

Supporting ASEAN Good Aquaculture Practices: Preventing the Spread of Trans-boundary Aquatic Animal Diseases

Rolando V. Pakingking Jr. and Evelyn Grace de Jesus-Ayson

The FAO Fishery Statistics had indicated that Asia is the top producer of fish and fishery products from both capture fisheries and aquaculture. Specifically, Southeast Asia had contributed 9-31% of the total aquaculture production in Asia from 1950 to 2014 with Indonesia and the Philippines accounting for the most at 23-63% and 10-45% of the total, respectively. Aquaculture has been viewed as a solution to the growing concern on food security issues as well as for the socio-economic stability of many countries in Southeast Asia. For such reason, aquaculture operations are being intensified to compensate for the declining production from capture fisheries and in order to nail the gap between supply and demand for fish and fishery products in the world. With intensification, aquaculture production has already overtaken the contribution of capture fisheries to the world's total fisheries production. However, concerns on the safety and quality of aquaculture products have been raised as result of intensified fish farming operations. Added to such concern is the irresponsible introduction of aquatic species for aquaculture that serve as carriers of pathogens. As a result, a large number of infectious aquatic diseases have emerged threatening the sustainability of aquaculture in the Southeast Asian region. In an effort to address the emergence of transboundary diseases in the region, the Aquaculture Department of SEAFDEC (SEAFDEC/AQD) launched a program on Healthy and Wholesome Aquaculture which includes as one of its main objectives, the need to continue improving aquaculture production through innovations in fish health management.

There is no doubt that the recent rapid development of aquaculture has led to improved production. In fact in 2013, aquaculture production had already surpassed that from capture fisheries by 51% (FAO, 2016a; FAO, 2016b). However, it should be recalled that irresponsible aquaculture practices as well as over-development of aquaculture, especially in the Southeast Asian region, had brought about the occurrence of infectious aquatic diseases damaging the region's aquaculture production by hundreds of million USD. It was at this point that the ASEAN Member States (AMSs) recognized the need to promote responsible aquaculture in the region. Thus, with technical assistance from SEAFDEC and with funding support from the Japanese Trust Fund, the AMSs cooperated in the regionalization of the Code of Conduct for Responsible Fisheries (CCRF) and came up an agreement that "States should take necessary actions to appropriately manage aquaculture within their jurisdictions based on the Regional Guidelines" (SEAFDEC, 2001a).

Such declaration was enhanced when the ASEAN-SEAFDEC Member Countries through the Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region adopted in November 2001, resolved to "increase aquaculture production in a sustainable and environment-friendly manner by ensuring a stable supply of quality seeds and feeds, effectively controlling disease, promoting good farm management and transferring appropriate technology" (SEAFDEC, 2001b). This proclamation was backed up by specific provisions in the Plan of Action that indicated the need to "improve capabilities in the diagnosis and control of fish diseases within the region by developing technology and techniques for disease identification, reliable field-side diagnosis and harmonized diagnostic procedures, and establishing regional and inter-regional referral systems, including designation of reference laboratories and timely access to disease control experts within the region" (SEAFDEC, 2001b). Moreover, considering that the uncontrolled introduction of aquatic species had led to occurrence and transfer of aquatic diseases, the ASEAN-SEAFDEC Member Countries also emphasized to "reduce risks of negative environmental impacts, loss of biodiversity and disease transfer by regulating the introduction and transfer of aquatic organisms..."

As aquaculture continues to develop and being concerned about the industry's sustainability, the ASEAN-SEAFDEC Member Countries declared in the subsequent Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region Towards 2020 adopted in June 2011, to "mitigate the potential impacts of aquaculture on the environment and biodiversity including the spread of aquatic animal diseases caused by the uncontrolled introduction and transfer of exotic aquatic species and over-development of aquaculture" (SEAFDEC, 2011). The countries also affirmed the need to "continue the national efforts to control serious disease outbreaks by providing support to: (i) R&D to improve the ability to handle new and emerging diseases and surveillance of transmission of diseases to wild populations; and (ii) regional initiatives on harmonization of regional disease control standards, disease reporting and implementation of contingency plans to handle new and emerging diseases;" and to "develop regional warning systems on aquatic animal health and diseases to inform other Member Countries of relevant epidemiological events and to raise awareness of new diseases that may pose risks. Build emergency preparedness capacity through rapid and timely

responses to reduce potential catastrophic consequences of diseases” (SEAFDEC, 2011).

