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STATUS OF CHEMICALS AND AQUA DRUGS USED IN FRESHWATER AQUACULTURE IN NORTH-EASTERN BANGLADESH

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Abstract

Chemicals and drugs are widely used to increase aquaculture production in Bangladesh. The study was conducted in public and private aquaculture farms, hatcheries, nurseries and aquaculture entrepreneurs located in North-Eastern Bangladesh to know the status of chemicals and aqua drugs. Data were collected through questionnaire interview, personal contact, market survey and participatory rural appraisal (PRA) i.e. focus group discussion (FGD) with fish hatchery owners, nursery and culture farmers and retailers of aqua medicine and representatives of pharmaceutical companies. A number of diseases were reported in the study area by the farmers i.e. dropsy, fin and tail rot, and Epizootic Ulcerative Syndrome (EUS), which were treated using different chemicals and antibiotics. A variety of aqua drugs and chemicals were used in aquaculture for pond management, oxygen supplier, toxic gas reducer, antibiotics and growth promoters. JV zeolite, Oxymax, Bio Aqua-50, Oxy-dox F, Acemix Super Fish, etc. were used as growth promoters. Five brand antibiotics, with the trade names of Oxy-Dox-F, Doxy-A-Vet, Oxy-D-Vet, Oxy-tetra vet and Eskamycine, were used for treatment of diseases with the dosage of 0.8 mg kg^{-1} feed, 1 mg kg^{-1} feed, 15 - 20 g per 100 kg fish, 0.8 - 1.0 mg kg^{-1} feed and 1 - 1.5 g kg^{-1} feed, respectively. Liming (0.5 - 1 kg $decimal^{-1}$) was the most common treatment used by the farmers. Salt (250 - 500 g $decimal^{-1}$) and potassium permanganate (5 - 15 ppm) were also used. Some farms used pesticide to control parasitic infection in their ponds. Several under reported fish diseases were also found that could not be confirmed by laboratory diagnosis during this study. Further studies for laboratory diagnosis of the diseases are recommended to identify the actual causes and treatment.

Keywords: Antibiotics, disinfectants, aqua drugs, fish health management, freshwater aquaculture.

Introduction

Aquaculture is a fast growing food-production sector in the world. It provides a significant supplement to, and substitutes for, wild aquatic organisms and creates employment, generates income and provides opportunities for human development (lslam, 2001). The majority of aquaculture production in Bangladesh comes from freshwater fish farming (lslam, 2001). Fish health management is the management practices, which are designed to prevent fish diseases. Prevention of fish disease is accomplished through good water quality management, nutrition and sanitation. Fish diseases are one of the main constraints for successful implementation of intensive and semi-intensive technology of fish culture (Hossain, 1995). A range of diseases could be found in farmed aquatic animals in Bangladesh (Karim and Stellwagen, 1998; BFRI, 1999; Faruk *et al.,* 2004). Several classes of chemicals are commonly used in large quantity in fish industry, especially in developing countries where their uses are not regulated. Some of these chemicals are often non-biodegradable and persist in the aquatic environment as residues. Use of unapproved drugs or misuse of approved drugs in aquaculture fish poses a potential human health hazard. There are several important concerns with regard to the use of chemicals in aquaculture (Subasinghe *et al.,* 2000). Farmers want to get maximum yield, but few would like to increase their cost of buying chemicals. Due to the increasing demand of fishery product in Greater Sylhet region, a lot of hatcheries and fish farms are being established in the region. This is due to the availability of the quality spawn fry or broodstock of different fish species and decrease the natural resource from haor basin. Unfortunately, little attention has been paid on the

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documentation of chemicals and antibiotics used in aquaculture industry in the country. As a result, there is a lack of information regarding the present status and consequences of chemicals and antibiotics using in aquaculture sector especially in aquatic animal health management and needs examination. Considering the above facts, the study was conducted to identify different types of chemicals and drugs used in aquaculture activities in North-Eastern region of Bangladesh with its purpose, methods and dosages of application, and assessing their problems upon using.

Materials and Methods

Study area: The study was conducted in some public and private farms, hatcheries, nurseries and aquaculture farms located in North-Eastern region of Bangladesh, including Sylhet, Maulvibazar, Sunamganj and Hobiganj districts (Fig.1; Table 1). The study was also performed in some aqua drug shops and medicine representatives of respective companies from January to October 2014.

