

# Building and improving the capacity of fish and environmental health management strategy in Indonesia

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## Building and improving the capacity of fish and environmental health management strategy in Indonesia

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**Abstract.** Fish mortality due to outbreak and to the decrease in the quality of the environment is a latent problem increasingly complex in Indonesia. Extreme weather conditions with high rainfall intensity, reacute actually bring back several opportunistic pathogens of diseases such as Motile Aeromonads Septicemia. Various cases of mass fish deaths re-emerged, especially in public waters such as Maninjau Lake and Cirata reservoir is the sign of the decline in the quality and carrying capacity of the environment and it is suspected to be the main cause of the case. Over the past four years, fish mortality in public water has been regularly recorded and a peak of massive fish mortality occurred in 2016. A total of 4,725 tons of dead fish occurred which is estimated around 0.95 percent of the total production of freshwater net cages cultivation nationally. This amount is estimated to cost economic losses up to IDR 47.25 billion equivalent to 3.3 million US\$ (assuming the price of fish is IDR 10,000/0.71US\$ per kg). The occurrence of mass mortality of fish from net cages may reduce the aquaculture production originating from public waters up to 23.5 percent. Furthermore, risk of a new cross-border disease such as Acute Hepatopancreatic Necrosis Disease (AHPND); White Fecal Syndrome (WFS); *Enterocytozoon hepatopenaei* (EHP) and Tilapia Lake Virus (TiLV) heavily threaten aquaculture businesses. There is a need for cross-sectoral and even cross-country collaborative efforts, especially in anticipating the spread of cross-border fish diseases. This condition requires commitment and awareness from all stakeholders involved. Therefore, in order to promote sustainable aquaculture production, a national aquatic animal health (NAAH) strategy was formulated and will assist Indonesia government to: improve the national fish health services skills, make aware fish farmers undertaking responsible fish health management and to improve their capacity on emergency responses and contingency planning against diseases, reduce of important fish diseases and the use of chemicals in aquaculture, and prevent introduction of exotic disease. The implementation of NAAH strategy needs guidance, support and full commitment from the government. The Ministry of Marine Affairs and Fisheries through Directorate General of Aquaculture is the competent authorities who will share responsibilities in the implementation of NAAH strategy.

**Keywords:** fish disease, NAAH, management strategy



## 1. Introduction

A constant increased in aquaculture production usually faced problems of quality and quantity of the seeds, feeds, market, price and the most serious problem is fish diseases as well as decreased in the quality of aquaculture environment. Several fish diseases has led to serious economic and ecological losses to the national aquaculture business such as due to pathogen infection namely protozoan parasites, Motile Aeromonas Septicaemia (MAS), Streptococcosis, Mycobacteriosis, Vibriosis, Koi herpesvirus (KHV), Monodonbaculovirus (MBV), White Spot Syndrome Virus (WSSV), Infectious Myonecrosis Virus (IMNV), Iridovirus, and Viral Nervous Necrosis (VNN).

In term of economy, the effect of diseases to aquaculture leads to some losses such as decreased in production and productivity due to mortality, slow growth, low feed conversion efficiency, culture environment contaminated by fish pests and diseases, and inefficiency in the use of fisheries resources; decreased in product quality due to market potential disappearance; decreased in price and revenue due to slowing down of the intensification and extensification of aquaculture business caused by high risk and unsustainable, as well as not bankable. The indirect losses in relation to the fish diseases cases is very difficult to calculate because it is related with bank debt, unemployment, poverty, low and no new investment that support fish production such as feed industries, processing plant, aquaculture machinery etc., and the main aspect is less availability of fish protein supply which needed by people.

Table 1 showed the annual financial loss due to fish diseases on aquaculture fisheries based on epidemiological analysis of several potential fish diseases in aquaculture compared with the statistical data on national aquaculture fisheries. The economic losses was estimated 5.2 trillion IDR is shown in the Table 1 based on the smallest value losses due to fish diseases outbreaks which has been occurred and will always affecting aquaculture fisheries production centre all over Indonesia.

