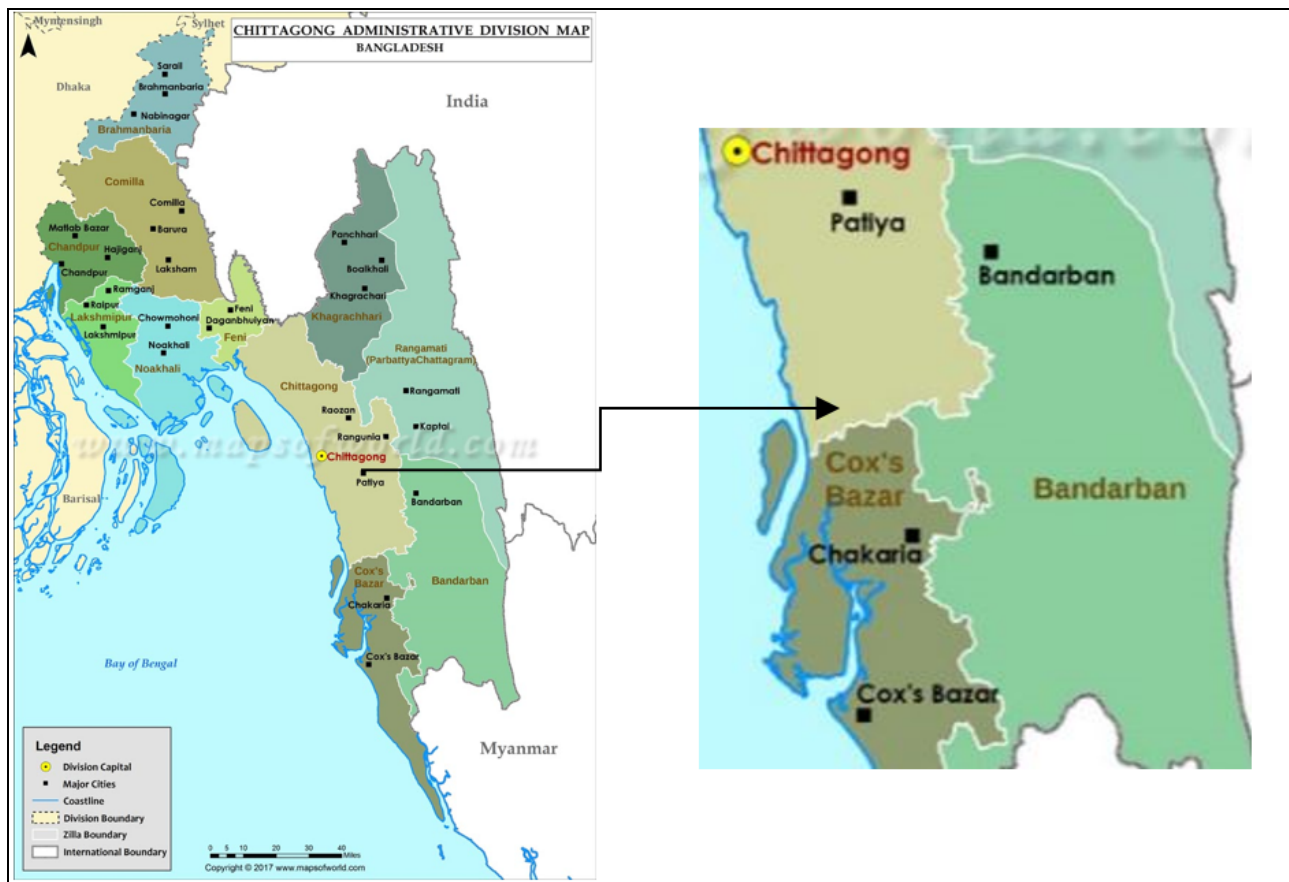


Fig 1: Map showing study area

3. Result and Discussion

3.1 Types of fish species cultured: Farms investigated in the present experiment could be categorized into six types such as type A, cultured tilapia, catfish and carp. Type B, cultured tilapia and carps, type C, cultured tilapia and catfish, type D, cultured Tilapia and koi, type-E cultured only catfish and rest of the cultured species in type-F. Percentages of the categories were 57, 12, 15, 4 and 4 respectively in the above mentioned types (Fig.2). Rahman *et al* 2017 [16] reported that mixed culture of carp, tilapia and catfishes is about 22%, carp and tilapia is 39% in comilla region.

