Minimizing the Risks of Aquatic Animal Disease Incursions: Current Strategies in Asia-Pacific

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ABSTRACT

In this new millennium, on-going strategies aimed at minimizing the risks of aquatic animal disease incursions in Asia-Pacific expanded and adjusted to the disease problems currently faced by the aquaculture sector. This paper briefly (a) discusses some of the most serious trans-boundary aquatic animal pathogens and diseases affecting Asian aquaculture; and (b) highlights regional and national efforts on responsible health management for mitigating the risks associated with aquatic animal movement. A regional approach is fundamental since many countries share common social, economic, industrial, environmental, biological and geographical characteristics. The development and implementation of the 'Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals', Aquatic Animal Disease Surveillance and Reporting System, National Strategies on Health Management, Aquatic Animal Pathogen and Quarantine Information System, and the establishment of the Asia Regional Advisory Group on Aquatic Animal Health are discussed. Capacity and awareness building on aquatic animal epidemiology, science-based risk analysis for aquatic animal transfers, diagnostics, molluscan health management and emergency response to disease outbreaks are highlighted. Whilst most of these strategies are directed in support of regional and national government policies, implementation will require pro-active involvement, effective cooperation and strategic networking between governments, farmers, researchers, scientists, development and aid agencies, and relevant private sector stakeholders at all levels. Health management is a shared responsibility and their contributions are essential to the health management process.

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INTRODUCTION

Aquatic animal health management strategies in Asia-Pacific aimed at minimizing the risks of disease incursions have expanded and adjusted to the current health problems faced by the aquaculture sector. The past three decades have witnessed remarkable expansion, intensification and diversification of the aquaculture sector which has become enormously reliant on external inputs through movements of live aquatic animals and animal products (broodstock, eggs, fry/fingerlings, seed, and feed). Asian aquaculture advanced from a traditional practice to a science-based activity and developed into a significant food production sector, contributing to national economies and providing better livelihoods for rural and farming families. The role of the fish farmer has also changed from simply raising fish to being a part of a production chain for the delivery of safe, high quality products to the end user. Increasing world trade liberalisation and globalisation as well as improved transportation efficiency contributed to a great extent to this trend. The aquaculture sector thus became a key supplier of aquatic food, provider of direct and indirect employment, and a great source of foreign trade earnings.

However, diseases caused by pathogens, resulting from unregulated and negligent movement of live aquatic animals, hindered sustainable aquaculture. Some of the most serious problems faced by the sector are those pathogens and diseases spread and introduced through movements of hatchery produced stocks, new species for aquaculture and development and enhancement of the ornamental fish trade.

Socio-economic and other associated impacts of diseases are shown in Table 1 for shrimp aquaculture and Table 2 for finfish aquaculture. The number of countries providing estimates of losses due to diseases are increasing and particularly evident among major shrimp producing countries which were gravely affected by diseases during the last decade. At the global level, combined estimated losses in production value due to shrimp diseases from 11 countries for the period 1987 to 1994 was US$ 3019 M (Israngkura and Sae-Hae, 2002).

The lack of cohesive policies and regulatory frameworks in most Asian countries, as well as inadequate technical information to develop guidelines for safe trans-boundary movement of live aquatic animals, were major factors.

REGIONAL AND GLOBAL EFFORTS TOWARDS RESPONSIBLE HEALTH MANAGEMENT

Various global instruments/agreements/codes of practice/guidelines (either voluntary or obligatory) exist which provide certain levels of protection all aimed at minimizing the risks of pathogens/diseases associated with aquatic animal movement. These are: (a) OIE's International Aquatic Animal Health Code (OIE 2003); (b) the Code of Practice on the Introductions and Transfers of Marine Organisms (ICES 1995) of ICES[1]; and (c) the Codes of Practice and Manual of Procedures for Consideration of Introductions and Transfers of

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[1] International Council for the Exploration of the Seas
[2] European Inland Fisheries Advisory Commission
[3] Food and Agriculture Organization of the United Nations
[4] World Trade Organization

Table 1. Examples of socio-economic and other impacts of diseases in shrimp aquaculture in selected Asian and Latin American countries.

