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Evaluation of the status of use of chemicals and antibiotics in freshwater aquaculture activities with special emphasis to fish health management

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Abstract

The study was carried out to understand current status of use of chemicals and antibiotics in fish health management in freshwater aquaculture activities. Data were collected through questionnaire interview, personal contact, market survey and participatory rural appraisal like focus group discussion with fish and prawn farmers, retailers of animal medicine and representatives of pharmaceutical companies. A range of chemicals including antibiotics were found available in market. Fish health management and disease treatment were the major areas where majority of such chemicals have been used. Other uses included pond preparation and management, growth promotion and improvement of water quality to enhance pond productivity. Commonly found traditional chemicals in health management included Lime, Salt, Potassium permanganate, Sumithion, Melathion, Formalin, Bleaching powder and Malachite green. Of the new products JVzeolite, Geotox, Green zeolite, Orgavit aqua, Fish vitaplus, AQ grow-G, Oxy flow, Oxy max and O₂-marine were most widely used compounds. Fourteen branded antibiotics were found in market of which Oxysentin, Renamox, Renamycin and Orgamycine were being widely used. Thirty three pharmaceutical companies were producing and marketing these products. The study also identified the problems associated with the use of chemicals which included lack of knowledge regarding use of chemicals, appropriate dose, method of application and indiscriminate use of chemicals.

Keywords: Chemicals, Antibiotics, Aquaculture, Health management

Introduction

Aquaculture in Bangladesh is expanding rapidly. Over the last decade it has expanded, diversified, intensified and technologically advanced. In aquaculture, as in all food production sectors, one of the inputs required for successful fish production is chemical. Chemicals are indeed an essential ingredient to successful aquaculture, which has been used in various forms for centuries (Subasinghe *et al.*, 1996). Chemicals used in aquaculture can be classified as purpose of use, the type of organisms under culture, the life cycle stage for which they are used, the culture system and intensity of culture, and the type of people who are using them. Chemicals and antibiotics are important components in health management of aquatic animals, pond construction, soil and water management, improve aquatic productivity, transportation of live fish, feed formulation, manipulation of reproduction, growth promotion and processing and value addition of the final product (GESAMP, 1997; Subasinghe *et al.*, 1996). A variety of other chemicals are also used in aquaculture for health management of fish apart from antibiotics. Some common chemicals include sodium chloride, formalin, malachite green, methylene blue, potassium permanganate, hydrogen per oxide, copper compounds, glutaraldehyde and trifluralin (Plumb, 1992).

A range of disease could be found in farmed aquatic animals in Bangladesh (Karim and Stellwagen, 1998; BFRl, 1999 and Faruk *et al.*, 2004). Farmers are using a range of chemicals and antibiotic for the treatment of diseased animal. Also, pharmaceutical companies and chemical sellers are influencing fish and prawn farmers to buy their products. The farmers have been using these chemicals without knowing their necessity and effectiveness.

There are problems associated with the use of chemicals. With the expansion of aquaculture in Bangladesh, there has been increasing trend in using chemicals in aquatic animal health management. 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. (Phillips, 1996; Hasan and Ahmed, 2002; Brown and Brooks, 2002; DoF, 2002 and Faruk *et al.*, 2005).

Unfortunately, little attention has been paid on the 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. Hence, the objectives of the present study were i) to identify types of chemical and antibiotic used in aquatic animal health management; ii) to know the purpose, dose and methods of their application and iii) to identify the problems associated with their use.

Materials and Methods

The study focused mainly on different upazillas in Mymensingh district where aquaculture clusters are located. Data were collected through questionnaire interview, personal contact, market survey and participatory rural appraisal like focus group discussion with fish and prawn farmers, retailers of animal medicine and representatives of pharmaceutical companies. 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 response, the final set questionnaire was prepared. For the interview, simple random sampling method was followed.