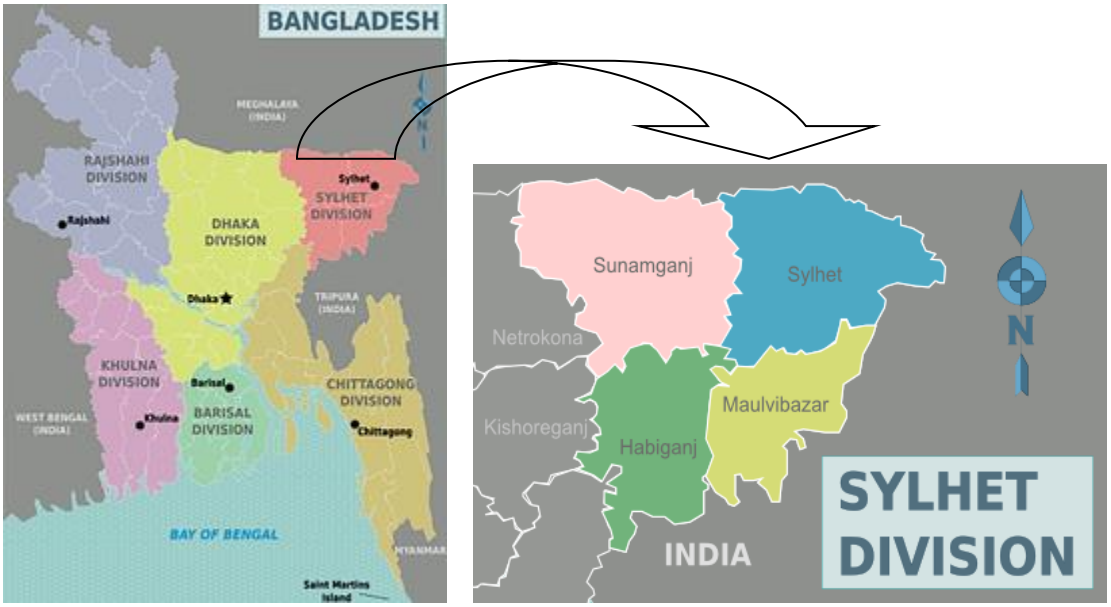

Fig. 1. Map showing the study area i.e. Sunamganj, Sylhet, Maulvibazar and Habiganj districts.

Data collection methods: Data were collected through questionnaire interview, personal contact, market survey and participatory rural appraisal (PRA) i.e. focus group discussion (FGD) with fish and prawn farmers, retailers of animal medicine and representatives of pharmaceutical companies (Table 2). For questionnaire survey a set of preliminary questionnaire, based on the objectives of the study, was prepared. The preliminary questionnaire was tested twice at the field level with few farmers, and based on the responses, the final set of questionnaire was prepared. For the interview, simple random sampling method was followed to avoid the biasness. PRA tools such as FGD were conducted with rural fish farmers (poor to rich). Five to six fish farmers were selected for data collection in our research to crosscheck the collected information for more reliability. Key informants such as District Fisheries Officer, Upazilla Fisheries Officer and Non-Government Organization (NGO) workers were interviewed by a semi-structured questionnaire. Key issues that came from FGD were also discussed with key informants to have more logical explanation.

Cross check interview: Cross check interviews were conducted with key informants such as Upazilla Fisheries Officers, local leaders and NGO workers, where information was contradictory or requested for further assessment. The interviews of respondents were conducted in their offices and houses.

Data processing and analysis: After collection, the primary and secondary data were reviewed, stored, coded and then input into computer for further analysis. At each stage of survey, data sheets were compared with original data sheets to ensure the accuracy of data entered. All the collected information were accumulated and analyzed by MS-Excel and then presented in textual, tabular and graphical forms.

Table 1. Selected aquaculture farms and companies studied.

Sl. No.	Name of the farms	Public/Private	District	Study area
1	Carp Hatchery Complex	Public	Sylhet	Khadimpara
2	Carp Hatchery Complex	Public	Sunamganj	Shantiganj
3	Carp Hatchery Complex	Public	Hobiganj	Kurshi, Nabiganj
4	Sylhet Dairy and Agro-Fisheries Pvt. Ltd.	Private	Sylhet	Fulbari, Gulapganj
5	Likhon Motsho Khamar	Private	Sylhet	Hatimganj
6	Albaraka Private Fish Farm	Private	Sylhet	Khadimpara
7	Sunamganj Agro-Fisheries Ltd.	Priavte	Sunamganj	Pagla
8	Sen Gupta Fisheries Ltd.	Priavte	Sunamganj	Derai
9	Muhammed Agro and Fisheries Ltd.	Priavte	Sunamganj	Muhammedpur
10	Mukit Mia Fisheries Ltd.	Priavte	Moulvibazar	Officebazar
11	Jalalabad Fisheries Ltd.	Priavte	Moulvibazar	Shikrail
12	Mathe Mathe Fisheries Ltd.	Priavte	Moulvibazar	Hail Haor
13	Hannan Motsho Khamar	Priavte	Hobiganj	Shahesthaganj
14	Mosharof Motsho Khamar	Priavte	Hobiganj	Nabiganj
15	Nabiganj Fisheries Ltd.	Priavte	Hobiganj	Nabiganj

