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Article

Aqua drugs and chemicals used in aquaculture of Zakigonj upazilla, Sylhet

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Abstract: In order to investigate present status of aqua chemicals and drugs used in various aquaculture activities in Zakigonj upazilla, Sylhet. A survey was conducted, with carp polyculture, tilapia and catfish farmers, aqua-medicine sellers, representatives of pharmaceuticals companies, from July 2014 to November 2014. Each group consisted of 25 respondents. According to the survey the most common dose of lime used by the farmers during pond preparation (62.67%) and culture period (53%) is 0.5-1 kg/40m^2. Urea and TSP used by the farmers mostly during culture period with most common dose of 100-150g/40m^2(37.3%) and 50-100 g/40m^2 (68%) respectively. Various categories of aqua drugs and chemicals were identified that were used by fish farmers for different purposes such as water quality management, disinfectants, improve dissolve oxygen level, disease treatment, antibiotics and growth promoter. Many pharmaceutical companies were found to provide these aqua drugs and chemicals with different trade names to fulfill the farmers demand. For pond and water quality management lime, urea and TSP are mostly used. Bleaching powder, Timsen, EDTA, Polgard, Virex, Aquakleen, Germnill, Pond safe were widely used as disinfectant. Health management and disease treatment were the major activities where farmers were seen to use a lot of chemicals. A range of chemicals including antibiotics were found available in market and being used in the aquaculture sector. Commonly found traditional chemicals in heath management included Potassium permanganate, Lime, Salt, Virex, Timsen, Aquakleen, Germnil, Pond Safe, Deletrix, Spa, Albez, Ablez were used regularly for disease treatment. Mostly used antibiotics are Renamycin, Oxysentin 20% Chlorsteclin Oxy-D Vet, Aquamycin, Orgamycin 15 %, Orgacycline-15% etc. Major active ingredients of these antibiotics were oxytetracycline, chlorotetracycline, amoxicillin, doxycycline etc. There are approximately fifty two pharmaceutical companies have been recorded to market around 300 products. Most of the products have been marketed from different countries like USA, Thailand, Malaysia, Belgium and China etc. The study also indicated some problems associated with the use of such chemicals due to lack of knowledge of farmers about the use of chemicals, appropriate dose, method of application and their indiscriminate use of chemicals. The study also highlighted the names and approximate price of aquaculture chemicals available with the chemicals sellers in Zakigonj, Sylhet.

Keywords: aqua drugs; chemicals; aquaculture

1. Introduction

Aquaculture is the fastest growing food production sector in the world which plays a significant role in the economy in term of food, nutrition, income, employment and foreign exchange earnings (Subasinghe *et al.*, 2002). According to the latest available statistics collected globally by FAO, world aquaculture production was

90.4 million tonnes by weight and US$144.4 billion by value in 2012, including 66.6 million tonnes of food fish and 23.8 million tonnes of aquatic algae (FAO, 2014). Use of aqua-medicines in aquaculture systems for various purposes is widely recognized. They are essential components in pond construction, health management, soil and water management, enhancement of natural aquatic productivity, transportation of live organism, feed formulation, manipulation and enhancement of reproduction, growth promotion and processing value enhancement of final product (Alderman *et al.*, 1994, GESAMP, 1997). There are several traditional chemicals and drugs were used in aquaculture for health management. These included sodium chloride, formalin, malachite green, methylene blue, potassium permanganate, glutaraldehyde and trifluralin (Plumb; 1992, Phillips; 1996; Hasan and Ahmed, 2002; Brown and Brooks 2002; DOF; 2002). Other popular traditional aqua-medicines included Zeolite, EDTA, gypsum, lime, alum were used for the purpose of pond soil and water quality management. These are widely used to neutralize acidity, increase total alkalinity, increase hardness in the soil and water of grow out pond, reduce turbidity in ponds, Chalets divalent and trivalent metal cations etc. Potasium permanganate ($KMnO_4$,) was one of the most widely used aqua-medicines in fish health management. It is a strong oxidizing agent approved for the purpose to treat ponds. It is good for treating external protozoa and bacterial infections (Plumb. 1992, Karim and Stellwagen. 1998; BFRI, 1999).

Zakigonj is an upazilla of Sylhet District in Sylhet Division, Bangladesh. This Upazilla is one of the prominent areas for fish culture in Sylhet Division. Aquaculture in this area is expanding and using more drugs and chemicals in aqua-health management are increasing. Also, pharmaceutical companies and chemical sellers are influencing fish farmers to buy their products. Most of the farmers do not know the appropriate dosages, method of application. Farmers were also not seen too aware about the mode of action of particular chemical. As a consequence, during disease treatment first they try with one chemical and if it does not work, they try for other one. They used doses of particular chemical on either from their own experiences, or from the instruction of the packet, if` there is any and from the suggestion of chemical sellers. Indiscriminate use of drugs and chemicals has harmful effect on ecosystem and human health. Many chemicals may persist for many months in aquatic system, retaining their biocidal properties. Some antibacterial, notably oxytetracycline, oxolinic acid and flumequine, can be found in sediments at least six months (Weston, I996). Antibiotics used in aquaculture involve the development and transfer of drug resistance to pathogenic bacteria from farmed animals to humans. The prevalence of antimicrobial resistance is increasing worldwide and this growing problem is often attributed to the widespread use of antibiotics for clinical purposes in human medicine and by the agriculture industry (lnglis, 1996; Bronzwaer *et al.,* 2002). Transferable antibiotic resistance can also originate in human pathogens. Genetic investigations of drug resistance fish pathogens revealed that known antibiotic resistant genes from human bacterial pathogen is can be responsible for antibiotic resistance in fish bacterial pathogens (Weston, l996). Bangladesh Fisheries Research Institute (BFRI) had initiated a project on drugs and chemicals used in aquaculture. They surveyed on drugs chemicals used in aquaculture with coastal and freshwater environment. They made a list of drugs and chemicals used in aquaculture concentrated some places of the country. However, many places of the country are untouched under this project. Therefore Zakigonj upazilla is one of them. There is a lack of information regarding the present status and consequences of aqua-medicines using in aquaculture activities in Zakigonj upazilla. The study on drugs and chemicals use in aquaculture in Zakigong upazilla needs to be investigated.