**Table 1.** Financial loss estimation per annum due to fish diseases on aquaculture

Culture ecosystem	Diseases	Main commodity	Mortality range (%)	Losses estimation/year (million rupiah)
Freshwater	Koi Herpesvirus (KHV)	Gold fish and koi	30-80	50,000
	Motile Aeromonas Septicaemia (MAS)	All type of freshwater fish	20-100	400,000
	Streptococcosis	Tilapia	20-50	15,000
	Mycobacteriosis	Gouramy	10-50	7,500
	Ichthyophthiriosis	All type of freshwater fish	25-100	50,000
	Others	All type of freshwater fish	10-100	150,000
	Sub total			<b>672,500</b>
Brackish water	White Spot Syndrome Virus (WSSV)	Tiger shrimp & vannamei	30-100	2,500,000
	Infectious Myonecrosis Virus (IMNV)	Tiger shrimp & vannamei	10-60	1,250,000
	Vibriosis	Tiger shrimp & vannamei	10-40	100,000
	Others	Tiger shrimp & vannamei	10-25	50,000
Sub total				<b>3,900,000</b>
Marine	Viral Nervous Necrosis (VNN)	Grouper	10-100	250,000
	Iridovirus	Grouper & seabass	30-70	150,000
	Vibriosis	Grouper & seabass	10-80	150,000
	Ice-ice	Seaweed	10-30	50,000
	Others	Cultured marine fish	10-50	100,000
Sub total				<b>700,000</b>
Total				<b>5,272,500</b>

In the last decade, national aquaculture faces some exotic diseases to the strategic commodities such as Infectious Myonecrosis Virus (IMNV) on vannamei and Scale Drop Syndrome on seabass and sea bream in Natuna and Batam islands. Since 2010 Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Syndrome (AHPNS), a new emerging diseases in penaeid shrimp at several countries such as China, Vietnam, Malaysia, Thailand, México, and India have been threaten shrimp industries and more than 30% production sites in those countries were closed. This disease has infected shrimp soon after stocking in on growing ponds, and caused high mortality which generally occurred in less than 30 days after stocking. In Thailand and China, this disease has destroyed vannamei shrimp industry and targeted production cannot be achieved.

The National Strategy Aquatic Animal Health and Environment (NSAAHE) is the summation of ideas on how the government, in collaboration with stakeholders, should develop policies, programs and potential regulations to address aquatic animal diseases in order to benefit aquaculture and aquatic animal resources in Indonesia. The objective of NSAAHE is to reduce and eliminate important fish disease outbreaks toward the improvement on productions, productivity, environment and business security on sustainable aquaculture basis. The purpose of this paper was to evaluate the benefits of NSAAHE in the field of fish health management and compare it with the new regulation of Ministry of Marine Affairs and Fisheries (MMAF) No. 13 / 2019 concerning control of fish diseases.

## 2. Methods

The NSAAHE draft uses FAO template which is already used by several countries in Asia, and we adopted a general framework. For drafting NSAAHE draft we did AAH capacity survey using questionnaires (e.g. kind of diseases, the control strategy of diseases) given to stake holders: companies, associations, service officials. The results of the questionnaire were analyzed and a focus group discussion was carried out with competent experts as material for compiling the NSAAHE draft.

## 3. Results and discussion

The national scope of the planning on the fish health management and environment is very important to maintain positive growth trend and to achieve competitive advantage in order to sustain best fish products quality to national and international consumers. Therefore, the formulation of national strategy on fish health and environment is undertaken through participative approach by getting inputs from key and related stakeholders, taking into account of their views through workshops and surveys. The Programme of the NSAAHE are developed from eleven elements. The program elements are: (1) Legislation, policy and institutional framework, (2) Surveillance, monitoring, and reporting, (3) Risks analysis, quarantine and fish health certification, (4) Diseases control emergency response and contingency planning, (5) Aquatic Animal Health Services and diagnostic laboratory, (6) Fish medicine management, (7) Development of residue control system, (8) Human resources development and capacity improvement, (9) Research and development, (10) National and international network (communication and information system), and (11) Resource mobilization.