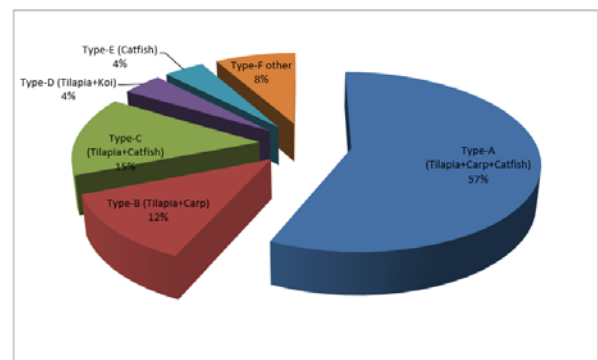


Fig 2: Percentages of different fish species cultured in fish farms

3.2 Major chemicals for pond preparation and fish health management: The chemicals found available in the market and are used at different stages of aquatic animal health management like during pond preparation, growth promotion, supply of oxygen, disinfectant, probiotic and fish disease treatment have been collected and compiled. Chemicals like Zeofresh, Lime, Hunter are used for the pond preparation. Hunter are used for controlling unwanted fishes. Jelani *et al.* (2012) [11] reported that lime, zeolite, fish toxin, insecticides

and different fertilizers are used for the preparation and water quality management in Noakhali district. In Bangladesh lime is the most commonly used chemicals due to its low price and effectiveness in water quality management (Sultana, 2004). Faruk *et al.* (2008) [6] found drugs like Geotox, JV Zeolite, Mega Zeo, and Bio Aqua used for improving water quality. The list of such chemicals with their active ingredients prescribed dose, source and approximate price are shown in Table 2 and Fig. 3.

Table 2: Chemicals Use for Pond Preparation and Water Quality Management

| Trade Name | Active ingredients | Dose | Source | Price (Taka) |
|----------------|--|--------------|----------------------------------|--------------|
| Zeofresh | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O, K ₂ O, TiO ₂ | 24kg/acre | Square Pharmaceuticals Ltd. | 430Tk/10kg |
| Zeolite Gold | SiO ₂ , MgO, CaO ₂ etc. | 25kg/acre | Fishtech BD Ltd. | 410Tk/10 Kg |
| Mega Zeo Plus | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O, K ₂ O and Mn | 20kg/acre | ACI Animal Health Ltd. | 340Tk/10 Kg |
| JV Zeolite | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O, K ₂ O and Mn | 22kg/acre | Eon Animal Health Ltd. | 350 Tk/10 Kg |
| Matrix | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O | 10 kg/acre | Eon Animal Health Ltd. | 695Tk/5Kg |
| Aqua pure | SiO ₂ - 60-65%, Al ₂ O ₃ - 18-22%, CaO- 15-18%, MgO- 2-5%, Fe ₂ O ₃ - 2-3%, Na ₂ O-1-2% | 10kg/acre | Square Pharmaceuticals Ltd. | 570Tk/5 Kg |
| Zeo Prime | SiO ₂ -66%, Al ₂ O ₃ -20%, Fe ₂ O ₃ -3%, CaO-6%, MgO-3%, K ₂ O-3%, Na ₂ O-4%, MnO-0.05%, P ₂ O ₃ -0.16% | 24kg/acre | SK+F Bangladesh Ltd. | 550Tk/10 kg |
| ACME's Zeolite | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O | 25kg/acre | The ACME Laboratories Ltd. | 550Tk/10 kg |
| Zeopel | SiO ₂ -72%, Al ₂ O ₃ -12%, Fe ₂ O ₃ -1.9%, CaO-3.7%, MgO-1.2%, K ₂ O-3.8%, Na ₂ O-0.65%, MnO-0.08%, P ₂ O ₃ -0.03%, Cr ₂ O ₃ -0.03% | 24kg/acre | SK+F Pharmaceuticals Ltd. | 550Tk/10 kg |
| Lime | CaO, Ca(OH) ₂ | 100 kg/acre | Chemical Seller | 25 Tk/kg |
| Aqua Lime | CaCO ₃ , Ca(OH) ₂ | 100 kg/acre | ACI Animal Health | 27.5Tk/kg |
| Zeolite | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O | 20-30kg/acre | National Agricare Imp. Exp. Ltd. | 550Tk/10kg |
| Zeo-Ren | SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , CaO, MgO, Na ₂ O, K ₂ O, P, Mn | 20-25kg/acre | Renata Ltd. | 400Tk/10kg |
| Hunter | Rotenon 9% | 5-6 kg/acre | Eon Animal Health Products Ltd. | 400Tk/kg |
| Aquagreen-G | Sea weed extract, Enzyme precursors, micronutrients | 4-5kg/acre | Square Pharmaceuticals Ltd | 410Tk/Kg |

