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Present Status of Chemicals and Aqua Drugs Used in The Freshwater Fish Health Management of Kurigram District in Bangladesh

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ABSTRACT

A survey was conducted to assess the current status of aqua-drugs and chemicals used in freshwater aquaculture practices in Kurigram district, Bangladesh. Data were collected through random sampling using participatory rural appraisal (PRA) tools, including structured questionnaires, personal interviews, market surveys, and focus group discussions (FGDs), involving fish hatchery owners, nursery and grow-out farmers, aqua-medicine retailers, and representatives of pharmaceutical companies. The results revealed that farmers had varying levels of experience and training, with limited access to formal training opportunities. Major water quality problems reported included dissolved oxygen (DO) deficiency (94%), gaseous problems (54%), poor phytoplankton availability (33%), turbidity (32%), algal blooms (19%), and pH imbalance (11%). Common fish diseases observed were fin rot (48%), tail rot (47%), epizootic ulcerative syndrome (EUS) (31%), argulosis (25%), exophthalmia (24%), dropsy (23%), and gill rot (17%). To mitigate these problems, farmers commonly applied various aqua-drugs and chemicals, such as zeolite (43%), Matrix (18%), Zeorich (13%), and Green Cal Aqua (7%) for pond preparation and fish health management, while potash (41%), Timsen (22%), lime (14%), and Virex (12%) were frequently used for disease treatment. The study also identified significant challenges related to the inappropriate and indiscriminate use of these chemicals, primarily due to farmers' limited knowledge regarding proper dosages, application methods, and potential impacts. The findings highlight the need for improved training and awareness programs and are expected to support fish farmers in adopting appropriate chemical use for healthier and more sustainable aquaculture practices.

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Introduction

Bangladesh stands out as a prominent player in global aquaculture production. The advantageous geographic location of Bangladesh is accompanied by a diverse array of aquatic species, offering abundant resources that bolster the potential for fisheries development (Shamsuzzaman et al., 2017). Aquaculture in Bangladesh has emerged as the second largest export sector, following textiles (Hasan et al., 2015). The fisheries sector is currently addressing the food needs of the country's growing population by providing animal-source protein. It plays a vital role in ensuring food security, generating employment opportunities, alleviating poverty, earning foreign exchange, and promoting overall socio-economic development and sustainable livelihoods (Rashid and Zhang, 2019; DoF, 2022). Significant aquaculture relies heavily on the use of prepared feeds, as well as the application of agrochemicals, antibiotics, and various aquatic pharmaceuticals (Sharkar et al., 2014). These drugs and chemicals are crucial for managing fish health, constructing ponds, managing soil and water quality, enhancing natural aquatic productivity, formulating feed, manipulating reproduction, promoting growth, and adding value to the final product (Subasinghe et al., 1996). Farmers primarily use these chemicals for health management and disease treatment (Shamsuzzaman and Biswas, 2012). In Bangladesh, aquaculture practitioners utilize both traditional and commercial medications for pond preparation, maintaining water quality, enhancing growth, and treating diseases (Hasan et al., 2015). The prevalent chemicals comprise sodium chloride, formalin, malachite green, methylene blue, potassium permanganate, hydrogen peroxide, and glutaraldehyde (Plumb, 1992; Roy et al., 2021).

In Bangladesh, fish sickness has emerged as a significant obstacle to obtaining optimal productivity and a critical factor in the financial viability of aquaculture. Consequently, fish producers employ a diverse array of pharmaceuticals and antibiotics to address these issues (Sudheesh et al., 2012). The detrimental effects of indiscriminate chemical usage frequently result in issues such as drug resistance, tissue residue, and unfavorable consequences for species biodiversity (Spanggaard et al., 1993; Herwing and Gray, 1997; Hasan et al., 2015). Numerous issues associated with the utilization of aquaculture pharmaceuticals were identified, including insufficient knowledge concerning chemical application, methods of administering chemicals and antibiotics, indiscriminate drug usage, residual effects, and expiration dates, as well as inadequate diagnostic facilities for accurate disease identification (Singh and Singh, 2018). The proliferation of fish farming in Kurigram district is resulting in a daily increase in the utilization of aqua-drugs and chemicals. The majority of fish farmers in this region lack education and possess insufficient understanding regarding chemical usage, acceptable dosages, and application procedures. The current study was conducted to ascertain the status of aquaculture medications and chemicals utilized in fish health management, including their company names, active components, intended purposes, recommended dosages, and pricing.

