Improving Aquatic Animal Health in Asia

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ABSTRACT

During the last two decades Asian aquaculture has expanded, diversified, intensified and advanced technologically. Its growth and contribution to national economic and social goals are expected to continue provided enabling environments for sustainable development are established. Bitter experiences and substantial economic losses have demonstrated that good health management is a key to success in aquaculture. Prevention and control of disease, avoidance of introductions and transfers of pathogens, development and adoption of better farm management practices, capacity building and targeted research are all vital components of good health management. Although progress has been made in Asia, much remains to be done to achieve adequate capacity in aquatic health management. The rapid growth of the aquaculture sector increases the risk to unsustainable development, thus there is an urgency for achieving necessary management capacity. Globalization and liberalization of international trade will also require adherence to international health guidelines and standards if Asian aquaculture is to maintain or increase its share of international markets. Increased consumer awareness of food quality and safety, animal welfare and environmental issues will also exert pressure in local and regional markets. These are some of the issues that need to be addressed. The development and implementation of integrated, practical health management strategies to this end, including appropriate regulatory frameworks and enforceable laws, will only be possible with relevant national policy and appropriate institutional arrangements. The scientific community must continue to provide the necessary knowledge-base through targeted research and dissemination of information; however, ensuring institutional, financial and human capital will continue to depend on political will.

INTRODUCTION

According to the most recent statistics (FAO, 2003), aquaculture's contribution to global supplies of fish, crustaceans and molluscs continues to grow, increasing from 3.9% of total production by weight in 1970 to 27.3% in 2000. Aquaculture is growing more rapidly than all other animal food producing sectors. Worldwide, the sector has increased at an average compounded rate of 9.2% per year since 1970, compared with only 1.4% for capture fisheries and 2.8% for terrestrial farmed meat production systems. The growth of inland water aquaculture production has been particularly strong in China, where it averaged 11.5% per year between 1970 and 2000 compared with 7.0% per year in the rest of the world over the same period. Mariculture production in China increased at an average annual rate of 14% compared with 5.4% in the rest of the world.

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In 2000, reported total aquaculture production (including aquatic plants) was 45.7 million metric tonnes (mmt) by weight and US$ 56.5 billion by value. China was reported to have produced 71% of the total volume and 49.8% of the total value of aquaculture production. More than half of the total world aquaculture production in 2000 was finfish, and the growth of the major species groups continues to be rapid, with no apparent slowdown in production to date. World aquatic plant production was 10.1 mmt (US$ 5.6 billion), of which 7.9 mmt (US$ 4.0 billion) originated from China. Other Asian countries that are major aquaculture producers include Bangladesh, India, Indonesia, Japan, the Philippines and the Republic of Korea (FAO, 2003).

In contrast to terrestrial farming systems, where the bulk of global production is based on a limited number of animal and plant species, more than 210 different farmed aquatic animal and plant species were reported in 2000. This great diversity reflects the large number of aquatic species that are readily adaptable to the wide range of production systems and conditions present in the different countries and regions of the world. It should also be noted that the number of species farmed is probably considerably higher than reported, as more than 9.7 mmt (21.2%) of global aquaculture production was not reported at the species level in 2000. This "unspecified" group is likely to include species that have not yet been recorded individually as being cultured.

In 2000, more than half of global aquaculture production originated from marine or brackish coastal waters. The mean annual growth rate (for the period 1970-2000) was, however, highest for freshwater aquaculture production. Although brackish water production represented only 4.6% of total global aquaculture production by weight in 2000, it comprised 15.7% of total production by value. The main species groups reared in fresh water were finfish. High-value crustaceans and finfish predominate in brackish water, and molluscs and aquatic plants in marine environments (FAO, 2003).

During the past three decades, aquaculture has expanded, diversified, intensified and made technological advances. The potential of this development to enhance local food security, alleviate poverty and improve rural livelihoods has been well recognized. The Bangkok Declaration and Strategy (see Subasinghe *et al*., 2001) emphasizes the need for the aquaculture sector to continue development towards its full potential, making a net contribution to global food availability, domestic food security, economic growth, trade and improved living standards.