Country	Disease/Pathogen	Losses and other impacts	Reference
1992			
Thailand	Yellowhead Disease (YHD)	US$ 30.6 M in 1992	Nash *et al*., 1995
1993			
China PR	Shrimp Diseases	US$ 420 M in 1993	Wei Qi, 2002
		60% decline in production from 210 000 mt to 87 000 mt in 1993	Yulin, 2001
Vietnam	Shrimp diseases (Monodon Baculovirus (MBV), White Spot Disease (WSD) and YHD	US$ 100 M in 1993	Khoa *et al*., 2001
1994-1998			
Australia	Shrimp diseases: Mid-crop Mortality Syndrome (MCMS), Gill-associated Virus (GAV)	US$ 32.5 M lost value of *P. monodon* production during the period 1994-1998	Walker, 2001
Thailand	YHD and WSD	US$ 650 M in 1994; 12 % production decline from 250 000 mt in 1994 to 220 000 mt in 1995; shrimp losses for 1997 nearly reached 50% of total farm output value. Figures exclude losses in related businesses such as feed production, processing and exporting, feed production, ancillary services and lost income for labourers	Chanratchakool *et al*., 2001
Honduras	Taura Syndrome Virus (TSV)	Production decline by 18%, 31% and 25% in 1994, 1995 and 1996, respectively.	Corrales *et al*., 2001
India	YHD WSD	Production loss of 10 000 to 12 000 mt during 1994-1995 caused by two viral epizootics; US$ 17.6 M economic loss in 1994 alone	Mohan and Basavarajappa, 2001
Malaysia	WSD	Annual losses since 1995 estimated at US$ 25 M	Yang *et a*l., 2001
Bangladesh	WSD	US$ 10 M production losses in 1996; export losses; massive unemployment	Rahman, 2001
Panama	TSV	1996 outbreak resulted to 30% reduction in production	Morales *et a*l., 2001
Costa Rica	TSV	TSV outbreak in 1996 caused reduction in survival rate from 65% to 15%.	Vargas, 2000
Philippines	Shrimp diseases (viral and bacterial infection)	Decline in export from 30 462 mt to 10 000 mt in 1997; great reduction in number of hatcheries	Albaladejo, 2001
Sri Lanka	WSD	Production loss of 1 B Rs in foreign income during 1996 outbreak; 90% of production units closed	Siriwardena, 2001
	Mixed infection of WSD and YHD	68% and 70% drop in shrimp exports in terms of quantity and value in 1998	Siriwardena, 2001
1999			
Ecuador	WSD	US$ 280.5 in 1999 equivalent to 63 000 mt; closing of hatchery operations; 13% laying off of labor force (26 000 people); 68% reduction in sales and production of feed mills and packing plants	Alday de Graindorge and Griffith, 2001
Honduras	WSD	13% reduction in labor force	Corrales *et al*., 2001
Nicaragua	WSD	5-10% survival rate	Drazba, 2001
Panama	WSD	US$ 40 M worth of export loss; closure of major hatcheries; loss of jobs (5000 people directly and indirectly involved in the industry)	Morales *et al*., 2001

Table 2. Examples of socio-economic and other impacts of diseases in finfish aquaculture in selected Asian countries.

Country	Disease/Pathogen	Losses and other impacts	Reference
1983-1993			
Thailand	Epizootic ulcerative syndrome	US$ 100 million	Chinabut, 1994
1989-1993			
Malaysia	***Diseases of cage-cultured grouper, snapper and seabass***	US$ 1.3 M in potential income - combined loss estimates of private sector and government farms	Wong and Leong, 1987 cited in Arthur and Ogawa, 1996
Thailand	***Seabass diseases***	US$ .8 M in 1989	ADB/NACA, 1991
Thailand	***Grouper diseases***	US$ 1.07 M in 1989	ADB/NACA, 1991
China	Bacterial diseases of fish (*Aeromonas hydrophila, Yersinia ruckeri* and *Vibrio fluvialis*)	> US$ 120 M annual losses between 1990-1992	Wei Qi, 2002
Thailand	Jaundice disease in catfish	US$4.3-21.3 M in 1992	Chinabut, 2002a
Malaysia	Vibriosis	US$ 7.4 M – outbreak in 1990	Shariff, 1995 cited in Arthur and Ogawa, 1996
Singapore	Grouper diseases	S$ 360 500 in 1993	Chua *et al*., 1993
1994-1998			
Japan	***Marine fish disease***	US$ 114.4 M	Arthur and Ogawa, 1996
1998-2002			
Thailand	*Alitropus typus*	US$ 234-468/cage culture of Tilapia in 1998-1999	Chinabut, 2002b
Philippines	Grouper diseases	75% reduction in household income, 19.4% increased debt (n=72)	Somga *et al*., 2002
Singapore	Grouper iridovirus	>50% mortality among Malabar grouper	Chang, 2001
China	Viral nervous necrosis (VNN)	100% mortality among 3 species of grouper	Zhang, 2001
Singapore		80 to 100% mortality among fry and fingerlings	Chang, 2001
Indonesia		100% mortality among larvae in national hatcheries in 1999-2000	Yuasa and Koersharyani, 2001
Indonesia	Suspected Koi herpes virus (KHV)	50 billion Rupiah	NACA, 2002