Along with the agreements and declarations made by the ASEAN-SEAFDEC Member Countries, SEAFDEC for its part intensified the implementation of its activities on fish disease management under the holistic program on Healthy and Wholesome Aquaculture. Early on and with funding support from the Japanese Trust Fund (JTF), SEAFDEC/AQD embarked on a five-year Regional Fish Disease Project in 2000 which focused on the development of fish disease inspection methodologies for artificially-bred seeds. In 2004, the Project was extended for another five years to give more emphasis on developing fish disease surveillance system that could assist the AMSs in their efforts towards preventing and managing fish diseases (Ogata, 2009). As a result, a well-coordinated network was established for the timely and efficient reporting of any outbreak of aquatic diseases in the region, while the AMSs now have its own regionally-recognized reference laboratory for specific aquatic diseases.

Meanwhile, as aquaculture continues to develop, problems keep on emerging as a consequence of the translocation or introduction of exotic species that brought about diseases in different areas or territories (Iwama, 1991). These transboundary diseases, known for their significant economic, trade and/or food security importance for a considerable number of countries, are easily spread to other countries. When their incidence reaches epidemic proportions, control and management including exclusion would require cooperation between and among several countries (FAO, 2007). Being highly transmissible, transboundary diseases could wipe out stocks, threaten food security, and potentially disrupt trade relations. Once introduced, these diseases put to risk wild fish populations when infected stocks find their way into the natural environment as well as pose a permanent threat to farmers because of their capability of contaminating hatchery-reared stocks or new species for aquaculture (Lavilla-Pitogo *et al.*, 2011). Some examples of transboundary diseases that affected the aquaculture industry of the Southeast Asian region are shown in **Table 1**.

Table 1. Some transboundary diseases that impacted aquaculture production in Southeast Asia

| Diseases | Affected Organisms |
|---|--------------------|
| Epizootic ulcerative syndrome (EUS) | Freshwater fish |
| Koi herpes virus disease (KHVD) | Koi, carps |
| White spot disease (WSD) | Shrimps |
| Taura syndrome (TS) | Shrimps |
| Infectious myonecrosis virus (IMNV) | Shrimps |
| Viral nervous necrosis (VNN) | Marine fish |
| Acute hepatopancreatic necrosis disease (AHPND) | Shrimps |

Over the years, outbreaks of diseases have affected cultured and wild fish populations resulting in decreased production and economic losses (de la Pena, 2004). Particularly, the shrimp industry has been beset with disease issues, starting with the white spot disease (WSD) epizootic which probably began in China in 1992 and subsequently spread to Taiwan, Japan and the rest of Asia. The white spot syndrome virus (WSSV), the causative agent of white spot disease (WSD), was first described in Japan where an initial outbreak occurred in cultures of *Penaeus japonicus* in 1993 and was thought to have originated from imported stocks from China.

Taura syndrome, caused by the Taura syndrome virus (TSV), was first recognized in shrimp farms in Ecuador in 1992. TSV spread rapidly to virtually all the shrimp-growing regions of the Americas and was introduced to Asia through shipments of infected shrimp postlarvae and broodstock. TSV outbreaks were first reported in Taiwan and later in Thailand and Indonesia. The most recent disease affecting cultured shrimp in Southeast Asia is acute hepatopancreatic necrosis disease (AHPND). Known earlier as early mortality syndrome or EMS, this disease was first reported in Viet Nam and later in Thailand, Malaysia, and the Philippines.

Issues and Concerns

Effective disease prevention and control require rapid and reliable detection of pathogens and exclusion of potential carriers, diagnosis, surveillance, reporting and an early warning system. Diagnostic procedures are classified according to levels of complexity and harmonized to become effective tools in aquatic animal health management. Farmer-friendly diagnostic methods have also been developed for pond-side application. Understanding disease and their recognition needs to be heightened among small-scale fish farm operators in rural communities (Lavilla-Pitogo *et al.*, 2011).