Table 2. Target group, location and sample size.

Sl. No.	Target group	Location	Sample size
1	Carp polyculture farmers	Khadimpara, Shantiganj, Kurshi, Nabiganj	10
2	Catfish farmers	Fulbari, Gulapganj, Hatimganj, Khadimpara	5
3	Tilapia farmers	Pagla, Derai, Muhammedpur	12
4	Fish farm owners	Muhammedpur, Officebazar, Shikrail, Hail Haor, Shahesthaganj	15
5	Drug/Chemical dellers	Sylhet, Sunamganj, Hobiganj and Moulavi bazar	5

Results and Discussion

Aquaculture in Bangladesh is increasing rapidly. Based on the present survey, aquaculture in the North-Eastern Bangladesh is also growing with the gradual intensification of the culture systems.

Aquaculture practices and culture systems: Carp polyculture in both public and private farms followed semi-intensive culture system, with the higher (1.5x) production in private farms than the public farms (Table 3). Mono-sex tilapia and Thai pangas monoculture in private farms followed intensive culture systems, with the production of 8,000 - 10,000 kg ha^{-1} and 22,000 - 25,000 kg ha^{-1}, respectively (Table 3). Islam and Haque (2010) reported that after stocking with 10,775 carp fry ha^{-1} in carp polyculture technique, the production was 2,861.08 kg ha^{-1} in North-Western districts of Bangladesh, which was much lower than the production of both public farms and private farms in the study area of the Greater Sylhet region. Edwards and Hossain (2010) reported that smaller farms in Mymensingh region typically produce 40,000 kg ha^{-1}. Rahman *et al.* (2012) reported that after stocking with 100,000 tilapia fry ha^{-1} in tilapia intensive culture, the average production was 10,275.2 kg ha^{-1} in Hathazary upazila of Chittagong District.

Table 3. Culture practices, stocking density and production of public and private farms in the study area.

Culture practices	Type of farm (public/private)	Culture system	Stocking density (no ha^{-1})	Production (kg ha^{-1})
Carp polyculture	Public	Semi-intensive	10000 - 12000	6000 - 7000
	Private	Semi-intensive	14000 - 15000	9000 - 12000
Monosex tilapia monoculture	Private	Intensive	45000 - 50000	8000 - 10000
Thai pangas monoculture	Private	Intensive	40000 - 42000	22000 - 25000

Chemicals used for pond preparation and water quality management: A comprehensive variety of aqua drugs, mostly zeolite, was used to prepare and refine water quality of the fish farms**.** JV Zeolite was remarkably used (27% of the total uses) followed by Mega Zeo plus (22%), Aqua Pure (19%), Aqua Zeo plus (13%), ACME zeolite 11% and Zeo prime 8% (Table 4). Among them JV Zeolite, Mega Zeo plus, ACME zeolite and Aqua Pure were commonly used in both public and private. Private farms used all types of chemicals and drugs, but public farms used a few of them. The reasons for using large number of chemicals and drugs in private farms are: i) high stocking density, ii) lack of proper management practices, iii) lack of technical knowledge, and iv) motivation by chemical traders. On the contrary, public farms followed proper management practices with optimum stocking density due to adequate technical knowledge and skill. Jelani *et al.* (2012) reported that different types of zeolite like JV Zeolite, Mega Zeo Plus, Mega Zeo were chosen for quick results of water quality maintaining and being used to maintain water colour and remove turbidity of large number of farms in North-East region. Faruk *et al*. (2008) stated that zeolite like Geotox, Green zeolite, Zeocare, Bis zeolite, JV Zeolite etc. were used in pond preparation and improving water quality of fish pond in freshwater aquaculture.

Table 4. Chemicals used for pond and water quality management.