Marine and Freshwater Organisms (Turner 1988) of EIFAC[2]. There are also relevant articles included in the Code of Conduct for Responsible Fisheries (CCRF) of FAO[3] (FAO 1995), the Convention on Biological Diversity (CBD 1992) and WTO's[4]. Sanitary and Phytosanitary (SPS) Agreement (WTO 1994). Since present international protocols are not always practically applicable to the disease concerns of aquatic food production and trade in the Asia region, the need for effective health management protocols that focus on the species and disease problems of the region was recognized. A regional approach was considered the most appropriate, since many countries in the region share common social, economic, industrial, environmental, biological and geographical characteristics. A regionally adopted health management program will also facilitate trade and protect aquatic production and the environment upon which they depend from preventable disease incursions.

Development and Implementation of the 'Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals'and the 'Beijing Consensus and Implementation Strategy'

Between 1998-2002, FAO and NACA[5] together with 21 participating governments[6] through the government-designated National Coordinators on Health (NCs) with technical and financial assistance from regional and international organizations (*e.g.*, OIE, AAHRI[7], ACIAR[8], FHS-AFS[9]) and experts on aquatic animal health developed and implemented a Regional Programme on aquatic animal health management through FAO's Technical Cooperation Programme for a project (TCP/RAS 6714 and 9605) "Assistance for the responsible movement of live aquatic animals in Asia".

The 'Technical Guidelines', the first major output of the Regional Programme, contain a set of Guiding Principles on movement of living aquatic animals within and across national boundaries and proposes practical and effective strategies to minimize the risks of introduction, spread and establishment of trans-boundary aquatic animal diseases. Technical protocols on a number of health management measures (*e.g.*, disease diagnostics, health certification and quarantine, pathogens to be considered, surveillance and reporting, zoning, import risk analysis, contingency plan, institutional and policy frameworks, capacity building and implementation) are included. The 'Technical Guidelines' are accompanied by an Implementation Strategy, a Manual of Procedures (FAO/NACA 2001) and an Asia Diagnostic Guide to Aquatic Animal Diseases (Bondad-Reantaso *et al*., 2001).

The 'Technical Guidelines' are the first of a regional technical guidelines providing support to the implementation of the relevant provisions of FAO's CCRF, endorsed by the ASEAN Working Group on Fisheries as an ASEAN policy document and the ASEAN-SEAFDEC Millenium Conference "Fish for the People"; and supported by the APEC Fisheries Working Group through a number of aquaculture health projects.

Aquatic Animal Surveillance and Disease Reporting

The Asia-Pacific Quarterly Aquatic Animal Disease Reporting System (QAAD Asia-Pacific), established with the OIE Regional Representation for the Asia-Pacific to improve international disease reporting, is a second major output of the Regional Programme. Until last quarter of 2002, 17 quarterly issues were published (see for example NACA/FAO, 1999; OIE, 2000), and the reporting system is continuing with good progress, long-term financial assistance granted by the NACA member governments, and technically supported by the Asia Regional Advisory Group on Aquatic Animal Health (AG) and NACA Secretariat. As a result, a clearer, progressive health profile for diseases important to the Asian region is emerging which represents important building blocks of information required for instituting

