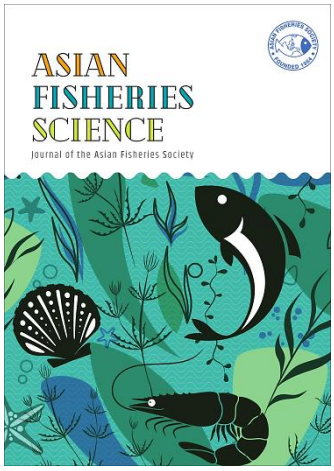

Status of Aquaculture Component of the Philippine National Action Plan on Antimicrobial Resistance

SIMEONA E. REGIDOR[1,*], SONIA S. SOMGA[1], JOSE O. PACLIBARE[2]
[1]National Fisheries Laboratory Division, Bureau of Fisheries and Aquatic Resources, 860 Arcadia Bldg., Quezon Avenue, Quezon City, Philippines
[2]Munoz, Nueva Ecija, Philippines

*E-mail: simeona03@yahoo.com

ISSN: 0116-6514
E-ISSN: 2073-3720
https://doi.org/10.33997/j.afs.2020.33.S1.014

Abstract

The Philippine Bureau of Fisheries and Aquatic Resources, in order to address the issue on antimicrobial resistance (AMR), actively participated in the efforts of the Department of Health in response to the call of the Tripartite Collaboration on AMR, i.e. the World Health Organization, the World Organisation for Animal Health and the Food and Agriculture Organization of the United Nations (FAO) to develop country National Action Plans on AMR using the One Health approach to promote best practices to avoid the emergence and spread of AMR. Thus, "The Philippine National Action Plan to Combat Antimicrobial Resistance: One Health Approach" (PNAP) has evolved and continuously being improved. At present, studies on AMR and antimicrobial use in the Philippine aquatic sector are very limited. The BFAR participated in the FAO project FMM/RAS/298 Strengthening Capacities, Policies and National Action Plans on Prudent and Responsible Use of Antimicrobials in Fisheries which enhanced the understanding of AMR in aquaculture and laboratory capacity. As part of the project, a survey on the use of antimicrobials in Philippine aquaculture was conducted. Eighty four respondents from the shrimp and tilapia farming sectors and two aquaculture product suppliers participated. Results showed that antibiotics are no longer applied in participating grow-out farms monitored for residues and there has been no detection of antibiotics in shrimp or fish meat from registered farms. About 77 % of the respondents know the regulations on the use of antimicrobials and the majority of them are aware of banned and regulated antibiotics in food animals.

Keywords: antimicrobial resistance, One Heath, aquaculture

Introduction

Aquaculture in the Philippines has a long history and involves many species and farming practices in diverse ecosystems. Most of the production comes from the farming of the seaweed *Kappaphycus* spp., milkfish *Chanos chanos* (Forsskål, 1775), tilapia *Oreochromis niloticus* (Linnaeus, 1758), and the shrimps *Penaeus monodon* Fabricius, 1798 *and Penaeus vannamei* Boone, 1931. The Philippines used to be one of the top shrimp producing countries in the world, but after its decline in the late 1990s, mainly because of disease problems, shrimp production remains low. At present, the Philippines is the 11th largest producer of fish and fishery products due to government interventions and private-sector efforts to increase production.

The condition in many aquaculture systems, whereby animals are confined in a relatively small space during culture, causes stress and make them susceptible to diseases. Aquafarmers use antibiotics available in the market to cure disease. Previous studies by Baticados and Paclibare (1992), Primavera et al. (1993), Lacierda et al. (1996), Somga et al. (2012), Alday-Sanz et al. (2012), showed that farmers used antibiotics in aquaculture.

The imprudent use of antimicrobials in human health is recognised as a major contributor to antimicrobial resistance (AMR) in human pathogens. There are instances where antimicrobials used in both food-producing and companion animals, including aquatic animals are key contributing factors.

It is in this context that the Bureau of Fisheries and Aquatic Resources (BFAR), to ensure safety of fish food, currently implements an antimicrobial residue monitoring program that includes control of veterinary drugs in aquaculture and the prevention of movement of contaminated fish and fishery products. These are also required by trading partners of the Philippines.