2. Materials and Methods

The present investigation was based on field survey where primary data were collected from farmers, chemical sellers and representative of different pharmaceuticals companies.

2.1. Study area

The study area was selected depended on the objectives of the study. Zakigonj upazilla (Figure 1) situated in the north-east region of Bangladesh was selected for the present study.

2.2. Preparation of the survey schedule and duration of study

According to the objectives of the study, a survey schedule (for 75 farm owner, 25 shopkeepers and marketing representatives of different pharmaceutical companies) was prepared to collect the expected data. At first a set of questionnaire was prepared and pre-tested to verify the relevance of the questions and the nature of the sample producers. After pre-testing and necessary adjustment, a final set of questionnaire was developed. The

questionnaire covered mainly farmer's profile, culture details, type of chemicals used with dose and price. The survey was carried out five months from July 2014 to November 2014.

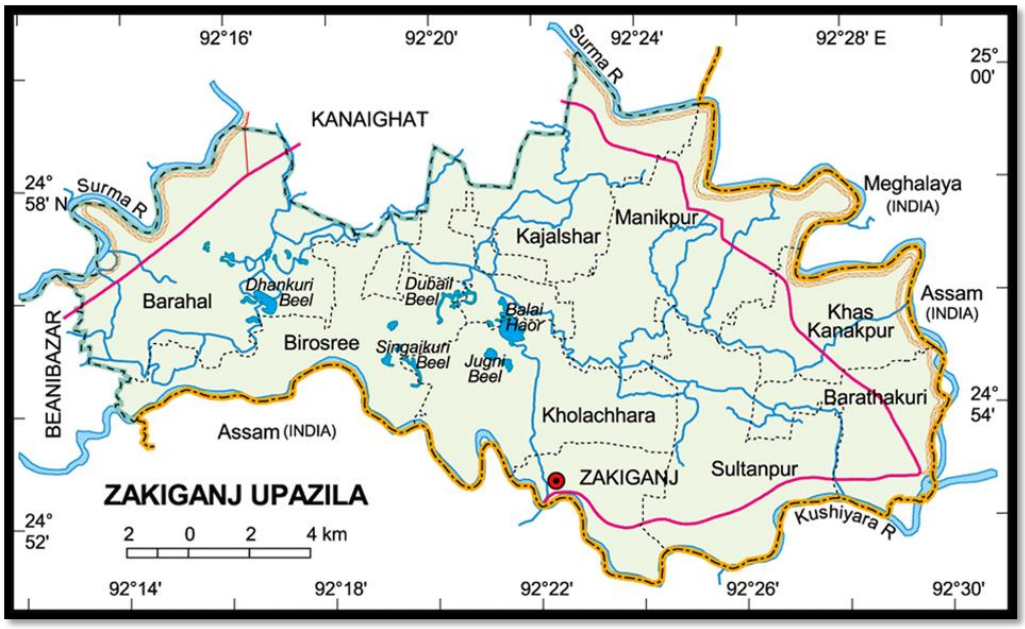

Figure 1. Zakigonj upazilla map.

2.3. Target group

Since aquaculture activities in Zakigonj area quite diversified, data were collected from different target group to have an overall picture of the drugs and chemicals used in aquaculture in this area (Table 1). Data were collected from 75 pond owners randomly covering the selected study areas. For each category of farmers, five unions were selected depending on the intensity of fish farming for specific target groups. Then five farmers were selected randomly from each union.

Table 1. Sample size of the survey.

SL. No.	Target Group	Specific location of the survey in Zakigonj Upazilla	Sample size
1.	Carp polyculture farmers	Kajalshar, Khas Kanakpur, Kholacchara, Barohal and Manikpur union	25
2.	Catfish farmers	Zakigonj, Khas Kanakpur, Sultanpur, Birasree and Kajalshar union	25
3.	Tilapia farmers	Zakigonj, Bara Thakuri, Barohal, Kholacchara and Sultanpur union	25
4.	Chemical sellers and marketing representatives of different companies	Zakigonj upazilla Market	25

2.4. Data collection method

Data were collected through questionnaire interview. The questionnaire was composed of both closed and open form of question. A set of preliminary questionnaire was prepared. Major topic of questionnaire were the name of chemicals, active ingredients purpose of use, method of application and doses duration, source, effects on environment, impact on health and productivity. For the interview, simple random sampling method was followed.

2.5. Analysis of data

The collected data were scrutinized and summarized carefully before the actual tabulation. Some of the data were collected into local units and those data were converted into international units. After data entry, the data were analyzed with Microsoft Excel.

3. Results and Discussion

3.1. Use of fish poison

About 72% farmers did not use any poison in their aquaculture activities. Only rotenone is found to use by the farmer as fish poison in nursery and culture pond for removing predatory, wild and unwanted fish from pond. Most of the farmers did not use any chemical while about 28% farmers use rotenone (Table 2 and Table 3).

Table 2. Use of fish poison (%) during pond preparation.

Poison	Carp farmers (N=25)	Catfish farmers (N=25))	Tilapia farmers (N=25)	Overall average (%)
None	72	64	80	72
Rotenone	28	36	20	28

Table 3. Chemicals used as fish poison in study area.

