

# SEAFDEC Regional Fish Disease Program: Safeguarding the Quality of Aquaculture Products and Environmental Integrity of the Southeast Asian Region

Hiroshi Ogata

In the Southeast Asian region, aquaculture has always been a major part of the economic strategy adopted by many countries for reducing poverty. This is in view of its great potentials to fill the gap between supply and demand for fish and fish products the role that it has maintained as an important producer of high quality protein for domestic consumption as well as a major generator of export earnings. However, the continuing population growth, the decline in marine fish catch, and the widespread poverty in the rural areas of the region make it imperative that sustainable aquaculture be promoted to ensure food security and generate livelihood.

Aquaculture production worldwide has been very promising posting a growth rate of 27% from 2001 to 2006. In 2006, the total production from aquaculture worldwide was 66,746,713 mt of which 8,296,465 mt or about 12% was contributed by the Southeast Asian countries, which showed a production growth of about 51% from 2001 to 2006 (**Table 1**). Compared with production from marine capture fisheries, the region's production for the same period had a growth rate of only about 12%, and in 2006 the region accounted for about 17% of the world's total production from marine capture fisheries (**Table 2**).

**Table 1.** Production from aquaculture of the Southeast Asian countries (mt)

Countries	2001	2002	2003	2004	2005	2006
Brunei Darussalam	99	157	160	708	708	700
Cambodia	17,500	18,250	26,300	37,515	42,000	50,200
Indonesia	1,076,749	1,137,151	1,228,559	1,468,612	2,124,093	2,219,883
Lao PDR	50,000	59,716	64,900	64,900	78,000	78,000
Malaysia	177,021	183,990	192,160	202,227	205,834	198,317
Myanmar	121,266	190,120	252,010	400,360	485,220	574,990
Philippines	1,220,456	1,338,394	1,448,504	1,717,028	1,895,848	2,092,274
Singapore	4,443	5,027	5,024	5,406	5,917	8,573
Thailand	814,121	954,696	1,064,409	1,259,983	1,304,213	1,385,801
Viet Nam	608,098	728,041	967,502	1,228,617	1,467,300	1,687,727
<b>Total for SEA</b>	<b>4,089,753</b>	<b>4,615,542</b>	<b>5,249,528</b>	<b>6,385,356</b>	<b>7,609,133</b>	<b>8,296,465</b>
<b>World's Total</b>	<b>48,583,171</b>	<b>51,968,834</b>	<b>55,202,344</b>	<b>59,867,278</b>	<b>63,298,924</b>	<b>66,746,713</b>

Source: FAO Fishstat Plus (2008)

**Table 2.** Production from marine capture fisheries of the Southeast Asian countries (mt)

Countries	2001	2002	2003	2004	2005	2006
Brunei Darussalam	1,578	2,044	2,221	2,417	2,390	2,390
Cambodia	43,200	45,882	55,607	55,817	60,000	60,500
Indonesia	3,967,145	4,074,066	4,383,158	4,321,805	4,406,559	4,468,010
Malaysia	1,235,367	1,276,185	1,287,336	1,335,725	1,213,681	1,296,250
Myanmar	949,670	1,029,460	1,053,720	1,132,340	1,228,710	1,375,670
Philippines	1,816,067	1,902,531	2,036,552	2,073,994	2,106,543	2,161,537
Singapore	3,342	2,769	2,085	2,173	1,920	3,103
Thailand	2,631,474	2,643,728	2,651,277	2,636,412	2,615,523	2,579,025
Viet Nam	1,481,175	1,575,640	1,647,233	1,733,434	1,791,100	1,816,100
<b>Total for SEA</b>	<b>12,129,018</b>	<b>12,552,305</b>	<b>13,119,189</b>	<b>13,294,117</b>	<b>13,426,426</b>	<b>13,762,586</b>
<b>World's Total</b>	<b>85,433,786</b>	<b>85,797,889</b>	<b>82,821,495</b>	<b>87,032,941</b>	<b>85,787,539</b>	<b>83,081,146</b>

Source: FAO Fishstat Plus (2008)

