

Department of Animal Health (DAH) Report of Viet Nam Emergency Diseases - Prevention and Control Shrimp Diseases in Viet Nam From 2016 to 2018

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Abstract

Acute Hepatopancreatic Necrosis Disease (AHPND), known as Early Mortality Syndrome (EMS) before 2013, was first reported in Vietnam from the Mekong River Delta without laboratory confirmation in the end of 2010. *Vibrio parahaemolyticus* was recognized as the causative agent of AHPND reported by Dr. Tran Loc in 2013. From 2010 to 2015, AHPND spread quickly to a wide range of shrimp production areas in Viet Nam. White Spot Disease (WSD), in dual infection with AHPND, cause serious disease, each year nearly 1 % in total culture area stopped operation. Although the diseases decreased significantly from 2013 to 2018, AHPND and WSD are still the most serious problem encountered by shrimp farmers in main shrimp production areas. Both tiger shrimp (*Penaeus monodon*) and whiteleg shrimp (*Litopenaeus vannamei*) have been infected with AHPND and WSD; most cases occur 15–60 days after stocking. AHPND and WSD occur year round; however, it is most frequently observed between March to September. Vietnam has alleviated the effect of AHPND and WSD effectively in the current year. This can be attributed to the application of multiple solutions to prevent and control AHPND and WSD such as (1) improve farmers' production conditions, awareness, facilities and bio-security measures; (2) implement active surveillance in main shrimp production areas for early warning; (3) broodstock and postlarvae are not accepted if positive for any OIE listed diseases; (4) movement control to prevent spreading disease; (5) encourage developing disease-free farms; (6) improve capacities and complete aquatic animal health system.

Introduction

Viet Nam has 28 coastal provinces with more than 3,260 km coastal line with large area of beach and many river systems such as Red river system and Mekong river system. Those are not only appropriate environment and condition for developing agriculture including brackish shrimp and catfish but also to exploit aquatic resources. With this advantage, the aquaculture industry of Vietnam develops with high speed, especially shrimp and catfish, and become one of the most aquatic product exporters in the world that contributes so much in GDP of Vietnam. From 2016 to 2018, the total aquatic animal product was 6.7 million tones, 7.3 million tonnes and 7.7 million tones, respectively. Viet Nam exported aquatic animal products and obtained about USD 7.1 billion, 8.3 billion and 9 billion from 2016 to 2019, respectively.

Viet Nam has approximately more than 743,000 hectares (ha) of brackishwater shrimp farms. The main area stocked with brackishwater shrimp in Viet Nam was the Mekong River Delta (southern Viet Nam) with about 565,000 (ha) (92 % in total shrimp cultivate surface of Viet Nam). Mekong River Delta contributes more than 95 % shrimp product of Viet Nam. In this area, all coastal provinces develop shrimp farms such as Ben Tre, Tien Giang, Tra Vinh, Soc Trang, Bac Lieu, Kien Giang and Ca Mau provinces. Based on the management systems, farm facilities, infrastructures, and shrimp stocking density, the shrimp farms are divided into 6 types: high technical – intensive, intensive, semi-intensive, extensive, improved extensive and integrated rice and shrimp farming. The shrimp farms are often impacted by diseases such as WSD, AHPND (or EMS), white faeces disease and other diseases.

Among these diseases, WSD and AHPND effected shrimp production in Viet Nam the most. EMS was first reported in Viet Nam in So Trang province in the end of 2010. In 2011, EMS continuously occurred and spread to other provinces such as Tien Giang, Ben Tre, Tra Vinh, Soc Trang, Bac Lieu, Kien Giang and Ca Mau provinces. It made shrimp production reduced sharply. The Ministry of Rural Development (MARD) tried their best to identify the pathogen and carried out prevention and control activities. MARD also called for help from international organizations such as, OIE and FAO. *Vibrio parahaemolyticus* with phage was identified as the causative agent of AHPND (Lightner *et al.*, 2013). WSD occurred in shrimp production areas from 1994-1995 and have been reported in many production areas in Viet Nam (from the North to the South). In 2015, 5,369 ha were affected by AHPND in 23 provinces compared with 23,850 ha in 2014 (Hien, 2016). In recent years, AHPND and WSD often occur during the main shrimp production period, but Viet Nam has applied various interventions to effectively control these diseases.