Materials and Methods

Selection of Study area

In order to know the present status of aqua drugs and chemicals used in freshwater fish culture, a study was carried out in Kurigram district. Among the nine upazilla of kurigram district, three upazilla namely Bhurungamari, Nageshwari and Fulbari was selected for this study (Figure 1). Kurigram district is bordered by Kuchbihar district of West Bengal (Indian State) to the north, Gaibandha district to the south, Asam (Indian State) to the east, Rangpur and Lalmonirhat district (West Bengal to the West). The position of the district is between 20° $03'$to $26^{\circ}03'$ North latitudes and between 89° $27'$ to $89^{\circ}47'$ east longitude. Most of the area of Kurigram are low land and flood affected. These low land area are suitable for fish culture. Besides, these fish farmers are now more interested to culture the fish in their agricultural land. Consequntly, this area are now becoming one of the most fish producing area all over the country. For this reason, this area was selected for the present study considerng the farmers interest in fish culture and successful fish production of this area.

Figure 1. Map of the study area (Red circle indicated the study area)

Preparation of questionnaire

Three questionnaires were prepared for data collection from the fish farmers, for aqua-medicine producing companies and chemical sellers. The key points incorporated in the farmer form were: i) name and addresses of the fish farmer, ii) experience of fish culture, iii) preparation of fish pond, iv) use of chemicals during pond preparation, v) water quality problems, vi) disease problems faced by fish farmers, vii) use of traditional chemicals, viii) use of antibiotics, ix) use of probiotics, x) use of growth promoter, xi) source of knowledge about the chemicals, xii) training of fish farmers on the use of chemicals, xiii) improvement of fish health condition after using chemicals, xiv) main problems faced by fish farmer in fish farming. The questionnaires for chemical sellers included: i) name of shop and owner, ii) main customers, iii) source of aqua medicines, iv) available chemicals with their trade name, active ingredients, purpose of use, recommended dose and price, v) satisfaction of customers and vi) advising farmers on use of drugs.

The points incorporated in the medical company form were: i) name of shop and owner, ii) main customers, iii) source of aqua medicines, iv) types, purposes, active ingredients, recommended dose, price of aqua medicines, v) satisfaction of customers and vi) suggestions given to the customers on the uses of drugs and aquaculture problems.

Data collection method

The data were collected from May to October 2022. During the study period, data was collected through questionnaire interview, personal contact, market survey and focus group discussion. Primary data were collected by direct interviews with farmers, representative of pharmaceutical companies and aqua-medicine seller. Data was collected randomly during the survey. A total of 120 farmers (40 farmers from each upazilla) were interviewed for the collection of data. The questionnaire form was filled in by interviewing 120 fish farmers (40 farmers from each upazilla) for the collection of data. Question was asked systematically and all necessary data was recorded properly. A simple introduction was also needed to give the fish farmer for the clearance of the motives of this study. Focus Group Discussion (FGD) was conducted with fish farmer and hatcheries owner. A total of three Focus Group Discussion (FGD) was carried out with about 5-7 members of each group. Secondary data were collected from Upazilla Fisheries Officer (UFO) and Assistant Fisheries Officer (AFO). For this reason, crosscheck interviews were conducted with Upazilla Fisheries Officer (UFO), Assistant Fisheries Officer (AFO). Secondary data were also collected from various books, reports, journals, bulletins, thesis paper and organizations.

Data analysis

After data collection, all the data were arranged in tabular form to fulfill the objectives of the study. Some of the data were collected into local units and those data were converted into international units. By combining the both information from the study area, final result was prepared. For processing and analysis purpose, MS Excel and MS Word have been used.

Results

Aqua drugs and chemicals producing companies

Many aqua-medicine companies were found in Kurigram district whose provide various aqua medicines used for various fish health management purposes. About 20 aqua drugs producing companies were recorded in the selected areas. All of these aqua medicine companies were supplied around 76 aqua drugs which were used for water quality management, disinfection, improvement of dissolved oxygen, as antibiotics, probiotics and growth promoters. The list of aqua drugs producing companies recorded in the study area are given in Table 1.

