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Article

Agrochemicals used in freshwater aquaculture in Jhenaidah district, Bangladesh

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Abstract: The present experiment was conducted in order to investigate the use of agrochemicals in freshwater aquaculture with emphasis on fish health management. The selected area was Mahespur upazila under Jhenaidah district and the study duration was six months. The main group was fifty fish farmers and the data were collected through interview with fish farmers and key informants (chemical seller). Ten categories of chemicals were identified that are used by fish farmers for various purposes such as pond preparation, water quality management, controlling diseases, supplying oxygen, killing fish predators, Ten pharmaceutical companies were found to provide the agrochemicals to fulfill the farmers need. These companies are Novartis Anmal Health Ltd, Fishtech (BD) Ltd, SK+F BD Ltd, Renata Ltd, ACI Animal Health, Opsonin Pharma Ltd, Eon Animal Health Products Ltd, Square Pharmaceuticals Ltd, Sciencetech Agro Industries Ltd, Rals. In the study area some kinds of diseases were founded such as Epizotic Ulcerative Syndrome (EUS) in Rohu (*Labeo rohita*), Catla (*Catla catla*), Mozambique tilapia (*Oreochromis niloticus*), Black spot in Stinging cat fish, skin diseases, gill damage, tail and fin rot in Yellow tail catfish (*Pangasius pangasius*). For highest stocking density tilapia and pangus were mostly affected by diseases in winter. Farmers use various chemicals such as for water quality management agriculture lime, Geotox, JV Zeolite, Mega Zeo Bio, Aquakleen and Biomin, as antibiotic they use Novamix 101, Erocot, Captor, Oxysentin 20%, Renamycin, Aquamycin and Oxysentin 20% are antibiotics with different trade names were seen in the market as well as used by the fish farmers in the study area. The fish farmers use a wide variety of disinfectants in freshwater aquaculture. Timsen, Polgard plus, Formalin, Bleaching powder, EDTA are found available in all the shops of Mahespur. Formalin is used to control protozoan diseases. Virex is used to destroy virus and bacteria. Fish farmers use oxygen suppliers to increase the oxygen level in the water body. Oxidizing agent, hydrogen peroxide are major active ingredients of such chemical. The recovery of fish diseases was found 80-90% in the study area. During field observation many problems were identified in case of using agrochemicals which included lack of skill and knowledge of farmers about the application, withdrawal period of agrochemicals and drugs and some adverse effects on fish and human health.

Keywords: aqua medicine; agrochemicals; inland aquaculture; Jhenaidah district; Bangladesh

1. Introduction

In Bangladesh the production of aquaculture is increasing day by day through diversification (Mahmud *et al*., 2012). In the past, people depended mainly on wild fishes and other natural resources but catches have declined due to increased fishing effort and range of other anthropogenic pressures (Apu, 2014). As a result, aquaculture has grown rapidly to fill the gap. Maheshpur is an Upazila under Jhenaidah District. Fish culture mainly dependent on the input of formulated feeds and the application of agro chemicals. But different types of diseases

could be found in farmed aquatic animals in Bangladesh (Karim and Stellwagen, 1998; BFRI, 1999; Faruk *et al*., 2004a). A number of diseases like Epizootic Ulcerative Syndrome (EUS), skin erosion, gill damage, tall and fin rot are common in farmed fishes of Bangladesh (Faruk *et al*., 2004b). To cure disease and maintain proper health condition of fish agrochemicals play a vital role. Chemicals are indeed an essential ingredient to successful aquaculture, which has been used in various forms for centuries (Subasinghe *et al*., 1996). Chemicals and antibiotics are important components in health management of aquatic animals, pond construction, soil and water management, improving aquatic productivity, transportation of live fish, feed formulation, manipulation of reproduction, growth, processing and value addition of the final product (Subasinghe *et al*., 1996). In aquaculture, chemicals can be classified by the purpose of uses, the type of organisms under culture, the life cycle stage for which they are used, the culture system, intensity of culture and by the type of people who use them (Primavera *et al*., 1993). The world agrochemicals is a general term used to refer to chemicals that are employed to control, destroy, mitigate, prevent or repel pests on agricultural products (Meisinger and Delago, 2002). Agrochemicals include pesticides, lime, antibiotic, hormones etc. Commonly used chemicals in Bangladesh aquaculture are lime, rotenone, various forms of inorganic and organic fertilizers, phostoxin, salt, dipterex, antimicrobials, potassium permanganate, copper sulphate, formalin, sumithion, melathion etc. (Brown and Brooks, 2002; Faruk *et al*., 2005). Although aquaculture industry is growing in Mahespur upazila, Jhenaidah, Bangladesh, and a large number of aqua chemicals are being used by the farmers, but no previous systematic investigation were conducted to evaluate the present status of agrochemicals used in aquaculture in this present study area. Considering above mentioned prospects and knowledge gap, this study was conducted to identify different types of agrochemicals used in aquaculture in the study area and to know the purposes, dose and mode of application of the used agrochemicals.