Considering therefore that aquaculture is an important factor that could contribute to food security in the region as shown in **Table 1**, its sustainable development was highly emphasized during the ASEAN-SEAFDEC Millennium Conference in November 2001. Thus, in the Resolution on Sustainable Fisheries for Food Security for the ASEAN Region (SEAFDEC, 2001) which was adopted during the Millennium Conference, the Ministers of the ASEAN-SEAFDEC Member Countries 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.*” This declaration was also clearly specified and spelled out in the accompanying Plan of Action also adopted in November 2001, which specifically indicated among others 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.*” Moreover, the Plan of Action also specified the need to “*reduce risks of negative environmental impacts, loss of biodiversity, and disease transfer by regulating the introduction and transfer of aquatic organisms*”, and “*formulate guidelines for the use of chemicals in aquaculture, establish quality standards and take measures to reduce or eliminate the use of harmful chemicals.*”

In the last two decades, aquaculture in Southeast Asia has grown very rapidly. However, due to irresponsible introduction of aquatic species that were carriers of pathogens, a large number of infectious diseases have emerged threatening the sustainability of aquaculture in the region. Furthermore, the occurrence of aquatic diseases has not only led to low production but has also threatened food security and raised alarming environmental concerns. It is for this reason that SEAFDEC intensified the implementation of a regional program on fish disease. As early as 2000, SEAFDEC through its Aquaculture Department (AQD) based in Iloilo, Philippines and with funding support from the Trust Fund Program of the Government of Japan’s Fisheries Agency (JTF) implemented the Regional Fish Disease Program which included the five-year activity on the Development of Fish Disease Inspection Methodologies for Artificially-bred Seeds under Phase I that covered research, hands-on training, annual meetings, and workshops. This was followed by Phase II starting in 2004, which focuses on the Development of Fish Disease Surveillance System.

## Development of Diagnostic Methods for Important Viral Diseases of Aquatic Animals

As the main thrust of Phase I of the SEAFDEC Regional Fish Disease Program, diagnostic methods have been developed to ensure healthy and wholesome trading of aquaculture products in the Southeast Asian region. The implementation of Phase I was also an opportune time to prevent the spread and control of an emerging viral disease of common carps known as *koi herpes virus* (KHV) which almost devastated carp production in the region. The timely efforts of SEAFDEC to address such concern had ensured the sustainability of carp culture, a major economic livelihood in many Southeast Asian countries.

The main activities under Phase I were implemented to address the concerns related to the reported viral diseases in cultured shrimps and fishes in Southeast Asia. Nagazawa (2004) reported that the white spot syndrome virus (WSSV) of the black tiger shrimp (*Penaeus monodon*) and the viral nervous necrosis (VNN) in marine fishes are two well known examples of such viral diseases affecting the aquaculture industry in the region. WSSV was in fact one of the root causes of the devastation of the shrimp culture industry that brought acute economic slow-down in Southeast Asia in the 90s. During the implementation of Phase I, diagnostic methods such as the polymerase chain reaction (PCR) were standardized for the WSSV (de la Peña *et al.*, 2007) while methods to prevent and control VNN infection in marine fish hatchery have also been developed (de la Peña *et al.*, 2005). In addition, husbandry techniques (e.g. use of live bacteria or probiotics and “green water” culture system) to control the luminous vibriosis caused by *Vibrio* spp. such as *Vibrio harveyi*, a common bacterial disease that has also heavily affected shrimp aquaculture in the Southeast Asian region,



*Analysis of shrimp virus (above); and on-site monitoring of fish diseases (left)*



*Diseased grouper (above) and shrimp (left)*



*On-site training on carp KHVD and Spring Viraemia of Carp (SVC) detection conducted by AQD in Vietnam*

were also developed as alternatives for chemotherapy (de Castro-Mallare *et al.*, 2005).

Moreover, diagnostic methods have also been standardized for monodon baculovirus (MBV) and hepato-pancreatic parvovirus (HPV) in shrimps, and other aquatic diseases (Catap *et al.*, 2003; Catap and de la Peña, 2005; de la Peña *et al.*, 2008). Results from the standardized diagnostic and husbandry methods for disease control have been disseminated to the region through training and massive information dissemination.