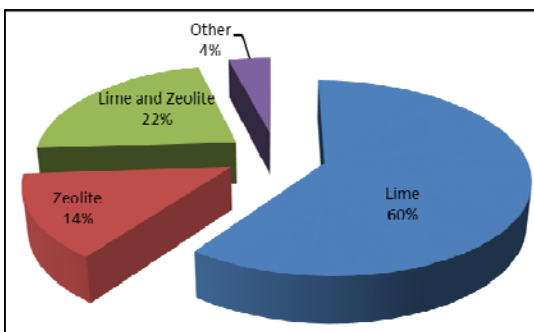


Fig 3: Chemicals for Pond Preparation and Water Quality Management

3.3. Aqua drugs used as disinfectant: Farmers used disinfectant to keep their pond free from pathogen, remove excess blue green algae, and to treat diseased fish. The following disinfectants listed in Table 3 were found available in the market. Present study shown that 40% farmer use potassium permanganate as disinfectant, 38% of the farmer use commercial disinfectant like aquakleen, timsen, pathonil etc. (Fig 4). Rahman *et al* 2017 [16] reported that 22% farmer use potassium permanganate as disinfectant in their culture pond in comilla region.

Table 3: List of disinfectant used in study area

| Trade Name | Active ingredients | Dose | Source | Price (Taka) |
|------------------|--|--------------------|--------------------------------|--------------|
| Aquakleen | Each 1L contains: Tetradecyl Trimethyl Ammonium Bromide: 6.6 g, BKC-83g, Amino Nitrogen-10000ppm | 1L/acre | Square Pharmaceuticals Ltd | 468Tk/Litre |
| Timsen | n-Alkyl dimethyl benzyl ammonium chloride 40%, stabilized urea60% | 20-80g/33 decimal | Eon Animal Health Products Ltd | 261/50 g |
| Virex | Potassium Peroxymono sulphate 50% | 100-200 /33 dec | ACI Animal Health | 110/10g |
| Polgard plus | 3-Methyl and 4-Methyl two chain brominated compound | 500 ml/acre | Fish tech (BD) Limited | 490/200 ml |
| Pathonil | Alkyl dimethylbenzyl ammonium chloride 80%, BKC 80% | 200ml/33 decimal | ACI Animal Health | 265Tk/100ml |
| Sansure | BKC-80% | 100ml/33 decimal | Opsonin Pharma Ltd | 285Tk/100ml |
| Germa strong | Glutaraldehyde- 182g/L, Benzalkonium chloride- 41.6 g/L | 100ml/33 decimal | Verno Bio Solutions Ltd. | 1300Tk/1L |
| Potash | KMnO ₄ | 10gm/decimal | Chemical seller | 190/kg |
| Salt | NaCl | 500-1000g/ decimal | Chemical seller | 18/kg |
| Bleaching powder | Clorine | 0.1-1 ppm | Chemical Seller | 55/kg |