The BFAR is the government agency responsible for addressing the issue of AMR in aquaculture. This authority is provided by Republic Act (RA) 10611- "Food Safety Act of 2013" and RA 8550 – "The Philippine Fisheries Code of 1998" and its revision, RA 10654 - "An Act to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing". The National Fisheries Laboratory Division (NFLD) is in charge of the development of plans and programs on AMR. Such programs are supported by a network of fish health officers (FHOs) deployed in various regions throughout the country.

In response to the World Health Organization's (WHO) endorsement of the One Health approach to combat AMR during the 2011 World Health Assembly, the Philippines developed the "Philippine National Action Plant to Combat Antimicrobial Resistance: One Health Approach" (PNAP), launched in 2015 during the First Philippine AMR Summit.

The PNAP outlined an integrated approach by concerned agencies to prevent the occurrence of AMR. BFAR identified seven key strategies relevant to the aquaculture sector. These are:

1. Commit to a comprehensive, financed national plan with accountability and civic society engagement
2. Strengthen surveillance and laboratory capacity
3. Ensure uninterrupted access to essential medicines of assured quality
4. Regulate and promote rational use of medicines, including in animal husbandry and ensure proper patient care
5. Enhance infection prevention and control across all settings
6. Foster innovations, research, and development
7. Development of a risk communication plan to combat AMR

The objective of this paper is to share information on two aspects, namely: 1) brief description of activities and achievements on AMR in aquaculture relevant to the four pillars of the Food and Aquaculture Organization's (FAO) Action Plan on AMR, i.e., governance, awareness, evidence, and best practice including impacts; and 2) outcome of the survey on antimicrobial use (AMU) in aquaculture.

Activities and Achievements on AMU and AMR in Philippine Aquaculture

Governance

Governance of AMU and AMR in aquaculture is a collaborative effort between the Food and Drug Administration of the Department of Health (FDA/DOH) and the BFAR of the Department of Agriculture (BFAR/DA). The scope of the FDA/DOH mandate includes licensing and registration of drug establishments, registration of products and evaluation, assessment and approval of veterinary drugs used in aquaculture. The BFAR is responsible for monitoring and surveillance activities pertaining to: 1) health status of cultured animals in aquaculture farms; 2) usage of drugs in the primary and post aquaculture farms; and 3) drugs incorporated in the aquafeeds. The monitoring and surveillance system is evolving and continuously being improved particularly on building capability on risk-based inspection as well as strengthening the existing manual of operation of the National Residue Control Program (NRCP).

Under the PNAP, an Inter-agency Committee on AMR (ICAMR) was created and composed of representation from different concerned government agencies including the NFLD. The ICAMR follows a coordinated approach in developing and implementing intervention strategies for AMR stewardship in the human and animal sectors.

The PNAP, which the BFAR is continuously refining, closely resembles the FAO's Action Plan on AMR in its focus on four pillars within the seven key strategies. It issued Fisheries Office Order 104, series of 2018, designating the AMR Regional Coordinators of BFAR for better farmer engagement and smoother implementation of programs and activities to address issues of AMR.

Several national laws give the BFAR authority and responsibility for AMR. The relevant provisions to ensure enforcement and management on the use of drugs and AMR are RA 10611 and RA 10654.

Republic Act 10611, the "Food Safety Act of 2013", states that the BFAR shall be responsible for the development and enforcement of food safety standards and regulations for fresh fish and other seafoods including those grown by aquaculture, in the primary production and post-harvest stages of the food supply chain. The BFAR shall be responsible for the registration of food businesses, licensing of fishery establishments, official certification of products and services, official accreditation of inspection and certifying bodies, and other official controls prescribed by the regulatory system and in compliance with the international commitments.

Section 62 of Republic Act 8550, known as the "Philippine Fisheries Code of 1998", as amended by RA 10654, known *as* "An Act to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing" states that all fish and fishery products for export, import and domestic consumption shall meet the quality grades/standards, labelling and information requirements set by the DA-Bureau of Agriculture and Fisheries Standards (DA/BAFS) and by the BFAR as well as international standards set by the Codex Alimentarius Commission (CAC).

BFAR also assists the BAFS in the development of Philippine National Standards (PNS) on codes of aquaculture practices. Examples of these are: PNS/BAFS (2014), PNS/BAFS (2017a), PNS/BAFS (2017b).