Disease surveillance and reporting have been enhanced in most countries and the awareness about transboundary diseases has been heightened. The Asia-Pacific Quarterly Aquatic Animal Disease Reporting System (QAAD) established in 1998 by FAO/NACA/OIE-Tokyo covers both the OIE-listed and other diseases deemed important to the Asia-Pacific region. The QAAD includes reports of the occurrence of specified diseases of fishes, mollusks and crustaceans from 21 countries and areas (Australia, Bangladesh, Cambodia, China, Hong Kong, India, Indonesia, Iran, Japan, DPR Korea, Republic of Korea, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Viet Nam). This transparent reporting system allows countries to know the status of diseases that pose threats to the aquaculture industry in the region.

Nevertheless, the Southeast Asian region still has a lot to learn about bringing in new and exotic species and their accompanying threat of disease introduction. Controlling the spread of important pathogens through the introduction of exotic species remains a major concern and outbreaks of introduced diseases continue to spread to new areas, causing serious socio-economic impacts and concerns on their effect on the wild populations. On the other hand, the effect of diseases in carrier wild populations should be considered, especially when sourcing broodstock for hatcheries. Surveillance of wildlife based on the protocols recommended by the Import Risk Analysis framework of the Office International des Epizooties (OIE) could be developed and evaluated for prioritizing pathogens for surveillance in wildlife species (McKenzie *et al.*, 2007).

Quarantine is important in preventing the spread of serious pathogens of aquatic animals. In the strictest sense, quarantine is the confinement of aquatic animals of unknown or questionable health status in secure facilities such that neither they nor any pathogens they may be carrying can escape into the external environment. During this period, the animals are observed, tested and treatment may be applied, and a decision would be made as to whether or not they should be released to the external environment. The purpose of quarantine is to minimize the risk of introducing infectious agents (pathogens) into the national territory of the importing country and their escape and spread to susceptible species. The secondary objective is to prevent the entry of aquatic organisms that have not been approved for introduction.

The AMSs have established quarantine and/or health certification procedures for aquatic animals and have invested in training quarantine/aquatic animal health officers,

establishing quarantine holding facilities and supporting diagnostics laboratories. However, implementing quarantine has not been totally successful and has not prevented the entry of serious exotic aquatic animal diseases due to a number of reasons including: the lag time between emergence of a new disease and its recognition as a serious pathogen of international importance, and when accurate and reliable diagnostic tools are developed and become generally available; the sheer volume of commodity traded and the diversity of forms of trade; and the lack of capital and human resources that governments are able to invest to this undertaking. It is to be noted that the levels of capacity among countries in the region for disease diagnosis, surveillance, quarantine and control of transboundary movement of aquatic animals vary significantly (Arthur, 2004) as shown in **Table 2**.

Strategies under the national aquatic animal health programs of Southeast Asian countries (**Box 1**) are embodied in the Asian Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals and the Beijing Consensus and Implementation Strategy (FAO/NACA, 2001a). The Manual on Procedures for the Implementation of the Asia-Pacific Technical Guidelines on

Box 1. Components of a National Strategy for Aquatic Animal Health (FAO/NACA, 2000)

- National pathogen list
- Disease diagnosis
- Health certification and quarantine measures
- Disease zoning
- Disease surveillance and reporting
- Contingency planning
- Import risk analysis
- National strategies and policy frameworks
- National and regional capacity building

Table 2. Capacity of AMSs for disease diagnosis, surveillance and health certification to control movement of aquatic animals

| Country | AHPND Outbreak | Diagnostic Laboratories | Surveillance | Movement Control | Capacity Building |
|-------------------|------------------|-------------------------|--------------|---|-------------------|
| Brunei Darussalam | No | Yes | Yes | No, health certificate from country of origin is required | Yes |
| Cambodia | Yes, unconfirmed | Yes | | Yes | Yes |
| Indonesia | No | Yes | Yes | Yes | Yes |
| Japan | No | Yes | Yes | Yes | Yes |
| Lao PDR | No | | | Yes | Yes |
| Malaysia | Yes | Yes | Yes | Yes | Yes |
| Myanmar | No | Yes | | Yes | Yes |
| Philippines | Yes | Yes | Yes | Yes | Yes |
| Singapore | No | Yes | Yes | Yes | Yes |
| Thailand | Yes | Yes | Yes | Yes | Yes |
| Viet Nam | Yes | Yes | Yes | Yes | Yes |