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[5] Network of Aquaculture Centres in Asia-Pacific
[6] Australia, Bangladesh, Cambodia, China PR, DPR Korea, Hong Kong SAR China, India, Indonesia, Iran, Japan, Korea RO, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, and Vietnam.
[7] Aquatic Animal Health Research Institute
[8] Australian Centre for International Agriculture Research
[9] Fish Health Section of the Asian Fisheries Society

control and eradication as well as early warning, risk assessment, contingency plans and emergency preparedness programs for aquatic animal diseases and epizootics. Surveillance and reporting systems serve as a 'value added' label to aquaculture and fisheries products, as they reflect a country's commitment and ability to collect and provide documented information and evidence on the health, origin and quality of each commodity. Countries with a sound aquatic animal health infrastructure and a demonstrated record of surveillance, containment and disease control programs provide them a significant trade benefit.

ACIAR recently published a surveillance toolbox for aquatic animal diseases, a practical manual and software package that is valuable in collecting reliable, high quality information about aquatic animal diseases using rapid, inexpensive techniques suitable for developing countries (Cameron, 2002).

NATIONAL STRATEGY ON AQUATIC ANIMAL HEALTH AND EXAMPLES

National strategies on aquatic animal health management, a third major output of the Regional Programme, provide a framework for the national level implementation of the 'Technical Guidelines', and contain the action plans of government at the short, medium and long term, following the concept of "phased implementation based on national needs". Participating countries of the Regional Programme are at different stages of development of the National Strategy. Australia's five-year national strategic plan for aquatic animal health, "AQUAPLAN", was already in place prior to the implementation of the Regional Programme (AFFA, 1999). It comprises eight key program under which Australia's government and private sectors have identified priority projects to achieve the program objectives (AFFA 1999). These are: (a) international linkages, (b) quarantine, (c) surveillance, monitoring and reporting, (d) preparedness and response, (e) awareness, (f) research and development, (g) legislation, policies and jurisdiction, and (h) resources and funding. Under the program, the following documents have been released: (a) Australian Aquatic Animal Disease Identification Field Guide (March 2000); (b) AQUAPLAN Zoning Policy Guidelines (August 2000, January 2001)); (c) AQUAVETPLAN Enterprise Manual (December 2000); and (d) AQUAVETPLAN Furunculosis Disease Strategy Manual (June 2001).

Other countries such as Hong Kong SAR and Singapore also have existing national strategies in place. These countries were provided an opportunity to further strengthen their national strategies according to the various regional activities and new aquatic animal health concepts introduced under the Regional Programme. Other countries such as India, Indonesia, Myanmar, Nepal, Philippines, Thailand and Vietnam conducted national level consultations with relevant government agencies involved in aquatic animal health management, as a first step in the process building on the resources available for its development and implementation. Priority setting based on a comprehensive assessment of the needs for aquatic animal health management is the first essential step. There are, of course, costs involved and although opportunities exist to seek funding and technical assistance from donor agencies, the primary responsibility of finalising the National Strategy and identifying and allocating resources rests within the responsible authorities. Political will is essential.

AQUATIC ANIMAL PATHOGEN AND QUARANTINE INFORMATION SYSTEM

The Aquatic Animal Pathogen and Quarantine Information System (AAPQIS), a fourth major output of the Regional Program, was aimed to (a) provide a mechanism for assessing information on aquatic animal pathogens and diseases, with tools to help map, track and cross-reference literature at the regional level to support government's disease control programs, and (b) to serve as information resources for risk analysis as well as reference information for aquatic animal disease diagnosticians and researchers. The information contained in the information database are derived from scientific literature by a team of established experts in different fields of aquatic animal health. AAPQIS has now become FAO's self-sustained and self-improved information system on aquatic animal health and is currently undergoing revision and improvement using state-of-the-art technology. AAPQIS in Latin America, Mediterranean, Africa and North America are currently being developed.

ESTABLISHMENT OF THE ASIA REGIONAL ADVISORY GROUP ON AQUATIC ANIMAL HEALTH

The Regional Advisory Group on Aquatic Animal Health (AG), one of the major recommendations in the Beijing Consensus and Implementation Strategy, was formalized in 2001. The AG, representing an official group of experts on aquatic animal health, institutionalized and financed by the national governments, under NACA's inter-governmental framework, meets annually to provide high level technical advice to NACA for better health management in the region. Through the AG and its activities, formal technical assistance and advice are now provided by FAO, NACA and OIE to Asian governments, in the implementation of the 'Technical Guidelines'.

