Current Status, Issues, and Gaps on Aquatic Emergency Preparedness and Response Systems Practiced by Cambodia

Chan Dara Khan*, Sokleang Chhorn, and Somony Thay
Aquatic Animal Disease and Health Management Office, Department of Aquaculture Development, Fisheries Administration, MAFF, Cambodia
E-mail: chandara_khan@yahoo.com

Abstract

A few decades ago, Cambodia was rich in both freshwater and marine fisheries resources because of its favorable geographical area. However, the fisheries resources have depleted and were unable to totally fulfill the increasing fish demands of its people. This was caused by various factors including unfavorable climate changes, increase in population, improper agricultural production practices, and other human-affecting activities. In this sense, aquaculture development in Cambodia becomes increasingly important in order to reduce the fishing pressure on its natural resources which are mainly for food security and economy of Cambodian people. Aside from this, aquatic animals in the country are vulnerable to infectious aquatic transboundary diseases as a result of insufficient and low transboundary diseases monitoring capacity. Neither the official list of aquatic transboundary diseases was created nor are the emergency preparedness and response systems for effective management of transboundary disease outbreaks in Cambodia has been well-established. Nonetheless, the government fisheries officers of both central and provincial levels have conducted fish health monitoring and undertake sample collection from fish farmers since 2016 in 10 targeted provinces as funded by the European Union's Programme. Regarding the capacity of the diagnostic laboratory, officers can perform level I and II but not for all species and diseases. Level III diagnoses cannot be effectively performed yet due to the lack of facilities, skills, and knowledge. The Marine Aquaculture Research and Development Center (MARDeC) is the only main laboratory for aquatic animal health diagnosis in the country. To minimize the spread of aquatic transboundary diseases in freshwater and seawater, the Ministry of Agriculture, Forestry and Fisheries has been moving to initiate and establish policies regarding: (1) the registrations, licensing, and law enforcement; (2) the inspection of sites; (3) and the issuance of health certificate and quality seals. However, those national regulations and legislation regarding the movement of aquatic animal stocks are not yet practical or effective. Importantly, the Royal Government of Cambodia needs both technical and financial assistance. It requires an improvement, amendment, and enforcement of the regulations, laws and the standard operating procedures (SOPs). It requires laboratory capacity building and SOPs for responsible management to establish the aquatic emergency preparedness and response systems for effective management of transboundary disease outbreaks in Cambodia as well as Southeast Asia.

Introduction

On the map of Cambodia, one can see a complex hydrological system that looks like a huge dumbbell body of water stretching across the northwest of the country, this is known as Beoung Tonle Sap or Tonle Sap Lake. This lake is the most prominent feature on the map of Cambodia with the connections to long Tonle Sap River and the Mekong River. On the southwest lies the Gulf of Thailand with a coastline of 435 km (Hav and Leap, 2005). Geographically, 30% of Cambodia is covered with seasonal and permanent wetlands. Cambodia has one of the largest and most diverse freshwater fisheries in the world with bigger fisheries were observed in geographically much larger nations like China, India and Bangladesh (SPFF, 2011). Cambodia is rich in both freshwater and marine fishery resources. More than 500 freshwater fish species (Rainboth, 1996) and over 562 marine fish species (Try, 2003) have been identified. The average fish consumption of Cambodians is 52 kg per person per year, the highest recorded level in the world (Hortle, 2007). People around the Tonle Sap Lake alone consume fish between 67-80 kg per capita (Lang, 2015).

The high fishing pressure caused by the increasing demand for fish and fisheries products in the rural areas and the fast developing urban centers (Joffre *et al.*, 2019), in addition to the unfavorable climate change, increase in population, flooded forest clearance for agricultural production, hydro-power dam constructions in upstream Mekong River, over-fishing and some illegal fishing, considerably affected Cambodia's capture fisheries. In this sense, aquaculture development in Cambodia became increasingly important as the remedy to rectify the vulnerable fisheries resources which so far have potentially contributed to the employment and livelihoods of the poor, to food security, and to the country's gross domestic product (GDP) and foreign exchange balance (SPFF, 2011). Additionally, Lang (2015) reported that 27,000 people were employed in the aquaculture sector in Cambodia.