Table 1. List of aqua drugs producing companies recorded during the present study

Sl. No	Name of companies	Sl. No	Name of companies
1	Eon Animal Health Products Ltd.	11	Renata Pharmaceuticals Ltd.
2	Square Pharmaceuticals Ltd.	12	Opsonin Agrovet
3	ACI Animal Health	13	All Care Pharmaceuticals
4	SK+F Bangladesh Ltd.	14	Rals Agro Ltd.
5	The ACME Laboratories Ltd.	15	Organic Pharmaceuticals Ltd.
6	Chemical Seller	16	Solver Agro Pharma Ltd.
7	National Agricare Imp. Exp. Ltd.	17	Avon Animal Health
8	NAAFCO Pharmaceuticals Ltd. Novartis	18	Anvet Pharma
9	Pharmaceuticals Ltd.	19	S.S.S Agro care Ltd.
10	Popular Pharma	20	Macdonald BD.

Clients of the aqua drugs and medicines in the study area

The main sources of the aqua drugs and medicines in the investigated areas were different chemical sellers, dealer of particular fish medicine companies, veterinary and poultry feed shops. In the study areas, fish farmers and hatchery owners were mainly involved in fish culture and health management activities. Therefore, the main customer of these chemicals and aqua drugs were the fish farmers and hatchery owners.

Farmers experience on fish culture

Almost all of the fish farmers were experienced in fish culture. Some of them had gained this experience and profession from their father and even their grandfather also. From the investigation of the study area, it was found that 20.83% farmers had the experience of 1-8 years, 31.67% farmers had the experience of 9-16 years, 28.33% farmers had the experience of 17-24 years, 12.5% farmers had the experience of 25-32 years, 3.33% farmers had the experience of 33-48 years, 1.67% farmers had the experience of 41-48years, 1.67% farmers had the experience of 49-56 years (Figure 2).

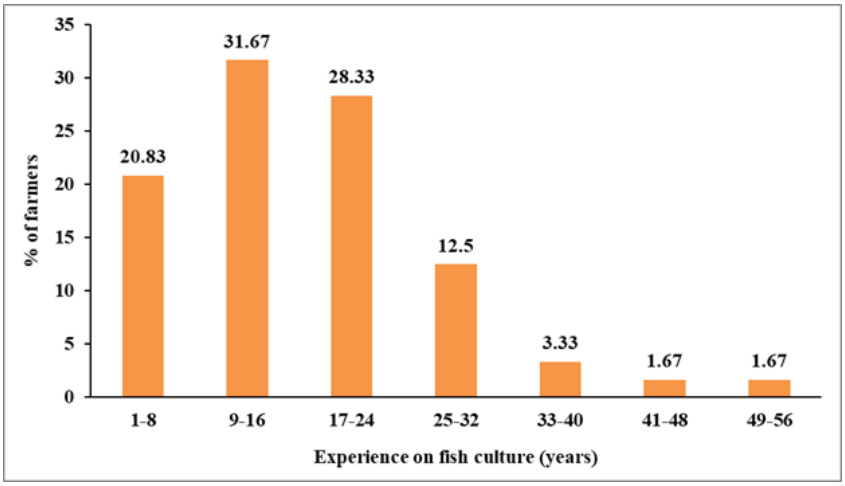

Figure 2. A graphical presentation of fish farmers experience on fish culture in the study area

Training experience of farmers on fish culture

About 59.17% fish farmers didn't received training on fish culture, while 40.83% fish farmers received training program organized by DoF, different NGO'S and representatives of the fish medicine companies in order to increase the popularity of their products (Table 2).

Table 2. Training experience of farmers

Participant fish farmers	No of fish farmers(n=120)	% of fish farmer
Yes	49	40.83
No	71	59.17

Training opportunity of fish farmer

The duration of the training program organized by various GOs and NGOs is presented in Figure 3. Among the 49 trained fish farmers, majority 67.35% of the fish farmers received 3 days training, followed by 1 days (10.20% farmers), 7 days (8.17% farmers), 2 days (4.08% farmers), 30 days (4.08% farmers), 90 days (4.08% farmers) and 21 days (2.04% farmers).