Disease is now recognized as a primary constraint to sustainable aquaculture and responsible for severely impeding both economic and socio-economic development of many countries of the world. The shrimp aquaculture sector, in particular, suffered losses estimated at US$ 3019 million, on a global scale, affecting major shrimp producing countries such as Bangladesh, China, India, Indonesia, Ecuador, Mexico, Philippines, Taiwan Province of China, Thailand and Vietnam (Israngkura and Sae-Hae, 2002). Establishing appropriate policies and regulatory frameworks on aquatic animal health, developing technical guidelines for the safe trans-boundary movement of live aquatic animals, awareness and capacity building on health management (national and regional levels), improved compliance to regional/international treaties and obligations and robust regional/international cooperation are recent strategies to minimize the risks of disease incursions in Asian region (FAO/NACA, 2000; 2001). Enhanced support to these on-going strategies is necessary.

Aquaculture is also facing a serious image problem, due to the negative picture caused by a number of well-publicized cases (e.g., mangrove destruction by commercial shrimp farms, escapes of cage cultured fish, residues of banned chemicals in shellfish, build-up of pathogens affecting wild stocks of Pacific salmonids, etc.). New and better solutions are required to reduce the harmful impacts, both real and theoretical, of aquaculture and to build a more positive public image of the industry as an economically and environmentally sustainable, as well as socially responsible endeavor.

THE CHALLENGES TO AQUACULTURE IN THE THIRD MILLENNIUM

At the recent Conference on Aquaculture in the Third Millennium, held in Bangkok in February 2000 (Subasinghe *et al*., 2001b), many of the world's experts met to review the past, present and future status of world aquaculture. They also held in-depth discussions on their experiences in the sector and sought to develop ideas on how to reach the desired goals for the future of aquaculture and ways that aquaculturists and government policy makers might find the inspiration to achieve this potential.

The challenges facing aquaculture development were aptly summarized by Jia *et al*. (2001), "...The challenge is to develop approaches, which are realistic and achievable, within the context of current social, economic, environmental and political circumstances. Such approaches should not focus only on increasing production; they should also focus on producing a product, which is ***affordable, acceptable*** and ***accessible*** to all sectors of society."

The affordability of aquaculture products depends on a wide range of factors, many of which are country or regionally specific. They include such variables as the cultured species, production cost, target market and market access. Affordability of a given aquaculture product to a particular segment of society is often as much a political problem (related to socio-economics and income level), as it is a scientific problem (related to finding technical solutions to lower the cost of production so that aquaculture products become affordable to a wider segment of society). Providing guidance to aquaculture development to derive maximum socio-economic benefits and provide an affordable source of protein to as many people as possible must be dealt with at the national and international levels.

Aquaculture products must also be acceptable to the consumer, in terms of both the actual and perceived quality and safety of the product. Increasingly, consumers also require that the aquaculture products must be produced using methods that are environmentally friendly, socially responsible and economically sustainable. The consumer's perception of issues such as aquaculture's contribution to increased social equity, food security and poverty alleviation will thus become increasingly important if the industry is to achieve its full potential.

The public's perception that aquaculture products may be of lower quality and/or unhealthy to consumers relative to wild-caught products arises from the occasional well-publicized cases involving the irresponsible use of drugs and chemicals (see Subasinghe *et al*., 2000; Subasinghe, 2003), and the possible generation of environmental contaminants by aquaculture facilities. Problems related to the presence of chemical residues above the maximum residue levels (MRLs) and of detectable amounts of prohibited drugs in aquaculture products will continue to plague the industry and weaken consumer confidence

unless it is addressed firmly and on a united front. Importing countries will continue to enact more stringent regulations as lobby groups and the general public continue to demand improvements to the sector, including increasingly responsible use of drugs and chemicals. In developing countries, where consumer awareness of food safety and environmental issues have been relatively slow to develop, these topics will become increasingly important as living standards and general awareness rise.

The responsible use of chemicals and drugs, including a general reduction in situations where their use is necessary, can be achieved through adopting better management practices (BMPs), including adherence to good sites, good water, quality seed, quality feed, better husbandry and effective health management.