The implementation of fish health and environment management needs guidance, support and full commitment from the government. Funding is an important issue in the implementation of NSAAHE. Therefore, MMAF should become regulator, competent authority and main supporter in term of funding for the NSAAHE implementation. Detail implementation plan including list of programme/priority activities, identification of responsibility and resources as well as implementation time frame are described further in the strategic plan and annual programme of the related stakeholders. We only discussed about (1) legislation, policy and institutional framework, (2) surveillance, monitoring, and reporting, (3) improvement of information and reporting system, (4) risks analysis, quarantine and fish health certification, (5) diseases control, emergency response, and contingency planning, (6) aquatic animal health services and diagnostic laboratory, (7) expand and maintenance the scope of laboratory accreditation, and (8) fish medicine management.

### 3.1. *Legislation, policy and institutional framework*

Policy, regulation, and institutions are needed with aims to put in place appropriate legal frame work for competent authority on aquatic animal health.

According to the Law No.31/2004 that currently changed into regulation No.45/2009 article 12, 17, and 19, the MMAF has a mandate to implement the management of fish health and environment, dangerous fish entry and fish medicines application. The implementation of fish health and environment at the MMAF level is undertaken by Directorate of Culture Area and Fish Health, Directorate of Fish Feed and Remedies and Fish Quarantine and Inspection Agency (FQIA) through Centre for Fish Quarantine and Quality Control for Fisheries Products.

Directorate of Culture Area and Fish Health, DGA has task and function in controlling important fish pest and diseases such as surveillance, emergency response, contingency planning, biosecurity implementation at the farm level, medication and handling of fish outbreaks, fish medicine control (registration, license for fish medicines supplier, export and import recommendation and surveillance and monitoring of fish medicines distribution); monitoring national residues (setting up parameter residues based on international standard, investigation of presence dangerous materials (fish medicines, contaminant and prohibited chemicals which is exist on fisheries products, aquaculture environment protection such as pollutant, controlling dangerous species, rehabilitation of aquaculture environment and fish welfare.

The substance of fish health and environment management has been mandated in Law 31/2004jo 45/2009 articles 12, 17, and 19. Its implementation should be followed up through the Government regulation as elaboration law according to the mandate given. Umbrella regulation should be included in the government regulation in relation to the pest and diseases control, fish control medicines and welfare, national monitoring residues, aquaculture environment management and laboratory. More clearly, the regulations for supporting the implementation of aquatic animal health management required are:

- 1) Competent authority of fish health and environment;
- 2) Aquatic animal health services;
- 3) Surveillance and monitoring fish diseases;
- 4) Emergency response for outbreak fish diseases;
- 5) National list of fish diseases;
- 6) National residue monitoring plan;
- 7) Aquatic animal welfare;
- 8) Invasive alliance species to Indonesian areas;
- 9) Responsible and prudent used of genetic modified organism for aquaculture;
- 10) National list of invasive alliance species;

Recently, the regulations we need above already published Ministerial regulation Permen KP No.13/20019 concerning fish health and environment management. This new regulation covered number 1 to number 4 above.

### 3.2. *Surveillance, monitoring, and reporting*

The objectives of this programme are (a) to determine prevalence and risk factors, (b) to notify freedom of disease, (c) to investigate disease outbreaks, (d) to monitor introducing and spreading of new diseases, (e) to monitor free disease required by destination country, and (f) to increase awareness on fish diseases.