RA 10654 mandates BFAR to develop and implement a 5-year Comprehensive Fisheries Development Plan focusing among others to food security by increasing aquaculture production in key species. Major programs are implemented in order to provide safe and quality fish free from hazardous substances like antibiotics (BFAR, 2016).

Regional efforts also play an active role in responsible AMU. Guidelines for the Association of Southeast Asian Nations (ASEAN) was developed for the competent authority to regulate the use of veterinary drugs and chemicals in aquaculture (ASEAN, 2013). It also aims to develop measures to eliminate the use of harmful chemicals in aquaculture. The document includes the list of veterinary drugs and chemicals that are banned and those that are allowed to be used by ASEAN member countries.

Awareness

Several activities in the form of fora, symposia, technical assistance, training programs and other activities are regularly being conducted to ensure that plans, programs and modern technologies, and information are imparted to various stakeholders including the use of drugs and good practices.

The BFAR actively continues to participate in several department-wide food safety activities of the DA. In these programs, BFAR provides information on food safety, farm registration, disease and residue monitoring, and surveillance programs to stakeholders at the local government unit level. At every opportunity, in the trainings and meetings that BFAR conducted, participants were made aware of the issue of AMR. These activities include:

a) Food Safety Road Shows in the islands of Luzon, Visayas and Mindanao where policy, codes of practice like good aquaculture practice (GAqP), and the FAO project FMM/RAS/298 were discussed and disseminated to stakeholders for their information and compliance to the requirements;

b) Industry Congresses, such as the National Tilapia Congress and National Shrimp Congress, provided awareness on food safety requirements and updates on fish health;

c) Training on GAqP which updated the sector on prudent use of antimicrobials;

d) Participation in the celebration of the World Antibiotic Awareness Week where invited stakeholders shared good aquaculture practice in shrimp farming in Negros province;

e) National Planning Workshops of FHOs which discussed, among others, the implementation of the FAO project FMM/RAS/298 and shared the knowledge and experience gained from the participation of the Philippine delegates to the three regional workshops of said project.

Other details on training activities are in Tables 1 and 2.

Table 1. Trainings, workshops and public consultations held by Bureau of Fisheries and Aquatic Resources on antimicrobial resistance related topics in 2017.

	Title of activity	Date/ Location	Scope	Number of participants
1	Training Workshops on the Implementation of Philippine GAqP*	March 1- 4/ Metro Manila March 13-16,/ Cebu City March 21-24/ Davao City	Capacity building BFAR production and extension officers	50
2	Public Consultations			
	a. GAqP for Seaweeds and Soft-Shell Crab (SSC) Product Standard	June 5-7/Luzon	Stakeholders consulted prior to approval of the Standard	50
	b. GAqP for Seaweeds and Mollusks- Product Standard	June 13-15/Visayas		50
	c. GAqP for Mollusks and SSC Product Standard	June 19-21/Mindanao		50

*EU-TRTA-technical and funding assistance.

Table 2. Training/workshops on strengthening laboratory capability held by Bureau of Fisheries and Aquatic Resources in 2017.

Date	Title	Scope	Number of participants
May 15-19	Workshop on the Harmonisation of Central and Regional Fisheries Laboratories	ISO/IEC 17025:2005 Standards	60
June 27-30	Training on the Detection of the Tilapia Lake Virus (TiLV) and Hepatopancreatic Microsporidiosis (HPM) in Shrimp	Detection of tilapia lake virus (TiLV) using PCR Detection *Enterocytozoon hepatopenaei* (EHP), the causative agent of HPM in shrimp	35
September 4-8	Workshop on the Standardisation of the Analytical and Sampling Methods of the Central and Regional Fisheries Laboratories	Developed manual of operations, including standard procedures for laboratory analyses and sampling procedures	60
September 18-22 and 25-29	Training of the Central and Regional Fish Health Laboratory Analysts on Standard Fry Quality Assessment in Shrimp	Trained the BFAR fish health laboratory analysts on shrimp fry quality criteria including the physical, morphological and behavioural characterisations	50
November 6-10	Training in Histopathological Examination of Shrimp Tissues for, new and emerging significant diseases	Strengthened the capability of laboratory analysts in disease diagnosis by histopathological examination	15
November 20-24	Year-end review and Planning Workshop of the Network of Activities by the fisheries laboratories	National and regional plans targeting and harmonisation of monitoring surveillance inspection and reporting system	60
December 4-8	Lecture on Biotechnology 101: Basic Molecular Techniques in the Diagnosis of Diseases	Capability building of laboratory analyst	25