Trade Name	Active Ingredients	Dose	Sources	Price(Tk.)
Hunter	Rotenone 9%	7 kg/ 4046.86 m^2	Eon Animal Health Products Ltd.	400/kg
Aquanone	Rotenone and rotenone isomers	7.2 kg/ 4046.86 m^2	Square Pharmaceuticals Ltd.	400/kg
Acurote Gold	Rotenone 9%	8 kg/ 4046.86 m^2	ACI Animal Health Limited.	440/kg

Sultana (2004) also found similar result about fish poison use in Mymensingh area.

3.2. Doses of chemicals

3.2.1. Lime

About 62.67% farmers use lime at 0.5-1 kg/40m^2 while during culture most of them prefer <0.5 kg/40m^2 (53%). A dose of 0.5-1 kg/40m^2 was also used by about 39% of the farmers during culture period. However, the higher dose of >1.6 kg was not used by the farmers during culture period but only 6.67% farmers used this dose in pond preparation.

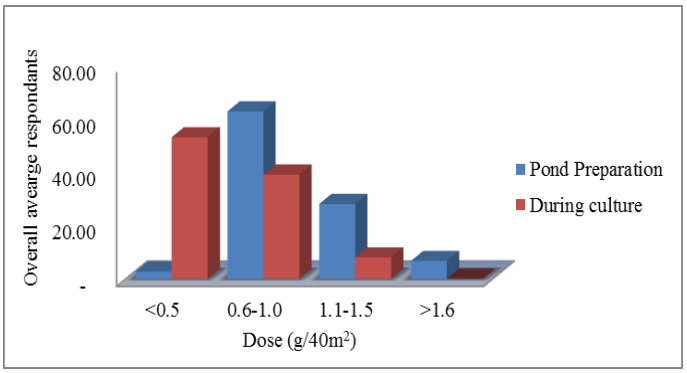

Figure 2. Doses of lime used (%) during pond preparation and culture period.

Chinabut and Lilley (1992) stated that quick lime and slaked lime both have a very high p^H and in addition to increased alkalinity, can have a sterilizing effect against disease. Chowdhury *et al.* (2003) reported that lime and salt treatment of 250 kg/ha respectively were found to be the most effective to suppress the ulcer disease through pond treatment. Sultana (2004) also found similar results about lime use in Mymensingh area. Brown and Brooks (2002) also found in a survey that 40% of farmers in Bangladesh use lime for disease treatment. Lilley *et al.* (1997) reported the success in pond treatment by using agricultural lime at the amount of 150-600 kg/ha in 1.0 m.

3.2.2. Use of urea

A dose 100-150g per 40m^2 was used by most of the farmers. About 37.3% farmers use this dose during pond preparation. Most of the farmers (58.7%) do not prefer to use urea during culture period. The overall average dose of <100g per 40m^2 and 150-200g/40m^2 were used by 8% and 9.3% farmers respectively during culture period. Most of the catfish farmers (72%) did not used urea during culture period, 56% catfish farmer also did

not use urea during the pond preparation. Only a few farmers (4%) were found to use higher dose 200-250 g of urea during pond preparation. This dose was found to use by only (1.3%) during culture period.

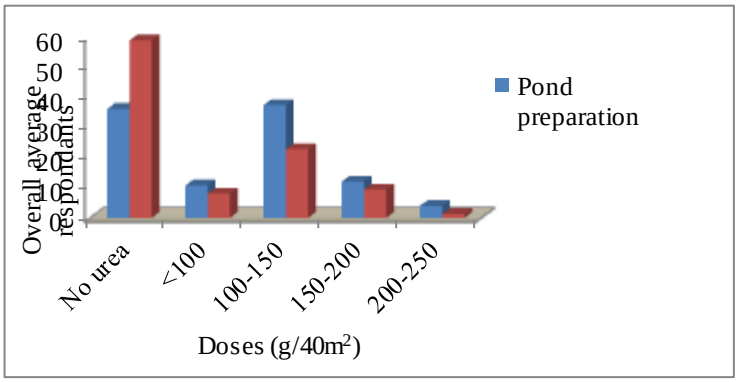

Figure 3. Use of urea (%) during pond preparation and culture period.

Faruk *et al.* (2005) observed that commonly used chemicals in aquaculture are lime, salt, urea, TSP etc. Sultana (2004) also found similar results about lime use in Mymensingh area.

3.2.3. Triple super phosphate (TSP)

TSP is an important chemical used by the farmers to increase natural food production in pond. Most of the farmers used 50-100 g/40m^2 of TSP. The dose was applied by about 58.7% farmers during pond preparation and 68% farmers during culture period. A dose of <50g per 40m^2 was also used by about 20% farmers during pond preparation and 21.3% farmers during culture period. The highest dose >100g/40m^2 of TSP was used by 10.7% farmers during culture period while during culture period this dose was used by only 2.7% farmers.

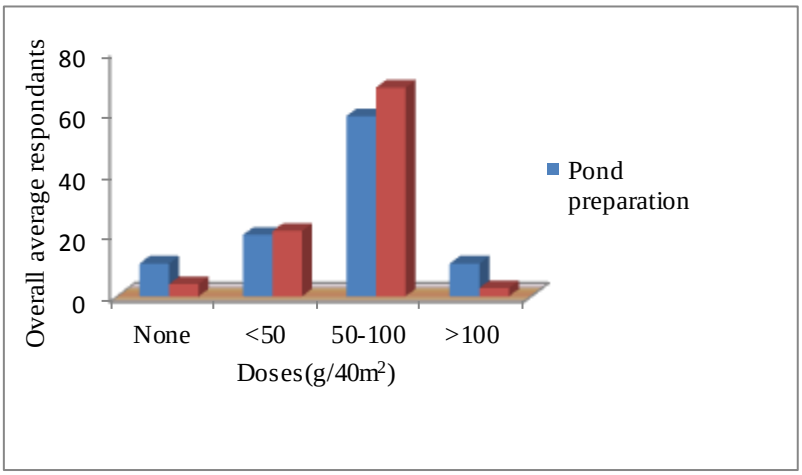

Figure 4. Use of TSP (%) during pond preparation and culture period.