The objectives of surveillance are to detect new or exotic diseases to be able to declare that population is disease free, to determine distribution or prevalence as well as causes of diseases, to review the success of control or eradication programme of specific disease. Monitoring activities covers the collection, compilation, data processing and information distribution on the status of diseases on population level (introducing and spreading of new diseases). The results of the monitoring are aims to observe the distribution important fish pest and diseases and quarantine fish



diseases. Those informations will be used as reference in prevention and controlling fish pest and diseases. However, the coordination and integration of those activities should be set up within a better regulation and programme.

The surveillance of fish disease with scientific standard have been started in Indonesia. Arief Taslihan *et al.* (2014) have studied on the Prevalence and Risk Factors of White Spot Syndrome Virus in Tiger Shrimp at Traditional Ponds: A research has been conducted to determine the status of the WSSV epidemic on traditional shrimp ponds in Demak regency. Using A cross-sectional research method, they found the prevalence of WSSV infected farms was 65.6%. The risk factors analysis found that the factors that affected high prevalence of WSSV were screening of seed, pond size and drying ponds. Every year, Centre of Fish Quarantine and Inspection Agency, and Directorate of Culture Area and Fish Health undertaken regular monitoring on the fish health status in fisheries production centre, exporters, and fish traders.

### 3.3. Improvement of information and reporting system

Database on fish health resulted from surveillance, monitoring and laboratory testing should be improved continuously. Data information system at Directorate of Culture Area and Fish Health through SSMPPI and information on fish quarantine system through SISTERKAROLINE both are very good existing information systems. Unfortunately both systems have not been integrated yet. Therefore, integration of the fish health information system from related institution should be develop as a national database to accommodate the results on surveillance, laboratory testing, information on health management and other related information.

There is a need to prepare common reports for collection and information distribution (weekly, monthly, quarterly, etc) of all issues related to aquaculture. The database will be based on complete and constant data management which will enhance the capacity for rapid detection of new and exotic aquatic animal diseases. The feed back to the farmer will be given and risk management based on their health status will be advised.

Therefore, capacity building for operators, field extension officers, and farmers at all levels i.e. provincial and district levels need to be carried out. Skills personal at all levels will smooth the information flow and at the same time increase the accuracy and speed of information at normal and emergency situation. As a results, competent authority and crisis centre could response quicker at emergency situation.

### 3.4. Risks analysis, quarantine and fish health certification

The objectives of this programme are to provide the data risk assessment to determine whether the importation of aquatic animals and aquatic animal products is allowed by the importing countries in compliance with national and international standard; to standardize the decision making tools for importation/exportation permit (quarantine or Health certificate); to prevent the diseases spreading within state areas in the country and to other country.

Quarantine is one of the steps in risk management which is now implemented to the imported live fish. Quarantine has updated biannually the list of quarantine fish pest and diseases through the Minister of Marine Affairs and Fisheries Decree. The last list of quarantine fish pest and disease was Ministry Regulation No 26/KEPMEN.KP/2013. Harmonization on the publishing of the certificate for live fish and fish products need to be improved.

Invasive Alien Species (IAS) according to IUCN is a non native species that introduced, establish, proliferate, and spread that threaten biological diversity. Due to the regional and global issue on ASEAN Economic Community, there is a need to enhance the ability to detect and prevent the spread of emerging disease due to trans boundary diseases risks to the Indonesian areas through coordination and collaboration among ASEAN countries.

Livestock and fish products movement are the main sources for entry and spread the outbreak of important fish pests and diseases. Therefore, MMAF acknowledged the importation risk analysis (IRA) as acceptable methods which can be accepted internationally and can be used in determining the

risks due to live and processed fish importation. In order to control and ensure the quality and safety of fish products entering the Indonesia, IRA already to be conducted as stipulated in the Minister of Marine Affairs and Fisheries Regulation No: PER.16/MEN/2011 concerning importation risk analysis live fish and fish products. The scope of this guideline includes Import Risks Analysis procedure, assessment time and schedule, and requirements that should be fulfilled by the importers. The guideline also include the Formulation of independent Importation Risk Analysis Team.