Trade name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
JV Zeolite	Eon Animal Health Products	SiO_2. Al_2O_2. Fe_2O_3. CaO. MgO. Na_2O. K_2O	During pond preparation 7 kg/ 33 decimal, during culture 4 kg /33 decimal every 15 days.	1	7	8	53
Mega Zeo Plus	ACI Animal Health	SiO_2. Al_2O_2. Fe_2O_3. CaO. MgO. Na_2O. K_2O. Mn	For 3-6 feet deep water body 25 kg $acre^{-1}$ after stocking 15 - 20 kg in same water body.	2	8	10	67
Zeo-Prime	SK + F	Hydrated SiO_2, Al_2O_2	10 kg $acre^{-1}$ for 4-5 ft. depth	-	3	3	20
Aqua-Zeo Plus	Advanced Agro	SiO_2. Al_2O_2. Fe_2O_3. CaO. MgO. Na_2O. K2O	8 kg/33 decimal for 3 - 5 ft. depth	-	5	5	33
ACME Zeolite	ACME	SiO_2. Al_2O_2. CaO. MgO. Na_2O.	30 kg $acre^{-1}$ for 4-5 ft. depth	-	4	4	27
Aqua Pure	Square Pharma-ceuticals Ltd.	Hydrated SiO_2. Al_2O_2 with deodorizing Agent	During pond preparation: 10 - 16 kg $acre^{-1}$; at 3-6 ft water depth, During pond management: 8-10 kg $acre^{-1}$	1	6	7	47

Chemicals used as predator removal: Acurotay gold (32%) were remarkably used in the study area followed by Hunter (28%) Phostoxine (20%), Rotenil (12%) and Raj-fume-56% (8%) (Table 5). Among the above chemicals, Rotenil and Raj-fume-56% were not used by public farms, but the others were commonly used by both public and private farms. The reasons for using more chemicals and drugs by the private farms than the public farms are mentioned above. Jilani *et al.* (2012) stated that rotenone phostoxin and endrin were used as predator removal in Noakhali District. About 70% farmers used rotenone to remove harmful aquatic animals in nurseries, 80% farmers used in culture preparation.

Chemicals used as insecticides and ectoparasiticides: Chemicals like Engreb and Argulex are generally used for controlling Back swimmer (Hash poka) and treat Argulosis in fish farm. From the present study it was found that Argulex (55%) were remarkably used as insecticides and ectoparasiticides followed by Paratics (35%) and Engreb (10%). Among the above chemicals, only Paratics was used by the public farms (Table 6). Faruk *et al*. (2008) stated that melathion, dipterex, melachite green, methylene blue were useful for eradication of external parasites as well as fungal diseases. Tonguthai (2000) reported that acriflavin, dipterex, malachite green was widely used in fish pond to treat for crustacean, monogenean, and protozoan parasites in Thailand. Trichlorfon, malathion, dichlorvos were used for Shrimp pond management in Stockholm, Sweden mentioned by GESAMP (1997).

Table 5. Chemicals used as predator removal.

Trade Name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Aqurotay gold	ACI	Rotenone 9%	35 g decimal^{-1} ft^{-1} depth	2	6	8	53
Rotenil	SK + F	Rotenone 9%	1kg acre^{-1} (depth 4-5 ft.)	-	-	3	20
Hunter	Eon Animal Health Co. Ltd.	Rotenone 9%	18g decimal^{-1} ft^{-1} depth	1	6	7	47
Phostoxine	FishTech Co. Ltd.	Almmonim phosphide	2-3 Tablets decimal^{-1}	1	4	5	33
Raj-fume 56%	Aquaculture International Co. BD	Almmonim phosphide	2 Tablets decimal^{-1}	-	-	2	13

Table 6. Chemicals used as insecticides and ectoparasiticides North-Eastern Bangladesh.

Trade name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Argulex	Eon Animal Health Co. Ltd.	Trichlorofon-40%	12-13 ml / decimal / 3 ft depth	-	11	11	73
Engreb	Eon Animal Health Co. Ltd.	Cypermethrine 10%	7 ml / 33 decimal / ft depth	-	2	2	13
Paratics	Advanced Agro	Sumithione 10%	1 ml / decimal / 3 ft depth	2	5	7	47

Chemicals used as disinfectants: In the study area, Timsen was vastly used and comprehended 35% of the total uses followed by Virex (23%), Polgard (19%), Aquakleen (13%) and Advance-Agro (10%) (Table 7). According to the respondents, disinfectants were found to be very effective for prevention of some bacterial and fungal infections, sanitizes water due to its antiviral, antibacterial and antifungal properties. These disinfectants, except Advance-Agro, were commonly used by both public and private farms. Advance-Agro was only used by the private farms. Faruk *et al.* (2008) described that Timsen and Emsen were very effective in prevention of some bacterial and fungal infection as well as they destroyed viruses. Formalin was also used to control protozoan disease. BKC (Benzal Konium Chloride) was used for controlling bacterial disease and Efinol could also be used as stress resistance. Tonguthai (2000) recommended a number of chemicals like Benzal konium chloride, Formalin, Iodine, Sodium hypochlorite, Calcium hypochlorite as pond and hatchery disinfection in Thailand.