Pathogens are often a significant constraint to aquaculture production (see Subasinghe, Bondad-Reantaso and McGladdery, 2001a). We should endeavor to keep pathogens out of aquaculture facilities by reducing reliance on external resources so that introduction into aquaculture facilities of fry and broodstock of unknown or questionable health status is reduced or eliminated. Movement of live aquatic animals and their products must be done in a more responsible matter, following internationally accepted protocols, such as those specified by the World Animal Health Organisation (or Office International des Épizooties, OIE). Increased biosecurity measures, including quarantine, health certification and inspection are required at all levels. Knowledge of the precise health status of shipments of live aquatic animals, whether destined for international trade or only for transfer between adjacent farm sites, will be required. To maintain international markets and prevent major losses in cultured and wild stocks, the ability to react quickly and effectively to potentially serious disease outbreaks will be essential. This will involve implementing surveillance and monitoring programs, developing disease zones (infected and disease-free), and establishing contingency plans and disinfection protocols to deal with disease outbreaks.

In cases where serious pathogens have become enzootic in aquaculture production areas, we should develop ways to achieve good production levels in the presence of such pathogens. This will include developing environmentally friendly methods for disease control and prevention such as vaccines and other alternatives to veterinary drugs; increasing the use of bioremediation measures, probiotics and immunostimulants; producing improved feeds and adopting better management practices and in particular developing disease resistance strains to such enzootic pathogens.

To achieve these goals, it will be necessary to improve consultation and dialogue with and among farmers. This can be accomplished by forming and promoting industry organizations and fish-farmer societies. Such organizations can promote responsible aquaculture practices through the establishment of BMPs and adoption of Codes of Conduct.

Government and the private sectors need to work together to develop innovative approaches to solving industry problems. Examples include developing resource and problem-based cluster management practices within broader integrated coastal area management (ICAM) schemes; exploring opportunities for certifying and labeling aquaculture products and production processes through developing appropriate science-based generic technical standards; and developing and implementing more appropriate and enforceable national policies and regulatory frameworks.

HEALTH MANAGEMENT IN ASIAN AQUACULTURE

Asian aquaculture has two main facets: small-scale, rural aquaculture and industrial, commercial aquaculture. Although these two sectors utilize different production practices and are carried out for different purposes, they often culture the same species of fish and shellfish and thus are often plagued by the same disease problems. Both sectors thus require sound health management practices, but different approaches are needed to implement them effectively.

In Asia, there are several important considerations for developing and implementing effective health management programs. Asian countries differ considerably in their socio-economic situations and cultural contexts. In most countries, small-scale farms and farming practices still dominate the sector, and will continue to do so in the foreseeable future. In such small-scale, rural situations, farmer understanding and awareness of health problems are often quite inadequate. Many countries in Asia don't have the required infrastructure or necessary human capacity to deal with serious disease situations. Thus, they are often unable to comply with relevant regional or international agreements and treaties, a situation that may lead to restricted access to international markets for their products. At present, many international protocols governing aquatic animal health management can't be effectively applied in Asia. Because of the extreme diversity of situations, many proven success stories from other parts of the world will not succeed in Asia unless the methods used are carefully adapted to regional and local circumstances.

The phased development of aquatic animal health management programs based on national needs, priorities and capacities is required. For small-scale, rural aquaculture, the overriding concern should be the quest for affordable food production and improved livelihoods. Therefore, for small-scale aquaculture, approaches should be more state-driven, with low technology and low-cost health management. Creating an enabling environment for the development of small-scale, rural aquaculture is the responsibility of the state.

For industrial, commercial-scale aquaculture, the governing factor is trade and access to international markets. Therefore, the approaches used should be private-sector driven, with high technology and, where necessary, moderate to high-cost health management. However, creating an enabling environment for commercial aquaculture to flourish is still the responsibility of the state.

THE WAY FORWARD

Technological Advances

Although small-scale, rural aquaculture and industrial, commercial-scale aquaculture often seem to have little in common, there is tremendous opportunity for linking low and high technology by using knowledge gained through molecular methods to develop low-cost disease control measures. Considerable progress has been made towards developing improved molecular diagnostic methods for serious aquatic animal pathogens, particularly those affecting shrimp and marine fish. However, we must also continue to pay attention to diagnostic methods such as histology, and continue to train additional expertise in this area. Polymerase chain reaction (PCR) technology is increasingly useful in the rapid diagnosis

of serious disease agents; however, its wider application requires efforts in validation, harmonization, inter-calibration and standardization (see, for example, Walker and Subasinghe, 2000). More molecular research, in conjunction with the application of epidemiological approaches to health management, should be used to improve existing knowledge on the infection biology of pathogens.