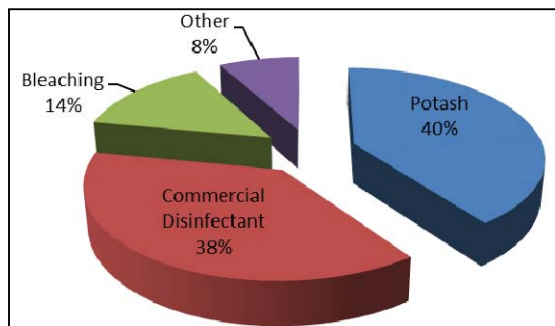


Fig 4: Widely used disinfectants in study area

3.4. Chemical used for oxygen supply: Different types of drugs are used for increase dissolved oxygen in aquaculture pond shown in Table 4. Study shows that 26% farmer use Oxy Ren for oxygen supply. It was found that some of the listed chemicals are also used to eliminate hardness and poisonous gases. Faruk *et al.* (2008) [6] observed that oxymax are also used to remove hardness and toxic gases.

Table 4: Chemical used for Oxygen enhancer

| Trade Name | Active ingredients | Dose | Source | Price (Taka) |
|-------------|--|-----------------|---------------------------------|--------------|
| Oxylife | Sodium percarbonate | 500gm-1kg/acre | Square pharmaceuticals Ltd. | 650Tk/kg |
| Bio ox | Sodium carbonate,H ₂ O ₂ | 500gm-1kg/acre | ACI animal health | 580Tk/kg |
| ACI-OX | Sodium carbonate,H ₂ O ₂ | 500gm-1kg/acre. | ACI animal health | 680Tk/kg |
| Oxy flow | Sodium carbonate,H ₂ O ₂ | 500gm-1kg/acre | Elanco Ltd. | 800/kg |
| Oxy-Ren | Sodium carbonate | 500gm-1kg/acre | Renata Ltd. | 600Tk/kg |
| Oxymax | Sodium carbonate,H ₂ O ₂ | 500gm-1kg/acre | Eon animal health products ltd. | 720/kg |
| Oxy more | Sodium carbonate per-oxyhydrate | 500gm-1kg/acre | SK + F Bangladesh Ltd. | 720/kg |
| Oxy gold | Sodium percarbonate | 500gm-1kg/acre | Fishtech Ltd. | 680/kg |
| Oxy-A | Sodium percarbonate | 500gm-1kg/acre | The Acme Laboratories Ltd. | 580/kg |
| Best oxygen | Sodium percarbonate | 250-500 g/acre | Univet ltd. | 580/kg |

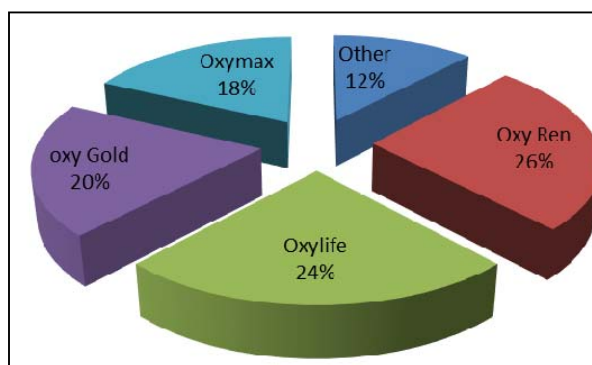


Fig 5: Commonly used chemicals for oxygen suppl

3.5. Chemicals used for disease treatment

Potash, lime, methylene blue, benzalkonium chloride, salt and malachite green, were found to be used for common fish disease treatment. Potash, lime, Aquakleen, Timsen etc. are used for EUS. Ali (2008) [1] observed that methylene blue,

malathion, salt, lime, sumithion and protacide were used to treat various disease problems of fishes of Bangladesh. The list of such chemicals with their active ingredients, dose, sources and approximate price are shown in Table -5.