Shrimp diseases

In 2018, Viet Nam lost 1.6 % in total culture area because of diseases. Shrimp farms were affected by AHPND, WSD, MBV, and other diseases. Among these, AHPND and WSD are the most serious thus, the Vietnamese Government focused on the prevention and control of these diseases. Diseases usually occur in small farms where farmers did not apply or follow biosecurity practices. From 2008 to 2019, Taura Syndrome Virus (TSV), Yellow-head Virus (YHV) had not been detected in shrimp farms, although many active surveillance programs were conducted by local government and center government.

Status of AHPND

Epidemiology

Severity and economic impact

From 2016 to 2018, less than 1 % of the total culture area was affected by AHPND (Table 1). Lowest was observed in 2018, wherein only 0.76 % of the total culture area was affected compared to in 2016 (0.94 %) and 2017 (96 %).

AHPND caused serious economic losses in shrimp production in Viet Nam. It was estimated that annually, a total of more than USD 50 million was estimated to be lost due to this disease annually. However, Viet Nam still needs to carry out cost-effective analysis to identify the exact economic figures.

Species affected

Both tiger (*Penaeus monodon*) and white-leg shrimp (*Litopenaeus vannamei*) have been infected with AHPND. Table 1 shows that percentage of total culture area affected by AHPND were different between tiger shrimp and white-leg shrimp. White-leg shrimp was more susceptible to AHPND than tiger shrimp (more than 9 times). The tiger shrimp being a local species is adapted better to the environment in Viet Nam compared with the imported white-leg shrimp. Additionally, the white-leg shrimp was usually cultured at higher density than tiger shrimp. More epidemiological

research studies to identify species factor that may be highly associated with risk of AHPND infection.

Stages of the shrimp affected

On average, shrimps were infected with AHPND 35–40 days after stocking, a wide range from 0 up to 149 days, but a narrower period is about from 16 to 60 days after stocking (Table 2).

Risk factors

Risk factors identified during the 2011 to 2018 surveillance program are the following: large culture area of farm, sun-dried sediment of culture pond method, located closely to other farms that used the same AHPND-affected water source, the depth of pond (more than 1.2 meter or less), pond size (bigger 0.25 hectares and less) and presence of wild animals.

History of occurrence

In 2010, unconfirmed AHPND outbreaks were first reported in the Mekong River Delta (main shrimp production region). In 2011, the disease spread to a wide range of shrimp production areas, including Ninh Thuận (16 ha), Soc Trang (1,719 ha), Bac Lieu (346 ha) and Ca Mau (3,493 ha) provinces (OIE, 2012). In 2012, AHPND continuously spread to a wide range of shrimp production areas, not only along the Mekong Delta River such as Soc Trang (2,100 ha), Tra Vinh (1,642 ha), Bac Liêu

Table 1. AHPND impact on shrimp industry

	Year		
	2016	2017	2018
Proportion of disease(%)	0.94	0.96	0.77
Tiger Shrimp (%)	0.44	0.45	0.35
White-leg Shrimp (%)	4.53	4.12	3.36

(2,000 ha), Ca Mau (4,007 ha), Ben Tre (133 ha) but also in middle of Viet Nam (Quang Ngai, Binh Dinh, Ninh Thuan, Phu Yen, Khanh Hoa) (OIE, 2013)

One of the output of the project is the identification of *Vibrio parahaemolyticus* as the causative agent of AHPND (Tran Loc et al., 2013).

The project TCP/VIE/3304 was conducted by FAO “Emergency assistance to control the spread of an unknown disease affecting shrimps in Viet Nam” to help Viet Nam.

Currently, AHPND is continuously causing outbreaks in shrimp production areas in Viet Nam and the temporal pattern of the disease is presented in **Figure 1**.

Table 2. Stages of the shrimp affected AHPND

Age (after stonking)	Year 2016 Cum(%)	Year 2017 Cum(%)	Year 2018 Cum(%)
01-15	1.73	0.76	1.57
16-30	24.69	29.82	25.15
31-45	50.58	48.16	49.36
46-60	16.87	15.97	15.22
61-75	4.85	3.82	5.10
76-90	1.02	1.38	2.73
91-105	0.21	0.08	0.36
106-120	0.05	-	0.15
121-135	-	-	0.22
136-150	-	-	0.15