Because of the low individual values of most species of cultured molluscs and freshwater fish, the diseases affecting production of these organisms have received much less attention than those affecting higher priced commodities such as shrimp and marine cage-cultured fishes. Finding solutions to disease problems affecting the less attractive but more widely grown species (such as Indian major carps, Chinese carps, tilapias, etc.) will require increased attention.

Emerging disease problems, particularly in developing countries, are often slow to be recognized. Thus pathogens become widely spread, often globally, before the seriousness of their nature is recognized and reliable methods of detection, treatment and prevention are developed. Methods for detecting, reporting and responding much more quickly to such emerging diseases should be developed. An example of this problem is the recent epizootic of koi herpes virus (KHV) affecting koi and common carps (*Cyprinus carpio*) in Indonesia that have devastated carp production on the island of Java (see NACA/ACIAR, 2002).

Because of the serious risks to human and domestic animal health, the environment and market access posed by the overuse of antibiotics and other chemicals and drugs in aquaculture (see Subasinghe, 2003), further research into finding more environmentally friendly and less costly alternatives is urgently needed. This includes studies on the use of probiotics and immunostimulants, as well as on developing more systems-oriented approaches to aquaculture management to optimize growing conditions.

In the past, the commercial aquaculture industry has often been its own worst enemy, by spreading serious pathogens through the international and domestic movement of infected broodstock, fry and larvae. A more structured and science-based approach to introductions and transfers of aquatic species is necessary, including the use of science-based risk assessment procedures (import risk analysis, IRA) prior to the trans-boundary movement of live aquatic animals or their products (see, for example, Arthur and Bondad-Reantaso, 2004).

Biosecurity should be improved at all levels. At the international level, this includes the use of reliable health certificates, inspection by competent authorities, and where necessary, pre-border and/or post-border quarantine. The internationally recognized aquatic animal health standards (OIE, 2003) must continue to be more widely and effectively applied. At the farm level, individual aquaculturists can do much to increase the biosecurity of their facilities, and in doing so, increase the economic viability of their operations and those of their fellow aquaculturists (see Fegan *et al*., 2001).

The design and implementation of effective disease surveillance programs, early warning and reporting systems and contingency plans for dealing with serious disease outbreaks will help in reducing the social, economic and biological impacts of disease. The latter are needed at both the national and farm levels.

At the farm level, increased research into developing bioremediation and related husbandry management tools will help in adopting better management practices.

Genetics also has an important role to play in the future of aquaculture. Comprehensive genetic assessment of the populations from which broodstocks are derived is timely. Increased efforts towards domestication and development of disease resistant varieties of aquatic species need urgent attention. Advanced molecular genetics research, such as mapping of the shrimp genome, may result in long lasting solutions to some of today's crucial problems.

Capacity Building

Effective communication among all stakeholders is vital to better health management. Further emphasis on education, training and extension will assure the future sustainability of the sector. In this respect, professional societies have an important role to play.

The Role of the Private Sector

The private sector (farmers and service providers) has an important role to play in the development of national aquatic animal health management programs and effective Codes of Practice. Aquaculturists should participate in joint government/industry strategies for the improvement of aquaculture. They should also comply with legislation and regulatory frameworks developed to protect aquatic animal health, and assist government by providing the timely and accurate field information and observations necessary for early and effective disease control.

CONCLUSIONS

Asian aquaculture will continue to expand, diversify, intensify and advance technologically, increasing its contribution to national economic and social goals, provided that enabling environments for sustainable development are established. Past experience has shown that good health management is a key to success in aquaculture. Preventing and controlling disease, avoiding the international and domestic spread of pathogens, developing and adopting better farm management practices, capacity building and targeted research are all essential to good health management.

Although significant progress has been made towards achieving adequate capacity in aquatic health management in Asia, much remains to be done. Rapid growth increases the risk of unsustainable development, and thus achieving the necessary management capacity for aquaculture is an urgent priority. Globalization and liberalization of international trade will also require adherence to international health guidelines and standards if Asian aquaculture is to maintain or increase its share of international markets. Consumer awareness of food quality and safety, animal welfare and environmental issues will all exert increased pressure in local and regional markets. Appropriate regulatory frameworks and enforceable laws are also required.

The development and implementation of integrated, practical health management strategies to address these issues are only possible through establishment of relevant national policy and appropriate institutional arrangements. The scientific community must continue to provide the necessary knowledge base through targeted research and dissemination of information; however, ensuring institutional, financial and human capital will continue to depend on political will.

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