The first outbreak of the viral disease in koi and common carp (*Cyprinus carpio*) known as the koi herpes virus disease (KHVD) was reported to have caused mortalities in carps in Indonesia in early 2002 and in Japan in 2003. With potential threats of spreading in other Southeast Asian countries, SEAFDEC through the Regional Fish Disease Program initiated strategies for the prevention and control of the KHVD. Kanazawa (2005) cited that in 2003, the losses incurred by Indonesia due to the KHVD was more than US Dollars 15 million, and considering that common carp is an important source of protein in the rural areas in Southeast Asia, it has become necessary for AQD to conduct studies on KHVD taking into account its high virulence and devastating impact on the freshwater aquaculture sector.

Lio-Po (2004, 2005) cited that the results of the studies on KHVD conducted at AQD with funding from JTF have provided basic data on the status of the disease in the region and led to the prevention of the transboundary movement of KHVD in Southeast Asia.

## **E-learning on Principles of Health Management in Aquaculture**

Since 1988, AQD has been conducting classroom-based face-to-face training courses on health management in aquaculture on a regular basis at its main station in Tigbauan, Iloilo, Philippines. Later in the early 2000s, the teacher-student face-to-face setting had been changed into a distance-learning mode, which AQD considered more convenient and practical for a learner to acquire knowledge and skills in health management at his own place and at his own time.

A learner only has to have an Internet access to communicate with highly qualified instructors or with fellow learners. This new learning experience via information technology was developed for the AQD AquaHealth Online, which covers up-to-date knowledge on fish and crustacean diseases, the causal organisms and the methods of disease prevention and control (Lavilla-Pitogo and Torres, 2004). Targeting full-time working professionals, AquaHealth Online aims to introduce the principles of health management in aquaculture, and is envisaged that by the end of the course, online participants should be able to recognize diseased shrimps and fish, identify the cause(s) of the diseases, explain how the diseases develop, apply preventive and control measures to lessen the risks posed by the diseases, and use appropriate techniques for the preparation of samples for disease diagnosis. AquaHealth Online requires that participants should have basic knowledge of written English and competency in using computers and browsing the internet.

Lavilla-Pitogo and Torres (2004) cited that the shrinking fellowship and travel funds necessitated a shift in AQD's training paradigm. Thus, the AquaHealth Online was developed to train a large pool of geographically dispersed participants at minimum costs. Since its first session in 2002, AquaHealth Online has trained about 150 e-learners not only from Southeast Asia but also from other regions in the world. Based on the feedbacks from the e-learners, AquaHealth Online has proved that a state-of-the-art online course can be as effective as the face-to-face training.

## **Fish Disease Surveillance System**

Phase II of the Regional Fish Disease Program focuses on the Development of Fish Disease Surveillance System in

Southeast Asia to assist the Southeast Asian countries in their efforts in fish health prevention and management. Through this project, a network of the region's resources and facilities for fish health diagnosis has been established while human capacity building has been enhanced. While implementing this project, AQD has continued to refine the diagnostic methods to be able to develop new prevention methods for aquatic animal diseases. More importantly, a surveillance system for important viral diseases for shrimps in the region has been instituted.

As a result, the countries have developed a well-coordinated network for the timely and efficient reporting on any outbreak of any aquatic disease in the region as exemplified in the reporting of KHVD which spared the region's freshwater aquaculture sector from total economic collapse. As one of the most significant outcomes of this project, the countries in the region can now boast of its regionally-recognized reference laboratory for specific aquatic diseases.