Table 7. Chemicals used as disinfectants.

Trade name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Virex	ACI	Potassium peroximono sulphate 50%	100 -150 g / 33 decimal (depth- 5 ft)	2	5	7	47
Aquakleen	Square	Tetradesail Trimethyl Ammonium bromide	100 ml / acre (depth - 3 ft)	1	3	4	27
Timsen	Eon Animal Health	n-alkyl dimethyl benzyl ammonium chloride + stabilized urea	20-30 g/33 decimal for pond preparation and 80 g/33 decimal for disease treatment	2	9	11	73
Polgard	Fish Tech. Bd.	3 methyl, 4 Alkyl two chain brominated compounds	200 ml/33 decimal	1	5	6	40

Advance-Agro	Advanced Agrotech	Sodium dichloro-isocyanorate 50%	100-150 g/33 decimal (depth 3-5 ft.)	-	3	3	20

Chemicals used as Oxygen supplier: Some chemicals were also used to remove hardness and poisonous gases e.g. Bio-Ox, Oxymax, Oxy-A (Table 8). In the present investigation it was observed that Oxymax (29%) was vastly used followed by Bio-Ox (24%), Oxy-A (16%), Oxy-Gold (13%), Oxy-Sos (10%) and Oxymore (8%). Among the mentioned oxygen suppliers, Oxy-Sos and Oxymore were only used by the private farms. Ahmed *et al.* (2014) mentioned several chemicals like oxy life, oxy gold, pure-oxy, oxymax, Bio-ox were seen readily used for increasing dissolved oxygen in the shrimp gher. Shamsuddin (2012) mentioned that only few farmers used oxy life and oxy gold in Mymensingh region.

Table 8. Chemicals used as Oxygen supplier.

Trade Name	Company	Chemical Composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Oxymax	Eon Animal health Products Ltd.	H_2O_2 10%	250-500 g acre^{-1} (1 m deep water body)	2	9	11	73
Bio- Ox	ACI Animal Health	Sodium carbonate, H_2O_2	General dose 2.5 - 5.0 g acre^{-1}, In case of high deficiency 5-8 g acre^{-1}	2	7	9	60
Oxymore	SK+F Bangladesh Ltd.	Sodium carbonate peroxy-hydrate 90%	General dose 250 - 500 g acre^{-1}, In case of high deficiency 750 - 1000 g acre^{-1}	-	3	3	20
Oxy-Gold	Fish tech Ltd	Sodium Percarbonate	250 - 500 g acre^{-1}	1	4	5	33
Oxy Sos	Advanced Agro	Sodium Percarbonate Peroxide	300 - 500 g acre^{-1}	-	4	4	27
Oxy A	ACME	Sodium Percarbonate	200 - 500 g acre^{-1}	1	5	6	40

Table 9. Chemicals used as toxic gas reducer.

Trade Name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Gasonex plus	Fish tech. (BD) Co. Ltd.	Na-lorile ether sulphate	200-400 mg kg^{-1} Zeolite	1	2	3	20
Gastrap	Square pharmaceuticals Co. Ltd.	Lactic acid, *Bacillus* sp., Cellulase, Hemicellulase, amylase	200 mg acre^{-1}	-	7	7	47
Aqua Magic	Fish tech. (BD) Co. Ltd.	Azotabactor, Chorococcum, *Bacillus subtillis*, *Candida utilis*	5 kg acre^{-1}	-	4	4	27
Bio-Aqua-50	Eon Animal Health Co. Ltd.	*Yucca* plant extract	2-3 ml decimal^{-1} (depth 3-4 ft.)	1	8	9	60
Ammonil	Noverties pharmaceuticals Co. Ltd.	*Yucca* plant extract, *Bacillus subtillis*, *Candida utilis*	100 - 200g acre^{-1}	-	2	2	13
Aqua-photo	ACI	*Rhodoseudomonas* sp., *Bacillus subtillis*	1.5 - 2 ppm during pond preparation, 2.5	1	7	8	53