PRA tools such as focus group discussion were conducted with rural fish farmers. Six to twelve fish farmers were selected for each discussion. Key informants such as District Fisheries Officer, *Upazilla* Fisheries Officer and NGO workers were interviewed by a semi-structured questionnaire. Key issues that came from focus group discussion were also discussed with key informants to have more logical explanation.

Results and Discussion

The chemicals available in the market used at different stages of aquatic animal health management like pond preparation, growth promotion, increasing oxygen concentration, disinfectant, probiotic and fish and prawn disease treatment have been collected and compiled. Fish disease treatment was the major area where plenty of such compounds were used. The local animal feed and chemical shops are the main sources of such compounds.

Chemicals used for pond preparation and water quality management

A number of traditional as well as new compounds were seen in the market which are being used to pond preparation and improving water quality of fish pond. The list of such chemicals with their active ingredients, prescribed dose, source and approximate price are shown in Table 1.

Chemicals like Rotenone and Predator are used for controlling unwanted fishes as well as other harmful aquatic animals. Fertilizers are used to increase primary productivity. Controller and Plankto Forte are used as a good source of mineral.

Table 1. Chemicals used for pond preparation and water quality management

Trade Name	Active ingredient	Dose	Source	Price (Tk.)
Geotox	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	For 3-6 feet deep water body 20-25Kg /100 dec. After stocking 10-20 kg/100 dec.	Novartis Pharmaceuticals	55/kg
JV Zeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O, K ₂ O	During pond preparation 7 kg/33dec. During culture 3.5Kg/33 dec. every 15 days	Eon Animal health Products	50 /kg
Green Zeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O, K ₂ O,	During pond preparation 20-25 Kg/100 dec. During culture 10-15 kg/100dec.	Organic Pharmaceuticals	55 /kg
Pontox plus	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	For 3-6 feet deep water body 15 kg/100 dec. After stocking 10-20 kg .	Rals Agro Ltd.	55 /kg
Zeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	20-30 kg/acre	National Agricare Imp. Exp Ltd	50/kg
Benzo	Tetra acetyl ethylin diamin + Sodium perborate	200 gm/acre	Synzenta	400/250g
Zeocare	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	20-30 kg/acre	Nature Care	50/kg
Mega Zeo	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O, K ₂ O, Mn,	For 3-6 feet deep water body 25 kg /100 dec. After stocking 15-20 kg in same water body.	ACI Animal Health	45/kg
Lime	CaO, Ca(OH) ₂	1-2 kg/dec.	Chemical seller	12 /kg
Agriculturelime	CaCO ₃	Spread with water 6-10 ppm	Chemical seller	8-15/kg
Bis Zeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	20-30Kg/acre	Avon Animal Health	50/kg
SupureZeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	20-30 kg/acre	Avon Animal Health	50/kg
Bio-Tuff	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O, K ₂ O, TiO ₂	During pond preparation 15-20 kg/100 dec. During culture 7-10 kg/100dec. Every 30- 40 days.	Organic Pharmaceuticals Ltd.	50/kg
Well Zeolite	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	For 3-6 feet deep water body 6-8 kg /33dec dec. After stocking 3-6 kg	SK+F	50/kg
Bio Aqua	Extract of Uka cidizera tree	2 ml/100 dec (1m depth)	Eon Animal health Products	330/100 ml
Aquazet	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ CaO, MgO, Na ₂ O	20-30/acre	Lion Overseas	50/kg

Chemicals use as disinfectant

Disinfectants are widely used in many spheres of aquaculture. They are used both in hatchery and grow-out systems mainly for equipment cleaning, to maintain hygiene and in some cases to treat disease. The disinfectants listed in Table 2 were found available in the market.

According to the leaflet provided by the company, Timsen and Emsen are also very effective in prevention of some bacterial and fungal infection as well as they destroy viruses. Formalin is also used to control protozoan disease. BKC (Benzal Konium Chloride) used for controlling bacterial disease and Efinol can also be used as stress resistance.