Moreover it is already issued decision letter FQIA No.107/KEP-BKIPM/2017 concerning guideline of importation risk analysis invasive alien species and also No 337/KEP-BKIPM/2011 which already revised in 2018 concerning guideline of importation risk analysis pest and fish diseases.

National fish pathogen list in the future might include pathogen that present in the OIE list, NACA list and Indonesian interest. Those pathogen could be both that never been found and present in Indonesian territory and waters. The aims of updating the pathogen list is to prevent the introduction of emerging pathogens, and to control the fish and fish product movement among areas and island in the Indonesia territory to prevent the spread of the important disease. The reviewed and updated of the national fish pathogen list should be based on the active surveillance, monitoring, disease outbreaks report from surrounding countries, and international and regional fish disease meeting.

### *3.5. Disease control, emergency responses, and contingency planning*

The objectives of this programme are to prevent introduction of exotic fish diseases, to reduce endemic and outbreak of diseases, to improve emergency response capacity preparedness, to reduce negative impact of fish diseases.

Exotic, endemic and epidemic fish diseases are often occurred in aquaculture farms such as shrimp, common carps, catfish, tilapia, gouramy, eels, ornamental fish, and seaweed farm. Emergency response to fish diseases outbreak has not been implemented in proper way lately because the guideline and organization structure for the emergency response and contingency plan programme are not in well form. The current condition of diseases control and eradication is only undertaken during the outbreaks through the existing bureaucracy structure. The above mechanism leads to reactive and ad hoc emergency responses and contingency planning. As a result, no fixed standard operational procedure is available during outbreaks and contingency plan. Even though guide line is not available properly, the emergency response and contingency plan for emerging shrimp disease of EMS has been exercised since 2011. Legal framework, task force, diagnostic laboratory, workshop, and funding were conducted by central government collaborated with university, local government and private sector.

Based on the implementation of pilot project of biosecurity on farm level under TCP/INS/3402 in Banten and Lampung trough training and demonstration pond, the targeted shrimp farmers still did not really understand on comprehensive manner of biosecurity namely fencing, reservoir for water treatment prior to usage, disinfection of pond equipment and devices, screening of seed, and preventing the predator and carrier organism entering to the ponds. They perceived that application of several aspect of biosecurity, such as pond treatment and screening of seed are enough to prevent infection of shrimp pathogen. This condition was supported by the result of surveillance on demonstration pond in Banten and Lampung where the prevalence of WSSV was 93%.

At present disease control was done by farmers, and supported by nearest laboratory nor fisheries district office. Moreover, each district in the past has established crisis centre to response any disease outbreaks. However, since the member of the crisis centre has move and promoted, therefore it does work properly. It is then an urgent state to further develop disease control, emergency response system and contingency planning

It was clear that most of the farmers have not been implemented proper biosecurity. Therefore, (a) review of the guideline to reconstruct as simple, clear, understandable, and implementable as possible should be done, (b) mass production of the biosecurity guideline/manual should be distributed to all shrimp production centre, (c) followed with dissemination, group discussion, and capacity building especially for field extension and leader of farmer groups. Training on fish disease control including virus, bacteria and parasites to fish farmers, and extension officer in order to improve their capabilities



and awareness to fish diseases control. To support the National vaccination program (GERVIKAN), DGA undertake training course on fish vaccination to the extension, government officer, and technical services from feed and fish medicines companies. The training also includes sampling methods and certification training for the taking sample personal. This is quite important, because validity of the data is also depended upon the sample collector capability.

#### *3.5.1. Crisis Center establishment for emergency responses*

Formulation of the crisis center for the emergency responses consists of professional from different background such as aquatic animal health professional, veterinarians, epidemiologist, and biologist. This crisis centers will be lead by competent authority for fish health and environment in central, provincial and district levels. The structure, duty and command system of the crisis centre will also be developed and upgraded according to the coverage, span of control and personal availability.