CAPACITY AND AWARENESS BUILDING

Subasinghe *et al*. (2001) identified communication as a key strategy for an effective health management programme. This is based on a continuum of open communication and multidirectional information exchange and interaction/feedback at all levels of aquaculture activity, from the production stock to the international level. This strategy, achieved through the various capacity and awareness building activities, is one area that will continue to support efforts at providing resolutions to aquatic animal health problems in the region. Described below are some further updates of on-going activities to build and improve capacity concerning concepts/approaches that are recently being applied in aquatic animal health management.

Aquatic animal epidemiology

This is a new concept introduced into the region in 1996 through a training course (ACIAR Masterclass on Aquatic Animal Epidemiology) for a select group of senior aquatic animal health specialists. Epidemiology is now being applied in the disease reporting system and integrated in various research investigations and diagnostics (Lilley *et al*., 1998; Corsin *et al*., 2001; Morgan, 2001; Mohan *et al*., 2002). Most recently, epidemiology was one of the key approaches used in the emergency investigation of a serious disease outbreak of koi and common carps in Indonesia. There will be more demand for aquatic animal epidemiologists in the region and the use of epidemiology will significantly improve health management, risk analysis and disease control.

Risk analysis in aquatic animal movement

MacDiarmid (1997) defined 'risk analysis' as a tool intended to provide decision-makers with an objective, repeatable and documented assessment of the risks posed by a particular course of action. It is intended to answer the following questions: what can go wrong?, how likely is it to go wrong?, what would be the consequence of its going wrong?, what can be done to reduce either the likelihood or the consequence of its going wrong?

Import risk analysis (IRA) is the process by which importing authorities determine whether live aquatic animal imports or their products (*e.g.* genetic material, feed stuff, biological products, pathological material) pose a threat to the aquatic resources of their country. The process identifies the hazards associated with the movement of a particular commodity and mitigative options assessed; the results of the analyses are communicated to the authorities responsible for approving or rejecting the import. IRA is usually undertaken by the Competent Authority (CA) for the importing country; IRAs can, nonetheless, range from an individual farmer analyzing and assessing the risks associated with a potential, specific importation, to a full range IRA carried out by a multidisciplinary team (FAO/NACA, 2001). It is systematic, iterative, transparent, science-based and the process involves four major steps: (a) hazard identification, (b) risk assessment, (c) risk management; and (d) risk communication - a step that takes place throughout the entire IRA process.

To comply with WTO-SPS obligations, governments are encouraged to implement import/export decisions based on international standards or using science-based IRAs. Due to practical difficulties in interpreting the provisions in the SPS Agreement, it is important that countries, at the first instance, familiarize, understand and embrace the concept first and not be discouraged by the expected intricacy of the process (FAO/NACA, 2001). Countries will be confronted with a range of conditions and scenarios when conducting an IRA and regulations will vary from country to country. For developing countries, the greatest struggle will be information (both quantity and quality), capacity of staff, disease surveillance to demonstrate country/regional freedom from specific disease agents, legislation and decisions for determining what constitutes "acceptable risks".

Since 1997, when the EAFP[10] organized, at its 8th EAFP Conference, the EAFP Risk Assessment in Aquaculture, there followed activities all aimed at better understanding and gaining skills in conducting IRAs for aquatic animal health. These include the (a) OIE International Conference on Risk Analysis in Aquatic Animal Health (OIE, 2001); and the (b) APEC FWG 01/2002 "Capacity and Awareness Building on Import Risk Analysis (IRA) for Aquatic Animals". The latter which involved two regional workshops (First Workshop, 23 governments, 1-6 April 2002, Bangkok, Thailand; Second Workshop, 20 governments, 12-17 August 2002, Mazatlan, Mexico) that brought together policy makers, administrators, aquatic animal health scientists and private sector representatives in order to build awareness and capacity to understand and undertake risk analysis for aquatic animals at national and

[10] European Association of Fish Pathology

regional levels. This Project will (a) produce a Manual on IRA for Aquatic Animals to provide guidance to economies and governments in conducting IRAs for the international trade of aquatic animals; (b) establish a network of people with skills and capacities on IRAs for increased contacts between individuals and governments in undertaking improved biosecurity measures in the international trade of aquatic animals;; and (c) improve capacity in surveillance, monitoring and reporting of aquatic animal diseases and contingency plans for emergency disease situations.