Evidence

To support PNAP's key strategy 2, several initiatives focused on surveillance and monitoring system for AMU and AMR in food-producing animals. These initiatives include:

1. National Residue Control Program

The NRCP aims to monitor drug use and its residues in fish and fishery products by conducting national sampling to detect residues in economically important aquaculture products, namely tilapia shrimp, and milkfish. Sampling is based on production statistics, i.e. one sample for every 100 tons of production. The yearly sample target depends on the regional production data based on risk and the result of the previous year's monitoring data. One sample can be subjected to one or more residue analyses.

The NRCP includes farm registration based on compliance with the minimum requirement of GAqP. Activities include inspection on farm hygiene, disease surveillance and residue monitoring, and risk-based sampling. Sampling is also conducted at the feed mills. The aquatic feed mills are regulated by the Bureau of Animal Industry (BAI); sampling activities are conducted by FHOs who are deputised as Aquatic Animal Feed, Veterinary Drug and Control Officers.

The regulation on antimicrobials such as the banned antibiotics is issued through the Joint Administrative Order of the DOH and DA, and other antibiotics that are allowed for use but have maximum residue limits (MRLs).

There are five BFAR laboratories that conduct antibiotic residue analysis covering the whole country. The NFLD and Regional Fisheries Laboratories of Regions VI and VII are accredited with ISO/IEC 17025:2005 by the Philippine Accreditation Bureau. The Regional Fisheries Laboratories of Regions III and IV-A are currently preparing to apply for accreditation. Analysis can also be conducted by recognised third-party laboratories should the need arise.

A total of 2,130 analyses on residues from shrimp, milkfish, tilapia and feed samples from the monitoring activities were conducted in 2016. One sample of shrimp was detected to contain chlortetracycline above its MRL. Table 3 provides more details.

Table 3. Summary of sampling of fish tissues and feed done in 2016 and 2017 for analysis of antibiotic, chemicals and drug residues.

Analyses	2016				2017			
	Sample type				Sample type			
	Shrimp	Milkfish	Tilapia	Feeds	Shrimp	Milkfish	Tilapia	Feeds
a. Unauthorised substances								
Chloramphenicol	116	203	89	205	114	214	86	146
Furazolidone (AOZ)	122	205	89	-	113	211	86	-
Furaltadone (AMOZ)	122	205	88	-	113	211	86	-
Nitrofurantoin (AHD)	2	1	0	-	0	0	0	-
Nitrofurazone (SEM)	2	1	0	-	0	0	0	-
Diethylbestrol	0	28	0	-	0	36	0	-
Nitroimidazole	0	0	0	-	5	0	0	-
b. Antibacterials								
Chlortetracycline	23	41	4	8	49	66	5	91
Oxytetracycline	22	41	4	4	56	66	5	112
Sulfamethazine	21	41	4	4	47	66	5	26
Amoxicillin	6	4	1	-	5	5	0	-
Trimetoprim	6	4	1	-	5	5	0	-
Sulfadiazine	6	4	1	-	5	5	0	-
Oxilinic Acid	10	5	0	-	14	4	0	-
Erythromycin	10	5	0	-	14	4	0	-
Florfenicol	10	5	0	-	14	4	0	-
c. Anthelmintic								
Ivermectin	0	39	0	-	6	47	0	-
d. Mycotoxin								
Aflatoxin	0	0	0	93	0	0	0	144
e. Chemical elements								
Lead	17	25	2	-	36	30	7	-
Cadmium	17	25	2	-	36	30	7	-
Mercury	17	25	2	-	36	30	7	-
f. Organochlorine compound								
Organochlorines	15	21	0	-	25	22	4	-
g. Dyes								
Malachite Green	14	13	0	-	26	22	3	-
Leucomalachite Green	14	13	0	-	26	22	3	-
h. Ethoxyquin	0	0	0	3	0	0	0	10
Total	572	954	287	317	745	1100	304	529

The FDA, BFAR, and the BAI are now working on the best arrangements to prevent the irresponsible use of drugs and prevention of the occurrence of AMR.