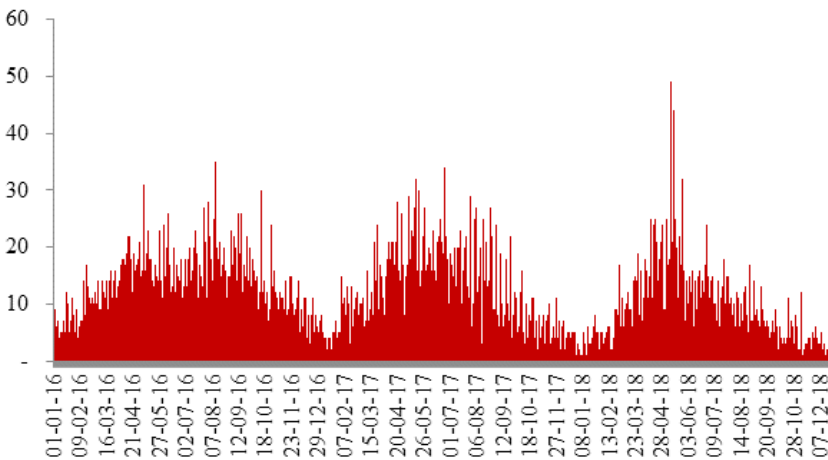


Figure 1. The epidemiological curve showing the temporal distribution of AHPND outbreaks occurred in Viet Nam from 2016 to 2018

Diagnostic methods employed:

shrimps die suddenly with high mortality rate in ponds. **Figure 4** shows healthy shrimp.

Disease signs

Infected shrimps have the following clinical signs: weakness, empty or little food in gut and pale (Figure 2), soft shell, atrophied (Figure 3) and hard to crush or swollen and easier to broken hepatopancreas; and

Diagnostic methods employed:

Real time – PCR was used to test AHPND. The test protocol followed the Standard/ Criteria no.: TCCS 01:2016/TY-TS of DAH,



Figure 2. Clinical signs of AHPND (red arrow) in shrimp: empty or little food in gut, decreased color of cover (pale) and pale hepatopancreas (Sources: Dr. Lighner and TCP/VIE/3304 (E))

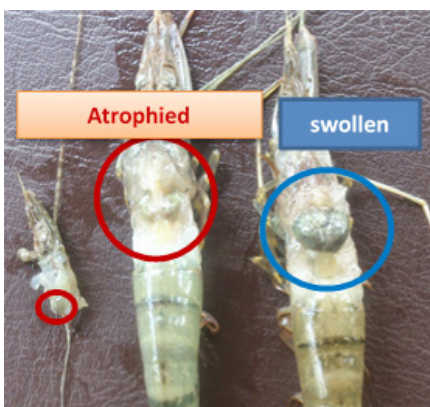


Figure 3. Clinical sign of shrimps infected with AHPND: swollen (encircled blue) and atrophied (encircled red) hepatopancreas



Figure 4. Healthy *P. monodon*

and used by all laboratories of DAH. This method uses primer set 3 (AP3): VpPirA-F, VpPirA-R and probe, kit Platinum qPCR SuperMix-UDG

PCR also was used to test AHPND. The test protocol followed the Standard/Criteria no.: TCCS 02: 2014/TY-TS of DAH, and used by all laboratories of DAH. This method uses primer set 3 (AP3): VpPirA-F, VpPirA-R, Taq PCR Master Mix kit.

Status of WSD in shrimp

Epidemiology

Severity and economic impact

In 2018, WSD was detected in 0.82 % of total of cultivate area. The proportion of infected AHPND area increased in comparison with 2016 and 2017. From 2016 to 2018, the proportion of infected area was less than 1 % (Table 3).

Table 3 indicates that proportion of infected WSD were significantly different between tiger shrimp and white-leg shrimp. White-leg shrimp was more susceptible to WSD than tiger shrimp (more than 5.7 times) thought out a 3-year period. This is for the same reason mentioned for AHPND.

Stages of the shrimp affected

On average, shrimps were infected with WSD after stocking for 35 days (a

wide range from 1 up to 195 days), but a narrower period is about from 16 to 60 days after stocking (Table 4).

WSD occur the whole year from January to December annually. However, outbreaks were recorded the most from March to September, the period considered best for shrimp culture in Viet Nam (Figure 5).

Diagnostic methods employed: PCR or RT-PCR or based on clinical signs.

Disease signs

Infected tiger shrimp or white leg shrimp has these symptoms observed at farm level: weakness, empty or little food in gut, swimming water surface, discoloration of the exoskeleton (pale) and at least one of specific signs: white spot (0.2–0.5 cm) in the cephalothorax and the uropod, that could not remove by temperature or brushing.