#### *3.5.2. Establishment of guideline for emergency response preparedness and contingency planning*

In addition to develop the tasks force and function, there is a need to formulate guideline and standard operational procedures for treatments, eradication, early detection and rapid diagnosis methods in the framework of emergency responses and contingency planning implementations. Those documents will be approved/endorsed by relevant authority.

#### *3.5.3. Establishment for emergency funds for aquatic animal disease outbreaks*

Government will provide appropriate compensation to the fish farmer which their fish should be destroyed due to disease outbreaks based on Government financial capabilities. This compensation is set in the draft of Government Act and should be followed by Standard Operational Procedures (SOP) on Compensation fee. In facing the disease outbreak and emerging disease, emergency responses should be set up in the form of public awareness by involving relevant stakeholders, encourage Public Private Partnership role to facility discussions/meeting periodically.

Emergency fund should be formulated as wise as possible, who will declare the outbreaks/disaster, what are the criteria, and how much the compensation could be paid. Because of limited budget from government, it might be potential to develop budget sharing from the private sectors and related stakeholders to handle the emerging disease.

### *3.6. Aquatic Animal Health Services and diagnostic laboratory*

The objective are to provide appropriate services of aquatic animal health and facilitate to trading-partner for domestic and export markets; to provide appropriate aquatic animal health services to fish farmers and related stakeholders, and to improve diagnostic laboratory capability and qualification

The scope of fish health and environment laboratory under central government of DGA covers a) Fish diseases analysis; b) Residue analysis; c) Water quality analysis; d) Fish feed analysis, and e) Fish medicines analysis. There are more than 30 Fish health Laboratories under DGA and at least 100 fish health and diseases laboratories belongs to local government both in provincial and districts level.

7 Improving the laboratory capacity for disease diagnostic has been done by two laboratories namely, Main Center for Freshwater Aquaculture Development (MCFAD) in Sukabumi, West Java and Brackishwater Aquaculture Center (BAC) in Situbondo, East Java were in collaborated with OIE has conducting Twinning Programme. Fish Disease Laboratory of MCFAD Sukabumi is proposed to be reference laboratory of KHV and conducting twinning program with National Research Institute of Aquaculture, Fisheries Research Agency, Japan as OIE reference laboratory for KHV. Fish Disease Laboratory of BAC Situbondo is 3 proposed to be reference laboratory of shrimp disease and conducting twinning program with Aquaculture Pathology Laboratory, Department of Veterinary Science and Microbiology, University of Arizona, USA as OIE reference laboratory for several shrimp diseases. The laboratory under FQIS, the BUSKI (Fish 5 Quarantine Reference Laboratory) also has twinning program on shrimp disease with Australia Animal Health Laboratory (AAHL), CSIRO

Livestock Industries, Geelong, Victoria, AUSTRALIA (OIE reference laboratory for Yellow head virus).

Proficiency test was conducted in collaboration with DGA and NACA, ACIAR during 2013-2014 for 10 fish diseases viruses. Four Laboratories namely MCFAD Sukabumi, MCBAD Jepara, BAC Situbondo, and Fish Health Investigation and Monitoring Center, Serang carried out proficiency test for 10 viruses namely KHV, WSV, YHV, TSV, IMNV, IHNV, Megalocitivirus (RSIV, ISKNV, GIV), NNV, MrNV, and SVCV. Beside the proficiency test, ring test was done in 2013, collaboration between DGA and ACIAR project with University of Sydney for Nervous necrosis virus (NNV) and Epizootic hematopoietic necrosis virus (EHNV). Twenty fish diagnostic laboratories from DGA, Fish Quarantine, Research and Development, University, and private company were participated in the ring test.

