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Introduction to Exotics and Trans-Boundary Movement of Aquatic Organisms: Policy Requirements and Relevance to Indian Aquaculture in the Post-WTO Scenario

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Aquaculture is one of the fastest growing industries with an annual growth rate of more than 11 per cent for the past 10 years, producing about 16 per cent of the world supply of animal protein, primarily for human consumption. FAO (2007) has estimated the production from aquaculture at 47.8 million tonnes in 2005 and the global aquaculture production in comparison has overtaken the global production of meat from bovine, ovine, porcine and poultry. Global aquaculture production has jumped from a mere 3.9 per cent of the food produced in 1970 to an impressive 47 per cent in 2006, which indicates a 10 per cent per annum growth. The Indian aquaculture sector led by shrimp and carp farming has recorded an impressive growth during the past decades, raising itself to the status of an industry and a major source of foreign exchange to the country to the tune of @15000 crores/year. The strength of Indian aquaculture lies in (a) large water bodies suitable for aquaculture, (b) tropical Climate, (c) species diversity and (d) availability of cheap labour. While the weakness include (a) unregulated development, (b) disease problems and (c) lack of scientific approaches and (d) non-compliance with guidelines and regulations.

World over, mortality due to diseases or decreased growth rates and/or decreased feed efficiency due to infections are major factors responsible for economic losses in aquaculture. The development and expansion of aquaculture has, to a significant extent, depended on exotic or non-native species and of the 230 plus aquatic species farmed today, majority are non-native in nature. As aquaculture production expands, diversifies, and becomes more intensive, the risks and effects associated with pathogen introduction, transfer, disease outbreaks, and pathogen spread are bound to be enhanced (Subasinghe et al (2001).

Aquaculture in post WTO regime

Subsequent to the introduction of World Trade organization (WTO) rules and associated regulations in 1995, especially the Agreements on the Application of Sanitary and Phytosanitary Measures (SPS) and Technical Barriers to Trade (TBT) agreement much changes have been brought about in aquaculture sector. These agreements have liberated the international trade in aquaculture from various barriers/restrictions imposed by importing countries at the same time retaining the rights of the member countries to protect themselves from risks to human, animal or plant health through the introduction of exotics and pathogens.

Trans boundary movements and the role of exotics in aquaculture

An exotic species is a non-native plant or animal deliberately or accidentally introduced into a new habitat beyond their natural geographical range. Many of these species are able to reproduce and survive outside their natural habitats and integrate with the natural flora and fauna and are referred to as alien, introduced, invasive, non-native, or non-indigenous species. The most common routes for exotic species to arrive in aquatic habitats are through deliberate introduction for sport, aquaculture/ aquariculture activity or unintentional introductions (shipping, ballast waters, biofouling on ship/vessel hull, as live food, escapes or intentional release of pets/aquarium animals, cultured organisms and even from research facilities).

The economics of introductions

The interest and objectives behind the deliberate use of exotics is mostly commercial in nature. The commercial/economic reasons for species introductions in aquaculture include (a) cost-efficient species in terms of production costs to output revenues, (b) high growth potential, (c) resistance to environmental stressors and pathogens, (d) good market opportunities, (e) pre-existing knowledge of rearing methodologies/ technologies etc. Other reasons for the introduction of exotics are connected with trade of species for recreational reasons (stocking, sport fishing), ornamental (species for public and private aquaria), biocontrol, and research and social/religious reasons.

Impacts of introductions

Exotic species can have many negative impacts on the environment, economy and human health, and introductions, either intentional or accidental, carry the same risks. When species are introduced into an area, they may cause increased predation and competition, diseases, habitat destruction, genetic stock alterations, and even extinction (Bondad-Reantaso, 2004). Besides competing with the native species for food and other requirements, these exotic animals bring with them a variety of pathogens (sub-clinical infections/carriers) which may pose serious threats and even decline of the native populations. The risk of pathogen transfer is generally considered greater for the movement of live aquatic animals when compared to the movement of processed and dead products. Approximately 68 per cent of fish species lost in North America over the last century were caused by an invasion of exotic species. Besides, change in fishing patterns due to a newly-established fishery or through changes in land use and resource access can also lead to socio economic disturbances.

