International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: RJIF 5.72
www.allsubjectjournal.com
Volume 3; Issue 11; November 2016; Page No. 27-31

Use of aqua drugs and chemicals in the fish farms of Katiadi, Kishoreganj

[1] Mohammad Idris Miah, [2] Sayedatunnesa, [3] Debashis Kumar Mondal, [4] Gias Uddin Ahmed, [5] Md. Moshiur Rahman

[1] Professor, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2] MS student, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[3] Senior Scientific Officer, Bangladesh fisheries Research Institute, Mymensingh-2201, Bangladesh
[4] Professor, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[5] Scientific Officer, Freshwater Station, Bangladesh fisheries Resaersch Institute, Mymensingh-2201, Bangladesh

Abstract
An experiment was conducted to assess the application mode of different commercial aqua drugs and chemicals in aquaculture activities and their impact on fish health. Thirty fish farms of Katiadi Upazila of Kishoreganj district were selected to observe the present status of use of commercial aqua drugs and chemicals and their impact on fish health. Data were collected through questionnaire interview with fish farmers, drug sellers, personal contact, market survey and representatives of pharmaceutical companies. Seven categories of aqua drugs and chemicals were identified that were used by fish farmers. Many companies include Fish Tech, ACI Animal Health, Square Pharmaceuticals Ltd, Renata Animal Health, Eon Fish Grower Ltd supplied those drugs. Different types of fish diseases were observed in the investigated areas. Farmers used various aqua drugs and chemicals such as Geotox, Zeolite, Mega Zeo, Oxyflow, Ammonil, Lime, Salt, Potassium permenganate, Sumithion, Formalin, Methylene blue, Malachite Green, Timsen, Oxysentin 20%, Captor, Aquqmycine, Megavit Aqua, Aqua Boost, Aqua Grow-P and ACmix Super - Fish against fish diseases and health problems of their cultured fishes. The results revealed that aqua drugs had a definite impact on the recovery of fish diseases that is 60% to 90% in various culture fishes of Kishoreganj region. The production values ranged from 6 to 14 tons/acre. In the present study water quality parameters were monitored and found to be within suitable range for freshwater aquaculture. During the field observation some problems were identified while using aqua drugs and chemicals which included poor understandings of farmers about the application of aqua drugs, inadequate withdrawal period and some adverse effects on fish and human health.

Keywords: aqua-drugs, impact, aquaculture and kishoreganj

1. 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) [14]. Chemicals and antibiotics are important 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) [5, 14]. With the expansion of aquaculture in Bangladesh, there has been increasing trend in using more chemicals for health management of aquatic animal. Farmers commonly used aquaculture drugs in Bangladesh including lime, rotenone, various forms of inorganic and organic fertilizers, phostoxin, salt, dipterex, antimicrobials, potassium permanganate, copper sulphate, formalin, sumithion and melathion for the treatment of diseased fish and shellfish (Phillips, 1996; Hasan and Ahmed, 2002 and Faruk *et al*., 2005) [9, 6, 4]. Sodium chloride is an age old treatment especially effective chemical when treating some fungal and parasitic disease in fish. Formalin is versatile and primarily an external parasitic drug used on fish and fish eggs as flush and prolonged or indefinite treatment for fungus control. Potassium permanganate is one of the widely used chemical which has strong oxidizing agent and is good for treating external protozoa and external bacterial infections (Plumb, 1992) [10].

However pesticides are also used in aquaculture for disease treatment such as organophosphates, organotin compounds, rotenone and saponin. In case of insecticides, sumithion is effective against various types of insects which cause serious damage of fry and fingerlings in both nursery and culture ponds. All farmers use fertilizers in their ponds and these fertilizers were used for increasing primary productivity which helps to reduce feed cost of farmers.

Malachite green is an organic dye that has been popular as a parasiticide and fungicide on fish. It is principally used in hatcheries rather than grow-out systems (Alderman, 1992) [1]. Common group of pesticides are organophosphates, organotin compounds, rotenone and saponin. Dichlovos, trichlorfon, dipterex, melathion and dursban are the widely used organophosphate applied to control ectoparasitic crustacean infections in finfish culture. Fertilizers are also widely used in the management of fish ponds to stimulate the phytoplankton bloom. Although (Reilly, 1992) [12] opined that fertilizers pose minimal risk to food safety in aquaculture, when used appropriately and any misuse could lead to hazard in aquaculture products.