2. Strengthening capacities, policies, and national action plans on the prudent and responsible use of antimicrobials in fisheries, and strengthening laboratory capability

The AMR surveillance plan in aquaculture developed during the first regional workshop of the FAO project FMM/RAS/298, held in Mangalore, India is now integrated in another FAO project covering terrestrial and aquatic animals. Aquaculture is under the project's third component: AMR surveillance of bacterial pathogens from diseased aquatic animals specifically, tilapia, milkfish and shrimp. This runs parallel with the surveillance of patients who have been diagnosed to be infected with AMR-resistant bacteria. Its objective is to develop evidence-based clinical guidelines for veterinarians on the proper use of antimicrobials in aquatic animals.

The AMR surveillance plan was developed during the Mangalore workshop, with the following details:

i. Target population include the following species, namely: tilapia (*O. niloticus*), milkfish (*C. chanos* and shrimp (*P. vannamei* and *P. monodon*)

ii. Study population: farms that are registered at BFAR

iii. Samples sources: Luzon area

iv. Sample size: this depends on case finding/syndromic surveillance on fish farms

v. Target organisms: *Streptococcus agalactiae* and *Streptococcus iniae* in tilapia, *Vibrio parahaemolyticus* in milkfish and shrimp

vi. Sampling strategy: 10 % of the BFAR registered farms in each identified region; farm with cases of mortalities and disease outbreaks

vii. Logistics: sample collection by FHOs; bacterial isolation and identification, antimicrobial susceptibility test by the NFLD.

At present, implementation of above plan is continuing; in addition, laboratory analysts have undergone appropriate trainings on AMR detection conducted by BAI; methods for AMR detection are being optimised; and work is continuing on procurement of reagents and consumables for sampling and laboratory analysis.

Best Practice

Best practice is synonymous with the PNAP's key strategy N5. The BFAR's strategy included programs on infection prevention and control such as the implementation of GAqP and strengthening animal health. Significant resources and efforts were invested on the NRCP and control of the use of drugs in the fishery sector. While there are questions on the association between AMR and AMU, it is certain that AMR would not exist if antibiotics would not be used in the first place.

Farm registration is not mandatory. In the aquafarm registration program, farmers send their applications to the BFAR regional offices and must comply with the required documentation. They must also allow BFAR FHOs to conduct inspection and sampling. The registered farms are monitored on their compliance to minimum requirement to GAqP by the regional FHOs.

The Philippine National Standard (PNS) on good aquaculture practices for different farmed species include the following:

1. PNS/BAFS 135 Code of Good Aquaculture Practice (GAqP)(PNS/BAFS, 2014)
2. PNS/BAFS 196Code of GAqP for Milkfish and Tilapia (PNS/BAFS, 2017a)
3. PNS/BAFS 197foCode of GAqP for Shrimp and Crab (PNS/BAFS, 2017b)

The Code on GAqP and mechanism for implementation was developed with technical and funding assistance from the European Union through the Trade-Related Technical Assistance.

The BFAR-accredited processing plants source their raw materials only from registered farms as part of the Hazard Analysis and Critical Control Point (HACCP) food safety system. This requirement compels farmers to be registered and comply with minimum requirements on GAqP. Further, an explanatory brochure for GAqP is being developed by the BAFS in coordination with BFAR to make it easy to understand and comply with.

Survey of AMU in Philippine Aquaculture

One of the components of the FAO project FMM/RAS/298 is the conduct of a survey on the use of antimicrobials in selected areas of the Philippines from November to December 2017. The survey aimed to understand the current status of the use of antimicrobials and other products in tilapia and shrimp aquaculture in the Philippines.