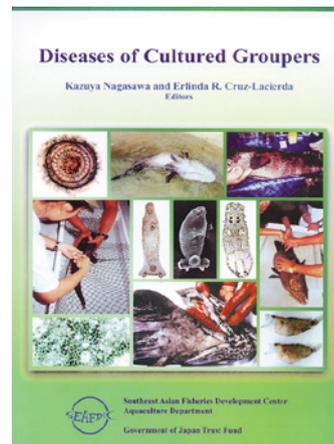
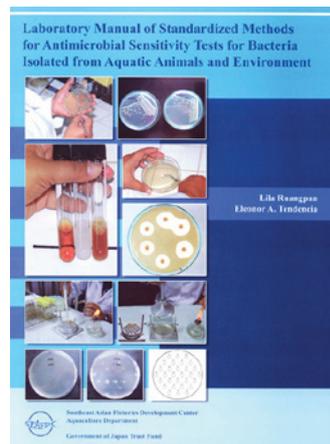
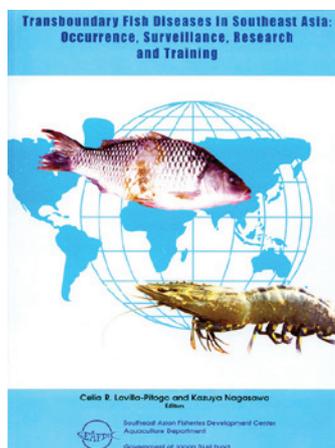
In order to review the emerging fish diseases and to keep the region abreast on the advances in pathogenesis, diagnosis, epidemiology, and surveillance of emerging diseases of aquatic animals the International Workshop on Emerging Fish Diseases in Asia was convened by SEAFDEC in December 2007 in Bangkok, Thailand. Attended by more than 70 participants from 17 countries including the Southeast Asian region, the information obtained from the Workshop has largely contributed to the promotion of responsible aquaculture in the region. Moreover, the knowledge gained by Southeast Asian countries on newly emerging aquatic diseases could boost their efforts in preventing the occurrence and spread of any aquatic diseases. This would then ensure that aquaculture products from the region are safe and wholesome for human consumption. The proceedings of the workshop would be published in September 2009.

## Monitoring Residual Chemicals in Aquaculture Products

Considering that the presence of chemical residues in aquaculture products poses threats to human health, SEAFDEC through the Regional Fish Disease Program has developed and standardized detection methods for residual chemicals such as pesticides and antibiotics in aquaculture products. This is aimed at securing safe and healthy aquaculture products from the Southeast Asian region.

The expansion of aquaculture farming activities over the years has made the health of the culture animals under constant threat from bioaggressors such as viruses, bacteria, parasites and fungi. In an effort to control the occurrence of such bioaggressors, many farmers use antibiotics and other chemicals without knowing that some could be toxic to humans and pose danger to the wellness of the environment. Improper use could also induce the development of resistant pathogens in the cultured aquatic species, the human consumers and the environment (Platon *et al.*, 2007).

With the cooperation of the Singapore-based SEAFDEC Marine Fisheries Research Department (MFRD), studies have been conducted to develop detection methods of residual antibiotics in aquaculture products. Oxolinic acid (OXA) and tetracycline (TC) are the most extensively used antibiotics in aquaculture and in order to determine the residue levels of OXA and TC in aquaculture products, high performance liquid chromatography methods had been developed (Tan *et al.*, 2005). Moreover, a compilation of the methods for chloramphenicol and nitrofurantoin residue testing were prepared by MFRD and AQD and disseminated to the region's fish disease laboratories (Ruangpan and Tendencia, 2004; Borlongan and Ng, 2004). Furthermore, evaluation methods for residual chemicals in aquaculture products have been established to secure the safety of aquaculture products while the use of antibiotics in the region's aquaculture industry has been closely monitored (Borlongan, 2005; Ruangpan and Pradit, 2005).



Publications relevant to fish diseases produced by AQD under the projects supported by the Japanese Trust Fund

## Conclusion and Way Forward

Through the R&D activities of the SEAFDEC Regional Fish Disease Program and with the knowledge learned and experiences gained from the program activities, the countries in the region would be able to continue their efforts in controlling aquatic diseases to safeguard the quality of their products that are meant not only for domestic consumption but also for export. SEAFDEC through the JTF Regional Fish Disease Program would continue to provide the means in order that the goals and objectives of the countries are achieved thus, ensuring that aquaculture products from the region are safe for human consumption and continue to satisfy standard quality criteria.

The occurrence of diseases in aquaculture is attributed to bad management practices that bring about deteriorated culture conditions, and in order to prevent disease outbreak some innovations have been adopted in the region including the installation of effluent reservoirs which was found effective in controlling viral diseases (Platon *et al.*, 2007). The number of recommendations for controlling fish diseases in aquaculture systems which Platon *et al.* (2007) have listed down should be considered specifically in the further development and refinement of the various methods and techniques for fish disease prevention and control. After all, many preventive measures are now being advanced that could inhibit the use of chemical inputs in aquaculture.