Diagnostics

Because of the scale of resource expertise and infrastructure required (*e.g.*, training, facilities) for disease diagnostics, FAO/NACA (2000) recommends the use of three levels of diagnostics (Levels I, II, and III) which have broad-scale application to disease detection and diagnostics. Countries are encouraged to move from one level to the next as capacities are improved and as resources become available.

Recently, molecular-based technologies (Level III diagnosis) are advancing rapidly. These tools include both immunoassays and DNA-based methods (*e.g.* fluorescent anti-body tests, enzyme-linked immunosorbent assays, radio-immunoassay, *in-situ* hybridization, dot blot hybridization and polymerase chain reaction). Walker and Subasinghe (2000) reviewed their use in disease diagnosis and pathogen detection and evaluated the research needs for their standardization and validation. While these tools provide quick results, with high sensitivity and specificity, and are particularly valuable for infections which are difficult to detect using standard histology and tissue-culture techniques, they have limitations in terms of appropriate applications, standardized sampling, testing procedures and interpretation of results (Walker and Subasinghe, 2000). Such techniques are also of narrow value to newly emerging diseases where the causative agent is unknown ñ in which case - histology, a non-specific general technique, is still the most appropriate method to accurately interpret pathology that will focus on the potential causative agent/s. While further development of these technologies will no doubt enhance rapid detection and diagnosis of disease crucial for early and effective disease control, there will be practical problems in their applications. A case example is the prevalent use of PCR in shrimp disease diagnostics. There are good evidence that PCR is a highly effective method and if appropriately applied for viral screening of broodstock and post-larvae and with good farming practices, the risk of disease occurrence and crop failure can be reduced. However, various factors (*e.g.*, high level of technical skills required to use PCR techniques; the wide range of tests available with varying target sites and sensitivities; misconception about PCR solving shrimp disease problems; and the current trend of using the technology for field kit use by non-specialists) have lead to difficulty in interpretation of results and farmer confusion. Current efforts in Asia-Pacific are geared towards (a) standardizing procedures for sample preparation, storage, extraction and analysis; (b) uniform training for technicians; (c) inter-calibration exercise for laboratories; and (d) continuing farmer education on disease prevention and good farm and health management.

Molluscan health management

While finfish and shrimp disease diagnostic capacities in the region are advancing rapidly, efforts at capacity building on molluscan health management in the region started only in 1999. Through financial support from FAO, technical coordination of NACA, and expert assistance from various institutions/organizations[11], the Asia-Pacific Molluscan Health Management Program was launched in 1999. The Program consists of three Phases (Phase I - 1999, II - 2002 and III - 2004) and is aimed at building capacity on molluscan health. At the end of the Program, we will expect: (a) a small group of Asian scientists trained on molluscan health management (Levels I, II and III); (b) an accurate picture of molluscan disease situation based on extensive country surveys; (c) an electronic mail based discussion group and extensive network of molluscan health specialist in the region supported by global experts; and (d) an institutional depository of molluscan disease resource materials and resource centers on molluscan health.