According to the National Strategic Plan for Aquaculture Development in Cambodia (NSPAD) for 2016 to 2030, aquaculture production has grown by an average 20% per year over the past decade, increasing from less than 50,000 metric tons in 2008 to 207,443 metric tons in 2017. Aquaculture accounts for 20% of the country total fish production and in that the inland aquaculture accounts for nearly 90%. Some 50% of the total aquaculture production originates from freshwater cage culture, practiced with several main species including giant snakehead (*Channa micropeltes*, 47%), pangasius (*Pangasianodon hypophthalmus*, 27%), and hybrid catfish (*Clarias*, 27%) and other species (3%). As for seed production and trends, it increased from 20 million seed in the 2000s to approximately 180 million seed in 2015. There are 55% of seed imported from the neighboring countries, 13% sourced from the wild; and 32% from Cambodian state and private hatcheries (NSPAD, 2017). Besides the import of seed from the neighboring countries, the practices of feeding local and imported low value 'trash fish' to some carnivorous species like giant snakehead, *C. micropetes* or mixed with other ingredients to make a farm-made feed for other species without proper screening, cleaning and disinfection are still being practiced. In this manner, the chance of contracting and spreading of transboundary diseases from another country to Cambodia and vice versa is known to be high risk.

Early Warning System

Cambodia's aquatic animals are vulnerable to infectious aquatic transboundary diseases as a consequence of the insufficient and poor transboundary diseases monitoring capacity as well as early warning system. Moreover, Cambodia has not yet developed the national list of aquatic transboundary diseases at the moment. However, some major aquatic animal diseases of finfish and crustaceans that are of concern have been identified. These are listed in the tables below, including their status, level of diagnosis and the affected species.

Early Detection System

Regarding the early detection systems for effective management of transboundary disease outbreaks in Cambodia, the officers of the Fisheries Administration Cantonment of each province contacts and reports any disease occurrences to the aquatic animal health officers at the national level (Fisheries Administration) and suspected/diseased aquatic animal samples are also sent for further diagnosis. Fish samples must be collected from farmers of the suspected areas. This is the existing framework that is being followed however, there is no national standard of operation in place yet. Since Cambodia is one of ASEAN Network of Aquatic Animal Health Centres (ANAAHC), Network

of Aquaculture Centres in Asia-Pacific (NACA) and World Organisation for Animal Health (OIE) member counties, it is required to report the outbreaks to the organizations, but Cambodia failed to regularly submit the reports due to some technical and financial constraints, insufficient number of personnel and diagnostic capability/capacity.

Concerning the capacity of diagnostic laboratory, the officers can perform level I and II but not for all species of aquatic animals and types of diseases. As for level III excluding histopathology, mycology and others, it is also not yet effectively performed due to the aforementioned constraints. Marine Aquaculture Research and Development Center (MARDeC) is the only main laboratory for aquatic animal health diagnosis nowadays. Some diseases such as bacillary necrosis of pangasius (BNP), red spot and motile *Aeromonas* septicemia, streptococcosis, acute hepatopancreatic necrosis disease (AHPND) or (EMS), infection with white spot syndrome virus (WSSV) are of concern in farmed aquatic animals of Cambodia. Moreover, several pathogens have been identified from farmed fish such as fish parasites: *Trichodina* sp., *Ichthyophthirius multifiliis*, *Epistylis*, *Apisoma*, *Dactylogyrus* sp., *Gyrodactylus* sp., *Lernaea* sp., *Argulus* sp., *Acanthocephalan*, *Henneguya* sp., *Cryptocaryon irritans*, *Traonchus* sp., *Hirudinea* sp., *Rocinela maculate* and *Benedinea* sp.; pathogenic bacteria: *Aeromonas hydrophila*, *Aeromonas* spp., *Edwardsiella ictaluri*, *Streptococcus* sp., *Vibrio* sp.; fungi: *Aphanomyces invadans* and *Saprolegnia* sp.; and RNA viruses (Viral encephalopathy and retinopathy). All in all, in order to be able to diagnose and report such kinds of transboundary diseases listed by NACA and OIE to the government and either local or international organizations,

Finfish Diseases	Status	Level of Diagnosis	Affected Species
1. Infection with *Aphanomyces invadans* (EUS)	+ (a)	I, II	Silver barb, Striped snakehead, Giant snakehead, Marble goby, Walking catfish
2. Koi herpesvirus disease (KHV)	*** (a)		
3. Grouper iridoviral disease (GIV)	***		
4. Viral encephalopathy and retinopathy (VNN)	+	III	Asian sea bass
5. Enteric septicaemia of catfish (ESC)	?	I, II	Striped catfish
6. Tilapia lake virus (TiLV)	0000		

Source: (a) (Racy 2004)

Crustacean Diseases	Status	Level of Diagnosis	Affected Species
1. Infection with Taura syndrome virus (TSV	(1999) (b)	I	*Penaeus vannamei*
2. Infection with white spot syndrome virus (WSSV)	(1999) (b)	I	*Penaeus vannamei*
3. Infection with yellow head virus (YHV)	(1999) (b)	I	*Penaeus vannamei*
4. Infection with infectious hypodermal and haematopoietic (IHHNV)	0000		
5. Infection with *Macrobrachium rosenbergii* nodavirus (WTD)	-	I	*Macrobrachium rosenbergii*
6. Acute hepatopancreatic necrosis disease (AHPND) or (EMS)	(2011-2013) (b)	I	*Penaeus monodon*
7. Monodon Baculovirus (MBV) Disease	(1999) (b)	I	*Penaeus monodon* *Penaeus vannamei*