Faruk *et al.* (2005) observed that commonly used chemicals in aquaculture are lime, salt, urea, TSP etc. Sultana (2004) also found similar results about lime use in Mymensingh area. Brown and Brooks (2002) found that in a survey in Bangladesh about 52% farmers used potassium permanganate, while 40% used lime, 11% used salt as a disease treatment, A few farmers used other treatments such as disinfectants (Savlon and Dettol). Banana leaves, fertilizer, alum and water exchange.

3.3. Chemicals used in fish health management

3.3.1. Chemicals used as disinfectant in the study area

Disinfectants are widely used throughout the world in many spheres of aquaculture. The greatest quantities are used in intensive culture, particularly in fish and shrimp hatcheries and grow-out facilities, they are used in site and equipment preparation, to maintain hygiene throughout the production cycle and in some cases, to treat disease.

Table 4. List of available disinfectant in market and used by the farmers in study area.

Trade Name	Active Ingredients	Dose	Sources	Price (Tk.)
Bleaching Powder	Chlorine	60 ppm	Chemical seller	50/kg
Polgard	3 methyl, 4 Alkyl two chain brominated compounds	500 ml/4046.86m^2	Fish Tech BD.	200/200 ml
Virex	Potassium peroxi mono sulphate 50%	100-150g/42m^2	ACI Animal Health	400/100g
Timsen	n-alkyl dimethyl benzyl ammonium chloride+stabilized urea	20g/40m^2 (for prevention)and 80g/42m^2 (for treatment)	Eon animal health products Ltd.	260/50g
Aquakleen	Tetradesail Tri-methyl Ammonium bromide, BKC	0.5-1.1/4046.86m^2	Square Pharmaceuticals Ltd.	300/L
Germnil	BKC 50% with Glutaraldehyde	1-1.5 Litre/4046.86m^2	NAAFCO Pharma Ltd.	780/L
Pond Safe	Alkyldimethylbenzylammonium Chloride Solution 80% Inert Ingredients 20%	500-600 ml/4046.86m^2 (for prevention) 600-800 ml/4046.86m^2 (for treatment)	Fish Tech BD.	400/100 ml

Disinfectants are widely used in many sphere of aquaculture. They are used mainly to disinfect hatchery and other equipment and in some cases as disease treatment. The chemicals widely used as disinfectants in aquaculture in Zakigonj area include Formalin, Lime, Bleaching Powder, Timsen, Malachite Green, EDTA, Virex, Etinol and Polgard Plus. Rahman (2011) also found disinfectants in his study such as Polgard Plus, Bactisal, Virex, Biogaurd, Lenocide, Timsen, Emsen, Aqua Cleaner Plus, Formalin and Bleaching Powder. Sheriff *et al.* (2000) observed that traditional disinfectants were Lime, Teaseed Cake, Fonnalin, Benzalkonium Chloride, Malachite Green and Hypochlorite. According to the information of leaflets provided by the Eon Animal Health Products Ltd, Timsen was also used as preventive measures for some bacterial, fungal and viral infections. According sales representative of Eon Animal Health Products Ltd, Efinol uses as stress resistant and Formalin to control protozoan diseases. Ali (2008) observed that Timsen was effective to prevent some bacterial and fungal infections Herwig (1979) mentioned that Formalin was active against a wide range of organisms, such as fungi, bacteria and ectoparasite. Lime was also used as disinfectant in both the study areas. Apud (1984) observed that farmers used Formalin as disinfectant and to control protozoan diseases and Lime as disinfectant.

3.3.2. Chemicals used to improve dissolved oxygen level in the study area

Several chemicals with very similar names were seen readily available in the chemical shops of the study are used for increase dissolved oxygen in fish pond. Oxidizing agent, hydrogen peroxide is the major active ingredients of such chemical.

Farmers of the investigated areas used several chemicals with very similar names to increase dissolve oxygen in fish ponds like Oxyflow, Oxymax, Oxy Plus, Bio Care, Bio- Ox, Oxy-Gold and Oxy·A. Rahman (2011) observed that aqua drugs like Oxy- Gold, Oxy Life, Bio Care, Oxy Plus, Pure Oxy, Oxymax and Oxyflow were used to increase dissolve oxygen. Oxydizing agent, Hydrogen Peroxide was the major active ingredients of such chemicals According to local agents of Novartis Pharmaceuticals Ltd. and Eon Animal Health Products Ltd., Oxyflow and Oxymax are used to remove hardness and poisonous gases. Ali (2008) mentioned that Oxyflow and Oxymax were used to remove hardness and poisonous gases.

3.3.3. Chemicals used for disease treatment in study area

Farmers used several chemicals for treating a variety of fish diseases with different dosage. Mostly traditional chemicals were available in the shops for treatment of fish disease. Potash, Lime, Salt, Virex, Timsen, Aquakleen, Germnil, Pond Safe, Deletrix, Spa, Albez, Ablez were used regularly for disease treatment (Table 5).

Table 5. List of available chemicals for increasing dissolved oxygen in market and used by the farmers in study area.