Chemicals used to increase oxygen concentration

Several chemicals were seen readily available in the chemical shops to use for increasing dissolved oxygen in fish pond. Oxydizing agent, hydrogen peroxide are the major active ingredients of such chemical (Table 3).

Table 2. Chemicals used as disinfectant

Trade Name	Active ingredient	Dose	Source	Price (Tk.)
EDTA	Sodium thio sulfate	0.1-1 ppm	Chemical seller	40/kg
Bleaching	Chlorine	60 ppm	Chemical seller	50/kg
Timsen	n-alkyl dimethyl benzyl ammonium chloride+ stabilized urea	20 g/33dec. (For prevention) 80 g/33dec. (For Treatment)	Eon Animal Health Products Ltd.	238/50 g
Emsen	n-alkyl dimethyl benzyl ammonium chloride+ stabilized urea	80 g/33 dec.	SK+FEskayef Bangladesh Ltd.	238/50 g
Water clear	Sodium Thiosulphate	In case of 5-6 feet deep water body 2-3 L/100 dec.	Organic Pharmaceuticals Ltd.	300/L
Pathocide	Benzyl chromium + Natural polymer of glucosamine	200 ml/33 dec.	Penta Agrovet Ltd	100/100 ml
Omicide	Benzyl ammonium chloride+ urea	200 ml/33dec. After 24 hours 150 ml	Lion Overseas Trading Company	100/100 ml
Lenocide	Alkyl benzyl dimethyl ammonium chloride+Poly-2-deoxy-2 Amino glucose	500-1000 ml/acre	Nature Care Com.	100/100 ml
Microdine-Iodine 20%	Nonyl alkyl ohenoxy poly ethane oxide iodine complex	2-2.5 L/ccre	Rals Agro Ltd.	80/400 g
Formalin	38% formaldehyde	1-3 ppm	Chemical seller	70/kg
BKC	Benzal Konium chloride	Spread with water, 0.5 ppm	Chemical seller	Tk. 1000-1500/Kg
Efinol	Efinol	5-8 g/1000 Liter water	Eon Animal health Products Ltd.	-

Table 3. Chemicals used for oxygen supply

Trade Name	Active ingredient	Dose	Source	Price (Tk.)
Oxyflow	H ₂ O ₂ 10%	General dose 250-350 g/acre In case of high deficiency 500 gm/acre in same water body.	Novartis Pharmaceuticals Ltd.	600/kg
Oxymax	H ₂ O ₂ 10%	250-500gm/acre (1 m deep water body)	Eon Animal health Products Ltd.	600/kg
O ₂ -Marine	H ₂ O ₂ 10%	33-40 Tab./33dec. (Generally) 66-90Tab/33dec	Organic Pharmaceuticals Ltd.	530/kg
Bio care	Sodium Lorile Ether Sulphate	80-120 ml/100 dec.	ACI Animal Health	350/L
Bio- Ox	Sodium carbonat, H ₂ O ₂	General dose 2.5-5.0 g/acre In case of high deficiency 5-8 g/acre in same water body.	ACI Animal Health	500/kg
Oxy plus	Na ₂ O ₂ .AlOH Na ₂ O ₂ -90%	500 g/acre	Navana Animal Health	530/kg
Oxygen Plus	O ₂ Promoter (H ₂ O ₂ /Ca ₂ O ₂)	General dose 250-500 g/acre; In case of high deficiency 750-1000 gm/acre	Avon Animal Health	530/kg
Oxymore	Sodium carbonat peroxyhydrat	General dose 250-500 g/acre; In case of high deficiency 750-1000 gm/acre	SK+F Bangladesh Ltd.	500/kg
Quick Oxygen	Sodium per carbonat+free Oxygen	General dose 250-350 g/acre; In case of high deficiency 500 g/acre	Organic Pharmaceuticals Ltd.	600/kg
Oxy-Plus	O ₂ Promoter (H ₂ O ₂ /Ca ₂ O ₂)	500 g/acre	Penta Agrovet Ltd	530/kg
O-Plus	O ₂ Promoter (H ₂ O ₂ /Ca ₂ O ₂)	500 g/acre	Nature Care	500/kg
Oxygrow	O ₂ Promoter (H ₂ O ₂ /Ca ₂ O ₂)	500 g/acre	Century Agro Ltd	530/kg
Oxysun	Sodium peroxide, Calcium Peroxide, Magnesium Oxide, Zinc Oxide	500 g/acre	Rals Agro Ltd. Bangladesh	530/5kg
Fish care powder	Oxide of Ca,P,S,Mn, Mg,Cu,N.	1kg/33dec.	S.S.S. Agro Care Ltd	70/400 g
Fish Curepas	Oxide of Ca,P,S,Mn, Mg,Cu,N.	1kg/33dec	M.R. Food and Protein Industries	70/400 g
Best oxygen	Sodium percarbonate	250-500 g/acre	Univet Ltd.	-
Oxy-Gold	Sodium Percarbonate	250-500 g/acre	Fishtech Ltd	-