Now concern is growing over the use and potential misuse of some of these chemicals. With the expansion of aquaculture in the Kishorgonj region, the use of chemicals, antibiotics and aqua drugs are increasing tremendously. But no appropriate research works have been carried on the use of drugs in aquaculture for fish culture and health management in that region. Therefore, the present research work was carried out to assess the list of drugs and chemicals used in aquaculture and their purpose, methods and dosage of application in Katiadi of Kishorgonj District.

2. Materials and methods

The present study was conducted in the fish farms of Katiadi Upazila under Kishorgonj district from August 2014 to February 2015. The sampling areas were Achmita, Mumurdia, Masua, Katiadi Charipara, Banagram and Gachihata. Data were collected through questionnaire interview, personal contact, participatory rural appraisal (PRA) and focus group discussion (FGD) with fish farmers and associations, market survey and retailers of aqua-drugs and chemicals. Crosscheck interviews were conducted with Upazila Fisheries Officer, Assistant Fisheries Officer and relevant NGO workers. After collection, the data were analyzed with Microsoft Excel. The sample size varied from different target groups such as 12 to 15 farmers, 3 to 4 drug shops or representatives from aqua drugs company and 1 to 2 farmers association from each sampling stations. The water quality parameters were measured weekly by using HACH test kit. The impact of different aqua-drugs and chemicals on fish health and production were measured through the farmer's opinions.

3. Results

Chemicals used for pond preparation and water quality management in the study area

From the present investigation, in Katiadi Upazila farmers were found to use five types of pond preparatory drugs such as Geotox, JV Zeolite, Mega Zeo, Agricultural Lime and Zeo-Fresh granular. Chemicals like Rotenone were used for controlling unwanted fishes as well as other harmful aquatic animals (Table 1).

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

Trade Name	Active ingredients	Dose	Sources	Price (Tk.)
Geotox	SiO_2, Al_2O_3, Fe_2O_3	For 3-6 feet deep water body 0.20-0.25Kg/dec. After stocking 0.10-0.20 kg/dec. about 30-40days.	Novartis Pharmaceuticals Ltd.	55/Kg
JV Zeolite	SiO_2, Al_2O_3, Fe_2O, K_2O, Mn, P	During pond preparation 7 kg/33dec. During culture 3.5Kg/33 dec.	Eon Animal health products Ltd.	50/kg
Mega Zeo	SiO_2 Al_2O_3, Fe_2O_3CaO, MgO, Na_2O, K_2O, Mn.	For 3-6 feet deep water body 0.25 kg/dec. After stocking 15-20kg in same water body	ACI Animal Health	45/kg
Agricultural lime	CaCO3	Spread with water 6 -10 ppm	Chemical seller	8 -15/kg
Zeo-Fresh granular	MgO, CaO, MnO_2	10 kg/acre 3-6 feet deep water body	Square Pharmaceuticals Ltd.	120/kg

Chemicals used as disinfectants in the study area

The disinfectants available in the markets were EDTA, Bleaching Powder, Timsen, Formalin and Efinol. Major sources of the chemicals are Rals Agro Ltd., Eon Animal health Products Ltd., Organic Pharmaceuticals Ltd., and Chemical sellers. Formalin is used to control protozoan disease and Efinol is used as stress resistance chemical (Table 2).

Table 2: Chemicals used as disinfectant in the study area

Trade Name	Active ingredients	Dose	Sources	Price (Tk.)
Formalin	38% Formaldehyde	1-3 ppm	Chemical seller	70/Kg
Bleaching powder	Chlorine	60ppm	Chemical seller	50/Kg
Timsen	n-Alkyl dimethyl benzyl ammonium chloride, Stabilized urea	20g/33dec. (For prevention) 80 g/33dec. (For Treatment)	Eon Animal Health Products Ltd.	230/50g
EDTA	Sodium thio sulphate	0.1-1.0ppm	Chemical seller	40/kg
Efinol	Efinol	5-8 g/100 Liter water	Eon Animal health Products Ltd.	75/g
Argulex	Trichlorfon	500 ml/acre	Fish tech	300/kg

Chemicals used to improve dissolve oxygen level in the study area

From the present research in Katiadi Upazila farmers were used Oxyflow, Oxymax, Bio-Ox, Oxy-Gold, Oxy-A for the improvement of dissolved oxygen level. Oxydizing agent, hydrogen peroxide was the major active ingredients of such chemical. Mostly used drugs were Oxyflow, Oxymax, Bio-Ox whereas Oxy-A was mostly used by the farmers (Table 3).