Trade Name	Active Ingredients	Dose	Sources	Price (Tk.)
Oxy gold	Sodium percarbonate	250-500g/4046.86m^2	Fishtech (BD) Limited	550/kg
Oxy plus	Na_2O_2+$Al(OH)_3$ Na_2O_2-90%	500g/4046.86m^2	Navana Animal Health	530/kg
Bio-Ox	Sodium carbonate, H_2O_2	General dose 2.5-5g/4046.86m^2. In case of high deficiency 5-8g/ 4046.86m^2 in same waterbody	ACI Animal Health	500/kg
Oxymax	H_2O_2 10%	250-500 gm/4046.86m^2	Eon Animal Health Products Ltd.	600/Kg
Oxy flow	H_2O_2 10%	General dose: 250-350g/4046.86m^2. In case of high deficiency 500 gm/4046.86m^2 in same waterbody	Novartis Pharmaceuticals Ltd.	600/kg
Oxylife	Oxygen precursors, Probiotics, Detoxificants	For normal dose 400g/4046.86m^2 For emergency 500g/4046.86m^2	Square Pharmaceuticals Ltd.	600/kg
Oxywell	Sodium percarbonate, Tetra acetyl ethylene di amine	150-200g/4046.86m^2	First care agro.	500/kg
Oxy- A	Sodium percarbonate	3-4g/ 40 m^2	ACME Laboratories Ltd.	480/kg

Table 6. List of available chemicals for disease treatment in market and used by the farmers in study area.

Trade Name	Active Ingredients	Sources	Price(Tk.)
Potash	$KMnO_4$	Chemical seller	180/Kg
Lime	Cao, $Ca(OH)_2$	Chemical seller	10/kg
Salt	NaCl	Chemical seller	8/Kg
Virex	Potassium peroximono sulphate 50%	ACI Animal Health	400/100g
Timsen	n-alkyl dimethyl benzyl ammonium chloride+stabilized urea	Eon animal health products Ltd.	260/50g
Aquakleen	Tetradesail Tri-methyl Ammonium bromide, BKC	Square Pharmaceuticals Ltd.	300/l
Germnil	BKC 50% with Glutaraldehyde	NAAFCO Pharma Ltd.	780/L
Pond Safe	Alkyldimethylbenzylammonium Chloride Solution 80% Inert Ingredients 20%	Fishtech (BD) Limited	400/100ml
Deletrix	Deltametrin-1.75%	Fishtech (BD) Limited	
Spa	Protein, cholesteren, ca, Vitamin-D, Carotinaid	Syngenta	4100/kg
Albez	Doxycycline, colistine sulphate+vitamin premix+mineral	Syngenta	253/250g
Ablez	Doxycycline, colistine sulphate+vitamin premix+mineral	Eon Animal Health Products Ltd.	255/250g

Fish disease treatments form the major areas where farmers use ample amount of traditional chemicals. According to the farmers of Zakigonj upazilla, chemicals such as Potassium Permanganate, Lime, Formalin, Salt, Bleaching Powder and Timsen were commonly used in aquaculture. Some previous studies also revealed that chemicals used in fish disease treatment included Potassium Permanganate, Lime, Formalin, Salt, Methylene Blue, Malachite Green, Melathion, Bleaching Powder and Timsen in aquaculture of Bangladesh (Phillips, l996, Brown and Brooks, 2002; DoF, 2002; Faruk *et. al*., 2005). Ali (2008) and Rahman (20ll) found several aqua drugs like Lime, Salt, Potassium Permanganate, Sumithion, Melathion, Formalin and Bleaching Powder were used as disease treatment. According to the farmers of the study area, treatment of diseases in aquaculture had a great value when chemicals used properly but could cause great threads for aquatic organisms if not properly applied Moreover for the success of aquaculture, chemicals must be judiciously and responsibly used. Smith (2002) also contributed that it is important to apply drugs appropriately against disease and proper application methods should apply for aqua-health management.

3.3.4. Antibiotics used for disease treatment in study area

In the present investigation about 8 branded antibiotics with different trade name were seen in the market as well as used by the fish farmers in the study area which are shown in Table 6. The active ingredients of such

antibiotics are mainly oxytetracyclin, chlorotetracycline amoxicillin etc.According to the information leaflet of above antibiotics, all of those antibiotics are effective against bacterial disease. Some of above antibiotics like oxysentin 20%, orgamycin 15% and orgacycline 15% is also effective against EUS. Chlorsteclin and fish cure plays vital role in growth promotion as well as effective against some of disease like dropsy, tail and fin rot, gill rot of fish, etc.

Table 7. List of available antibiotics in market and used by the farmers in study area.

Trade Name	Active Ingredients	Dose	Sources	Price(Tk.)
Renamycin	Oxytetracycline	28-42 g/100 kg feed, 10days	Renata Pharmaceuticals Ltd	82/100g
Oxysentin 20%	OxytetraclineHCl BP	100-200 g/100 kg feed,5-7 days	Novartis Pharmaceuticals Ltd.	700/kg
Chlorsteclin	Chlortetracycline	200-300 g/100 Kg feed (5-7days)	Novartis Pharmaceuticals Ltd.	300/kg
Bactitab	Oxytetracyclin 20%	50 g/kg body weight,5-7 days	ACI Animal Health	70-80/100g
Oxy-D Vet	Oxytetracycline 20% and Doxycycline 10%	1 g/4 Kg fish feed daily	Eon Animal health Products Ltd.	70/100g
Aquamycin	Chlorotetracyclin	Control: 1-1.5 Kg/ton feed at 5 days interval Prevention:400-500g/ton feed at 10 days interval	Fishtech (BD) Limited	700-800/kg
Orgamycin 15 %	Oxytetracycline HCl BP (WSP)	In case of prevention 60 gm/100 kg feed 10 days	Organic Pharmaceuticals Ltd.	70/100g
Orgacycline-15%	Chlorotetracycline	200-300 g/10 kg feed (5-7days)	Organic Pharmaceuticals Ltd.	70/100g

3.3.5. Chemicals used for growth promoter in study area

Several chemicals were found in the chemical shops used as growth promoter as well as for increasing production. Aqua boost contains ß-glucan, immunostimulant, which enhance non-specific immunity in fish. A list of growth promoters is shown in Table 7.