		- 3 ppm for treatment

Chemicals used as toxic gas reducers: Several aqua-drugs were reported to be used as toxic gas reducer in different farms revealed by the respondents. The commonly used toxic gas reducers are Bio-Aqua-50, Aqua-photo, Aqua Magic, Gasonex plus and Ammonil (Table 9). In the current survey it was witnessed that Bio-Aqua-50 was immensely used and comprehended 28% of the total uses followed by Aqua-photo (24%), Gastrap (21%), Aqua Magic (12%), Gasonex plus (9%) and Ammonil (6%) (Fig. 4.6). Hossain (2012) mentioned about 7 chemicals to be used as toxic gas reducers such as gastrap, gas stop, gasonex plus, ammonil in Bogra district. Faruk *et al.* (2008) stated that Bio-Aqua-50 was used for the improvement of water quality in respect to freshwater aquaculture activities.

Table 10. Chemicals used as stress reducer.

Trade Name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Aqua-C	ACI	Ascorbic acid (Vit-C)	0.1 - 0.3 g kg^{-1} feed	2	7	9	60
Glucovet Premix	ACME Pharmaceuticals Co. Ltd.	Ascorbic acid (Vit-C)	1 - 2 g l^{-1}	-	4	4	27
Osmosaline	Eon Animal Health Co. Ltd.	natural Betanin	1 - 2 g l^{-1}	-	7	7	47
Cevit Aqua	Square Pharmaceuticals Co. Ltd.	L-ascorbic acid (Vit-C)	2 - 3 g kg^{-1} feed	-	5	5	33
Vita X-CK	Eon Animal Health Co. Ltd.	Vit-C,K	1 g per 3 – 5 kg feed	-	2	2	13
Eskavit-C	SK + F	Vit-C 100%	1 g kg^{-1} feed	-	3	3	20

***Chemicals used as stress reducers*:** Virtually 6 branded stress reducers with different trade names were used by the fish farmers (Table 10). From the existing scrutiny it was found that Aqua-C was exceedingly used upto 30% of the total uses followed by Osmosaline (23%), Cevit aqua (17%), Glucovit premix (13%), Eskavit (10%) and Vita X-CK (7%). The available stress removers were Aqua-C, Osmosaline and Cevit aqua.These stress reducers, except Aqua-C, were only used by the private farms. Aqua-C was used by both public and private farms. Hossain (2012) mentioned several aqua-drugs such as cevit aqua, ossi-c, osmosaline, aqua-c etc. to be used as stress reducer in Bogra District. Vitamin C, Vitamin B12 and Vitamin E were used for Shrimp health management in Stockholm, Sweden mentioned by GESAMP (1992).

Chemicals used as growth promoter: Nearly 5 branded growth promoters with dissimilar trade names were used by the fish farmers in North-Eastern Bangladesh (Table 11). From the existing study it was found that Spa growth promoter was exceedingly used upto 28% of the total uses followed by Acimix super fish (25%), Square Aquamix powder (22%), Charger gel (16%) and Eskavit (9%). The mentioned growth promoters, except Charger gel, were only used by the private farms. Charger gel was used by both public and private farms. According to the respondents, growth promoter support to improve growth rate, improve FCR (Food Conversion Ratio) and thus increase the yield. Ahmed *et al.* (2014) reported that aqua boost, aqua nourishes, square aqua mix, penamin and charger gel were used as growth promoters in Khulna region. Shamsuddin (2012) that aqua boost, bio-grow and charger gel were used as growth promoters in Mymensingh region. Hossain (2012) described about 5 chemicals, which were used as growth promoter in different fish farms in Bogra district. Monsur (2012) reported that chemicals like megavit aqua, aqua boost; aqua savor, acimix super fish etc. were used as growth promoter in Jamalpur and Sherpur district.

Antibiotics used for disease treatment: In the study area, Oxy-D-Vet was highly used 31% of the total uses followed by Oxy-tetra vet powder-50 (27%), Oxy-Dox-F (23%) and Eskamycine (11%), Doxy-A-Vet (8%) (Table 12). The chemical composition of such antibiotics is mainly Oxytetracycline and Doxycycine. The mentioned antibiotics, except Oxy-Dox-F and Doxy-A-Vet, were only used by the private farms. Oxy-Dox-F and Doxy-A-Vet were used by both public and private farms. According to the information from respondents, these antibiotics were effective against bacterial diseases.