## References

- Borlongan, IG and Ng, JPC. 2004. Laboratory Manual of Standardized Methods for the Analysis of Pesticide and Antibiotic Residues in Aquaculture Products. Southeast Asian Fisheries Development Center. Aquaculture Department, Tigbauan, Iloilo, Philippines; 46 p
- Borlongan, IG. 2005. Detection of Pesticide Residues in Philippine Aquaculture Products; pp 329-335. *In*: Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- Catap E. S. and G.D. Lio-Po, 2005. Fungal disease. *In*: Nagasawa K. and E.R. Cruz-Lacierda (eds) Diseases of Cultured Groupers, SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines. pp.29-31.
- Catap ES, Lavilla-Pitogo CR, Maeno Y and Traviña RD. 2003. Occurrence, histopathology and experimental transmission of hepatopancreatic parvovirus infection in *Penaeus monodon* postlarvae. *Dis. Aquat. Org.* 57:11-17
- Catap, ES and de la Peña, LD. 2005. Standardization of Diagnostic Methods for Monodon Baculovirus (MBV) and Hepatopancreatic Parvovirus (HPV): Establishment of Monoclonal Antibodies (Mabs) against MBV and HPV; pp 27-57. *In*: Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- Cruz-Lacierda E.R. Lio-Po G.D., Catap E.S. and A.J.T. Pineda, 2005. Histopathology of koi herpesvirus (KHV) disease. *In*: Nagasawa K. (ed) Recent Advances in the Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. Southeast Asian Fisheries Development Center Aquaculture Department, Iloilo, Philippines, pp. 379-382.
- de Castro-Mallare, TR, Golez, NV and Tendencia, EA. 2005. Experimental Evaluation of Probiotics as Biocontrol/Bioremediation in the Rearing of Shrimp (*Penaeus monodon*); pp 153-167. *In*: Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- de la Peña L.D., Lio-Po G.D. and C.D. Sombito, 2005. Standardization of PCR techniques as the detection method for koi herpesvirus (KHV) infection in koi and common carp. *In*: Nagasawa K.(ed) Recent Advances in the Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. Southeast Asian Fisheries Development Center Aquaculture Department, Iloilo, Philippines, pp. 371-378.
- de la Peña LD, Lavilla-Pitogo CR, Villar CBR, Paner MG, Capulos GC. 2008. Prevalence of monodon baculovirus (MBV) in wild shrimp *Penaeus monodon* in the Philippines. *Aquaculture* 285:19-22
- de la Peña LD, Lavilla-Pitogo CR, Villar CBR, Paner MG, Sombito CD, Capulos GC. 2007. Prevalence of white spot syndrome virus (WSSV) in wild shrimp (*Penaeus monodon*) in the Philippines. *Diseases of Aquatic Organisms* 77:175-179.
- de la Peña, LD, Lavilla-Pitogo, CR, and Paner, MG. 2005. Standardization of PCR Techniques as the Detection Method for White Spot Syndrome Virus (WSSV) Infection in Shrimp (*Penaeus monodon*); pp. 19-26. *In*: Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- FAO Fishstat Plus. 2008. FAO, Rome Italy.
- Lavilla-Pitogo, CR and Torres, PL Jr. 2004. AquaHealth Online: A New Learning Environment for Capacity Building in Aquatic Animal Health; pp. 53-66. *In*: Lavilla-Pitogo CR, Nagasawa K (eds). 2004. Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 254 p