Diagnostic methods employed:

Real time – PCR was used to test WSD. The testing protocol followed the Standard/Criteria no.: TCCS 01: 2014/TY-TS of DAH, apply to all Labs of DAH. This method uses primer: WSSV1011F, WSSV1079R and probe (WSSV-p), kit Platinum qPCR SuperMix-UDG.

Table 3. WSD impact on shrimp industry

	Year		
	2016	2017	2018
Proportion of disease (%)	0.57	0.72	0.82
Tiger shrimp (%)	0.34	0.42	0.50
Whiteleg shrimp (%)	2.28	2.59	2.84

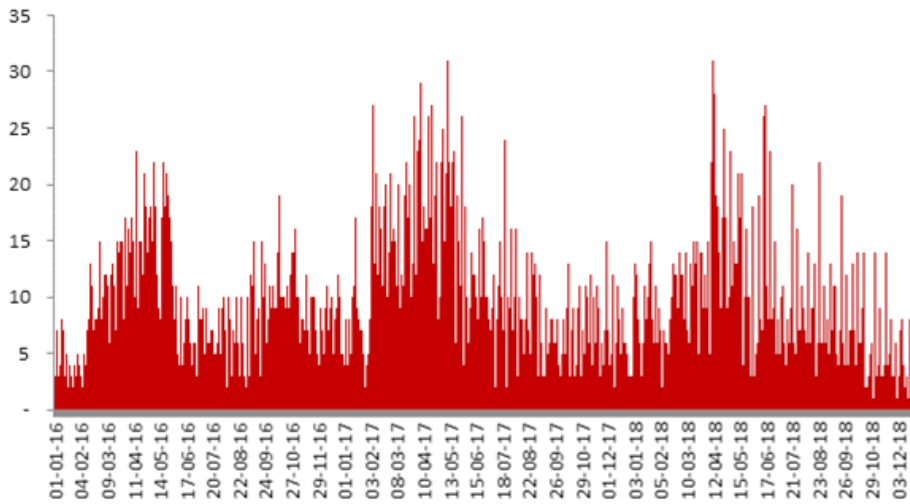


Figure 5. The epidemiological curve showing the temporal distribution of WSD outbreaks occurred in Viet Nam from 2016 to 2018

Table 4. Stages of shrimp affected with WSD.

Age (after stocking)	Year 2016 Cum (%)	Year 2017 Cum (%)	Year 2018 Cum (%)
1-15	1.31	1.1	1.96
16-30	27.11	28.37	28.35
31-45	43.23	42.23	45.66
46-60	19.15	23.95	15.97
61-75	6.06	2.8	5.3
76-90	2.43	1.07	1.52
91-105	0.34	0.3	0.78
106-120	0.15	0.12	0.41
121-135	0.11	0	0
136-150	0.04	0.06	0
151-165	0	0	0.04
181-195	0.07	0	0



Figure 6. Clinical sign of *P. monodon* infected with WSD: spots on the head and tail cover of infected shrimps (source: Dr. Bui Quang Te)

Prevention and control (AHPND, WSD and other aquatic animal diseases)

The following techniques and policies were developed and applied to prevent and control diseases in shrimps:

Techniques

Improve biosecurity measures at both hatcheries and shrimp production farms. New techniques and standards for cultivation and management, such as VietGAP, GlobeGAP, PRC, RT-PCT, were introduced to all shrimp production areas. All DAH's laboratories ($n = 7$) are currently using the standardized PCR protocol to test for the agent causing AHPND. In addition, there are more than 22 provincial laboratories.

Improving the capacity of farmers and staff of the aquatic animal health services by conducting several training courses. The subject and content of the training courses are: epidemiological characteristics of disease, disease and diagnosis methods, good aquaculture practices, management and response to disease, technique for recording, managing and analysis of survey data and report.

Trainings are also offered to improve the capabilities of staff of private companies. The subject and content are:

- (1) policies,
- (2) sampling for test shrimp products before exporting,
- (3) biosecurity,
- (4) disease surveillance technique and design of surveillance program to prove a disease free farm status.

DAH sends high qualified technical staff teams to farmers to work with them and local veterinary agencies to carry out prevention and control activities. The DAH team also helped farmers and local veterinarians to identify disease and if detected to apply interventions. They also instruct local veterinary staff to improve their knowledge on the disease, epidemiological techniques for outbreak investigation, surveillance, data collection, cleaning and analysis.

Broodstock and postlarvae producers and shrimp farms are encouraged to build disease-free farms. At present, 4 corporate-owned companies conduct biosecurity and active surveillance programs to prove disease-free facilities following the Australia Act (based on OIE code) or/and Vietnam regulation.