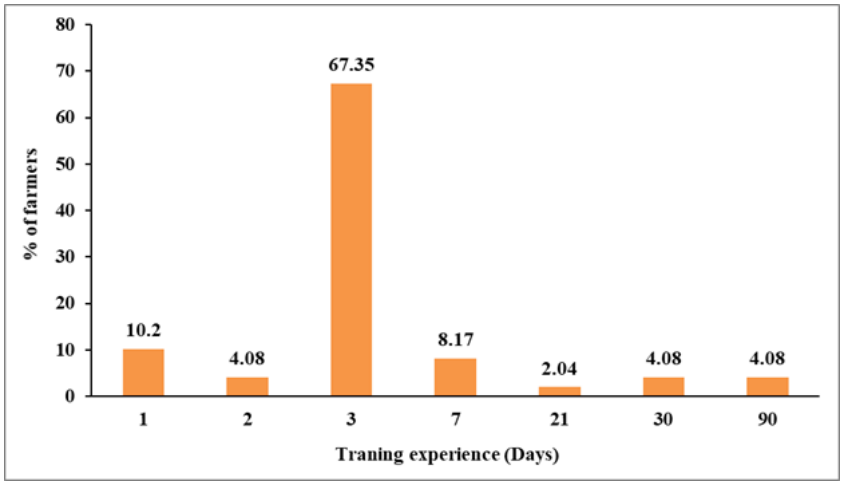

Figure 3. A graphical presentation of training opportunity of fish farmer in the study area

Preparation of pond before stocking of fish seeds

It was found that about 97.5% fish farmers prepared their ponds before stocking the fish seeds, while the rest 2.5% fish farmers were stocked fish seeds without any preparation (Table 3).

Table 3. Preparation of pond before stocking fish seeds

Response of fish farmers	No of fish farmers (n=120)	% of fish farmers
Yes	117	97.5
No	3	2.5

Water quality problems faced by the fish farmers in the study area

Various water quality problems faced by the fish farmers in the selected areas are shown in Table 4. Pond preparation and maintaining water quality is very crucial in order to increase the fish production to a significant degree. The selected fish farmer faced various water quality problems including dissolve oxygen (DO) deficiency (94% of farmers), gaseous problems (54% of farmers), poor phytoplankton (33% of farmers), turbidity (32% of farmers), algal bloom (19% of farmers) and p^H (11 % of farmers).

Diseases faced by the fish farmers in the study area

Fish diseases occurred in the study areas are represented in Table 5. The majority fish farmers in the study areas reported various fish diseases like fin rot (48%), followed by tail rot (47%), EUS (31%), argulosis (25%), exophthalmia (24%), dropsy (23%) and gill rot (17%).

Table 4. Water quality problems faced by the fish farmers in the study area

Water quality problems	Prevalence (%)	Death of fish (%)	Treatment	% of farmers
DO deficiency	61.53	22.40	Water exchange, Oxygen tablet	94%
Gaseous problems	37.71	10.78	Water exchange	54%
Poor phytoplankton	34.74	1.11	Zeolite, urea, TSP	33%
Turbidity	7.5	1.17	Lime	32%
Algal bloom	8.39	1.16	Withdrawal of bloom manually	19%
P^H	15.56	5.33	Water supply, lime	11%

Table 5. Diseases faced by the fish farmers in the study area

Disease	Clinical signs	Prevalence (%)	Death (%)	% of farmers
Fin rot	Reddish color, rotten on base	37.09	18.43	48%
Tail rot	Reddish color, rotten on base	35	16.74	47%
EUS	Red spot and infection	35.49	14.27	31%
Argulosis	Rubbing or flashing against solid, excess mucous	33.22	10.04	25%
Exophthalmia	Eye swollen	8.86	13.49	24%
Dropsy	Swollen abdomen	27.58	13.30	23%
Gill rot	Gill swelled and discolored gradually	10.09	5.56	17%

Chemicals used for pond preparation and water quality management

Pond preparation is very important in order to increase the productivity of the whole system. Again, maintaining optimal water quality is very important in determining the success or failure of fish production to a significant degree. A wide range of chemicals were frequently employed in the pond preparation process and for the maintenance of optimal water quality in the survey area such as fish farmers used Zeolite (43% of fish farmers) in greater percentages, followed by Matrix (18%), Zeorich (13%), Green Cal Aqua (7%) and others (14%) (Figure 4).