All of the growth promoters play a vital role for rapid growth of fish. Some of these chemicals like aqua boost, fish vita plus, Aqua savor, Eon fish grower, Aqua gel, Panvit aqua, Charger gel, Vitamin F aqua, Aci mix super fish, etc. also improve disease preventing ability of fish. Megavit aqua also increase hatching rate and Aquamin helpful in developing bone of fishes. Aqua savor and Grow fast help in recovering in from malnutrition as well as improve physical condition of fishes.

Aqua drugs of different companies found in the chemical shops of both the study areas as growth promotors were Megavit Aqua, Aqua Bost, Aqua Savor, Fibosol, Aqua Grow·P, Vitamix F Aqua, AQ Grow·G, Aquamin, ACmix Super-Fish and Aquamin Powder. The active ingredients of the mentioned products are Vitamin, Mineral, Amino Acid, Organic Acid, B-Glucan, Binder, Aloe Vera and Multivitamin. Ali (2008) observed Aqua drugs like Megavit Aqua, Aqua Bost, Orgavit Aqua, Vitamin Premix, Aqua Savor, Grow Fast, Diginex Aqua, Fibosol, Aqua Grow-P, Vitamix F Aqua, Cevit Vet, Diamond Fish, AQ Grow-G, Nature Aqua GP, ACmix Super-Fish and Aquamin Powder with the active ingredients included Vitamin, Mineral, Amino Acid, Organic Acid, B-Glucan, Binder, Aloe Vera and Multivitamin were used as growth promotor. From the research finding of Rahman (2011), it was observed that aqua drugs used as growth promotor were Charger Gel, Aqua Boost, Bio- Grow and Grow Fast. All the growth promotors played a vital role for rapid growth of fishes. According to chemical sellers of both the study areas, Aqua Boost and AC Mix Super-Fish also used to prevent diseases in fish. Moreover Aqua Savor and Aqua Grow-P were used against malnutrition as well as to improve health of fish. Faruk *et al.* (2008) observed that Aqua Boost and AC Mix Super-Fish also had disease preventing ability in fishes. The authors farther mentioned that growth promotors like Vitamins, Minerals and Phospholipids enhanced in growth and survival of cultured fishes.

3.3.6. Chemicals used as immunity increaser and stress reducer in study area

Several aqua-medicines were found in the aqua-medicine shops that were reported to be used as immunity increaser. The available immunity increaser were Ossi-C, Vitex-C, Charger gel, Biomin Pondlife, Profs, Aqua photo, Novio plus, Uni sense, Osmosaline, Aquaclear-S etc. The active ingredients of such medicines were mainly vitamin-C, Ca, P, Amino nitrogen, betain, glucan, polyssceharides, beta-glucans, oxolinic acid

bitaglucan, Vit-D3, herbs, polysscharix, oligosscliarix. The price was found to be quite affordable by the commercial aqua farmers.

Table 8. List of available growth promoter in market and used by the farmers in study area.

Trade Name	Active Ingredients	Dose	Sources	Price (Tk.)
Aqua Savor	Amino acid premix	2-3 kg /Ton feed	Eon Animal health Products Ltd.	750/kg
Eon Fish Grower	Multivitamin and Minerals	1.5-3 g/Kg	Eon Animal health Products Ltd.	150-170/kg
Aqua Gel	Amino Acid, Fatty Acid, Macro and macro minerals and natural antioxidants	5-10 g/ Kg feed for prevention 10-15 g/Kg Feed	Square Pharmaceuticals Ltd.	1000/kg
Panvit Aqua	Vit- A, D_3, B_1, B_2,	In hatchery 05-1 ml/ ton water and for nursery 5-10 ml/kg feed	Square Pharmaceuticals Ltd.	350/kg
Square Aquamix	Vitamin , Minerals, Amino Acid, Probiotic, Yeast and Antioxidant	1g/ kg feed	Square Pharmaceuticals Ltd.	170/kg
Acimix super-fish	Vitamin mineral+ antioxident	1 kg/ton feed	ACI Animal Health	350/2.5kg
Aqumin	Cu, Co, Mg, Fe, Zn, I, Ca, P,D, L. Mithiolin, L-lysin, HCl	1 gm/kg feed	ACI Animal Health	150/kg
Provit gel	Vitamin A, Vitamin B_1,B_2,B_6, Vitamin C, Vitamin D, Niacinamide, Calcium pentothinate, Folic acid , Inositol, Lysine, Methionine, Protein hydrolyzate	10g/ Kg feed	First care Agro. Ltd.	1050/kg
Growth Gel	Gel forming vitamins binders and attractant for aqua feeds	3-5g/kg	Eon Animal health Products Ltd.	1000/kg
Megavit aqua	Vitamin, Mineral and Amino acid supplement	1g/kg feed	Novartis Pharmaceuticals Ltd.	320-350/kg
Grow fast	Vitamin, mineral and amino acid supplement	200–300 ml/100 kg feed	Rals Agro	350/kg
Aqua Boost	Organic acid, Beta-Glucan	500 g/MT feed	Novartis Pharmaceuticals Ltd.	300/kg
Vitamin- F Aqua	Vitamin+Mineral+ Amino Acid	2.5kg/ ton feed	ACME Laboratories Ltd.	300-350/kg
Charger gel	1-3 D glucan, polysaccharides, Betain, β-glucans	2-4g/kg feed	Fishtech (BD) Limited	1060/kg

3.4. List of aqua medicine marketing companies in Bangladesh

Commercial aquaculture has been significantly going through a silent revolution in Bangladesh for last few years. Fish farmers are getting habituated to modern aquaculture technology and systems day by day. As the culture system is developing to a high density aquaculture from extensive culture system so that the associated risks during culture have been increasing simultaneously in the culture ponds. At present there are approximately around 52 national, multinational and local companies involved in production, import and marketing of aqua medicines throughout Bangladesh. The list of these aqua medicines marketing companies in Bangladesh are as follows (Table 10).