Table 5: List of chemicals used for disease treatment.

| Trade Name | Active ingredients | Dose | Source | Price (Taka) |
|----------------|---|---------------------|---------------------------------|--------------|
| Potash | KMnO ₄ | 5-15 gm/decimal | Chemical seller | 190/kg |
| Salt | NaCl | 250gm/decimal | Chemical seller | 18/kg |
| Timsen | n-Alkayl di-methyl benzyl ammonium chloride + stabilize urea | 80 g/33 decimal. | Eon animal health products ltd. | 261/50 g |
| Aquakleen | Each 1L contains: Tetradecyl Trimethyl Ammonium Bromide: 6.6 g, BKC-83g, Amino Nitrogen-10000ppm | 1L/acre | Square Pharmaceuticals Ltd | 468Tk/Liter |
| Virex | Potassium Peroxymono sulphate 50% | 100-200 /33 decimal | ACI Animal Health | 110/100 g |
| Pathonil | Alkyl dimethylbenzyl ammonium chloride 80%, BKC 80% | 200ml/33 decimal | ACI Animal Health | 265Tk/100ml |
| Lime | CaO, Ca(OH) ₂ | 100kg/ha | Chemical seller | 18/kg |
| Methylene Blue | C ₁₆ H ₁₄ N ₃ SCI | 0.15 ppm | Chemical seller | 70/100 ml |
| Bleaching | Chlorine | 60 ppm | Chemical seller | 60/Kg |
| Melethion | Active melathion | 500g/acre | Chemical seller | 63/100 ml |

3.6. Antibiotics for disease treatment

In the present investigation about 14 branded antibiotics with different trade name were seen in the market as well as used by the fish farmers which are shown in Table 6. Monsur (2012) found Oxysentin 20%, Aquamycine, Captor and Acimox powder as antibiotics. Islam (2013) [9] found Oxy-Dox-F, Renamox, Ciprovvet and CT-Dox. Faruk *et al.*, (2005) [5] observed that Aquamycine, Oxy-Dox-F 100, Captor,

Oxysentin 20%, Doxy-A Vet WSP, Tetravet WSP, Moxilin Vet WSP, Renamycin Soluble Powder and Oxy-D Vet were used as antibiotics to cure different bacterial diseases of cultured aquaculture species in Bangladesh. In the present investigation 52% farmer use erythromycin, 18% use ciprofloxacin and 10% use oxytetracycline. Rahman *et al* 2017 [16] reported that 44% farmer of comilla region use oxytetracycline for disease treatment.

Table 6: List of antibiotics used for disease treatment.

| Trade name | Active ingredients | Doses | Source | Price (TK) |
|----------------|---|---------------------------------|-----------------------------|----------------|
| Renamycin | Oxytetracycline | 5gm/kg feed for 5 days | Renata pharmaceuticals Ltd. | 82Tk/100 gm |
| Otetra-vet 20% | Oxytetracycline | 5gm/kg feed for 5 days | Square pharmaceuticals Ltd. | 80 Tk/100 gm |
| Biomycin | Oxytetracycline | 5gm/kg feed for 5 days | Biopharma Ltd | |
| Aquamycine | Oxytetracycline | 5 gm/Kg feed for 5-7 days | ACI Animal Health Ltd. | 70Tk/100 g |
| Oxy-D Vet | Oxytetracycline 20% Doxycycline 10% | 5-10 g/Kg body wt. for 5-7 days | Eon Animal Health Ltd. | 173Tk/100 gm |
| EST-Vet | Erithromycine thiocyanate, Sulfadiazine, Trimethoprim | 3-5gm/kg feed for 3-5 days | Eon Animal Health Ltd. | 393Tk/100gm |
| Cotrim-vet | Sulphamethoxazole + trimethoprim | 0.5 mg/kg body weight | Square pharmaceuticals Ltd. | 70–80Tk/100 gm |
| Sulprim-vet | Sulfadiazine, Trimethoprim | 3-5ml/kg feed for 3-5 days | Square pharmaceuticals Ltd. | 170Tk/100ml |
| Renatrim | Sulfadiazine, Trimethoprim | 3-5ml/kg feed for 3-5 days | Renata Ltd | |
| AT-vet | Sulfadiazine, Trimethoprim | 3-5ml/kg feed for 3-5 days | ACME Laboratories Ltd | |
| Erisen-vet | Erythromycin, Sulfadiazine, Trimethoprim | 5gm/kg feed for 3-5days | Square pharmaceuticals Ltd. | 326Tk/ 100gm |
| Micronid | Erythromycin, Sulfadiazine, Trimethoprim | 5gm/kg feed for 3-5 days | Renata Ltd | 362Tk/100gm |
| Ciprocin-Vet | Ciprofloxacin | 5ml/kg feed for 5 days | Square Pharmaceuticals Ltd | 1000Tk/500ml |