Table 3: Chemical used to improve dissolve oxygen level in the study area

Trade Name	Active ingredients	Dose	Sources	Price (Tk.)
Oxyflow	H_2O_2 10%	General dose 250-350 g/acre. In case of high deficiency 500 g/acre in same water body	Novartis Pharmaceuticals Ltd.	630/Kg
Oxymax	H2O2 10%	2.5-5g/dec (1 m water depth)	Eon Animal Health	350/L
Bio-OX	Sodium carbonat, H2O2	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-Gold	Sodium Percarbonate	2.5-5 g/dec	Fish Tech Ltd	550/kg
Oxy-A	-	3-4g/dec	The Acme Laborates Ltd.	480/kg

Chemicals used for fish disease treatment in the study area

Farmers used eight types of chemicals for treating a variety of fish diseases with different dosage. Potash, Lime, Formalin, Salt, Methylene Blue, Malachite Green, Melathion, Timsen and Ablaze were used regularly for fish disease treatment (Table 4).

Table 4: Chemicals used for disease treatment in the study area

Trade Name	Active ingredients	Sources	Price (Tk.)
Potash	$KMnO_4$	Chemicals seller	185/kg
Ablaze	Vitamin, Minerals and anti-microbial agents	Eon Animal Health Products Ltd.	390/Kg
Formalin	40% HCHO	Chemical seller	70Kg
Salt	NaCl	Chemical seller	8/kg
Methylene Blue	$C_{10}H_{18}ClN_3SH_2O$	Chemical seller	350/25g
Malachite Green	$C_2H_2O_4$	Chemical seller	500/25g
Melathion	Active melathion	Chemical seller	60/100ml
Timsen	n-Alkyl dimethyl benzyl ammonium chloride and stabilized urea	Eon Animal Health Products Ltd.	230/50g

Antibiotics used for disease treatment in the study area

Most farmers used Oxysentin 20%, Captor, Acimox (vet) Power and Aquamycine for disease treatment. These broad spectrum antibiotics were found to use by mixing with fish feed (Table 5).

Table 5: Antibiotics used for disease treatment in Katiadi Upazila

Trade Name	Active ingredients	Dose	Purpose	Price (Tk.)
Oxy-dof-f	Oxytetracline 20%, doxycycline 10%	0.5-1g/kg feed,5-7 days (For treatment)	Effective against *Aeromonas* or *Vibrio* spp. In fish	700/kg
Aquamycine	Oxytetracycline hydrochloride 25%	0.3-1 g/Kg feed (5-7days)	Do	300/kg
Renamycin	Oxytetracycline	2.8-4.2 g/ kg feed, 10 days.	Do	82/100g
Ranamox	Amoxicillin Trihydrate	2.8-4.0 g/kg feed, 10 days continuously	effective against columnaris, edwardsiellosis and mycobacterosis	1400/kg
Renamox 15%-vet	Amoxicillin Trihydrate	2.8-4.0 g/kg feed, 10 days continuously	Do	70/100g
Acimox (vet) Powder	Amoxiciline (Trihydrate)	1 g/1 kg feed	Do	75/100g
Captor	Chlorotetracyclin HCl BP 45%	2.5-3.5g/kg feed (3- 5 days)	Effective against *Aeromonas, Vibrio*	275/kg

Aqua drugs used as growth promoter in the study area

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, Aquamin, Aquamin powder, ACmix and many more Aqua Boost contains organic acid, B-glucan, immunostimulent, which enhance non – specific immunity in fish (Table 6).