Table 9. List of available immunity increaser in market and used by the farmers in study area.

Trade Name	Active Ingredients	Dose	Sources	Price (Tk.)
Ossi-C	Oxolinic Acid, Beta glucan, Vitamin C	4-5g/ Kg feed	Fish tech (BD) Limited	1800/kg
Vitex C	Vitamin C BP	1-5g/ kg feed , 2-5 g/1000 Litre for hatchery	Eon Animal health Products Ltd.	1800/kg
Cevit- Aqua	Ascorbic Acid	For prevention 1 g/ kg feed and for treatment 2-3 g/kg feed	Square Pharmaceuticals Ltd.	2000/kg
Aqua C	Ascorbic Acid	0.1-0.3g/kg feed	ACI Animal Health	1700/kg
Osmosaline	Betain	5-10g/100 Litre(Fry transportation), 10-20g/1000 Litre (Hatchery tank)	Eon Animal health Products Ltd.	1800/kg
Biomax	Probiotics and Nutrients	For pond preparation 3-4 kg/ 4046.86 ^{2}m for 3 feet water, During stocking 4-5 kg/ 4046.86 ^{2}m for 3 feet water	Square Pharmaceuticals Ltd.	2500/kg
Profs	Fourth generation probiotic	50-70 g/42m^2/ 3 feet water	Eon Animal Health Products Ltd.	500/100g
Aqua Photo	Bacillus subtilisand Rhodoseudomonas	50–70 ml/155 m^2	ACI Animal Health	350/L
Probio Aqua LQ	Photosynthetic and Heterotrophic Bacteria	1-2 liter/4046.86 ^{2}m /3 feet water for pond preparation and 25-3 liter/4046.86 ^{2}m / 3 feet water	Square Pharmaceuticals Ltd.	
Novio plus	*Bacillus mensentericus, B. subtilis, B. licheniformis, Lactobacillus acidophilus, Saccharomyces cerevisiae*,	1-3 g/ kg feed	ACI Animal Health	520/500g
Uni ecosense	*B. subtilis, B. licheniformis, B. polymyxa, B. pumuls, Thiobacillus deniftrificans,Aspergillus oryzae, Aspergillus niger, Pseudomonas denetrificans, Bacillus coagulans*	Fish:250-300g/4046.86 ^{2}m Shrimp:75-100 g/4046.86 ^{2}m	First care	500/kg
Aquaclear -S	*Bacillus mensentericus, B. subtilis, B. licheniformis, Lactobacillus acidophilus,Nitrobacter sp, N7trosomonas sp. , Aspergillus oryzae, Saccharomyces cerevisiae, Excipient q.s.p*	First dose: 1Kg/ 4046.86 ^{2}m for 1m water depth From second dose: 500g/ 4046.86 ^{2}m for 1m water depth	Square Pharmaceuticals Ltd.	560/500g

Table 10. List of available toxic gas remover in market and used by the farmers in study area.

Trade Name	Active Ingredients	Dose	Sources	Price(Tk.)
Bio- Aqua-50	Yucca plant extract, Saponin Components, Glyco components	60-70 ml/42m^2	Eon Animal Health Products Ltd.	2900/kg
Gastrap	Lactic acid bacillus, *Bacillus Subtilis*, *Saccaromyces cerevisiae*, Xylogen, Amylase, Protease, Cellulase, Hemicellulase, Phytase, Betaglucanase, Lypase, Aminonitrigen	200g/4046.86m^2 for 3-6 feet water	Square Pharmaceuticals Ltd.	3000/kg
Ammonil	Yucca plant extract, *Bacillus subtilis*, *Candida utilis*	100-200g/4046.86m^2	Novartis Pharmaceuticals Ltd.	2800/kg
Pond D tox	*Pracoccus pantotrophus*	4 ppm	Fish tech BD	2800/kg
Gasonex (+)	*Pseudomonas* sp, *Bacillus subtilis*, *Nitrococcus* sp	General dose 250-500 g/4046.86m^2; In case of high deficiency 750-1000 gm/4046.86m^2	Fish tech BD	2950/kg

3.5. No. of Products of Different Pharmaceuticals companies

In the present study, about 52 companies were found either producing or marketing products targeting aquaculture. ACI Animal Health Ltd., Organic Pharmaceuticals Ltd., Renata Ltd., Square Pharmaceuticals Ltd., Acme Laboratories, Novartis Animal Health Ltd etc. were seen to produce different products for aquaculture. While Eon Animal Health Products Ltd., CP Company, Rals Agro Ltd., Ellwellas Marketing Ltd. have been marketing various products from different countries including India, USA, Thailand, Taiwan, Indonesia, Malaysia and Spain. They provide detail information about the purposes, dosages, duration and method of application of chemicals in the leaflet. However, farmers had different opinion about the use and efficacy of many of the products. Some companies were seen to provide technical assistance to the farmers. Thus, the farmers fetch considerable pressure from the commercial companies to use a variety of products in their farms. Several products have been sold without any explanation of their action. The present survey revealed that among the 52 companies more than 50 % of the products were produced by twelve companies like Fish Tech BD,(6%), Organic Pharmaceuticals Ltd. (4%), Rals Agro Ltd. (4%), Novartis Animal Health Ltd. (5.66%), Eon animal Health Product Ltd. (7%), ACI Animal Health Ltd. (7.34%), CP Aquaculture (5.66%), Square Pharmaceuticals Ltd. (4.33%), Advanced Animal Health(5.67%). C.P. India (2%), First Care Agro. Ltd. (4%), Novartis (2.33%) and the rest (46.67%) were supplied by the 26 companies.