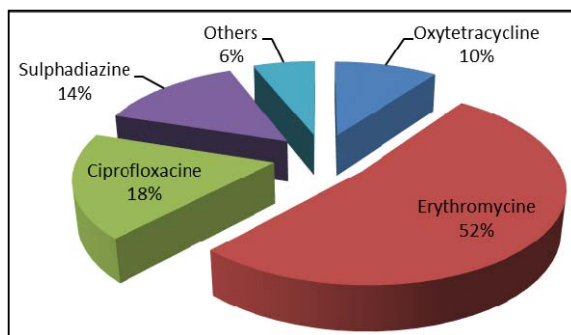


Fig 6: Commonly used antibiotics in north Chittagong

3.7. Chemicals used as growth promoter

Several aqua-medicines were found to be used as growth promoter. These drugs are normally used with ready feed. Some are used as vitamin premix during feed manufacturing.

Islam (2010) [10] observed that Resistol, Charger Gel, Ossi-C and Cevit Aqua were used as growth promoter. Present study shown that Eon fish grower and square aquamix are the most preferable growth promoter.

Table 7: List of chemicals used as growth promoter

| Trade name | Active ingredients | Doses | Source | Price (TK) |
|-------------------|--|--------------------|----------------------------|--------------|
| Square Aquamix | Vitamins, minerals, Aminoacids, prebiotics, yeast, and antioxidant | 1gm/kg feed | Square Pharmaceuticals Ltd | 310Tk/kg |
| Eon Fish Grower | Vitamin + Mineral premix | 1.5-3 gm/kg feed | Eon Animal Health Ltd. | 255Tk/kg |
| Aqua boost | Organic acid, β-glucan | 500 gm/MT feed | Elanco Ltd. | 300Tk/kg |
| Megavit Aqua | Vitamin, mineral and amino acid supplement | 100 gm/100 kg feed | Elanco Ltd. | 380Tk/kg |
| Charger Gel | 1-3 D-Glucan, Polysaccharides, Btain, Beta Glucan | 6-8 gm/Kg feed | Fishtech | 1060Tk/Kg |
| Aqua Gel | Essential amino acid, omega-3 & omega-6 fatty acid. | 5-15gm/kg feed | Square Pharmaceuticals Ltd | 560Tk/kg |
| Vitamix F aqua | Vitamin, mineral and amino acid | 2.5 kg/ton feed | ACME laboratories Ltd. | 300–350Tk/kg |
| Acimix super-fish | Vitamin mineral + antioxidant | 1 kg/ton feed | ACI Animal Health | 350 Tk/kg |
| Spa | Protein, Cholesterol caratenoid, Vit-D, Ca | 10-15gm/kg feed | Eon Animal Health | 580Tk/kg |
| Nutrimax | Vitamin, mineral | 1gm/kg feed | SK + F Bangladesh Ltd | 500Tk/kg |