2. Materials and Methods

2.1. Study area and period of study

The study was carried out from November 2018 to May 2019 on the fishing community of Mahespur upazila under Jhenaidah district. The area is located between 23°21' to 23.35° north latitude and 88°54.8' to 88.9133° east longitude.

2.2. Selection of target group and sample size

The target group was fishermen who were involved in using agro chemicals using for fish health management permanently (as the primary income source) and partially (as the secondary income source) from aquaculture. The data were collected randomly from 50 fishermen and agrochemicals seller.

2.3. Data collection

Primary data were collected by field survey and selection of fishermen, questionnaire interview, and Focus Group Discussion (FGD). Secondary data were collected from various books, reports, journals, bulletins, thesis paper and organizations.

2.4. Data processing and analysis

After data collection, these were verified to eliminate errors and inconsistencies. Any kind of inconsistencies in collected data were searched and discarded from the data. Data were processed and finally analyzed using tabular method. The data of local units were converted into international unit before analysis. The data were calculated by Microsoft Excel 2010.

3. Results

3.1. Basic profile of the fishermen

3.1.1. Family size and type

The result showed about 70% families were small (2-4 person), 24% families were medium (5-7 person) and 6% families were large (8 person and above) (Figure 1).

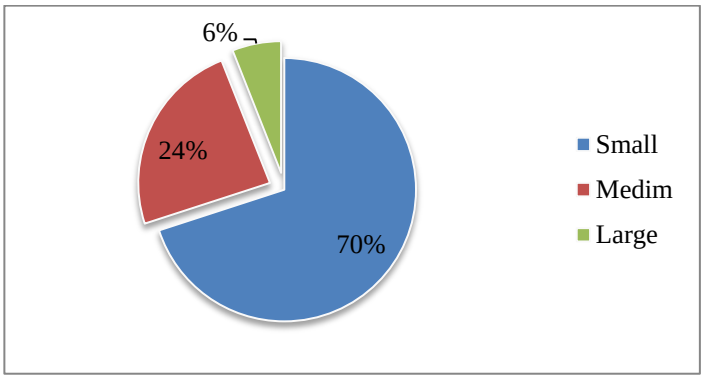

Figure 1. Family size of the respondents.

3.1.2. Age of the fish farmers

About 18% of the fish farmers were less than 26 years and 2% were 15-18 years old. They are divided into three categories. Young (18-25) years, middle (26-45) years and old above 45 years (Figure 2).

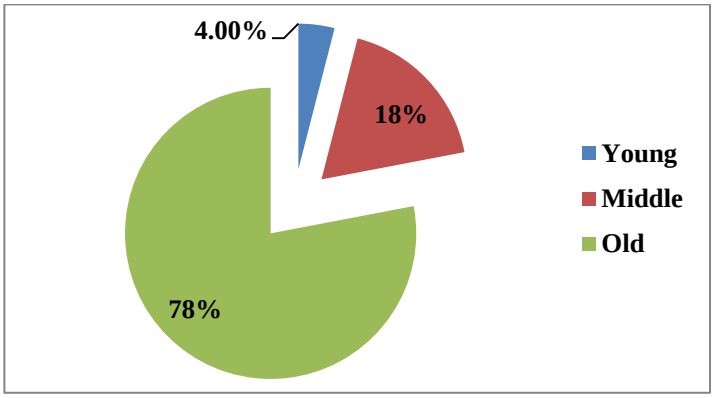

Figure 2. Age categories of the respondents.

3.1.3. Educational status

About 6% fish farmer had no education. About 35% people can only sign only and 80 % were gained their primary education only. 5% fish farmer had education up to S.S.C level only. Between them 4 % fish farmer had gained higher education and acquired bachelor degree (Figure 3).

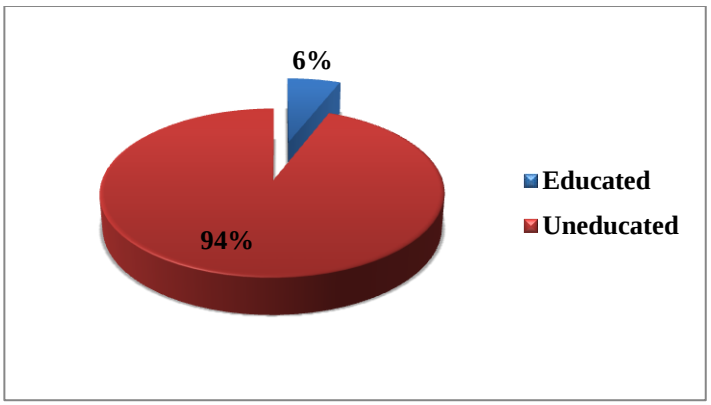

Figure 3. Educational status of the respondents.