Table 6: Aqua drugs used as growth promoters in the study area

Trade Name	Active ingredients	Dose	Sources	Price (Tk.)
Megavit Aqua	Vitamin, Mineral and Amino Acid Supplement	1g/kg feed	Novartis Pharmaceuticals Ltd.	300/kg
Aqua Boost	Organic acid, B-Glucan	500 g/MT feed	Novartis Pharmaceuticals Ltd.	300/Kg
Aqua Savor	Amino acid premix	2-3 kg/Ton feed	Eon Animal Health products Ltd.	750/kg
Fibosel	Glucan and Mannos polymer	200-300 g/Ton feed	Eon Animal Health products Ltd.	325/200g
AQ Grow-P	Herbal growth promoter premix	1-2 g/kg feed	ACI Animal Health	230/kg
Vitamix F Aqua	Vit+Mineral+Amino acid	2.5 kg/Ton feed	The Acme Laboratories Ltd	300-350/kg
AQ Grow-G	Herbal growth factor	1-3ml/kg feed	ACI Animal Health	300/kg
Aquamin	Cu, Co, Mg, Fe, Zn Ca, P, Methiolin, L-Lysin HCl.	1 g/kg feed	ACI Animal Health	150/kg
ACmix super-Fish	Vitamin and Mineral premix	1-25 kg/100 kg feed	ACI Animal Health	350/2.5kg
Aqumin Powder	Mineral Harbs	5-10 kg/Ton	ACI Animal Health	150/kg

Impact of aqua drugs on fish health and diseases at farmer level in the study area

Shing and Magur were the most susceptible species without reasonable symptoms having 30% prevalance. EUS was detected in Tilapia, Rui, Catla and Mrigal with 70% prevalence. Indian major carp found to be susceptible with Lernaeasis having 80% prevalence was reported by the farmers. Pangus were also affected by tail rot and fin rot disease with 60% prevalence. Tilapia was also affected by cataracts with 40% prevalence.

Some clinical signs of such disease were red spot on body surface, lesion on body surface, red or bloody gills, small black specks on the body, gasping at the air and white or gray fungus on eyes. Most of the fish species are gasping at the surface with their mouth. Tail rot and fin rot disease are found in Pangus. Exophthalmia in tilapia on eyes as symptoms of unusually bulging of one or both eyes. EUS was detected in Tilapia, Rui, Sharpunti and Mrigal. Small black specks on the body are found in Shing. Most fishes are restless and rub against the side and bottom of the pond (Table 7).

In Katiadi Upazila, EUS affected tilapia were treated by farmers with antibiotics as Renamycin, Renamox and Oxysentin having 85-90% recovery. Tail rot and fin rot affected Pangus were treated with Tetracycline, Methylene blue, Chiromycetin having 60% recovery. Ammonia poisoning was seen with Rui, Catla where farmers need to regular water testing and maintenance with a result of 90% recovery. Farmers used Renamycin and Geolite Gold as drugs

with a result of 85% recovery. Farmers used Oxylife, Oxyflow and Bio-oxy as the treatment on oxygen deficiency of Rui, Catla resulting 90% recovery. There were various spots on skin, tail, gill and abdomen in some parts of Pangus, where farmers used Aquamycine, Tetracyclin and Renamycine as drugs and achieved 70-80% recovery.

Table 7: Impact of aqua drugs on fish health and disease recovery in the study area

Area	Species	Disease prevalence (%)	Clinical sign	Commercial aqua drugs used	Affected months	Recovery
	Rui,	EUS (60%)	Red spot on	Renamycine @ 50	August	80%
	Sarpunti	EUS (60%)	body surface	mg/kg body weight,	August	80%
	Tilapia, Rui, Catla, Mrigal	EUS (70%)	Red spot on body surface, lesion on body surface	use antibiotics	August	85%
	Rui, Catla, Mrigal	Ammonia Poisoning (60%)	Red or bloody gills, gasping for air	Regular water testing and maintenance will prevent it	January	90%
Katiadi, Kishorgonj	Tilapia	Exophthalmia (75%)	Unusually bulging of one or both eyes	OTC medications for bacterial infections and parasites	December	70%
	Rui, Catla	Oxygen deficiency (70%)	gasping at the surface with their mouth	Oxylife, Oxyflow, Bio- oxy	December	90%
	Shing	Black spot (30%)	small black specks on the body	use commercially available drugs	January	70%
	Pangus	Tail rot and Fin rot (40%)	Destruction of fins or tail, exposed fin rays	Teteacycline, Chioromycetin, Methylene blue	February	60%
	Indian major carp	Lernaeasis (20%)	fishes are restless and rub against the side and bottom of the pond	$KMnO_4$: pond treatment at 4 ppm	January	80%
	Tilapia and white fishes	Cataracts (40%)	White or gray fungus on eyes	OTC medication for fungus	December	75%

Water quality parameters

The value of water quality parameters were recorded weekly in the study area from August to February (Table 8).