Sources: Country Reports presented during the Meeting on Current Status of Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training (Arthur, 2004)

Box 2. Examples of risk management measures for importation of live aquatic animals (Arthur *et al.*, 2004)

- Sourcing from stocks of known disease status, including the use of specific pathogen-free (SPF) stocks
- Importing eggs only
- Requiring quarantine in the country of origin
- Requiring quarantine and testing within the receiving country
- Using the International Council for the Exploration of the Sea (ICES) protocols
- Requiring the use of specific diagnostic tests and standards
- Requiring pre-shipment and/or post-shipment treatments

Health Management for the Responsible Movement of Live Aquatic Animals (FAO/NACA, 2001b) is also available. Examples of risk management measures for importation of live aquatic animals are shown in **Box 2**.

Role of AMSs and SEAFDEC in Addressing the Issues and Concerns

While aquaculture activities of the region have remarkably been intensified, monitoring and surveillance of aquatic diseases have become very important. During the Thirty-fifth Meeting of the SEAFDEC Program Committee in 2012 and Thirty-sixth Meeting in 2013, the Member Countries raised the concern regarding the outbreaks of AHPND and other transboundary diseases in the region, and acknowledged the need for concerted regional effort to address this issue (SEAFDEC, 2013; SEAFDEC, 2014a). In this connection, the SEAFDEC Council during its Forty-sixth Meeting in 2014 asked SEAFDEC/AQD to consider intensifying its activities related to aquatic animal health management as this could have impacts on the trade of fish and fishery products from the region (SEAFDEC, 2014b). Specifically, the SEAFDEC Council recommended that aquatic animal health management, including control and prevention of transboundary aquatic animal diseases, be included in the formulation of future programs of SEAFDEC and its partners in the region since addressing this issue would require collaborative effort.

In responding to the requirements of the Member Countries, SEAFDEC/AQD with funding support from the Japanese Trust Fund embarked on a new five-year project in 2015, on Reinforcement and Optimization of Fish Health Management and their Effective Dissemination. The Project is aimed at: developing and accelerating rapid and effective fish and shrimp health management; enhancing the efficacy of vaccine treatment in tropical cultured species; establishing protective measures against persistent and emerging parasitic diseases of tropical fish; identifying risk factors and developing protective measures against Early Mortality Syndrome (EMS); and extending and demonstrating technology to practitioners, officers, among others of the Member Countries. This

Project would therefore address the concerns of the AMSs on the need to address occurrence of emerging aquaculture diseases, the most recent of which is the shrimp disease known as *Enterocytozoon hepatopenaei* (EHP) caused by a microsporidian parasite (SEAFDEC, 2016a).

In an effort to share the results of the Project's activities to the Member Countries, SEAFDEC/AQD in collaboration with the Government of the Philippines through the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA-BFAR), organized the ASEAN Regional Technical Consultation on EMS/AHPND and other Transboundary Diseases for Improved Aquatic Animal Health in Southeast Asia on 22-24 February 2016 in Makati, Philippines. The Consultation was made possible through the Government of Japan's strong commitment in supporting the initiatives related to enhancing food security and safety in the AMSs, through the Japan-ASEAN Integration Fund (JAIF). The country reports presented during the Consultation focused on the occurrence of EMS/AHPND and other transboundary diseases in AMSs and their capacities for disease diagnosis, surveillance, health certification and control of live aquatic animals (SEAFDEC/AQD, 2016).