Table 11. Chemicals used as growth promoter.

Trade name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Charger gel	Fish Tech Co. Ltd.	1 - 3 D-glucan, Polysaccharides	2 - 4 g kg^{-1} feed	1	4	5	33
Spa	Eon Animal Health Co. Ltd.	Protein, Cholesterol caratenoid, Vit-D, Ca	10 - 15 ml kg^{-1} feed	-	9	9	60
Square Aquamix powder	Square Pharmaceu-ticals Co. Ltd.	Vitamins, Amino acids, Minerals, Pre-biotic, Antioxidants	1g kg^{-1} feed	-	7	7	47
Acimix super fish	ACI	Vitamins, Trace minerals and amino acids	2.5 g kg^{-1} feed	-	8	8	53
Eskavit	SK + F	Vitamins, Minerals and Premix	2.5 g kg^{-1} feed	-	3	3	20

Table 12. Antibiotics used for disease treatments.

Trade Name	Company	Chemical composition	Dosage	Respondent farms, n=15			
				Public	Private	Total	%
Oxy-Dox-F	ACI Animal Health	Oxytetracline 20%, Doxycycine 10%	0.8 mg kg^{-1} feed	2	4	6	40
Doxy-A-Vet	ACME	Doxycycline 20%	1 mg kg^{-1} feed	1	1	2	13
Oxy-D-Vet	Eon Animal Health	Oxytetracline 20%, Doxycycine 10%	0.15 – 0.20 g kg^{-1} fish	-	8	8	53
Eskamycine	SK+F	Oxytetracline 20%	1 - 1.5 g kg^{-1} feed	-	3	3	20
Oxy-tetra-vet powder 50	Square	Oxytetracline 30%	0.8 -1 mg kg^{-1} feed	-	7	7	47

Table 13.Traditional chemical used for Health management.

Trade Name	Chemical Composition	Sources	Dosage	Purposes	Respondent Farms, n=15			
					Public	Private	Total	%
Potash	$KMnO_4$	Chemical seller	5 - 15 ppm	Disinfectants	2	1	3	20
Lime	CaO, $Ca(OH)_2$	Chemical seller	0.5 - 1 kg $decimal^{-1}$	Ectoparasiticides, Fungicides and maintaining pH	3	12	15	100
Salt	NaCl	Chemical seller	250 - 500 g $decimal^{-1}$	Disinfectants, Ectoparasiticides and Fungicides	3	12	15	100
Sumithione	Fanitrothion	Chemical seller	3 - 4 ml per 33 decimal/ ft. depth	Insecticides	1	1	2	13
Copper Sulphate	$CuSO_4$	Chemical seller	15 - 25 mg $decimal^{-1}$	Weed control and Ectoparasiticides	3	3	6	40
Fertilizer	TSP, Urea and MP 43-45% P, 40-45% N,	Chemical seller	100 - 150 g $decimal^{-1}$	Increased primary productivity	3	10	13	87

The use of drugs and chemicals associated with a number of problems identified during the present study are:

- Drugs and chemicals may create problem for non-target species.
- Fish farmers have lack of required knowledge about the use of drugs and chemicals.
- Fish farmers have lack of required knowledge about residual effect and withdrawal period of drugs and chemicals.
- Drugs and chemicals may persist in aquatic system for longer period.
- Drugs may create drug resistant strains of bacteria.
- Indiscriminate use of chemicals.
- Lack of information on the label of chemical about possible health hazard.
- Pressure on farmers from drug and chemical sellers.
- Lack of awareness about the safety issues in using hazardous chemicals.
- Poor diagnostic facilities of lack of knowledge for diagnosis of fish disease.
- Lack of technical manpower to prescribe aqua drugs and chemicals.

It may be concluded that aquaculture plays a vital role in the national economy of Bangladesh as well as in the fulfillment of the animal protein demand, opportunity for employment, poverty alleviation and earning foreign currency. With the expansion of aquaculture and intensification of the culture systems in Bangladesh, many pharmaceuticals companies supplied different types of aqua drugs and chemicals with different trade names to fulfill the farmers demand for the most valuable purposes of the fish health management and disease treatment. Fish Disease is great threat to achieve optimum production and becomes a limiting factor to economic success of aquaculture in Bangladesh. Further in depth study in aqua drugs and chemicals to control potential diseases throughout the country is warranted.

References

Ahmed G U, Faruk M A R and Islam K R. 2014. Study on impact of aqua drugs and chemicals on shrimp health in Bangladesh. Mar. Res. Aqua. 2(1):17-23.