It was found that some of the above chemicals are also used to remove hardness and poisonous gases e.g. Oxyflow and Quick oxygen. Some chemicals like Oxymax, O₂-Marrine and Oxy plus also help in preventing diseases in fish.

Chemicals used for disease treatment

Apart from antibiotics a handful of chemicals mostly traditional were seen available in the shops for treating fish disease. No information leaflet was available on dose and methods of application of such chemicals. No pharmaceutical companies are dealing with the basic traditional chemical rather they are engaged in producing new products. These types of chemical are shown in Table 4.

Table 4. Chemicals used for disease treatment

Trade Name	Active ingredient	Source	Price (Tk.)
Potash	KMnO ₄	Chemical seller	185/kg
Eco- solution	Eco-Solution	Chemical seller	85/L
Lime	CaO, Ca(OH) ₂	Chemical seller	12/kg
Formalin	40 % HCHO	Chemical seller	70/kg
Salt	NaCl	Chemical seller	8/kg
Albez	Doxycyclin, colistine sulphate + vitamin premix + mineral	Syngenta	253/250 g
Protacide	C ₂₂ H ₄₂ ClN+C ₂₃ H ₂₅ ClN ₂ +C ₂ H ₅ OH + Some inert component	Elwellas	-
Methylene Blue	C ₁₀ H ₁₈ ClN ₃ S _x H ₂ O	Chemical seller	350/25 g
Malachite green	C ₂ H ₂ O ₄	Chemical seller	500/25 g
Melathion	Active melathion	Chemical seller	60/100 ml
Spa	Protein, chloesteren, Ca, Vitamin-D, Carotinaid	Syngenta	4100/kg
Timsen	n-alkyl dimethyl benzyl ammonium chloride+ stabilized urea	Eon Animal Health Products Ltd.	238/50 g
Sumithion	Fanitrothion	Chemical seller	90/100 ml

From above chemicals in Table 4, Eco-solution is effective for viral diseases. Melathion, DiptereX, Melachite green, Formalin, Salt, Methylin blue, etc. are useful for eradication of external parasites as well as fungal diseases. Lime is also used for common fish diseases. Spa is effective for both disease treatment and growth promotion purposes. Moreover, timsen is used for treatment of several diseases and as a disinfectant.

Antibiotics for disease treatment

In the present investigation about 14 branded antibiotics with different trade names were seen in the market as well as used by the fish farmers which are shown in Table 5. The active ingredients of such antibiotics are mainly Oxytetracycline, Chloro-tetracyclin, Amoxicillin, Co-trimoxa zole, Sulphadiazine and Sulphamethoxazole. The price seems quite affordable by the commercial aqua farmers.