The expansion and diversification of aquaculture, coupled with globalisation and liberal trade policies in the wake of WTO policies, witnessed a rapid movement (both regulated and clandestine) of aquatic animals and animal products across the world. The sector has contributed to the introductions of many species of exotic fish, seaweeds and invertebrates. Approximately 17 per cent of the world's finfish production is due to alien species, introduced salmonids account for about 20 per cent of the world's farmed salmon in Chile while the production of the African cichlid tilapia is much higher in Asia (>700 000 tonnes) when compared to Africa (about 40000 tonnes). In Asia pacific, China has moved far ahead with the introduction of 129 aquatic species and the total production of introduced species increased from 780,000 tonnes in 1998 to 2.5 million tonnes in 2006 (FAO, 2010). Other examples of non-native species used in aquaculture include the rainbow trout (*Oncorhynchusmykiss*) which are farmed across the globe, Pacific oysters (*Crassostreagigas*) dominate shellfish production in Europe and many species of shrimp (e.g. *Penaeus vannamei*) are farmed outside their native ranges. Out of a total of 3141 new introductions recorded by FAO, 1386 (38.7 per cent) resulted from this activity (Bartley and Casal, 1998). The introduction of the brine shrimp, *Artemiafranciscana* as a larval feed into the Indian aquaculture facilities during the 1980s and its subsequent establishment in the Indian hypersaline habitats is a typical example of an exotic organism believed to have replaced a native species *(Artemiaparthenogenetica*) from its natural habitat. (Vikas et al, Vijayan& Syda Rao). Thus aquaculture has become a leading vector of aquatic invasive species worldwide and without proper care, the rapid expansion of this sector will result in the spread of even more pests.

Transboundary movements and diseases

In nature, various barriers (geographical, physical and biological) restrict the movement of animals from one region to another. Each species of animal and each geographic region are potentially associated with their own native pathogen populations which have evolved over years to adjust and adapt to their particular environments and more or less live in equilibrium with their natural hosts.But once they are allowed to cross over to another environment having different physico-chemical and biological components, they may behave in totally weird and unexpected ways. Many pathogens that probably cause sub-clinical disease in their native habitats alter their virulence and cause major disease outbreaks when they enters a new habitat, region or naive/susceptible host populations. Similarly, farmed/introduced fish can be exposed to native pathogens, leading to totally unexpected results. Further, practices like poly/mixed culture provide the opportunity for pathogens to jump across host barriers, infect and establish in new host species. FAO has defined Transboundary Animal Diseases (TAD) as *"Those that are of significant economic, trade and/or food security importance for a considerable number of countries; which can easily spread to other countries and reach epidemic proportions; and where control/ management, including exclusion, requires cooperation between several countries"* (Otte et al, 2004).Increased movements of people and goods have facilitated the emergence and spreading of many transboundary animal diseases – Bovine Spongiform Encephalitis (BSE) in cattle in Europe and Severe acute respiratory syndrome (SARS) in humans in East Asia being notable examples.

Transboundary Aquatic Animal Diseases (TAAD)

Translocation of aquatic animals has been frequently identified as an event that has preceded major outbreaks of a disease that was previously unknown in the affected region or species. Furunculosis in European trout, Whirling disease in US, Crayfish Plague in Europe, viral nervous necrosis (VNN) in marine fish, and many molluscan diseases are typical examples. Epizootoic Ulcerative Syndrome (EUS)epidemiccaused by the fungus, *Aphanomycesinvadans* in Asian freshwater and estuarine fishes has spread throughout Asia, Australia and has even reached the African continent. The recent outbreaks of Koi herpes virus (KHV), in the neighbouring South-East Asian countries is a cause of worry for India. The potential sources of introduction of a pathogen into the habitat include live fish, eggs, larvae, contaminated water, wrappings or packaging etc. Factors like pathogenicity, host-pathogen interactions, vectors, climatic conditions, susceptibility and resistance of the hosts etc. play an important role in deciding/modifying the outcome of pathogen introductions. Open aquatic farming systems favouring easy dispersal of the pathogens along with their ability for long-term survival outside the host further complicates the issue (Rodgers et al. 2011) The 230 plus, mostly non-native, aquatic species farmed, along with diverse culture systems and practices, may enhance the emergence and spread of transboundary pathogens in totally unpredictable ways. Rivers and water bodies shared by adjacent countries can also act as channels for pathogen transfer between countries.