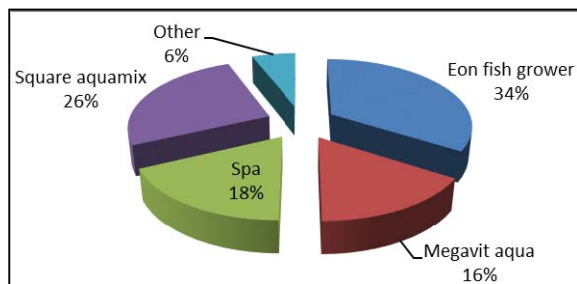


Fig 7: Commonly used chemicals as growth promoter in north Chittagong

3.8. Use of probiotics in fish farming at north Chittagong
 The probiotics contained different beneficial bacteria including *Bacillus subtilis*, *B. Pumilus* and *Saccharomyces cerevisiae* (Table-8). Islam (2013) [9] found the use of Navio Plus, Biozime, Aqua Bost and Pro Marine to increase disease resistance in shrimps. Present study showing pond care, probio aqua, profs, and aqua star pond are the most popular type of probiotics used in the studied area. Rahman *et al* 2017 [16] reported that 39% of fish farmer use profs as probiotic in comilla region.

Table 8: List of probiotics used in study area

| Trade name | Active ingredients | Doses | Source | Price (TK) |
|----------------|---|------------------|----------------------------|--------------|
| Pond care | <i>S. faecalis</i> and other bacteria | 50g/ acre | SK + F Bangladesh Ltd. | 375 Tk/100gm |
| Biomax power | <i>Bacillus subtilis</i> And eight other beneficial bacteria | 3-4kg/acre | Square Pharmaceuticals Ltd | 400Tk/kg |
| Probio aqua LQ | <i>Rhodopseudomonas sp.</i> | 2-3L/acre | Square Pharmaceuticals Ltd | 580Tk/L |
| Profs | <i>Bacillus sp.</i> and <i>Padiococcus sp.</i> | 50-70 gm/33 dec. | Eon Animal Health Ltd. | 660/100gm |
| Bio plus | <i>Bacillus sp.</i> And <i>Rhodopseudomonas sp.</i> | 1.5-2 L/acre | ACI Animal Health | 480 Tk/500ml |
| Aqua star pond | <i>Bacillus sp.</i> , <i>pediococcus sp.</i> , <i>Enterococcus sp.</i> , <i>paracoccus sp.</i> and organic career | 0.5-1kg/ha | Renata Ltd. | 1650Tk/kg |

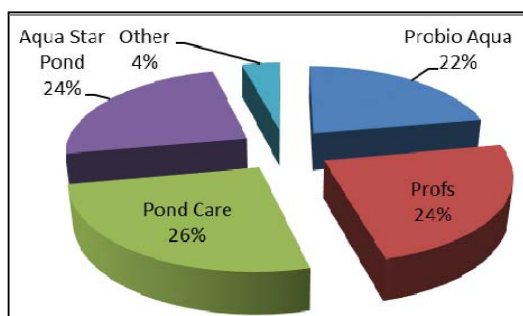


Fig 8: Commonly used probiotics in North Chittagong

3.9. Chemicals used as toxic Gas removal
 Toxic gas occurring in pond created by the breakdown of waste/sludge i.e. fish food, excrement and plants. Farmers were seen to use toxic gas removal agent to their culture pond. Rahman *et al* 2017 [16] reported that Bio aqua-50, Gasonex, Gastrap, Ammonil etc. are used as toxic gas removal. About 5 toxic gas removals with different trade name were found to different farm. Their name, dose and sources are given in Table-9.