To support Aquaculture industrialization program, Indonesian Government developed an integrated field fish health services located in the central of aquaculture production areas called POSIKANDU (Pos Pelayanan Kesehatan Ikan Terpadu). POSIKANDU, is an on farm integrated fish health unit in the centre of aquaculture production areas. POSIKANDU is the frontline of fish health and environment monitoring and information system at aquaculture production centre at field level. POSIKANDU capacity should be improved to be able to contribute more in early warning system and rapid responses toward the control of fish diseases outbreaks and aquaculture environment pollution. Therefore strengthening of POSIKANDU needs to be undertaken through capacity improvement of POSIKANDU (human resources, infrastructures and methods). The present of POSIKANDU in the fish production centre provide better laboratory services, and at the same time could be used as a meeting point for farmers and other related stakeholders to share and educate each other.

POSIKANDU consists of a building (60 m<sup>2</sup>) covers diagnostic room, consultation room, fish medicines room, and administration room. POSIKANDU provides several fish health and environment services through: monitoring on water quality and fish diseases, sampling for residues, medicine, vaccination, consultation services as well as information services both in passive and active way. Until now, there have been established more than 100 POSIKANDU in districts/municipalities which are prioritized in industrial areas for shrimp, milkfish, catfish, channel catfish, tilapia, grouper and seaweed. Therefore, it is needed to strengthen POSIKANDU through improvement of human resources, infrastructure, and testing methods.

### 3.7. Expand and maintenance the scope of laboratory accreditation

Laboratory has important role in guarding aquaculture activities therefore, its capacity must be improved to enable produce good quality testing result to protect diseases outbreaks, environmental degradation and food safety. Facilitation and standardization of testing laboratory for fish pest and diseases, fish medicines and residues are required to meet quality assurance. It can be done through: (a) fulfilment of SNI, ISO/IEC 17025 quality requirement, (b) laboratory standardization in term of human resources, testing methods, facilities and infrastructures, (c) quality assurance, such as proficiency, validation and interlaboratory comparison tests, certified reference materials, and (d) human resources capacity improvement.

The present of testing and reference laboratory will also save the time and increase the responses when new pathogen is detected. Reference laboratory will support active surveillance and the results will be recognized by the importing country and OIE. Testing and reference laboratory can be maintain through: (a) strengthening the tasks and function of testing and references laboratories for fish pest and diseases, fish Medicine and residues, (b) establishment of testing and references laboratories for pest and diseases, medicine quality, feeds and residues, and (c) develop laboratory network of fish pest and disease, medicines and feeds as well as aquaculture residues.

### 3.8. Fish medicine management

The objectives are to register fish medicine for aquaculture, to assure safety used of registered fish medicine for fish and environment, and to control distribution and usage of fish medicine.

Fish medicines covers biologic products, pharmacetic products, premix, probiotics and herbal. Based on the MMAF Minister Decree No. 04/MEN/2012 concerning fish medicine. Fish medicines govern under several regulations such as MMAF decree No. PER.04/MEN/2012 on fish medicines, on changes over MMAF decree No. PER.01/MEN/2019 on fish medicines, MMAF decree No. 24/PERMEN-KP/2014 on Good Medicines Manufactures Practices, and No.52/KEPMEN/KP/2014, concerning classification of fish medicines. The assessment of the impact of drug usage in aquaculture is needed to be evaluated in order to know the quantity and quality of fish medicines used by fish farmers. Improper usage and non registered fish medicine found in the field should be withdrawal from the market and carried out by the Directorate General of Fisheries and Marine Affairs inspection. Indonesian government allow usage of antimicrobial substances for B1 group of tetracycline, oxytetracycline, enrofloxacin and erythromycin for aquaculture industry. At present withdrawal time for each substances to cultured fish species is limited. So, research to determine withdrawal time for authorized antibacterial under B1 group are required.

#### 4. Conclusion

The NAAHP is a "living" plan that is flexible to meet needs as they arise. The NAAHP should be updated every five years and will account for submitted recommendations.

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