During the Technical Consultation, it was noted that the outbreaks and incidence of EMS/AHPND has so far been limited to Viet Nam, Thailand, Malaysia and the Philippines. On the other hand, most countries have in place a system for reporting, monitoring, and surveillance for diseases as well as health certification systems for importation and exportation of live aquatic organisms to prevent entry or spread of pathogens (**Table 2**). The Technical Consultation mainly focused on EMS/AHPND since AHPND is a relatively new disease, and several gaps in understanding this health concern still need to be elucidated. Various issues were identified for R&D on AHPND. These include the use of live feeds (specifically polychaetes) as these are potential carriers of pathogens; genetic considerations, *e.g.* the effect of inbreeding on the shrimps' susceptibility to AHPND and other diseases; vertical transmission of AHPND-causing bacteria; transfer of plasmid carrying the toxin gene to other *Vibrio* species and possibly other bacterial pathogens; environmental risk factors for spreads and outbreaks of AHPND; use of green water technology as well as probiotics in the prevention of AHPND; mixed infection with other shrimp pathogens; development of antibiotic resistance; and development of other strategies for prevention and control of the disease. The outputs of Consultation are expected to address Strategic Objectives 38 and 39 under A.7 (Food, Agriculture and Forestry) of the ASEAN Economic Community Blueprint, as well as Strategic Objective 21 under B.3 (Enhancing Food Security and Safety) of the ASEAN Socio-cultural Community Blueprint.

Conclusion and Way Forward

The aforementioned Regional Technical Consultation established the Policy Recommendations to address the issues (Box 3) and agreed that such policies should be adopted or strengthened (SEAFDEC/AQD, 2016). These include the need for Member Countries to harmonize legislation(s) and regulation(s) related to aquatic animal health management including the legislation for transboundary movement of live aquatic animals; compliance with good aquaculture practices to maintain optimal environmental conditions during the culture period; develop and implement the guidelines on health management and good practices to prevent EMS/AHPND and other trans-boundary diseases; adopt capacity building programs that would ensure availability and capacity of public or private laboratory services; strictly implement a monitoring, surveillance and reporting system to relevant authorities and/or Competent Authority at country, regional and international levels; put in place an early warning system and develop emergency preparedness and contingency plans; strengthen cooperation and collaborative arrangements among the AMSs and with other regional and international organizations such as OIE, FAO, NACA and SEAFDEC

as well as the ASEAN Network of Aquatic Animal Health Centres (ANAAHC); promote and fund public-private partnerships at the national levels as well as cooperation among shrimp industries in the ASEAN Region; promote region-wide capacity building/education and information dissemination programs including technology transfer from an AMS to another AMS to enhance awareness of farmers and relevant stakeholders on R&D developments in transboundary diseases especially on management and control.

During the Forty-eighth Meeting of the SEAFDEC Council in April 2016, the Council recommended that cooperation among the AMSs should be strengthened in order to immediately address problems on aquatic diseases in a collaborative manner, and that a regional early warning system should be established through the leadership of SEAFDEC/AQD in collaboration with the ANAAHC, to keep other countries informed when disease outbreak occurs in one country (SEAFDEC, 2016b). After the endorsement by the SEAFDEC Council of the Policy Recommendations (Box 4), actions would be undertaken by SEAFDEC through the SEAFDEC/AQD and the AMSs, as appropriate.

Box 3. Issues on AHPND and HPM-EHP that should be included in future actions/studies on aquatic diseases management

Acute hepatopancreatic necrosis disease (AHPND)

- Use of live feeds for broodstock, specifically polychaetes which have been proven to be carriers of the pathogen
- Copying SPF (*Penaeus vannamei*) hatchery - effect on inbreeding/genetic erosion on susceptibility to AHPND; these breeding programs are long-term, usually highly expensive and need sufficient resources, therefore, should be carefully planned and efficiently implemented and sustained
- Misconception about SPF shrimps and its use; banning of SPF broodstock and live shrimp products from AHPND-affected countries
- Vertical transmission of AHPND bacteria (broodstock to post-larvae)
- Toxin plasmid transfer to other *Vibrio* species and possibly other bacterial pathogens that are common in the aquatic/rearing environment; *V. harveyi* and *V. owensii* have already been reported to carry the AHPND toxin plasmid
- Environmental risk factors for spread and outbreak of AHPND
- Mixed infection with other shrimp pathogens (Covert Mortality Disease or CMD, EHP, White Spot Syndrome Virus or WSSV)
- Efficacy of green water technology in prevention of AHPND infection; currently being practiced in Viet Nam and the Philippines with some degree of success
- Issue on extensive/non-registered farms: risk that they may pose to the spread and occurrence of the disease
- Probiotics: locally produced vs. imported; issue on banning probiotics for use in prevention of AHPND
- Biosecurity capacities of countries to prevent the entry of the pathogen
- Emergency preparedness and contingency planning
- Sharing of information and experiences among countries affected and not affected by the disease
- Lack of disease surveillance in processing plants and the wild population of Antimicrobial resistance
- Certification of Aquatic Animal Health (AAH) Professionals (other than veterinarians)
- Cooperation of government and producers in prevention and management of AHPND; Strengthen government and private sector partnership. Learn from the farmer experience and understand science behind and disseminate