Table 9: List of chemicals used for toxic gas removal.

| Trade name | Active ingredients | Doses | Source | Price (TK) |
|--------------|--|-----------------------|-----------------------------|---------------|
| Gastrap | Lactic acid <i>Bacillus</i> , <i>Bacillus subtilis</i> and Enzymes | 200 mg/acre | Square pharmaceuticals Ltd. | 326 Tk/ 100gm |
| Bio-Aqua-50 | Yucca plant extract, Saponin Components Glyco components | 60-70 ml /33 dec | Eon animal health Co. Ltd. | 2500Tk/L |
| Gasonex plus | Na-lorile ether sulphate | 200-400 mg/Kg Zeolite | Fish tech. (BD) Co. Ltd. | 435Tk/100gm |
| Aqua Magic | <i>Azotabactor chorococum</i> , <i>Bacillus subtilis</i> , <i>candida utilis</i> | 400g/acre | Fish tech.(BD) Co. Ltd. | 2700Tk/kg |
| Ammonil | Yucca plant extract, <i>Bacillus subtilis</i> , <i>candida utilis</i> | 100-200 g/acre | Elanco Ltd. | 2800Tk/kg |

3.10. Enzyme used for better digestion: Different type of enzyme was used by the farmer in studied area for better digestion, gut health, and to improve FCR. Rahman *et al* 2017 [16] reported that only one type of enzyme was used by the fish

farmers in fish feed named Biozyme in comilla region. Name, composition, dose, approximate price of available enzymes found in the study area are given in the table-10.

Table 10: List of enzymes used for better digestion

| Trade name | Composition | Doses | Source | Price (TK) |
|------------|--|-----------------|-----------------------------|--------------|
| Polzyme | Protease, Cellulase Xylanase, Lipase, Amylase | 1-3ml/kg feed | Square Pharmaceuticals Ltd. | 172Tk/250 ml |
| Biozyme | Amylase, β-glucanase, Lipase, Protease, Hemicellulase | 50gm/100kg feed | Fishtech (BD) Limited. | 560Tk/500gm |
| Acmezyme | Cellulase, Zylanase, Protease, Amylase, Phytase, Pectinase, Hemicellulase, Lypase, α-galactosidase | 1-3gm/kg feed | ACME Laboratories Ltd. | 600Tk/500gm |

3.11. Knowledge and training of fish farmer: Most of the farmer received short term training from DoF, different NGO like YPSA, Heed Bangladesh, and COAST Trust etc. Youth development center also provide short term training to the fish farmer. It was observed that 26% fish farmers had no training

while 74% farmers received short term training from different institution. Rahman *et al* 2017 [16] reported that 33% fish farmers had no training while 67% farmers received short term training from different government and NGOs institution.

3.12. Problems associated with unethical use of aqua drugs:

Several problems were identified due to unethical use of aqua drugs which included lack of knowledge regarding use of chemicals, lack of knowledge of application of chemicals and antibiotics, indiscriminate use of chemicals, lack of knowledge about residual effect and expiry date and lack of diagnostic facilities for proper disease diagnosis. Sometimes chemist sells higher antibiotic without any prescription or any consultation of fisheries professionals. Rahman *et al* 2017^[16] found that antibiotics were used indiscriminately without knowing the exact reasons of disease. Some farmers did not follow the described dosages for treatment. Inglis V. 1996^[8] reported that excessive use of antibiotics contributes the development of resistant strains of bacteria.

4. Conclusion

From the present study, it can be assume that use of aquaculture drugs is increasing day by day. Aquaculture in Bangladesh is heading towards commercialization and intensification. Different types of drugs and chemicals have become an essential part of successful commercial aquaculture production. The present study revealed that farmers of the selected areas got good results in disease treatments by applying single or combinations of various aqua-drugs and chemicals. In most cases got about 95% recoveries within a very short period of time. These results influenced farmer to use more commercial aqua-drugs. It was observed that most of the farmers did not have proper knowledge about the chemicals they were using especially those were available in the markets known by their trade names only. However, government policy makers, fisheries professionals, researchers and scientists should work together in addressing the issues of drugs used in aquaculture with the view to decrease the negative impacts.

5. Acknowledgement

The author's very much thankful to the people who are actively participate in this survey research and help authors to full fill the works. Authors also given thanks to the representative of different pharmaceuticals company, chemical seller, and farmer who were participate the experimental activities.

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