- Lio-Po G.D. and L. D. de la Peña, 2005. Viral diseases. **In:** Nagasawa K. and E.R. Cruz-Lacierda (eds) Diseases of Cultured Groupers, SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines. pp. 3-18.
- Lio-Po G.D. and M.D. Peñaranda, 2005. Detection and identification of viral pathogens in cultured marine fish. **In:** Nagasawa K. (ed) Recent Advances in the Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. Southeast Asian Fisheries Development Center Aquaculture Department, Iloilo, Philippines, pp. 67-84.
- Lio-Po G.D., Lacierda E.C., de la Peña L.D., Maeno Y. and Y. Inui, 2002b. Progress and current status of diagnostic techniques for marine fish viral diseases at the SEAFDEC Aquaculture Department. **In:** Inui Y. and E.R. Cruz-Lacierda (eds) Proceedings of the SEAFDEC-OIE Seminar Workshop on Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques, 4-6 Dec 2001, Iloilo City, Philippines, pp. 172-180.
- Lio-Po G.D., Leaño E.M., Guanzon N.G. Jr., Peñaranda M.D. and C.D. Sombito, 2005. Anti-luminous *Vibrio* factors associated with the 'green water' grow-out culture of the tiger shrimp, *Penaeus monodon*. *Aquaculture* 250:1-7.
- Lio-Po G.D., Leaño E.M., Usero R.C. and N.G. Guanzon, 2002a. *Vibrio harveyi* and the 'green water culture' of *Penaeus monodon*. **In:** Inui Y. and E.R. Cruz-Lacierda (eds) Proceedings of the SEAFDEC-OIE Seminar Workshop on Disease Control in Fish and Shrimp Aquaculture in Southeast Asia-Diagnosis and Husbandry Techniques, 4-6 Dec 2001, Iloilo City, Philippines, pp. 97-106.
- Lio-Po G.D., Villa-Franco A.U. and M.D. Peñaranda, 2005. Fish mucus and the luminous *Vibrio*. **In:** Nagasawa K (ed) Recent Advances in the Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. Southeast Asian Fisheries Development Center Aquaculture Department, Iloilo, Philippines, pp. 177-182.
- Lio-Po GD and Orozco, ZA. 2005. Detection and Transmission of the Koi Herpesvirus (KHV); pp 367-370. **In:** Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- Lio-Po, GD. 2004. Summary Brief: International Symposium on Koi Herpesvirus Disease; pp. 71-73. **In:** Lavilla-Pitogo CR, Nagasawa K. (eds). 2004. Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 254 p
- Nagasawa, K. 2004. Research and Training on Fish Diseases at the SEAFDEC Aquaculture Department in 2000-2004: A Review; pp. 41-52. **In:** Lavilla-Pitogo CR, Nagasawa K. (eds). 2004. Transboundary Fish Diseases in Southeast Asia: Occurrence, Surveillance, Research and Training. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 254 p
- Nagasawa, K. 2005. Research and Other Activities of the SEAFDEC Aquaculture Department for Koi Herpesvirus (KHV); pp 363-366. **In:** Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- Platon, RR, Yap, WG and Sulit, VT. 2007. Towards Sustainable Aquaculture in the ASEAN Region; pp 21-32. **In:** Fish for the People Volume 5 No. 1 (2007). Southeast Asian Fisheries Development Center, Bangkok, Thailand 48 p
- Ruangpan, L and Pradit Choncheunchob. 2005. Monitoring of Antimicrobial Usage and Drug Resistant Bacteria in Shrimp (*Penaeus monodon*) Culture in Thailand; pp 347-359. **In:** Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p
- Ruangpan, L and Tendencia, EA. 2004. Laboratory Manual of Standardized Methods for Antimicrobial Sensitivity Tests for Bacterial Isolated from Aquatic Animals and Environment. Southeast Asian Fisheries Development Center. Aquaculture Department, Tigbauan, Iloilo, Philippines; 55 p
- SEAFDEC. 2001. Resolution and Plan of Action on Sustainable Fisheries for Food Security for the ASEAN Region. Southeast Asian Fisheries Development Center, Bangkok, Thailand; 7 p
- Tan, LH, Ng, JPC, Seah, HH and Low, LK. 2005. Development of Detection Methods of Residual Oxolonic Acid and Tetracyclines in Aquaculture Products; pp 337-346. **In:** Nagasawa, K (ed). 2005. Recent Advances in Diagnosis and Prevention of Fish and Shrimp Diseases in Southeast Asia. SEAFDEC Aquaculture Department, Tigbauan, Iloilo, Philippines; 484 p

### About the Author

Dr. Hiroshi Ogata is the Deputy Department Chief of SEAFDEC Aquaculture Department (AQD) and the Trust Fund Program Co-Manager for AQD. Based in Tigbauan, Iloilo, Philippines, Dr. Ogata is not new to SEAFDEC and AQD since he was formerly assigned as Project Leader of the research project on Integrated and Sustainable Aquaculture Procedures in Sub-tropical and Tropical Countries of the Japan International Research Center for Agricultural Sciences (JIRCAS) which was implemented in the Philippines in collaboration with SEAFDEC/AQD from 2001 to 2006.