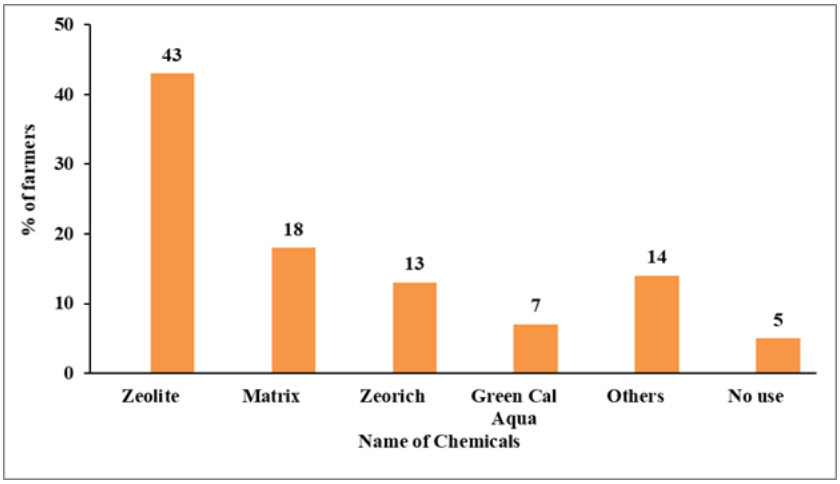

Figure 4. A graphical presentation of chemicals used for pond preparation and water quality management by the fish farmers in the study area

Chemicals used for disease treatment in the study area

In the intensive fish farming systems, fish farmers are confronting to various kinds of disease problems. For this reason, fish farmer uses some chemicals to treat the diseased fish. The results revealed that 41% fish farmers used Potash, followed by Timsen (22%), Lime (14%), Virex (12%) and others (11%) (Figure 5).

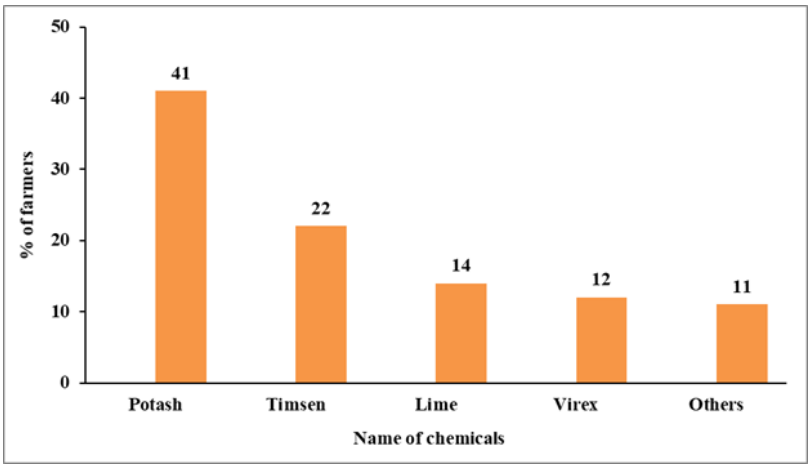

Figure 5. A graphical presentation of chemicals used for disease treatment by the fish farmers in the study area

Knowledge of aqua drugs and chemicals

In the investigated areas, it was recorded that 95.83 % farmers achieved knowledge on aqua drugs and chemicals from the discussion with the chemical sellers, hatchery owners and other fish farmers. 39.16% farmers gained knowledge from the government organizations, while 24.16% farmers achieved this from various company representatives (Table 6).

Table 6. Knowledge of aqua drugs and chemicals

Source of knowledge	Numbers of farmers (n=120)	% of farmers
Discussion with chemical seller, hatchery owner and other farmers	115	95.83
Government organization (GO)	47	39.16
Company representatives	29	24.16

Problems faced by the fish farmers in the study area

The selected fish farmers were also faced various problems during fish culture, management and harvesting activities. It was found that fish farmers faced flood/overflow problem (80%), lack of finance (73%), low price of the end product (68%), lack of technical knowledge (68%), diseases (60%), price of feeds and chemicals (53%), low quality of fish seed (43%), problem of fish leasing (39%), insufficient water in dry season (34%), lack of manpower (29%), joint partnership (29%), theft of fish (20%) (Table 7).