3.1.4. Pond ownership and land holding status

Among 50 fishermen of my study areas about 75% farmers having single ownership and 25% farmers having multiple ownership. About 82% fishermen had own land and the other farmer about 18% had culture others land (Table 1).

Table 1. The land holding statuses of farmer.

Categories	Min (ha)	Max (ha)	Mean ± SD
Small (.6-2.67) ha	0.6	2.67	1.613±0.536
Medium(2.81-6.69) ha	2.81	6.69	4.478±1.104
Large(6.82-12.04) ha	6.82	12.04	9.508±2.130

3.1.5. Occupation

The fishermen of my study area had more than two occupations. They all were not involved with fish culture completely. Fish culture was the main occupation of the maximum fishermen the percentage was about 94%. Besides fishing some people involved with other profession as their secondary occupation. The percentage of these kinds fishermen was about 6%. Some fishermen found in the study areas that they become involved with the secondary occupation when primary occupation means fishing cannot provide full time employment. Most of them were involved with agriculture besides of fishing.

3.1.6. Sources of credit

In my study areas it was found that about 76% fishermen used their own money for their culture practice. About 8% of them received credit facilities from the bank and others were involved with different NGOs for their credit facilities purposes. The amount of their loan was minimum 10,000BDT to 60,000 BDT respectively. The mean of loan was 32083.33±15733.33. They had to pay the extra interest was about 650BDT to 9,000BDT.

3.1.7. Training status

About 75% fishermen of my study areas had no formal training. They were gained experience by self-practice. About 25% fishermen were getting formal training from the Upazila Fishery office with the help of Department of Fisheries (DoF).

3.1.8. Crop farming status

About 6% fishermen were involved with crop farming besides of fish culture. Maximum of them were small fishermen. They were gross paddy only Boro season. The cultivated land were recorded that minimum 0.6 ha to 1.6 ha. The mean of cultivated areas was 0.98±0.54 and production 4278.33±1492.37. The average cultivation cost was 431666.67±33579.51. The mean gross income per ha was 59083.±45989.35.The data are given in the (Table 2).

Table 2. Crop farming status of farmer.

Issue	Min	Max	Mean ± SD
Cultivated area (ha)	0.6	1.6	0.98±0.54
Cultivation cost(BDT/ha)	4500	65000	431666.67±33579.51
Production (kg/ha)	2560	5250	4278.33±1492.37
Gross income(BDT/ha)	7250	95000	59083±45989.35

3.1.9. Household income and expenditures

In my study areas it was found that the HH income of the fishermen was minimum 15,000BDT and maximum 1,67,000 BDT. The mean of the amount was 52520±42408.24 BDT (Table 3).

Table 3. Household income and expenditures of the respondents.

Expenditure issue	HH (%)	Cost (BDT/year)		
		Min	Max	Mean ± SD
Food	100	8500	75000	38060±20714.19
Education	60	1000	30000	14640±11135.08
Health	100	500	5000	2458±1857.92
Cloths	100	1000	25000	8800±7886.96
Furniture	100	2000	70000	26340±24701.98
Others	100	1000	7000	3600±2626.39

3.2. Agrochemicals used by fish farmers in Maheshpur

3.2.1. Chemicals for pond preparation and water quality management

For water quality management agriculture lime, Geotox, JV Zeolite, Mega Zeo Bio, Aquakleen and Biomin pond life have been used in the study area (Table 4).

Table 4. List of water management chemicals used in pond.

Trade Name	Active ingredients	Dose	Source	Price (Taka)
Agricultural lime	$CaCO_3$	spread with water6-10 ppm	Chemical seller	8-15/kg
Mega Zeo Bio	SiO_2, Al_2O_3, CaO, MgO, Fe_2O_3, Na_2O	200 gm/dec	ACI Animal Health	340/10kg
Geotox	SiO_2, Al_2O_3, CaO, MgO, Fe_2O_3, Na_2O	For 3-6 feet deep water 20-25 kg/dec about 30-40 days	Noverties Animal Health Products Ltd.	55/kg
JV zeolite	SiO_2, Al_2O_3, CaO, MgO, Fe_2O_3, Na_2O, K_2O, Mn, P	6-7 kg/33 dec up to mud	Eon Animal Health Products Ltd.	350/10 kg
Biomin pond life	Probiotics	200/Bigha	Renata Ltd.	2100/kg

3.2.2. Antibiotics

All of these antibiotics are effective against bacterial disease. These broad spectrum antibiotics were found to use by mixing with fish feed. The list of antibiotics is given in Table 5.