Table 8. The average value of water quality parameters

Months Name	Parameters						
	Temperature (^{0}C)	DO (mg/L)	pH	Nitrite (mg/L)	Total alkalinity (mg/L)	Total hardness (mg/L)	Ammonia (mg/L)
August	29	4.5	8.2	0.1	110	120	0.2
September	27	5.2	7.5	0.3	80	100	0.1
October	24	5.4	7.9	0.5	80	90	0.3
November	22.5	5.0	8.0	0.2	100	90	0.1
December	18	6.0	7.4	0.1	120	60	0.2
January	16	4.3	7.5	0.0	70	80	0.0
February	19	4.9	7.6	0.4	130	70	0.4

4. Discussion

The present investigation was conducted to know the current use of commercial aqua-drugs and chemicals in aquaculture activities in Kishoreganj region. At present fourty two products of seven animal health companies were seen at the markets of investigated areas. A number of traditional as well as new aqua drugs were recorded during present investigation used for the improvement of water quality of fish ponds such as Geotox, JV Zeolite, Mega Zeo, Lime, Agricultural Lime and Zeo-Fresh granular were used in the study area. Hasan (2014) [7] observed slightly different types of chemicals used for improving water quality of fish ponds like Geotox, Green Zeolite, Lime, Pontox Plus, Mega Zeo, Benzo, Zeocare, Ammonil Bio Aqua Alpha Zeolite, Supreme-Zeolite, Bio-Tuff, Acmes Zeolite, Aquazet, Fish Grow and Biolite Plus. As disinfectants, farmers used mainly formalin, bleaching powder, EDTA, Timsen, Argulex and Effinol in the fish farms of Katiadi upazila. Monsur (2012) [8] mentioned that farmers of the Jamalpur and Sherpur region used Formalin, Bleaching Powder, Timsen, EDTA (Disodium Ethylene Diamine Teracetate) used as disinfectants. Ali (2008) [2] observed that Timsen was effective to active against a wide range of organisms, such as fungi, bacteria and ectoparasite. Farmers of the investigated areas used several chemicals with very similar names to increase dissolved oxygen in fish ponds like Oxyflow, Oxymax, Oxy Plus, Bio-Ox, Oxy-Gold and Oxy-A. Rahman (2011) [11] observed that aqua drugs like Oxyflow, Oxymax, Oxyplus, Bio Care, Pure Oxy, Oxy–Gold were used to increase dissolved oxygen. Oxidizing agent, Hydrogen Peroxide was the major active ingredients of such chemicals. Aqua Boost, Aqua Savor, Fibosol, AQ Grow-P, Vitamix F Aqua, Aquamin powder of different companies were found in the chemical shops of the study areas used as growth promoters. Shamsuddin (2012) [13] observed that farmers used Grow fast, Ossi-C, Silver mil and Revit C were used as a growth promoter in the Fulbaria, Gouripur and Fulpur Upazilas of Mymensingh district. Seven antibiotics with different trade names were used by the farmers in the study areas as Oxysentin 20%, Captor, Acimox (vet) Powder and Aquamycine. From the research findings of Shamsuddin (2012) [13] it was recorded that in the Fulbaria, Gouripur and Fulpur Upazila farmers used antibiotics were mainly Renamycine, Aquamycine, Amoxifish, Oxy-Dox-F, Oxysentin, Doxioxy, Amoxivet, Ascamicyne and Orgamycine. Various types of disease were detected in Katiadi Upazila. These were EUS in Rui, Catla, Mrigal, Sarpunti, Thai pangus and Thai Koi, red spot disease in Sarpunti, swollen abdomen disease in Shing and cataracts in Tilapia and white fishes. From the research findings of Monsur (2012) [8] it was observed that the diseases such as EUS, Edwardsillosis, red