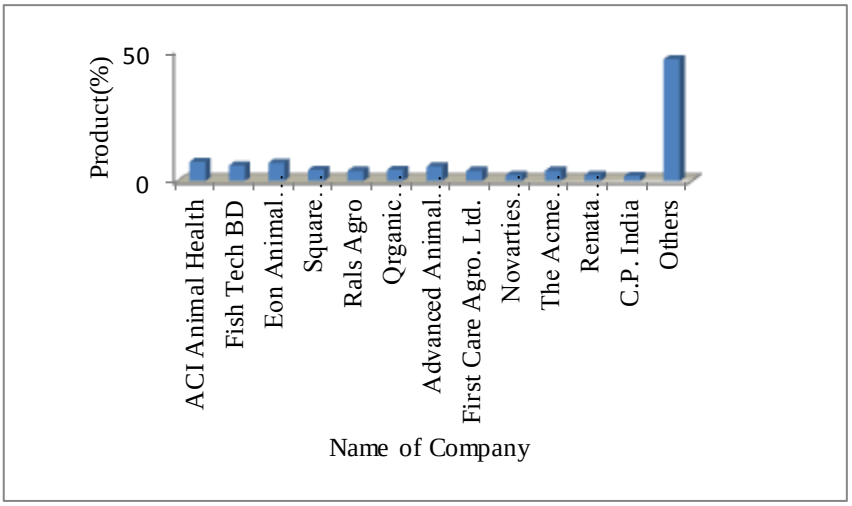

Figure 5. Product (%) of different pharmaceutical companies.

Table 11. List of aqua medicine marketing companies in Bangladesh.

S.L. No.	Company Name
1	ACI Limited
2	Advance Agrotech Bangladesh
3	Advance Animal Science Co. Ltd
4	Alltech
5	Allwell Marketing Company
6	Al-Madina Pharamaceuticals Ltd.
7	Anivet Agro Products Ltd.
8	Annex vet (pr.) ltd
9	Aquatech M. H. Limited
10	Avon Animal health Ltd.
11	Bengal Overseas Ltd.
12	Biohealth Company Limited
13	Bismillah Corporation
14	Century Agro Ltd.
15	Dier Pharma
16	Doctor's Agrovet Ltd.
17	Eon Animal Health Products Ltd.
18	Eskayef Bangladesh Ltd
19	First Care Agro Limited
20	Fish World
21	Fish tech (BD) Limited
22	Grameen agri care BD Ltd.
23	Haychem Bangladesh Ltd.
24	HOM Agro Enterprise
25	Impex Marketing Ltd.
26	Jayson Agrovet Limited
27	KR+F Agro Products Ltd.
28	Krishi Bangla
29	Lion Overseas Limited
30	M.R Enterprise
31	National Agricare Bangladesh
32	Nature Care MFG Ind. Ltd.
33	Navana Pharmaceuticals Ltd.
34	Novartis (Bangladesh) Limited
35	Nutrihealth Ltd.
36	Organic Pharmaceuticals Ltd
37	Penta Agrovet Ltd.
38	Pharma and Firm
39	Popular Pharmaceuticals Limited
40	Popular Pharmaceuticals Limited
41	Promi Agrovet Limited
42	Rals Agro Limited
43	Renata Limited
44	Silo Animal Health Ltd.
45	Solid Aquavet Ltd.
46	Square Pharmaceuticals Ltd
47	The ACME Laboratories Limited
48	Unique International
49	Univet Limited
50	Verno Bio Solution
51	Welltech Biotechnology Limited
52	Wilts Marketing Co. Ltd.

At present approximately 300 products of about 52 animal health companies were seen to market and field level. The pharmaceutical companies also employ number of promotion officers to sell their chemicals. Some

companies were seen to provide technical assistance to the farmers. Thus, farmers come under considerable pressure from commercial companies to use a variety of aqua drugs and chemicals in their farms. There are new aqua drugs being made available continually and often there is very little information available about their efficacy. Some aqua-medicines were found only trade names. Either farmers or sellers did not have clear idea about the active ingredient and method of applications of the particular aqua-medicines though they were using those without hesitation. Only few companies provide details product profile to the farmers. lt was seen that same products of different companies variable dosage. So farmer feels hesitation before using those aqua-medicines. Most of the farmers does not know efficacy of that products. The pharmaceutical companies should take care about those products.

3.6. Problems in use of drugs and chemicals

The present study identified some problems associated with the use of drugs and chemicals which included:

i) Lack of knowledge about use of chemicals
ii) Lack of knowledge of application of drugs and chemicals
iii) Indiscriminate use of chemicals
iv) Pressure on farmers from pharmaceutical companies and pesticide sellers
v) Lack of awareness about the safety issues in using hazardous chemicals
vi) Lack of information on the label of chemical about possible hazard
vii) Lack of knowledge about residual effect and expiry date.

4. Conclusions

The present study demonstrated current status of drugs and chemicals using in aquaculture in Zakigonj upazilla and pointed out some problems of the use of chemicals by the farmers which include lack of knowledge of the chemicals, doses and methods of application of these chemicals. There are few alternatives to minimize the adverse effects of aquaculture chemical are simply use less of them. Other alternatives could be used as bioremediation and use of probiotics, immunostimulants, vaccination and alternative therapeutic. However, policy makers, researchers and scientists should work together in addressing the issues of chemical use in aquaculture with the view to reduce the negative impacts.

Conflict of interest

None to declare.

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