BFRI. 1999. Fish diseases: prevention and control. Bangladesh Fisheries Research Institute, Circular leaflets no 6. 2ndedition. 7p.

Brown D and Brooks A. 2002. A survey of disease impact and awareness in pond aquaculture in Bangladesh, the Fisheries and Training Extension Project, Phase-II. In: Arthur J R, Phillips M J, Subsinghe R P, Reantaso M B and MacRae I H (Eds.). Primary Aquatic Animal Health Care in Rural, Small-Scale, Aquaculture Development. FAO Fish. Tech. Paper. No .406. pp.85-93.

Cruz-Lacierda E R, De la Pena L D and Lumanlan-Mayo S C. 2000. The use of chemicals in aquaculture in the Philippines. In: Arthur J R, Lavilla-Pitogo C R and Subasinghe R P (Eds.). Use of Chemicals in Aquaculture in Asia. In: Proceedings of the Meeting on the Use of Chemicals in Aquaculture in Asia 20-22 May 1996, Tigbauan, Iloilo, Philippines. pp.155-184.

DoF. 2002. Fish Fortnight Compendium. 10-24 August 2002, Department of Fisheries, Matsha Bhaban, Dhaka. pp. n 44-45.

FAO. 1995. Code of Conduct for Responsible Fisheries. FAO, Rome, Italy. 41p.

Faruk M A R, Ali M M and Patwary Z P. 2008. Evaluation of the status of use of chemicals and antibiotics in freshwater aquaculture activities with special emphasis to fish health management. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh. J. Bangladesh Agril. Univ. 6(2):381–390.

Faruk M A R, Alam M J, Sarker M M R and Kabir M B. 2004. Status of fish disease and health management practices in rural freshwater aquaculture of Bangladesh. Pakistan J. Biol. Sci. 7(12):2092-2098.

GESAMP. 1997. Joint Group of Experts on the Scientific Aspects of Marine Pollution. Towards safe and effective use of chemicals in coastal aquaculture. Rep. Stud. GESAMP. 65:1-37.

Hossain M A. 1995. Common Fish Diseases in Bangladesh and their Control Souvenir, Fisheries Fortnight- 95, Mymensingh, Bangladesh Fisheries Research Institute. 45p.

Husain M K. 2012. Study on drugs (aqua-medicines) used for fish culture at Shantahar and Adamdighi of Bogra district. MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. 50p.

Jilani A K, Saha D, Hossain M B, Shamsuddin M and Minar M H. 2012. Chemicals Used in Freshwater Aquaculture with Special Emphasis to Fish Health Management of Noakhali, Bangladesh. African J. Basic Appl. Sci. 4 (4):110-114.

Monsur A. 2012. Use of Aqua drugs and chemicals in Aquaculture of Jamalpur and Sherpur Region. MS Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. 50p.

Phillips M. 1996. The use of chemicals in carp and shrimp aquaculture in Bangladesh Cambodia, Lao PDR, Nepal, Pakistan, Sri Lanka and Vietnam. In: Use of Chemicals in Aquaculture in Asia. Arthur J R, Lavilla-Pitogo C R, Subasinghe R P (Eds.). Southeast Asian Fisheries Development Center, Aquaculture Department Tigbauan, Iloilo, Philippines. pp.75-84.

Rahman M M, Shamsuzzaman M M, Mahmood S, Sarker S and Alam M F. 2012. Economics of Tilapia Culture in Watershed Pond in Bangladesh. J. Aquacult. Res. Dev. 3:141.

Shamsuddin M. 2012. Impact of Aqua-Drugs and Chemicals on Health and Production of Fish. MS Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. 90p.

Subasinghe R P, Barg U and Tacon A. 2000. Chemicals in Asian aquaculture: need, usage, issues and challenges. In: Arthur J R, Lavilla-Pitogo C R and Subasinghe R P (Eds.). Use of Chemicals in Aquaculture in Asia. In: Proceedings of the Meeting on the Use of Chemicals in Aquaculture in Asia 20-22 May 1996, Tigbauan, Iloilo, Philippines. pp.1-5.

Tonguthai K. 2000. The use of chemicals in aquaculture in Thailand. In: Arthur J R, Lavilla-Pitogo C R and Subasinghe R P (Eds.). Use of Chemicals in Aquaculture in Asia. In: Proceedings of the Meeting on the Use of Chemicals in Aquaculture in Asia 20 - 22 May 1996, Tigbauan, Iloilo, Philippines. pp. 207-220.