spot, swollen abdomen and white spot were detected in the Sadar Upazila of Jamalpur district. According to the farmers of Katiadi Upazila, chemicals such as Potash, Formalin, Salt, Methylene Blue, Malachite Green Melathion, Timsen and Ablaze were used as a disease treatment. Ali (2008) [2] and Rahman (2011) [11] found several aqua drugs like Lime, Salt, Potassium Permanganate, Sumithion, Melathion, Formalin and Bleaching Powder were used as disease treatment. To treat EUS affected Rui farmers used Renamycine with a result of 80% recovery in the Katiadi Upazila. Besides, farmers used Oxytetracycline, Oxylife, Oxyflow, Tetracycline and Methylene Blue for the treatment of fish diseases in the study area. Hasan (2014) [7] mentioned that farmers used Renamycin, Polgard plus, Ossi-C, Tetravet, Revoflavin, Fish Cirpus and Cholin chloride for the treatment of EUS, White spot, Edwardsiellosis, Pop eye and Dropsy in the Trisal and Bhaluka upazila of Mymensingh district which had an average of 80-85% recovery. During the study period the temperature, DO, pH, nitrite, total alkalinity, total hardness and free ammonia value were 16^0-29^0c, 4.3-6.0 mg/l, 7.4-8.2, 0.0-0.5 mg/l, 70-130 mg/l, 60-120 mg/l and 0.0-0.4 mg/l respectively which were within the suitable range (DoF, 1996) [3].

5. Conclusion

The present study pointed out some problems of using aqua-drugs which included poor understanding of farmers about the application of drugs, inadequate withdrawal period and some adverse effects such as excessive use of aqua drugs and chemicals in aquaculture which influences water quality deterioration, environmental degradation, destructive hygienic conditions that favor fish stress, opportunistic infections and their dissemination, reduces larval growth and inhibit defense mechanisms. Finally, 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 therapy. 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.

6. References

1. Alderman DJ. Malachite green and alternatives as therapeutic agents. Europe Aquaculture Society Special Publication. 1992; 16:235-44.
2. Ali MM. Study on the chemicals and antibiotics used in aquatic animal health management, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh, 2008.
3. DoF. Matsha Pakkah Shankalan. Directorate of Fisheries, Ministry of Fisheries and Livestock, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. 1996; 8.
4. Faruk MAR, Sultana N, Kabir MB. Use of chemicals in aquaculture activities in Mymensingh area, Bangladesh. Bangladesh Journal of Fisheries. 2005; 29:1-10.
5. GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection). Towards safe and effective use of chemicals in coastal aquaculture. Rep. Stud. (IMO/ FAO/ UNESCO/ IOC// WMO/ WHO/ IAEA/ UN/ UNEP. 1997; 40.
6. Hasan MR, Ahmed GU. Issues in carp hatcheries and nurseries in Bangladesh, with special reference to health management. In: Primary Aquatic Animal Health Care in Rural, Small-Scale. Arthur JR, MJ Phillips, RP Subasinghe, MB Reantaso and MacRae LH (Editors), Primary Aquatic Animal Health Care in Rural. Small-Scale Aquaculture Development, FAO Fisheries Technology. 2002; 406:147-164.
7. Hasan MT. Aqua-drugs and chemicals: Impact on health and production of shrimp and fish in coastal and inland aquaculture of Bangladesh, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh, 2014.
8. Monsur A. Use of aqua drugs and chemicals of aquaculture in Jamalpur and Sherpur regions, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh, 2012.
9. Phillips M. 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 JR CR. Lavilla-Pitogo, RP Subsinghe (editors). Southeast Asian Fisheries Development Centre, Aquaculture Department Tigbauan, lloilo, Philippines, 1996; 1-6.
10. Plumb JA. Disease control in aquaculture. In: Shariff, I.M., Subasinghe, RP & Arthur JR: Disease in Asian Aquaculture: Fish Health Section of the Asian Fisheries Society, Manila, Philippines, 1992; 3-17.
11. Rahman MM. Status and impact of commercial aqua drugs and chemicals on fish health at farmer's level, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. 2011.
12. Reilly PJA. Review of the occurrence of Salmonella in cultured tropical shrimp. FAO Fisheries Circular No. 851, FAO, Rome, 1992; 19.
13. Shamsuddin M. Impact of aqua-drugs and chemicals on health and production of fish, MS Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh, 2012.
14. Subasinghe RP, Barg U, Tacon A. Chemicals in Asian Aquaculture: need, usage, issues and challenges. In: Use of Chemicals in Aquaculture in Asia, Arthur JR, CR Lavilla-Pitogo, RP Subasinghe (Editors). Southeast Asian Fisheries Development Center, Aquaculture Development Tigbauan, lloilo, Philippines, 1996; 1-6.