Hepatopancreatic microsporidiosis caused by *Enterocytozoon hepatopenaei* (HPM-EHP)

(Possible research areas for better understanding of the pathogen and disease mechanisms, as well as preventive and control measures)

- Identification of the reservoir of the pathogen to include live feeds other crustaceans that are common in the aquatic environment
- Detailed study on the effect of the pathogen on growth and survival of infected shrimps
- Preventive and control measures
- Co-infection with other important pathogens of shrimps (viral and bacterial), and its association to other shrimps diseases (e.g. White Feces Syndrome, AHPND)

Box 4. Policy recommendations and priority areas for R&D to address aquatic diseases

| Issues/Gaps | Regional Policy Recommendations |
|--|---|
| Legislative and policy frameworks | <ul style="list-style-type: none"> • Development of a national Strategy and Policy Framework • Member Countries should work to harmonize legislation and regulation related to aquatic animal health management including the legislation for transboundary movement of live aquatic animals |
| Strategy for prevention, control, and biosecurity | <ul style="list-style-type: none"> • Compliance with good aquaculture practices to maintain optimal environmental conditions during the culture period • Establishment of effective prevention system on EMS/AHPND and other diseases • Marker-assisted selective breeding • Development of vaccine against AHPND • IgY as feed additive (based on experiments, high concentration of IgY in egg yolk can reduce the mortality of shrimp due to presence of antibody to toxin) • Nano-bubble technology: ozone nano-bubble can prevent AHPND • Pond bottom management: use of central drain system • Phage therapy • Development and implementation of the Guidelines on Health Management and Good Practices to Prevent EMS/AHPND and other trans-boundary diseases • Strict implementation of the reporting system to relevant authorities and/or Competent Authority at country, regional and international levels <ul style="list-style-type: none"> - Early warning system - Monitoring system - Information for the regular report, annual report • Emergency preparedness and contingency plan: should be the responsibility of Competent Authority • Funds should be made available as joint endeavor by private and public sectors |
| Detecting the EMS/AHPND disease | <ul style="list-style-type: none"> • Diagnostic methods: should follow the OIE guidelines • Development of tool kit • Ensure availability and capacity of laboratory services, either public or private |
| Research and Development program at regional and national levels | <ul style="list-style-type: none"> • Refer to Box 3 |
| Cooperation among relevant stakeholders | <ul style="list-style-type: none"> • Strengthen cooperation arrangements of the following: <ul style="list-style-type: none"> • ASEAN Member States (AMSs) and international/regional organizations such as OIE, FAO, NACA and SEAFDEC • ASEAN Network of Aquatic Animal Health Centres (ANAAHC); in addition to cooperation arrangements, ANAAHC should also: <ul style="list-style-type: none"> - assess the status and find ways on how the network could be assisted in implementing its activities - identify what centers should be involved in ANAAHC per country - mobilize all aquatic animal health centers • Public-private cooperation at national levels • Cooperation among shrimp industries in the ASEAN Region |
| Capacity building program | This should also include technology transfer from an AMS to another AMS |
| Awareness building | <ul style="list-style-type: none"> • Enhance awareness of farmers and relevant stakeholders on R&D developments in transboundary diseases (especially on management and control) |

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About the Authors

Dr. Rolando V. Pakingking Jr. is a Scientist and Head of Fish Health Section of SEAFDEC Aquaculture Department based in Iloilo, Philippines.

Dr. Evelyn Grace de-Jesus Ayson is a Scientist and Head of the Research Division of SEAFDEC Aquaculture Department based in Iloilo, Philippines.