Table 5. The list of antibiotics used in pond of study area.

Trade name	Active ingredients	Purposes	Dose	Source	Price (Taka)
Aquamycin	Oxytetracyclin HCL 25%	To reduce mortality, To help retaining color of fishes	1-2 g/Kg feed	ACI Animal Health	70/100g
Renamycin soluble powder	Oxytetracyclin 200 mg	To improve immune system of fishes	50 mg/Kg fish body 10 days	Renata Ltd.	820/kg
Novamix 101	Doxycyclin	Effective for streptococcus infection	2-3 g/kg feed	Fishtech (BD) Ltd.	37/100g
Neoxel	Neomycinesulphate	Effective for all gram posiive gram negative bacteria	1g/20 kg feed	SK+F BD Ltd.	290/100g
Novamix 103	Erythromycin	To kill the aquatic harmful germ	2-3 g/feed	Fishtech (BD) Ltd.	330/100g
Captor	Chlortetracycline HCL 45%	To increase fish production, To improve immune system of fishes	50-70 g/100 Kg feed for 5-7 days	Novartis Anmal Health Ltd.	405/100g
Oxysent 20%in	Oxytetracyclin HCL 200 mg	Most effective in the treatment of EUS	100-200 g/100 kg feed for 5-7 days	Novartis Anmal Health Ltd.	840/1kg
Erocot	Erythromycin+Sulphodiazine	To improve immune system of fishes	1g/10 kg feed for 2-5 days	Opsonin Pharma Ltd.	420

3.2.3. Disinfectants

Timsen, Polgard plus, Formalin, Bleaching powder, EDTA are found available in all the shops of Mahespur. The list of disinfectant is given in Table 6.

Table 6. List of disinfectant used in pond of study area.

Trade name	Active ingredients	Purposes	Dose	Source	Price (Taka)
Timsen	n-alkyl dimethyl benzyl ammonium chloride-40%, Stabilized Urea-60%	Quickly eliminate micro organisms in fish ponds	80g/33 decimal (1st dose) 50g/33 decimal (2nd dose)	Eon Animal Health Products Ltd.	260
Formalin	40% Formaldehyde	To remove infectious disease	1-3 ppm	Chemical seller	70/kg
Bleaching Power	Chlorine	To kill virus microbes	60 ppm	Chemical seller	50/kg
Virex	Potassium peroxymono sulphate 50%	To protect from bacteria and virus, To protect from black gill, tail,rot and lesion	150-200 gm/1 bigha for 3-6 feet depth and after 1 days-1000gm/ bigha for 3-6 feet depth	ACI	170
Aquakleen	Tetradesailtrymethyl, ammonium, BKC, Amino nitrogenet	To protect from various microbes	0.5 L/acre	Square Pharmaceuticals Ltd.	432/L

3.2.4. Oxygen supplier

Oxydizing agent, hydrogen peroxide are major active ingredients of oxygen supplier. Oxygen supplier used in the study area is shown in Table 7.

Table 7. List of Oxygen supplier used in pond of study area.

Trade name	Active ingredients	Purposes	Dose	Source	Price (Taka)
Oxygold	Na_2Co_3, H_2O_2-90%	Produce/Supply Oxygen	750-1000 gm/acre	Fishtech (BD) Ltd.	670/kg
Oxygrow	10% Hydrogen peroxide	To supply sustained Oxygen for fish	250-300 gm/acre/3-6 feet depth (Two times weekly)	Novartis Anmal Health Ltd.	200
Oxylife	Oxygen precursors, probiotic and detoxificant	To remove toxic gases by aerobic decomposition of organic wastages	400 gm/acre (3-6 feet depth)	Square Pharmaceuticals Ltd.	610
Bio-Ox	Sodium per carbonate	To supply Oxygen	10 gm/dec	ACI Animal Health	475/kg
Bio Care	Sodium Lorile Ether Sulphate	To supply Oxygen	80-120 ml/100 dec	ACI Animal Health	300/L
Oxyren	Sodium Carbonate per Oxyhydrate	To help of the decomposition of organic wastages	500-700 gm/acre (3 feet depth)	Renata Ltd.	610/kg

3.2.5. Growth promoter

There are several chemicals found in the chemical shops which were used as growth promoter as well as to raise production of fish (Table 8).

Table 8. List of growth promoter used in pond of study area.