Table 7. Problems faced by the fish farmers in the study area

Problems	Number of farmers (n=120	% of farmers
Flood/overflow	96	80
Lack of finance	88	73
Low price of the end product	82	68
Lack of technical knowledge	81	68
Diseases	72	60
Price of feeds and chemicals	64	53
Low quality of fish seed	52	43
Problem of pond leasing	47	39
Insufficient water in dry season	41	34
Lack of manpower	35	29
Joint partnership	35	29
Theft of fish	24	20

Discussion

In this study about different aqua drugs and chemical companies were recorded in Kurigram district and all of those companies supplied aqua drugs and chemicals to fish farmers and hatchery owners whom were main clients of those compounds. Before stocking fish in the pond, pond preparation is very important step to maintain the water quality. In the present study, about 97.5% fish farmers prepared their ponds before stocking and faced various problems associated with water quality. A wide variety of chemicals were found in the markets which are being used for the pond preparation and refining water quality of fish ponds. Farmers of the investigated area were also used those diverse groups of aqua drugs and chemicals including Zeolite (43%), Matrix (18%), Zeorich (13%), Green Cal Aqua (7%) and others (14%). On the other hand, only 5% fish farmers didn't use any chemicals during pond preparation. In line with the present study, Geotox, JV Zeolite, Mega Zeo, Lime, BioAqua and Acmes Zeolite were applied for pond preparation and water quality management of Jamalpur and Sherpur districts of Mymensing region (Monsur, 2012) and Mega Zeo plus Acme's Zeolite, Matrix, Pond Gurd, Aqua Lime, Bio Aqua, Geotox, and others were used in the freshwater aquaculture of South-Eastern Bangladesh (Hossain et al., 2021). Furthermore, Akter et al. (2020) reported different types of chemicals like as megagio plus, megagio gold, aquastar pond, jv zeolite, zeo-fresh, aqua green, aqua pure, biomax, pond care, acme zeolite, zeopel, green zeolite, and pontox plus were used on fish health management in Bogura district, Bangladesh. Fish disease is being considered one of the most significant constraints for the sustainable development of the fish production. According to the respondent a number of diseases i.e. fin rot, tail rot, EUS, argulosis, exopthalmia, dropsy and gill rot were reported in the study area. Similar conditions were also observed by Akter et al. (2020). To treat the fish against fish diseases and diminish the health problems, farmers used various chemicals in this area. From the study, it was observed that chemicals used by the farmers against fish diseases at Kurigram district were Potash (41%), Timsen (22%), Lime (14%), Virex (12%) and others (11%). Ali (2008) observed that malathion, salt, lime, sumithion etc. were used to treat various fish diseases of Bangladesh and 37% fish farmers of coastal region used lime due to its effectiveness in low price (Sharkar *et al*. 2014). Timsen, pathonil, Virex, Aquakleen, Pathocide, BKC (Benzalkonium chloride), potassium permanganate, copper sulphate and Polgard plus etc. were used for disease control in South-Eastern region of Bangladesh (Hossain et al., 2021).

These aqua drugs and chemicals were supplied by different medicine companies. These medicine companies encourage the fish farmers to use their products by arranging training programs and discussions with the fish farmers. In the current study, about 59.17% fish farmers don't received training and only 40.83% received. Comparable research demonstrated that, only 12.5% fish farmers were received simple training while majority of the farmers about 87.5% were not received in Bogura district of Bangladesh (Akter et al., 2020). Due to the high prices of these medicines, some fish farmers were not able to use any chemicals. On the other hand, due to the lack of proper knowledge some of the fish farmers were used these medicines indiscriminately without considering their proper doses and purposes of their uses. Similar problems also faced by the farmers of Bogura district in Bangladesh (Akter et al., 2020). Therefore, they couldn't able to get the proper result of using those chemicals which ultimately adversely affect the aquatic fauna of aquatic environment. To overcome these problems various training programs should be organized by the GOs and NGOs for increasing the awareness of using aqua drugs and chemicals in aquaculture.

Conclusion

The current study was conducted in order to know the present condition of using aqua drugs and chemicals in the freshwater aquaculture of Kurigram district. From the study, it was found that fish farmer was facing various diseases and water quality problems. To solve those problems, the selected fish farmers were used 11 categories of different aqua medicines with different trade names. These aqua medicines were provided by representatives of different company in the market. These aqua medicines were available in the chemical seller and different veterinary and poultry feed shops. Fish farmer used these medicines for water quality management and fish health management. Therefore, the present study suggests the farmers about updated information on the commercial aqua drugs and chemicals to use for fresh water fish health management of freshwater fishes in Kurigram district.

Competing Interest

The authors declare that they have no competing interests.

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