Source: (b) (Lang and Sothea 2016)

Legend:

+	Disease reported or known to be present
+?	Serological evidence and/or isolation of causative agent but no clinical diseases
?	Suspected by reporting officer but presence not confirmed
+( )	Occurrence limited to certain zones
+?( )	Confirmed infection/infestation limited to one or more zones of the country, but no clinical disease
?( )	Presence of the disease suspected but not confirmed in a zone
***	No information available
0000	Never reported
-	Not reported (but disease is known to occur)
(year)	Year of last occurrence

Cambodia is seeking for the development and enhancement of its laboratory capability and capacity.

Early Response System

After the samples are submitted for diagnosis, the results and identification are recorded and reported to the Department of Aquaculture Development (FiA) and then to the provincial officers (Fisheries Administration Cantonment) for taking prompt and right actions to solve the occurring aquatic animal diseases. Up to this point, the fisheries officers of both central and provincial levels have been conducting fish health monitoring and undertake fish sample collection from fish farmers since 2016 in 10 targeted provinces under the European Union-funded programme "Promotion of Inclusive and Sustainable Growth in the Agriculture Sector: Fisheries and Livestock, DCI-ASIE/2012/023-197 Fisheries sub-sector Component, DCI-ASIE/2013/331-574 (EU-PGA-FiA)." Even though some activities on disease monitoring program have been conducted as shown in the table below, Cambodian early response system is seen as not yet functioning well. This is because, sample submission, transport, and diagnosis are not yet well conducted in a timely manner.

To minimize the spread of aquatic transboundary diseases in freshwater and seawater, the Ministry of Agriculture, Forestry and Fisheries have been moving to initiate and establish policies regarding the registrations, licensing, and law enforcement; the inspection on sites; and the issuance of the health certificate and quality seals. However, those national regulations and legislation regarding the movement of aquatic animal stocks are not yet practiced or in effect at the moment. On the other hand, not only has the government established and enforced the legal interventions but the government also has raised the awareness to its competent officers, public, and farmers regarding the aquatic animal disease and health management via several training workshops at central and provincial levels. Additionally, the aquatic animal disease and health management officers have also produced some manuals of fish health and disease management. They encourage aquatic animal farmers to adapt Good Aquaculture Practices, known as GAqP. In mid-June 2018, to facilitate and extend the work of the Aquatic Animal Health officers, the Ministry of Agriculture, Forestry and Fisheries approved the request to create the Office of Aquatic Animal Disease and Health Management under the Department of Aquaculture Development, Fisheries Administration.

Fish Sample Collection from 10 Target Provinces under National Fish Disease & Health Monitoring Program

Province	Farm	Level of Diagnosis		Affected Species	Year
		Pond	Cage		
Kampong Chhnang	17	10	7	*Channa micropeltes*	2016
Kandal	16	16	0	*Channa striata*	2016
Banteay Meachey	14	14	0	*Pangasianodon hypophthalmus*	2017-2018
Battambang	18	14	4	Oreochromis niloticus	2017-2018
Kampong Thom	18	9	9	*Anabas testudineus*	2017-2018
Kampong Cham	9	6	3	*Oxyeleotris marmorata*	2018
Pursat	14	6	8	*Cyprinus carpio*	2018
Prev Veng	9	6	3	Hybrid catfish *(Clarias batrachus* and *C. gariepinus)*	2018
Takeo	13	13	0	*Pangasius larnaudii*	2018
Preah Sihanouk	11	11	0	*Hypsibarbus pierrei*	2018
TOTAL	**139**	**105**	**34**		

Way forward

The Royal Government of Cambodia has realized the needs of both technical and financial assistance as it requires an improvement, amendment, and enforcement of the regulations, laws and the SOPs and it requires laboratory capacity building and SOPs for responsible management to establish the aquatic emergency preparedness and response systems for effective management of transboundary disease outbreaks in Cambodia as well as Southeast Asia. To mention a few, the upcoming EU-funded CaPFish Aquaculture Project (2019-2023), is currently the most important program on inland aquaculture sector in Cambodia. The expected results under sub-component 5 of the project on the leadership and management of the negative impacts of aquaculture production on the environment include the development of guidelines for managing and monitoring diseases, chemical and organic residues, and invasive species in Cambodia. In this manner, it is strongly expected that our aquatic animal health laboratory and personnel's capacity, skills and knowledge respectively will be improved, upgraded and enhanced. Ultimately, it is seen that the Royal Government of Cambodia will be able to set up its aquatic emergency preparedness and response systems by that time.

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