Table 5. Antibiotics for disease treatment

Trade name	Active ingredient	Dose	Source	Price (Tk.)
Oxysentin 20%	Oxytetracine HCl BP	100-200 g/100 kg feed,5-7 days (For treatment)	Novartis Pharmaceuticals	700/kg
Chlorsteclin	Chlortetracycline	200-300 g/100 Kg feed (5-7days)	Novartis Pharmaceuticals	300/kg
Ranamox	Amoxicillin Trihydrate	28-40 g/100 bd of fish, 10 days continuously.	Renata Pharmaceuticals Ltd	140/100 g
Renamycin	Oxytetracycline	28-42 g/100 kg feed, 10 days.	Renata Pharmaceuticals	82/100 g
Fish cure	Chloro-tetracyclin HCl	500 g/100 kg feed (3-5 days)	Rals Agro Ltd.	275/kg
Orgamycin 15 %	Oxytracycline HCl BP (WSP)	In case of prevention 60 gm/100 kg feed 10days In treatment 120-240 g/100 kg feed, 5-7 days	Organic Pharmaceuticals Ltd.	70/100 g
Orgacycline-15%	Chlorotetracycline	200-300 g/100 kg feed (5-7days)	Organic Pharmaceuticals Ltd	-
Acimox(vet) Powder	Amoxiciline (Trihydrate)	1 g/1 kg feed	ACI Animal Health	75/100 g
Bactitab	Oxytetracyclin 20%	50 g/kg body weight , 5-7 days	ACI Animal Health	70-80/100 g
Contrim vet Bolus	Co-Trimoxa zole	Mixed with feed; 1bolus/ 10-12 kg body wt	Square Pharmaceuticals	64 /100 g
Otetra vet power 50	Oxytetracycline	Mixed with feed; 11-16 g/ 100 kg body wt	Square Pharmaceuticals	156/100 g
Sulfatrim	Sulphadiazine & Trimethoprim	50 g/kg body weight , 5-7 days	Square Pharmaceuticals	70-80/100 g
Oxin WS	Oxytetracycline 20%	50 mg/kg body weight	Navana	70-80/100 g
Cotrim-Vet	Sulphamethoxazole + Trimethoprim	0.50mg/kg body weight	Square Pharmaceuticals	70-80/100 g

According to the information leaflet, all of these antibiotics are effective against bacterial disease. According to the leaflet, Oxysentin 20%, Orgamycin 15 % and Orgacycline-15% are also effective against EUS. It was also mentioned that Chlorsteclin and Fish cure plays vital role in growth promotion as well as effective against some disease like dropsy, tail and fin rot, gill rot of fish etc.

Chemicals used as growth promoter

Chemicals found in the chemical shops which are used as growth promoter as well as to increase production included Megavit Aqua, Aqua Boost, Aqua Savor, Vitamin premix, Fibosol, Grow fast, Orgavit aqua, AQ-Cell , AQGrow-G, Fish vita plus, AQ Grow-L, Growmax, Nature Aqua GP, Vitamix, F Aqua , ACmix and many more. Aqua boost contains β -glucan, immunostimulant, which enhance non-specific immunity in fish.

Widely used traditional chemicals in freshwater aquaculture for health management

Data from 50 freshwater fish farmers were analyzed to know the status of use of commonly available traditional chemicals which are shown in Table 6.

Table 6. Widely used traditional chemicals in freshwater aquaculture

Chemicals	Number of respondents (n = 50)	% of farmer
Lime	40	80
Salt	30	60
Potash	20	40
Melathion	10	20

Some previous studies also revealed the similar outcome regarding the use of chemicals in aquaculture in Bangladesh (Phillips, 1996; Brown and Brooks, 2002; DoF, 2002 and Faruk *et al.*, 2005).