White Spot Syndrome Virus (WSSV) an example

Outbreaks of WSSV, the most virulent virus known to affect cultured shrimps were first reported in *Penaeusjaponicus*in Taiwan and China in 1992.In 1993, it has spread to other species of shrimp and resulted in outbreaks in Japan and Korea. In 1994 it was reported from Thailand, India and Malaysia and by 1996 has spread over the entire Asian continent. In 1995, it was also reported in the USA, entered the central and South Americas in 1998 and Mexico in 1999. Entered Europe during 1995-2001, Iran in 2002 and Saudia

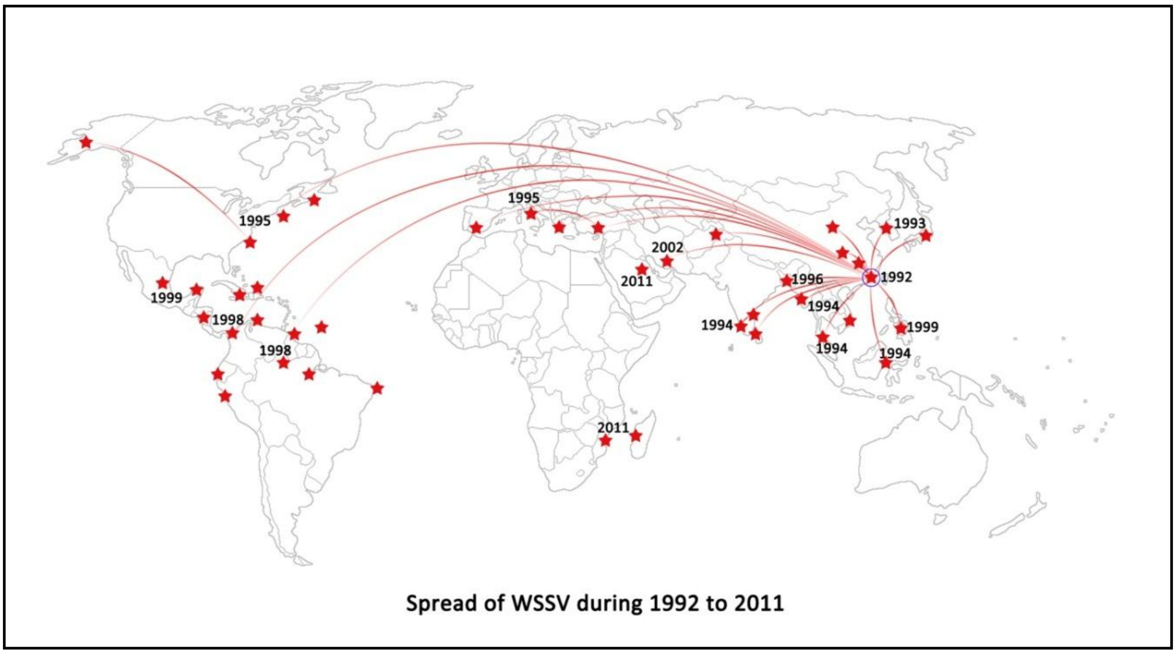


Fig 11.1 Spatial distribution of WSSV during 1992-2011

Arabia and Mozambique in 2011 (WAHID, 2012). Currently, WSSV is known to be present in all shrimp-growing regions except Australia. The practice of moving grossly normal brood stock and post larvae (PL) freely amongst countries was probably the most rapid and effective means of its spread throughout Asia (Flegel, 2006). Movement of frozen shrimp products from eastern to western hemisphere for trade and aquaculture has resulted in the transfer of WSSV from Asia to Americas, and Taura Syndrome Virus (TSV) from Americas to Asia (Lightner, 2005).