Active surveillance program

Carry out active surveillance programs for AHPND and WSD which is funded by farmers, local government and central government. For example, in 2015, the central government carried out active surveillance in 8 main shrimp production provinces: Quang Ninh, Nam Dinh, Ha

Tinh, Ninh Thuan, Binh Thuan, Soc Trang and Ben Tre. From 2017–2020, local government and central government carried out the National Plan for disease surveillance in shrimps and pangasius in the period between 2017 and 2020 in main shrimp production areas including stock to assess the prevalence proportion of disease (AHPND, WSD, HYD, IHNN)

Improve passive surveillance system: The standardized reporting system from the farm level to national level was used and online disease reporting system was developed led by DAH and Sub-DAH.

Build disease-free establishment:

Support and encourage the development of animal disease-free establishments. One Corporation was accredited disease-free with WSSV, AHPND, YHV, TSV and EHP (meet OIE standard); and 3 others on the process to be proven disease-free.

Other actions

- Established the National Steering Committee for Prevention and Control of Disease in Brackish Shrimps in November 2014. One of the committee's responsibilities is to advise Ministers to develop and carry out disease interventions in shrimps. Implement and inspect the annual disease prevention and control program of each province.
- Enhance capacity of laboratory system by investing and applying new techniques for Provincial Veterinarian Offices (sub-DAH: sub-Department of Animal Health) and Region of Animal Health Offices, take part in inter-laboratory testing.

- MARD allowed the use of some drugs, chemicals and biotic products to effectively control disease; however, farmers must ensure that aquaculture products are safe for human consumption, free from drug or chemical residues. Farmers are advised to use the correct doses of the product and to observe withdrawal time to comply with regulations on residue and food safety.
- Research Institute for Aquaculture (RIA) No. 1, 2, 3 and universities research the disease, risk factors and new methods to treat and respond to AHPND which includes finding antibiotics effective against the disease and a list of carrier animals; and aquaculture practices that will mitigate the effect of AHPND.

Scientific research done: scientific studies conducted/ongoing

In 2016, surveillance program for WSSV, AHPND, IHNNV and EHP in brackish water farmed shrimp were carried out. In 2017 and 2020, the National Plan for disease surveillance in pangasius and shrimp production including stock to assess prevalence proportion of disease (AHPND, WSD, YHV, IHNNV) was implemented.

From 2016 to 2018 DAH instructed other provinces to carry out active surveillance and formulate provincial plan for the prevention and control of OIE listed notifiable aquatic animal diseases using their own local budget and resources.

Research gaps

Epidemiological studies about risk factors, cost-effective study to determine exact

economic figures, AMR study especially in local government are lacking

Surveillance designs donot satisfy the guidelines set by the DAH or OIE in almost main aquaculture area due to the limited budget and resources for aquatic animal health.

Evaluation of the efficiency of aquatic animal health services.

Pond level identification of diseased shrimp

Because infected shrimps usually die in very short time, small size of shrimps and many cases do not show clinical signs that it is quite difficult for farmers to identify the disease correctly.

Treatment

Extensive, improved extensive and integrated rice and shrimp farms have normally poor farmers. They have little knowledge and capacity about diseases, bio-security, and response when diseases occur in farm or be threatened by AHPND from neighboring farms.

During disease outbreaks, small farms usually drain water directly to rivers without water treatment. This is one of the transmission methods by which disease spread quickly and become unmanageable in large areas.

Reporting

Attitude and awareness of many farmers are low on reporting diseases to local staff in the commune (In Vietnam, each commune have at least 1 field staff to record and report animal disease).

Country implementation of Aquatic Emergency Preparedness and Response Systems for effective management of aquatic animal disease outbreaks

Policy and Act.

Viet Nam has several laws related to the management of aquatic animal diseases that both farmers and AAH staff should follow. Among these are the following:

- Decree number 35/2016/ND-CP dated 15 May 2016 stipulating detail of some articles of Animal Health Law.
- Circular number 04/2016/TT-BNNPTNT dated 10 May 2016 stipulating prevention and control of aquatic animal diseases.
- Circular 10/2016/TT-BNNPTNT dated 01 June 2016 stipulating list of drugs are used and banned for animal.
- Circular 13/2016/TT-BNNPTNT dated 02 June 2016 stipulating management of drugs for animal.
- Circular number 14/2016/TT-BNNPTNT dated 02 June 2016 stipulating animal disease-free zones and establishments
- Circular number 26/2016/TT-BNNPTNT dated 30 June 2016 stipulating quarantine of aquatic animals and aquatic animal products, it applies to import products.