Survey structure

A survey questionnaire was developed with five sections, briefly described below:

1. Farm Information (owner, address, species, farm area, type of operation system based on stocking density, length of production cycle, number of production cycles per year)
2. Use of Antimicrobials (type of antimicrobials and other chemicals, mode of application, dosage, purpose of use, duration of use, withdrawal period, source of antimicrobial, veterinary prescription required, disposal of antimicrobials, monitoring of residue)
3. Disease Occurrence (major disease problem during culture operations, production losses, reporting the outbreak(s) to Competent Authority, use of antimicrobials during disease outbreak, efficacy)
4. Market Information (domestic or export market, sales through a middleman or direct to a processing plant)
5. National Regulations (awareness of national regulations on the use of antimicrobials, adoption of recommended management practices on the prudent use of antimicrobials, on-farm inspection by FHOs)

Since the use of antimicrobials is a sensitive matter because of its implications to product-market access, respondents were kept anonymous.

Distribution of the questionnaire

The survey targeted tilapia and shrimp farmers and distributors of aquaculture products. Face-to-face and telephone interviews with 86 respondents were conducted by 11 FHOs in 21 provinces throughout the country.

Results and Discussion

Survey on the use of drugs in aquaculture

The survey had a total of 84 respondents composed of 36 tilapia grow-out farmers, 48 shrimp hatchery and grow-out farmers, and additional two suppliers of aquaculture products.

The survey was conducted by the FHOs and provinces covered are indicated in Figure 1 below.

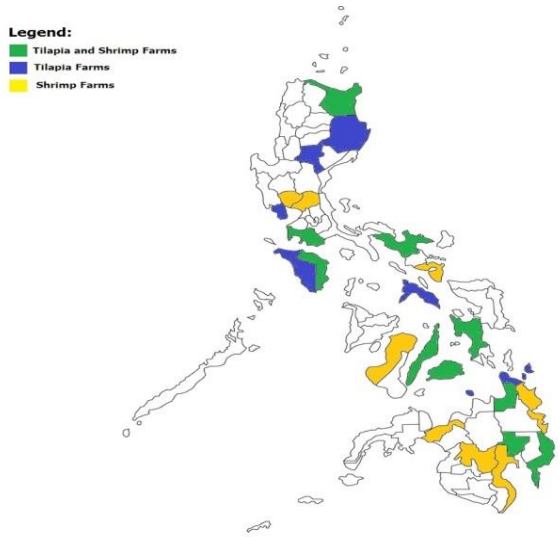

Fig. 1. Provinces in the Philippines where the survey on the use antimicrobials was conducted.

Use of antimicrobials

Among the farmer respondents (Table 4), 57 (68 %) were not using antimicrobials in their culture operation, while 27 (32 %) used probiotics, chemicals such as disinfectants and antibiotics. The antibiotic oxytetracycline is particularly used in shrimp hatchery operation. In grow-out systems, however, antibiotics were no longer applied since farms were being monitored for residues. There has been no detection of antibiotics in shrimp or fish meat from registered farms.

The application of antimicrobials is usually resorted to upon the recommendation by either the farm manager, suppliers, technicians in neighbouring farms, or consultants. Antimicrobials are usually used as prophylaxis and seldom for treatment and growth enhancer. Most of the products were sourced either in the local market or distributors and from technicians of feed companies.

Disease occurrence

There were diseases, health problems and mortalities reported by the respondents in shrimp and tilapia culture (Table 5). According to 40 respondents (48 %), disease problems were encountered. Shrimp farmers in the Negros Province report and send samples to the Negros Prawn Producers Cooperative laboratory in Bacolod City. Many respondents did not respond to the disease section of the survey thus highlighting the sensitivity of collecting such information.

In other cases, some shrimp farmers continue to use probiotics with increased frequency of application and some farmers apply twice the required dose. According to them, these practices are effective in improving the health condition of the stock or treating disease problems. In tilapia farming, 25 respondents (69 %) mentioned that they had not experienced disease in their farms. In most cases, tilapia diseases are mixed infection of bacteria and parasites predisposed by poor environmental conditions brought by overstocking, improper feeding practices, and poor water quality.

Market information

Aside from the domestic markets, 13 farms (15 %) supply their harvest for export. Harvests mainly go to local markets within the provinces. Some shrimp farms sell through a middleman and some supply directly to the processing plants.

Awareness of national regulation on the use of antimicrobials

As to awareness of national regulations on the use of antimicrobials, 65 respondents (77 %) mentioned that they know the regulations. Sixty respondents (71 %) are also aware of banned antibiotics, particularly chloramphenicol, in food-producing animals including aquatic animals. Most of them are from registered farms. Respondents who were not yet aware of the regulations were provided with the information on banned antibiotics in the Philippines, and the prudent use of antimicrobials allowed for use in aquaculture.