Trade name	Active ingredients	Purposes	Dose	Source	Price (Taka)
Aquaboost	Organic acid, betaglucan	To increase the immunity of fishes, To keep good health of fishes	50 gm/kg	Novartis Anmal Health Ltd.	670/kg
Charger Gel	1-3D-glucan, polysaccharide, Betain	To keep good health of fishes	2-4 gm/kg	Fishtech (BD) Ltd.	1060/kg
Aqua Gel	EAA, Fatty acid, minerals, antioxydent, enrich binder gel	To improve the tast of feed for better consumption	In prevention 5-10gm/kg feed per day,In treatment 10-15gm/kg feed per day for 7-10 days	Square Pharmaceuticals Ltd.	560/kg
Acimix super Fish	Vitamin, Mineral, Amino acid	To improve growth of fish	2.5 gm/kg feed	ACI Animal Health	325/2.5kg
Aquamin	Methionin, Lysin	To improve the tast of feed	2-4 gm/kg feed	ACI Animal Health	140/kg
Rena fish	Vit A,B,C,D3,E,K, Cu, Mn, Fe, Co etc	To keep good health of fishes	1kg/ton feed	Renata Ltd.	260/kg
Megavit-Aqua	Vitamin A, Ca, P, Na etc		100gm/100kg feed	Novartis Anmal Health Ltd.	360/kg

3.2.6. Chemicals for disease treatment

Most farmers use Virex, Ablaze, Salt, Sumithion, Methylene Blue, Malchite Green in the treatment of fish diseases. Mainly these were used to protect fishes from bacterial, viral and other fungal diseases (Table 9).

Table 9. List of disease treatment chemicals used in pond of study area.

Trade name	Active ingredients	Purposes	Dose	Source	Price (Taka)
Ablaze	Doxycycline-10000mg, Colistine Sulphate- 1000mg	In prevention single time in monthly	Mainly used in the treatment of lesion	Eon Pharmaceutical Ltd.	390
Salt	Nacl	For eradication of bacterial and external parasites	2.5% for 20-30 minute repeat in 48 hours	Chemical seller	12/kg
Methylene Blue	$C_{10}H_{18}CIN_3SH_2O$	To eradicate bacteria and fungus	3 ppm	Chemical seller	350/25gm
Malchite Green	$C_2H_2O_4$	To eradicate fungus and cyst of parasites	0.15 ppm	Chemical seller	500/25gm
Sumithion	Active sumithion	To eradicate copepods and crustacean parasites of fishes	0.25-0.50 ppm	Chemical seller	60/100ml

3.2.7. Gas reducer

The present study identified a range of chemicals were used to reduce gases and to maintain the proper quality (Table 10).

Table 10. List of Gas reducer chemical used in pond of study area.

Trade name	Active ingredients	Purposes	Dose	Source	Price (Taka)
Gastrap	Biologically derived scavengers, symbiotic in a fortified powder base	To provide oxygen, To increase growth and production	200gm/acre	Square Pharmaceuticals Ltd.	300/kg
Ammonil	Yucca plant extract *Bacilus subtilis*, Micro encapsulated enzyme	To remove ammonia and other harmful gases	200gm/acre	Novartis Anmal Health Ltd.	580/kg
Biopond	Zeolite, Probiotic	To reduce toxic gases in pond	2-3kg/acre in pond preparation, 1-1.5 kg/acre cultural pond	SK+F (BD) Ltd.	425/kg

3.2.8. Vitamin

Vitamin and minerals are important ingredients for growth of fish. Four vitamins with different trade names were found to use by the farmers (Table 11).

Table 11. List of vitamins used in pond of study area.

Trade Name	Dose	Source
Grow fast	1ml/3-4 L	Rals
Nutrigrow	0.5-1ml/ton of water for hatchery,0.5-10ml/kg of nursery pond	Sciencetech Agro Industries Ltd.
Ossi C	4-5gm/kg feed for 5-7 days	Fish tech
Energy Sea	3-5 gm/L for transport of large fish, 1000gm/33 dec before stocking of seed	Sciencetech Agro Industries Ltd.

3.2.9. Enzyme

Only one type of enzyme was used by the farmers in fish feed named Biozyme. They use it at a dose of 25-50 gm/100 kg feed. Fish Tech provides the enzyme to the farmers.

3.2.10. Predator killer

Farmers used rotenone powder to remove predator fish. Rotenone with a brand name Acurte Gold is provided by a pharmaceutical company Samco was found in the study area. The recommended dose of Acurte Gold was 15 gm/decimal/1 ft depth.

3.3. Impact of various agrochemicals on fish health and diseases of fish in the study area

EUS was detected in Tilapia, Rui, Catla and Mrigal with 70% prevalence. Indian major carps found to be susceptible with Lerneasis having 80% prevalence. Pangus were also affected by tail rot and fin rot diseases with having 60% prevalence (Table 12).

Table 12. Impact of various aqua drugs and agrochemicals on fish health and diseases recovery of fish in the study area.