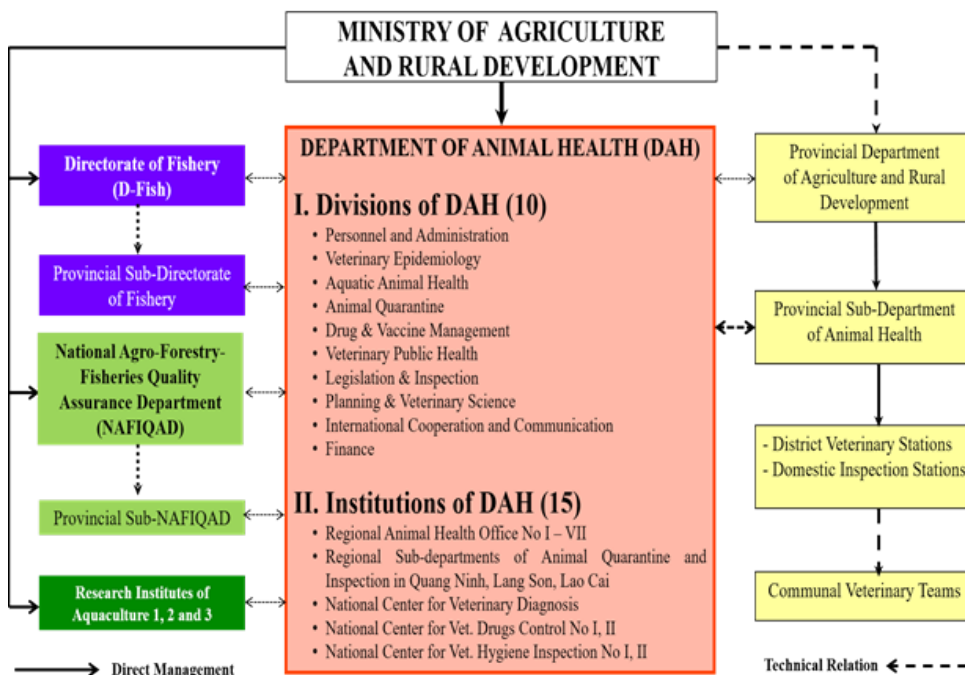


Figure 7. Organizational structure of animal health system of Viet Nam

- Circular number 36/2018/TT-BNNPTNT dated 25 Dec 2018 adjusts the Circular number 26/2016/TT-BNNPTNT.

Personnel competencies on recognition/diagnostic capacity/ capacity and reporting of a disease emergency

Monitoring system

The Department of Animal Health has 10 functional divisions located in Hanoi, 7 Regional Animal Health Offices I-VII throw country, NCVI, NCVDC I and II, NCVHI No. I and II, 3 Regional sub Department of Animal Quarantine in Lang Son, Lao Cai and Quang Ninh (3 provinces of border gate) (Figure 7).

Viet Nam also have 63 Sub-Department of Animal Health (Sub-DAH) in 63 provinces. Each district has one District Veterinary Station and each commune has at least 01 field staff.

Laboratory system

The aquatic animal health system has national laboratories, under DAH's management and local laboratories under provincial sub DAH and sub NAFIQAD. It has 41 public laboratories at both levels, of which 20 were granted with ISO 17025 and accredited by competent authority. The 41 public and 2 private laboratories are as follows:

- Central level: 8 aquatic animal disease testing laboratories of the Regional Animal Health Offices (RAHO) and the National Centre for Veterinary Diagnosis (NCVD).