There were 30 respondents (36 %) that followed the recommended practices provided by the FHOs,

Table 4. Chemicals and biological products used by 84 respondents that participated in the survey on use of antimicrobials in tilapia and shrimp aquaculture the Philippines.

Products used by respondents	Commercial name	Application	Withdrawal period
a. Probiotics			
	Sanolife Pro-2	Feed	N/A
	Sanolife Pro W	Water/soil	N/A
	Pond Plus	Soil	N/A
	Pond Dtox	Soil	N/A
	TOP S	Feed	N/A
	Super PS	Water/soil/feed	N/A
	EM-1	Water/feed	N/A
b. Disinfectant			
	PUR	Foot bath	7 days
		Hard surfaces and all equipment	7 days
		Water of grow-out pond for routine control of bacteria and viruses	7 days
		During bacterial challenge	7 days
	Virkon	Mixed in water	7 days
	Chlorine	Mixed in water	10 days at > 22 °C
	Lime	Soil/water	N/A
	Dolomite	Water/Soil	N/A
c. Immunostimulant			
	Beta Defense	Water/feed	N/A
d. Feed supplement			
	Aquamin	Feed	N/A
e. Antibiotics			
	Oxytetracycline	Feed	15 days at >22 °C

Table 5. Diseases and mortalities reported by 40 respondents who participated in a survey of tilapia and shrimp diseases in the Philippines.

Causes of disease and mortalities	No. of respondents
Shrimp	
Viral diseases	26
a. White Spot Disease	
b. Infectious Hypodermal and Hematopoietic Necrosis Virus	
Bacterial diseases	3
a. Luminous bacterial disease	
b. Acute Hepatopancreatic Necrosis Disease	
Parasite (*Enterocytozoon hepatopenaei*)	2
Tilapia	
Parasites	5
Bacterial disease	1
a. Streptococcocal infection	
b. Infection with *Aeromonas hydrophila*	
Mortalities due to poor water quality, specifically low Dissolved Oxygen	17

extension officers, and salesmen from feed and aquatic product companies. The 54 respondents (64 %) that did not provide comments believe that their practices based on their experiences work out for them. The advocacy of the government in promoting the Code of GAqP and training for stakeholders will help them improve their practices.

As part of the NRCP, registered farms are inspected and monitored for both banned and regulated antimicrobials, chemical elements, and dyes such as malachite green. Seventy respondents (83 %) mentioned that they were regularly inspected by BFAR relative to the use of antimicrobials.

Conclusion

The survey on AMU provided the information on the common antimicrobials applied by fish farmers. Majority of the farmers interviewed, particularly those involved in shrimp farming use probiotics. Those that are registered with BFAR has knowledge on possible residue build-up of antibiotics and are advised to observe withdrawal periods in case of usage of antibiotics that are allowed for use in aquaculture. Using regulated antibiotics requires a prescription from a veterinarian and application should be according to the product label. Antimicrobials are being regulated by the FDA and registration of some antimicrobials for animals including aquatic animals is delegated to the BAI. Its use in aquaculture is monitored through the NRCP.

The level of awareness among the farmers on the regulations about antimicrobials and banned antibiotics can be attributed to the promotion of the GAqP, where requirements on the usage of drugs and chemicals are included. However, continuous information, education campaign on GAqP are needed so that more farmers would become aware and the explanatory brochure will make it easy to understand.

Although considerable accomplishments were achieved in the monitoring and surveillance of the use of antibiotics, there is a need to strengthen the capabilities of the BFAR laboratories to detect AMR in the fishery sector.

The FAO Project FMM/RAS/298 builds upon the previous projects on strengthening national aquatic animal health programs and has helped BFAR be a better policymaker when it comes to AMR. It also allowed BFAR to realise the relevance of AMR prevention in aquaculture to AMR. In addition, international standard-setting bodies like the FAO/WHO on Codex Alimentarius and the OIE on animal (terrestrial and aquatic) health standards and many relevant national, regional and international entities are providing the necessary push and assistance on activities related to AMR in aquaculture.