Widely used new chemicals in freshwater aquaculture

From the list of a number of new chemicals found in market an attempt was made to find widely used new products by farmers. It was found that Geotox, JVzeolite, Green Zeolite, Megavit Aqua, Fish Vitaplus, AQ Grow-G, Oxy flow, Oxy max, O₂-Marine were the most widely used new chemicals in freshwater aquaculture in the study area (Table 7).

Table 7. Widely used new chemicals in freshwater aquaculture

Chemicals	Number of farmers (n = 50)	% of farmer
Geotox	12	24
JVzeolite	14	28
Green Zeolite	18	36
Megavit Aqua	14	28
Fish Vitaplus	13	26
AQ Grow-G	12	24
Oxy flow	11	22
Oxy max	14	28
O ₂ -Marine	18	36

Widely used antibiotics in freshwater aquaculture

The use of antibiotic substances is the cause of much controversy. Bacterial diseases of fish can be successfully treated with antibiotics. It is widely recognized that excessive use of antibiotics contributes the development of resistant strains of bacteria (Inglis, 1996). Of the antibiotics four antibiotics like Oxysentin 20%, Renamox, Renamycin and Orgamycine 15% were used widely by the farmers (Table 8) for the treatment of fish diseases.

Table 8. Widely used antibiotics in freshwater aquaculture

Chemicals	Number of farmers (n = 50)	% of farmer
Oxysentin 20%	17	34
Renamox	6	12
Renamycin	14	28
Orgamycine 15%	11	22

Chemical producing pharmaceutical companies

In the present study, about 33 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 reveled that among the 33 companies more than 50 % of the products were produced by seven companies like Organic Pharmaceuticals Ltd. (11.32%), Rals Agro Ltd. (9.43%), Novartis Animal Health Ltd. (5.66%), Eon animal Health Product Ltd. (7.55%), ACI Animal Health Ltd. (11.32%), CP Aquaculture (5.66%), Square Pharmaceuticals Ltd. (5.66%), and the rest (43.40%) were supplied by the 26 companies (Table 9).

Table 9. Supply of Aquatic Chemicals (%) producing pharmaceutical companies

Name of Company	Number of products n=106	Product (%)
Organic	12	11.32
Rals Agro	10	9.43
Novartis	6	5.66
Eon	8	7.55
ACI	12	11.32
CP	6	5.66
Square	6	5.66
Other 26 Companies.	46	43.40

It was also found from the present survey that the farmers were using most of the chemicals indiscriminately. There is no regulation on the use of chemicals in aquaculture in Bangladesh. On a worldwide basis, only a small number of chemicals are legally approved for use in aquaculture. The use of drugs and chemicals by the US aquaculture industry is strictly regulated by the US Food and Drug Administration (FDA) and the US Environmental Protection Agency (EPA). In the present investigation, some chemicals were found with only trade names. The sellers or farmers or extension workers do not have clear idea about the active ingredient of that particular chemical although they are using those without hesitation.

Problems in use of chemicals and antibiotics

The present study identified some problems associated with the use of chemicals and antibiotics which included i) lack of technical knowledge of fish farmers on fish health management ii) lack of knowledge about use of chemicals iii) unavailability of appropriate therapeutic iv) lack of knowledge of application of chemicals and antibiotics v) indiscriminate

use of chemicals vi) pressure on farmers from pharmaceutical companies and pesticide sellers vii) poor quality chemicals viii) lack of assistance from GO and NGOs ix) lack of awareness about the safety issues in using hazardous chemicals x) lack of information on the label of chemical about possible hazard xi) lack of knowledge about residual effect and expiry date xii) lack of diagnostic facilities for proper disease diagnosis and xiii) lack of trained manpower to prescribe fish medicine.

Conclusion

The present study demonstrated current status of chemicals and antibiotics used in aquatic animal health management and pointed out some problems of use of these chemicals by the farmers. Simply less use of chemicals is the best alternative to minimize the adverse effects of chemicals in aquaculture. 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.

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