Species	Diseases prevalence	Clinical sign	Agrochemical used	Affected month	Recovery
Rui, Sarputi	EUS (60%)	Red spot body surface	Renamycine 50mg/kg body weight	August	80%
Rui, Catla, Mrigal	Ammonia poisoning (60%)	Red or bloody gill, gasping at the air	Regular water testing and maintaince	January	90%
Tilapia,Rui, Catla, Mrigal	EUS (60%)	Red spot body surface	Antibiotics prevent it	August	85%
Rui, Catla	Oxygen deficiency (70%)	Gasping at the surface with their mouth	Oxyflow, Oxylife, Bio-ox	December	90%
Shing	Black spot (30%)	Small black spot on surface	Use commercially available drugs	January	70%
Magur, Shing,Pangus	Tail rot and Fin rot (40%)	Destruction of fins or tail, exposed fin rays	Tetracycline, Methylene blue	February	85%
Indian major carps	Lerneasis (20%)	Fishes are restless and rub against the side and the bottom of the pond	$KMnO_4$ pond treatment at 4 ppm	January	80%

4. Discussion

In the present study, it was noticed that among 50 fishermen of my study areas about 75% farmers having single ownership and 25% farmers having multiple ownership. About 82% fishermen had own land and the other farmer about 18% had culture others land. In my study areas the minimum and maximum value of 0.6ha and 12.04 ha. The result found in the present study differs from the result reported by Islam *et al*. (2014) and Asif *et al*. (2015) who stated that land condition of fisherman. In this study, it is observed that 80% farmers follow polyculture system and 20% farmers followed monoculture system. The cultured fish species are Rui, Catla, Pangus, Tilapia, Koi, Sarputi and other carps. Most of the farm in our country followed polyculture and some farm followed monoculture system (Rahman, 2012; Haq *et al*., 2017; Shajib *et al*., 2017; Zafar *et al*., 2017). The cultured fishes were Rui, Catla, Pangus, Tilapia, Koi, Sarputi, common carp, Mrigal and Magur in Jamalpur and Sherpur district. Faruk *et al.* (2008) observed that the farmer interviewed were male with an average age of 37 years and the average family size 6; another few study in different place of Bangladesh showed the similar results (Islam *et al*., 2014; Asif *et al*., 2015; Hossain *et al*., 2015; Islam *et al*., 2015; Sharif *et al*., 2015; Sultana *et al*., 2015; Ali *et al*., 2016; Hossain *et al*., 2016; Vaumik *et al*., 2017; Razeim *et al*., 2017; Zaman *et al*., 2017; Islam *et al*., 2017; Asif and Habib, 2017 Adhikary *et al*., 2018a; Mondal *et al*., 2018a; Mondal *et al*., 2018b; Adhikary *et al*., 2018b). But in this study, the interviewed age 34 years old and their average. At present 24 animal health companies were seen to market at field level. In the study area different types of diseases like EUS, tail rot, fin rot, red spot, white spot and dropsy in different fish species mainly in Shing, Koi, Tilapia and Pangus were observed. A number of authors reported the similar condition in aquaculture of Bangladesh (DoF, 2002; Faruk *et al.*, 2004; Asif *et al*., 2014; Shabuj *et al*., 2016; Yeasmin *et al*., 2016; Rahman *et al*., 2017; Neowajh *et al*., 2017; Biswas *et al*., 2018; Rahman *et al*., 2018). Most of the farmers of the selected areas used drugs and chemicals to control these types of diseases. It was observed that farmers of the study areas go good results in diseases treatment by applying single or combination of commercial aqua drugs and chemicals. In some cases after use of drugs they got about 95% recoveries within a short period of time. These result influence farmers to use more commercial aqua drugs and chemicals for diseases control and treatment. Normally in rural aquaculture farmers used traditional aqua drugs such as are lime, salt, urea, triple super phosphate (TSP), potassium permanganate, vitamins, antibiotics, (mainly oxytetracycline and chlorotetracycline), rotenone, phostoxin, sumithion, melathion and some hormones. It is also found that most of the farmers used chemicals and antibiotics (Chowdhury *et al*., 2015; Biswas *et al*., 2018; Adhikary *et al*., 2018). In the present study identified range of aqua chemicals and antibiotics marketed by different companies for using in various activities of aquaculture. Fish health management and diseases treatment were the major areas where farmers were seen to use a lot of such compounds. Other uses included growth promotion, improve water quality and as probiotics. Commonly found traditional chemicals in health management including are potassium permanganate, sumithion, melathion, formalin, bleaching powder, malachite green and methylene blue (Chowdhury *et al*., 2015; Rahman *et al*., 2017; Biswas *et al*., 2018; Rahman *et al*., 2018). Some previous