Acknowledgements

We thank the BFAR FHOs for conducting the surveys in their areas of jurisdiction and the respondents for the information they provided. We are grateful to Dr. Melba B. Reantaso for this project as it helped redirect the development and implementation of the aquaculture component of the PNAP.

References

Alday-Sanz, V., Corsin, F., Irde, E., Bondad-Reantaso, M.G. 2012. Survey on the use of veterinary medicines in aquaculture. In M.G. Bondad-Reantaso, J.R. Arthur & R.P. Subasinghe, eds. Improving biosecurity through prudent and responsible use of veterinary medicines in aquatic food production, pp. 29–44. FAO Fisheries and Aquaculture Technical Paper No. 547. Rome, FAO. 207 pp. http://www.fao.org/3/ba0056e/ba0056e.pdf

ASEAN.2013. Guidelines for the use of chemicals in aquaculture and measures to eliminate the use of harmful chemicals. ASEAN Secretariat, Jakarta. https://www.asean.org/storage/images/resources/ASEAN%20Publication/2013%20(12.%20Dec)%20-%20ASEAN%20Guideliness%20for%20Chemicals%20Final.pdf

Baticados, M.C.L., Paclibare, J.O. 1992. The use of chemotherapeutic agents in aquaculture in the Philippines. In: Shariff, M., Subasinghe, R.P., Arthur, J.R. Eds. , Diseases in Asian aquaculture. Fish Health Section, Asian Fisheries Society, Manila, Philippines, pp. 531–546. https://repository.seafdec.org.ph/handle/10862/350

BFAR (Bureau of Fisheries and Aquatic Resources). 2016. Philippine fisheries profile 2016. https://www.bfar.da.gov.ph/files/img/photos/2016FisheriesProfile(FinalVersion2.0).pdf

BFAR. 2016. Comprehensive National fisheries Development Plan (Medium Term Plan) 2016-2020. https://www.cardph.com/single-post/2016/02/04/the-comprehensive-national-fisheries-industry-development-plan-medium-term-20162020-prese

Lacierda-Cruz, Erlinda R., Dela Pena, L.D., Lumanlan-Mayo, S.C. 1996. The Use of Chemicals in Aquaculture in the Philippines. In Proceedings of the Meeting on the use of chemicals in aquaculture Asia (eds. Arthur, J.R. CR Lavilla-Pitogo, C.R., Subasinghe, R.P.) pp. 155-184. Use in chemicals in aquaculture. 20-22 May 1996, Tigbauan, Iloilo, Philippines. 155-184 pp. https://repository.seafdec.org.ph/handle/10862/433

PNS/BAFS. 2014. Philippine National Standard on Code of Good Aquaculture Practice (GAqP). 135. http://www.bafs.da.gov.ph/images/Approved_Philippine_Standards/PNS-BAFS135-2014CodeofGoodAquaculturePractice.pdf

PNS/BAFS. 2017a. Philippine National Standard on Code of Good Aquaculture Practice (GAqP) for Milkfish and Tilapia 196. http://www.bafs.da.gov.ph/databases

PNS/BAFS. 2017b. Philippine National Standard on Code of Good Aquaculture Practice (GAqP) for Shrimp and Crab 197. http://www.bafs.da.gov.ph/bafs_admin/admin_page/pns_file/PNS%20BAFS%20197_2017%20%20Code%20of%20Good%20Aquaculture%20Practices%20for%20Shrimp%20and%20Crab.pdf

Primavera, J.H., Lavilla-Pitogo, C.R., Ladja, J.M., dela Pena, M. 1993. A survey of chemical and biological products used in intensive prawn farms in the Philippines. Marine Pollution Bulletin 26, 35–40. http://www.fao.org/fi/staticmedia/MeetingDocuments/WorkshopAMR/presentations/09_Lavilla_Pitogo.pdf

Somga, S.S., J.R. Somga and Regidor S.E. 2012. Use of veterinary

medicines in Philippine aquaculture current status. In FAO Fisheries and Aquaculture Technical Paper No. 547. Improving biosecurity through prudent and responsible use of veterinary medicines in aquatic food production (eds. M.G. Bondad-Reantaso, M.G., Arthur, J.R., Subasinghe, R.P.), pp. 69–82, FAO, Rome, Italy. http://www.fao.org/3/ba0056e/ba0056e.pdf