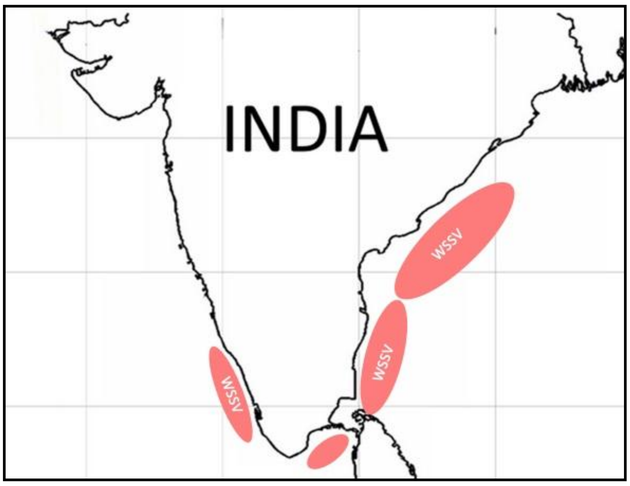


Figure 11.2 Post-WSSV shrimp farming in India

Carp and shrimp culture formed the face of Indian aquaculture and the predominant shrimp species cultured included *Penaeusmonodon* and *Penaeusindicus.* In the wake of the havoc created by the WSSV pandemic, the shrimp culture industry tried its level best to restore the production to the "previrus" years, but did not succeed. Movement of WSSV infected larvae (both knowingly and unknowingly) from infected regions to uninfected ones have accelerated the countrywide spread of the pathogen, a typical example of "biological magnification of pathogen". WSSV has now crossed species barriers, making almost all decapod crustaceans carriers, thereby widening the reservoir base. Even the brood stock collected from the wild cannot be assumed to be free of the virus. In this scenario, several farmers switched over to the culture of the giant freshwater prawn (*Macrobrachiumrosenberghii),* but white tail disease that emerged sooner resulted in heavy mortalities forcing the farmers to abandon freshwater prawn culture in many states. Efforts to make up the lost production resulted in the introduction of *Penaeus vannamei,* but the culture is presently threatened by the emerging infectious myonecrosis virus (IMNV) disease. Incidences of Early Mortality Syndrome (EMS) or Acute Hepatopancreatic Necrosis Syndrome (AHNS), another emerging disease of unknown etiology showing high mortalities in the early growout stages of both *P. vannamei* and *P. monodon* in many Southeast Asian countries indicate that the future of *P.vannamei* culture is also under threat (NACA 2012). All these examples indicate that as aquaculture develops, new species are cultured and new host-pathogen-environment interactions gets tested, biosecurity risks will go on increasing.

The economic fallout

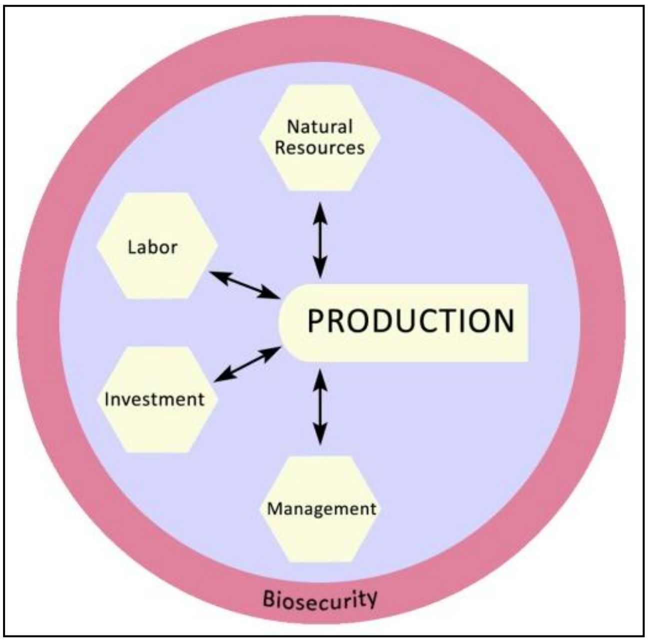
Very often, disease problems act as the major limiting factor in determining the economic viability in rearing systems including agriculture, animal husbandry and aquaculture. The damage due to diseases can be multifold, it includes direct losses to the farmer by way of loss of output, income and investment and indirect losses in terms of lost employment in the culture and associated/allied fields drop in foreign exchange earned etc. Combating diseases is a necessity for farmers. Though a farmer's decision to control the diseases or not is a private one, the presence of an infectious disease in a farm poses a threat to adjacent and even distant farms and can even affect other animal species and develop into an epidemic. This situation where high stakes are involved demand the intervention and action from public agencies or governments (Otte et al 2004). Transboundary diseases in aquatic systems have major economic implications (a) private and public costs of the outbreak (b) costs of the measures taken at individual, collective and international levels in order to prevent or control the infections and disease outbreaks.