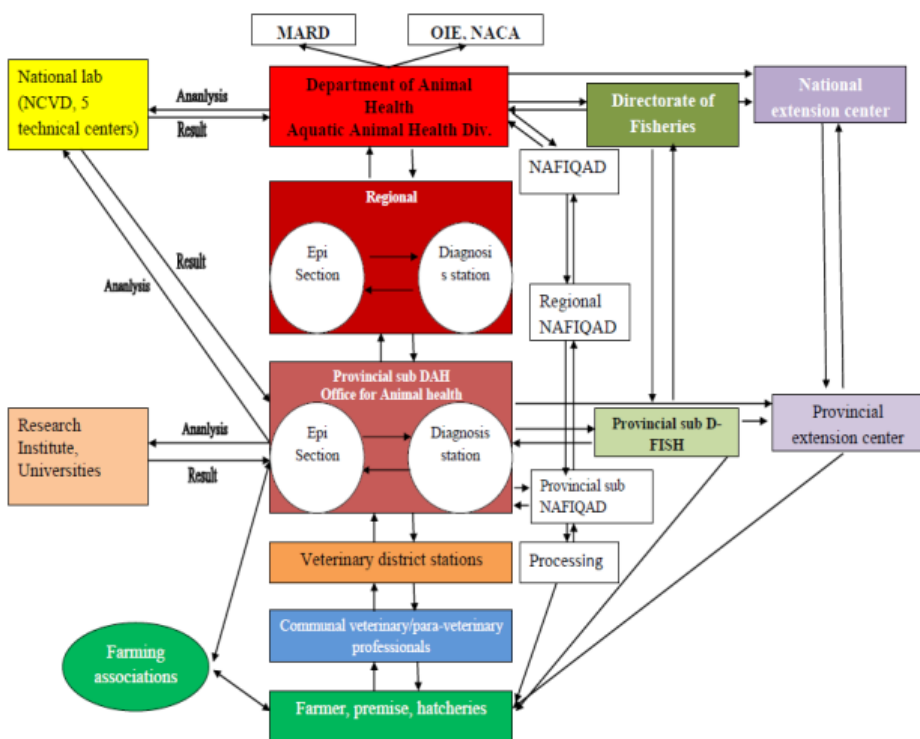


Figure 8. Gathering information and response disease system

- Local level: provincial sub DAH 27 laboratories (testing by conventional and Real-time PCR techniques).
- Agro-Forestry and Fishery Quality Assurance Department's management (NAFIQAD): 6 labs accredited in line with ISO 17025.
- and (2) Laboratories at three Research institutes for Aquaculture and fisheries universities.

Some private laboratories are also accredited to provide testing service for aquatic disease.

Aquatic animal quarantine system:

The agencies belonging to the Aquatic animal health system performing aquatic

animal quarantine function are the Animal Quarantine section in DAH (DAH headquarter, 7 Regional Animal Health Offices I-VII), 3 Regional sub Department of Animal Quarantine in Lang Son, Lao Cai and Quang Ninh (3 provinces of border gates) and 63 provincial Sub-DAHs.

The DAH manages import and export of animals and animal products, including aquatic animals and issues Health certificate for imported/exported aquatic animals/products (except Health Certificate for aquatic animal products exported for human consumption which is granted by NAFIQAD), 63 Sub-DAHs manage local transportation of animals and animals products through animal Quarantine Checking Points along transportation roads (Figure 9).