studies also revealed the similar reports about the use of chemicals used in aquaculture of Bangladesh (Philips, 1996; Brown and Brooks, 2002; DoF; 2002; Faruk et al., 2004; Chowdhury *et al*., 2015; Biswas *et al*., 2018; Adhikary *et al*., 2018). The water quality management plays an important role in growth, development, reproduction, survival as well as feed consumption. For water quality management agriculture lime, Geotox, JV Zeolite, Mega Zeo Bio, Aquakleen and Biomin pond life have been used in the study area. Farmers use different types of aqua-medicine during pond preparation and water quality improvement. Anwar (2014) observed that for water quality management Geotox, JV Zeolite, Life, Aquakleen, Biomin, Aquabost are used. Chemicals like Geotox, JV Zeolite, Mega Zeo, Lime, BioAqua and Ames Zeolite are repeated by Monsur (2012) for pond preparation and water quality management. Dissolved oxygen is one of the most important factors of pond water for aquaculture practices. Farmers of the investigated areas use several chemicals to increase oxygen concentration in pond like Bio-ox, Oxygold, Oxylife, Oxymas, Oxyren, Oxyflow and Oxysos. Monsur (2012) observed that farmers used Oxyflow, Oxymas, Bio Care, Bio Ox, Oxy-gold and Oxy-A to improve dissolved oxygen level in Jamalpur and Sherpur regions. Faruk *et al*. (2008) found that the farmers of the Mymensingh region used Bio-ox, Gesonex, Oxymarine, Oxy plus, Oxymas, Oxymore and Bio care to increase dissolve oxygen. Rahman (2011) observed that aqua drugs like Oxyflow, Oxymas, Oxy plus, Bio Care, Pure Oxy, Oxy-Gold were used to increase dissolved oxygen, Oxidizing agent, Hydrogen Peroxide was the major active ingredients of such chemicals. Ali (2008) reported that Oxyflow and Oxymas were used to remove poisonous gases. Several chemicals with almost similar names were seen readily available in the chemical shops to use for increasing dissolved Oxygen (DO) in ponds. The propensity of using harmful gas controller is higher than any other medicines used by farmers in Maheshpur upazila. In the case 36% farmers showed their tendency to use, because most of the farmers had problems with harmful gases in their ponds (Uddin *et al.*, 2014). Disinfectants are widely used in many spheres of aquaculture. As disinfectants, farmers use Timsen, Polgard plus, Formalin, bleaching Powder, EDTA and Eraprim vet in the study areas. Among them Timsen (disinfectant) is mostly available chemical in the chemical shops. Anwar (2014) mentioned that Hepartect-Aqua, Timsen, virex, Polgard Plus as disinfectant, Lime, Salt, Formalin, Potash and Malchinate Green were used against fish diseases in Jamalpur Sadar Upazila. Rahman (2011) stated that about 10 disinfectants from nine different sources were found to use by the farms in Mukta gasa, Fulbaria and Fulpur of Mymenshing district such as Polgard plus, Bactisal, virex, Biogard, Lenocide, Timsen, Emsen, Aquacleaner Plus, Formalin, Bleaching Powder. Shamsuddin (2012) observed that as disinfectants farmers used mostly Polgard plus, Aquakleen, Bleaching Powder, Bactisal, Virex and Timsen in the Fulbaria, Gouripur and Fulpur Upazilas of Mymenshing district. Seven antibiotics with different trade names are used by the fish farmers in the present study areas as Novamix 101, Erocot, Captor, Oxysentin 20%, Renamycine, Aquamycine and Oxysentin 20% are antibiotics with different trade names were seen in the market as well as used by the fish farmers in the study area. All of these antibiotics are effective against bacterial disease. Faruk *et al.* (2008); Chowdhury *et al.* (2015); Biswas *et al*. (2018); Adhikary *et al*. (2018) observed that several branded antibiotics were found in the market; among them Oxysentin, Renamycine, Renamox and Orgamycine were being widely used. Sarkar *et al.* (2014) reported that Renamycine, Bactitab, Chlorstechlin, Cotrim- Vet, Orgacycline were being used antibiotics in coastal region of Bangladesh. Monsur (2014) also reported that Antibiotics should be used for bacterial diseases. From the research findings of Shamsuddin (2012), it was reported that most of the farmers used Renamycine at the rate of 100 mg/kg feed for 7 days for its high activity against bacterial diseases. The present study revealed that commercial aqua drugs have some positive impact on fish health management and diseases treatments at farmer's level. The present study identified arrange aqua chemicals and antibiotics market by different companies for using in various activities of aquaculture fish health management and disease treatment where the measure areas farmers sin to use a lot of such compounds. The present study also noticed a number of new product with various trade names in the market which is included zeolite, Geotox, mega geo, Aqua boost, Oxyflow, Biotuff quick oxygen, Orgavit, Aqua, Aqua Gold, Timsen, Efinol etc us video and various antibiotics and probiotics. The local animal feed and chemicals shops are the main source options compound from where farmers usually purchased these. The number of authors also reported similar condition in aquaculture of Bangladesh (Amin, 2000; Faruk *et al.* 2004). Growfast, Ossi-C, Nutrigrow are found in the study areas. Shamsuddin (2012) observed that farmers used Grow fast, Ossi-C, Silver mil and Revit C were used as a growth promoter in Fulbaria, Gouripur and Faridpur upazila of Mymenshing. Faruk *et al.* (2008) also reported that farmers used growth promoter such as Megavit Aqua, Aqua Boost, Aqua Savor and Vitamin premix, Grow fast, Vitamix and Grow max in Jhenaidah district. Farmers used as growth promoters Megavit Aqua, Aqua Boost, Aqua Savor, Vitamin premix, Grow fast, Nutricell Aqua, Rapid Aqua, Cevit Vet, Acimix super fish etc. In the study area only few people farmers used growth promoters increase diseases resistance power of fish because of high price. Various types of diseases are observed in Maheshpur Upazila. August, December, January and