Emergency response to disease outbreaks

A recent regional experience in responding to an emergency disease situation is that of a suspected case of KHV incursion in Indonesia in June 2002. Within a two week period after receiving a formal request for assistance from the Government of Indonesia, NACA mobilised its resources, called for assistance from its network of partners and individual experts and coordinated and formed an Emergency Task Force. An international task force of 3 members (an epidemiologist, a virologist and aquatic animal health specialist) was immediately deployed to Indonesia and together with a local task of Indonesia's Department of Marine Affairs and Fisheries, conducted an investigation of the outbreak through field observations (*i.e.*, field visits, local/district officials and farmer interviews) and laboratory examinations (*e.g.*, histopathology, virology, PCR, and electron microscopy supported by number of laboratories[12]) of collected samples. The general direction of the Task Force investigation was to determine the possible involvement of KHV (Ariav *et al*., 1999, Hedrick *et al*., 2002), a disease whose characteristics were found to be similar to the current disease epizootic. The Task Force findings revealed that an infectious agent/s is involved in the outbreak (from epidemiological observations of sudden onset, rapid spread, specificity to koi and common carp, analogy with KHV outbreaks), that the disease was introduced to Indonesia through fish importation and spread into other areas through fish movements. As KHV was detected through PCR from all case samples, KHV might have played a role in the observed mortalities. Other agents may also be well involved such as parasites, bacteria (based on pathology report) and other environmental factors. The Government of Indonesia was advised to temporarily restrict the movement of koi and common carps through a Ministerial Circular which took effect in July 2002. An intensive information dissemination was also undertaken to raise awareness and inform the public sector about relevant information, including risks to human health, available at that time. The Government of

[11] Technical support provided by SEAFDEC-AQD, OIE, IFREMER-France, DFO-Canada, NIWA/MAFF-New Zealand, Australia's AFFA, University of Queensland, University of Tasmania, Queensland Museum and Darwin's DPIE, Korea's Cheju University and Maryland Department of Natural Resources – Cooperative Oxford Laboratory.

[12] Institute of Aquaculture, University of Stirling, Scotland, U.K.; University of California (Davis), U.S.A.; AAHRI, Thailand; Intervet, Singapore and Netherlands

Indonesia was also advised to report the matter to OIE and a report was immediately sent to OIE in 26 June 2002. A positive outcome of this epizootic is the approval of an emergency assistance to the Government of Indonesia through a Technical Cooperation Project "Health Management in Freshwater Aquaculture" funded by FAO to further assist Indonesia in finding resolution to this emergency situation.

The experience in this recent epizootic provided some valuable insights: (a) the importance of regional and international cooperation; (b) the need to increase awareness on emerging diseases in other parts of the globe and the possibility of it's spreading to the Asian region; (c) the need to improve diagnostic capabilities at both national and regional levels; (d) pro-active reporting of serious disease outbreaks as a mechanism for early warning; (e) the need to have contingency plans both and national and regional levels; (f) the need to improve compliance and implementation of policies reached at regional and international levels; (g) emergency preparedness as a core function of government services; and (h) financial planning towards immediate provision of funds for emergency disease situations be seriously considered both at national and regional levels.

Conclusions

The current strategy in Asia-Pacific emphasizes responsible health management to minimize the risks of disease incursions brought about by movement of live aquatic animals and their products. The ëTechnical Guidelines' provide valuable guidance for national and regional efforts in reducing these risks and a strong platform for mutual cooperation at national, regional and international levels. The strong technical and political support from regional, inter-governmental and global organizations such as AAHRI, ACIAR, APEC, ASEAN, FAO, FHS/AFS, NACA, OIE and SEAFDEC, and shared commitment from national governments, are all positive signs.

Countries intending to import live aquatic animals are bound to abide by a number of international agreements and other relevant regional guidelines. Improved compliance is necessary. Aquaculture suffered enormous losses and there are now important lessons learned from the past. The sector will continue to intensify and this will based heavily on movement of live aquatic animals and its products. Trade is important and will continue because it is a necessity for aquaculture development at both subsistence and commercial levels. Intensified trade will, however, also foster increased global exposure to disease agents, the impacts of which may be irreversible. On the other hand, strict or excessive controls will also lead to trade underground. Despite the various activities and advocacies done both at national and regional levels, the region is still facing continuous disease incursions. The risks of major disease incursion and newly emerging diseases will continue to threaten the sector, and unless appropriate health management measures are continuously put in place and implemented, the government and private sectors will be faced with more costs in terms of production losses, and efforts to contain and eradicate them than would have spent in preventing their entries into the system. There is no clear cut strategy - strong political will and national commitment from responsible administration, intensified regional and global cooperation and pro-active involvement, effective cooperation and strategic networking between governments, farmers/industry, researchers, scientists, experts, development and aid agencies, and relevant stakeholders at all levels towards harmonizing aquatic animal health management measures and promoting responsible trans-boundary movement of aquatic animals and products will reduce the risks. Health management is a shared responsibility and each stakeholder's contribution is essential to the health management process.

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