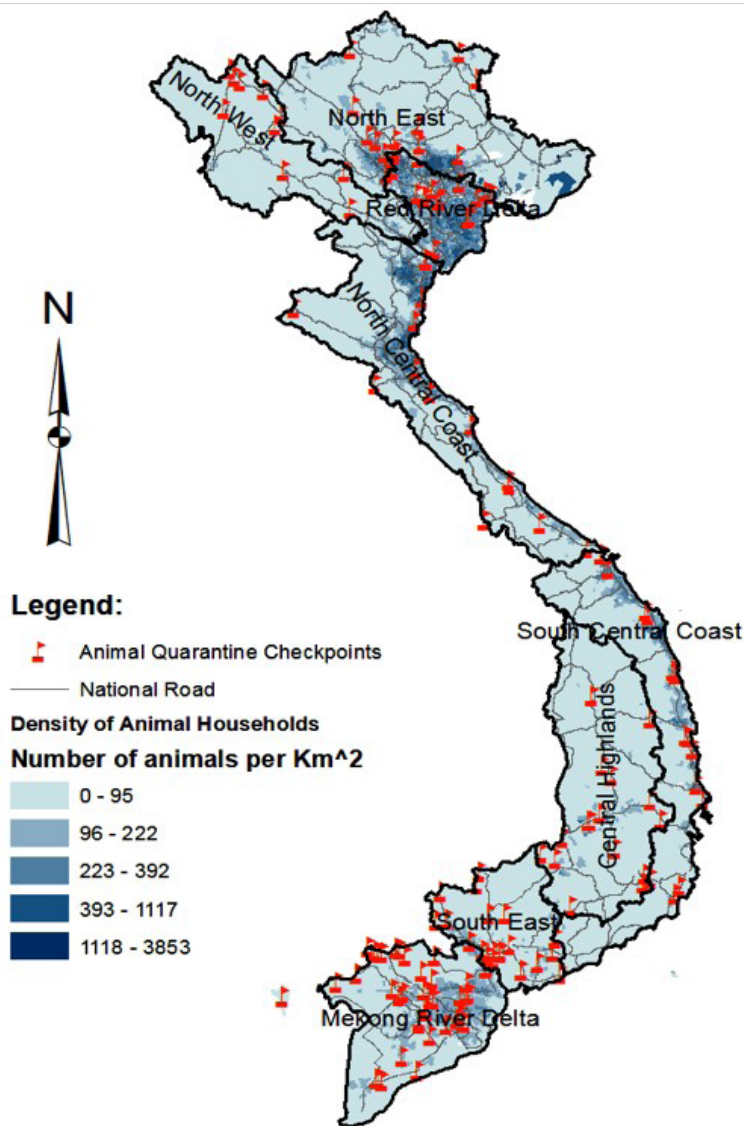


Figure 9. Quarantine of aquatic animals/products

Training programs

The government officially approved training and education plans for 630 participants per year on average at national level. At provincial level, yearly, each province organizes training for local staff and farmers on new regulations, knowledge and skills for prevention and control of aquatic animal disease.

Official training programs focused on the following topics:

- Enhancing aquatic animal disease management capacity for veterinary officials from central, regional and provincial levels. Post-graduate education at educational institutions in Viet Nam and overseas on

veterinary epidemiology (data analysis, disease warning), disease diagnosis, pathology, biosecurity, and other related topics

- Strengthening capacity of local aquatic animal health system on legislation, disease surveillance, reporting and response to disease outbreaks.

Surveillance systems (passive surveillance programs for targeted and non-targeted diseases and active surveillance programs for targeted disease)

Passive Surveillance programs

The owner of shrimp farms and aquatic animal health system implement passive surveillance following Circular number 04/2016/TT-BNNPTNT dated 10 May 2016 stipulating prevention and control of aquatic animal diseases.

Report

The owner of farming premise who observes diseased aquatic animals, aquatic animal with signs of disease, mass mortality due to disease, environment, and climate was responsible for making notification to competent authority.

Respond

Veterinary staff (field staff) in the commune, veterinary station (district level) should inform regulated level to local authority and Provincial Veterinary Office (sub-DAH), the DAH for prompt disease control.

- Outbreak investigation: inspection,

take sample to test, guide farmers to treatment

- Treatment of aquatic animal during disease outbreak: Harvest, treatment (if have drugs therapies are not encourage) or disposal by chemical means and disinfection of the culture area including material, instruments, human, water and pond area.
- Declaration of epidemics, organize control of aquatic animal diseases (If needed).
- Control transport of aquatic animals in epidemic areas.
- Report

Active Surveillance programs

Base on the purpose of programs, local government or central government could implement the active surveillance program to assess prevalence in some main culture area. Active surveillance usually follows the guideline of DAH.

Additionally, if farmers/compartments want to reach certificate of disease-free, they have to follow Circular number 14/2016/TT-BNNPTNT dated 02 June 2016 stipulating animal disease-free zones and establishments. The active surveillance program will be design to meet requirement of DAH ($P = 0.5$ for stock company, $P = 10$ for shrimp production companies) or OIE's regulation ($p = 0.2$).

Summary and recommendation

AHPND and WSD occur year round; however, it is most frequently observed between March to September. Both the tiger shrimp and the white-leg shrimp are infected but the white-leg shrimp is more

susceptible than the other. AHPND and WSD were more severe after stocking within 15 to 60 days.

To prevent and control AHPND and WSD, Vietnam apply multi-approach including a comprehensive policy system, enhancing technique and human resources development, and improving international collaboration.

Based on the Vietnamese experiences, below are recommendations to improve aquatic animal health in Southeast Asia.

1. Provide guidance to farmers to improve their production conditions, facilities and bio-security application;
2. Improve capacity:
 - Laboratory: Improve capacity on diagnosis; organize and take part in

inter-laboratory testing with OIE reference laboratory

- Field staff: improve capacity on outbreak investigation, surveillance/study design to assess disease.
3. Build, guide and carry out early disease warning system.
 4. Carry out intensive active surveillance at wide shrimp production areas for early warning.
 5. Build disease-free farms especially stock farms.
 6. Broodstock and post-larvae should not be accepted if positive for any OIE listed diseases.
 7. Movement control to prevent spreading the disease.

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