February are susceptible months of diseases outbreak in the study area. Monsur (2012) found that the affected month was August, November, January and February in Jamalpur and Sherpur district. However in February and March fish were also affected by diseases. In the study area some kinds of diseases were founded such as Epizotic Ulcerative Syndrome (EUS), skin diseases, gill damage, tail and fin rot. For highest stocking density tilapia and pangus were mostly affected by diseases in winter. In the study area different types of diseases like EUS, tail rot, fin rot, red spot, white spot and dropsy in different fish species mainly in Shing, Koi, Rui, Catla, Tilapia and Pangus were observed. A number of authors reported the similar condition in aquaculture of Bangladesh (Faruk *et al.* 2004). Most of the farmers of the selected areas used drugs and chemicals to control these types of diseases. It meant that's diseases problem was one of the major concern in aquaculture of the studied areas. Alam and Rashid (2014) mentioned that Tilapia (*Oreochromis nilotika*), Sharputi (*Puntius sarana*) Rui (*Labeo rohita*), Catla (*Catla catla*), Mrigal (*Cirrhinus cirrhosus*), Bagda (*Penaeus monodon*), Golda (*Macrobachium rosenbergi*),and Silver carp (*Hypophthalmicthys molitrix*) were affected by various types of diseases such bacterial infection, EUS (Epizootic Ulcerative Syndrome), ichthyophthiriasis, argulosis, swollen abdomen and white spot diseases in Shatkhira district. Anwar (2014) reported that EUS (Epizotic Ulcerative Syndrome), red spot and different parasitic diseases occurred in Pangus (*Pangasianolan hypohthalmus*), Tilapia, Sharputi, Rui, Mrigal, Thai koi (*Anabas testudineus*), Shing (*Heteropneustes fossilis*) and silver carp in Jamalpur Sadar Upazila. Monsur (2012) observed that in Jamalpur and Sherpur district farmers used mainly Renamycine, Polgrad plus, Ossi-C, Timsen, Bactisal and Aquamycine for the fish disease treatment. Prasad *et al.* (1996) found that chloramphenicol and oxytetracycline would be effective drug in curing the EUS lesion tetracycline and streptomycine were found to be less effective in curing the ulcers. The present study identifies that, in case of rui, sarputi Renamycine 50 mg/kg body weight are effectively used in curing the EUS. Farmers use Renamycin with a result of 80-85% recovery to treat EUS in rui, sarputi, tilapia in the study area. But Rahman (2011) mentioned that EUS affected tilapia was treated with Renamycin, Polgard plus and Ossi C with 80-95% recovery form disease in Fulpur and Muktagacha. About 52% farmers used potassium permanganate, while 40% used lime, 11% used salt as a disease treatment in Bangladesh. According to the reports of Brown and Brooks (2002), a few Farmers used other treatments such as disinfectants, banana leaves, fertilizers, alum exchange. The present study identifies that tail rot and fin rot affected pungus are treated with tetracycline, methylene blue having 85% recovery. Rahman (2011) observed that Edwardsiellosis affected pangus were treated with renamycine, Timsen, Polgard plus, Ossi C in Fulpur and with Geolite and Timsen in Fulbaria having 80% recovery in both upazilas.

5. Conclusions

In conclusion, the present study demonstrated current status of chemicals and antibiotics using in aquatic animal health management and pointed out some problems of the use of chemicals by the farmers who is include lack of knowledge of the chemicals, doses and method of application of these chemicals. There are few alternatives to minimize the adverse effect of aquaculture chemicals simply use less of them. Other alternatives could be used as bioremediation and use of probiotics immune stimulants vaccination and alternative therapeutic. However policy maker researches and scientist should work together in addressing the issues of chemical used in aquaculture with a view to reduce the negative impacts.

Conflict of interest

None to declare.

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