Economic losses from aquatic animal diseases still remains a grey area and authentic information from many parts of the world is hard to obtain. The largest economic losses reported so far have been from shrimp farming and the figures given in Table 1, provide a rough indication. The total collapse of the Shrimp farming Industries in Taiwan in 1987, China in 1992, and India in 1995 were due to infectious viral diseases, causing billions of dollars in lost revenue for the industry. Between 1995 and 1996, disease accounted for 71 per cent of the total losses to trout farming in the U.S., part of a continuing trend of a $ 3.02 billion loss to aquaculture from disease worldwide (Leong, 2001). It was estimated that loss from diseases accounted for 30 per cent of the operating costs in aquaculture (Lee and Bullis, 2003).

Table 11.1 Estimated losses from aquatic animal diseases. Most losses are from the introduction and spread of crustacean diseases (from Scarfe,. 2003)

Area	Year	Estimated losses (US $ million)
Thailand	1983-93	100
China	1993	400
India	1994	17.60
Thailand	1996	600
Ecuador	1999	280
Global	1997	300

Lessons from the shrimp farming sector



The most important diseases of cultured penaeid shrimp, in terms of economic impact, in Asia, the Indo-Pacific, and the Americas have infectious etiologies. Since 1993, diseases, especially those of viral etiology have emerged as the major constraint to the sustainability and growth of shrimp aquaculture. The pandemics due to the penaeid viruses, WSSV (White spot), TSV (Taura Syndrome) and YHV (Yellow Head), have cost the penaeid shrimp industry billions of dollars in lost crops, jobs, and export revenue (Table 11.2). The global loss caused by WSSV in 2000 is estimated to be 200,000 metric tons, valued at $ 1 billion (Rosenberry, 2001). While Indian shrimp farming losses due to WSSV is estimated to be 200-300 crores annually, from 1994, with an accumulated loss of about 3000 crores during the last ten years (Vijayan, 2007). The WSSV epizootic has resulted in heavy production losses with a negative impact on different aspects of the production system. Production in any system is closely related to various inputs like natural resources, investment, trade, employment, environment and management costs etc. and whenever production fails, these related areas are also affected indirectly.

Fig.11.3 Different facets of shrimp production

Table11. 2 Estimated economic losses since the emergence of WSSV, TSV, YHV and IHHNV (Adapted from Lee and O'Bryen, 2003).

Virus	Year of emergence	Production loss
WSSV	Asia 1992	$ 4-6 billion
WSSV	Americas 1999	$ > 1 billion
TSV	1991-92, Americas & South East Asia	$ 1-2 billion
YHV	1991, South East Asia	$ 0.1-0.5 billion
IHHNV	1981, South East Asia	$ 0.5 1.0 billion

The practice of using species outside their natural range to increase production or profitability can be expected to continue, legally or illegally and the spread of aquatic animal diseases through these movements of animals and their products remains a serious issue. Though blocking the introduction of exotic species may seem to be an attractive option, in the present global scenario, production and economic reasons prevents a total ban on introductions. Introduction of exotics have become a "necessary evil" in aquaculture and the solution is not to ban introductions or to abandon regulation of their movement, but rather to assess the associated risks and benefits and then, if appropriate, develop and implement a plan for their responsible use.

Legislations – the present scenario

The majority of countries possess basic animal health legislation of different levels. In most countries, there is no clear distinction between terrestrial and aquatic animal health legislation. In cases where specific regulations for aquaculture exist, their enforcement is applied mostly as an emergency procedure to deal with a specific problem, and not as the result of an established program for surveillance and monitoring of the health status of cultured organisms. Several countries have specific legislations to regulate the import and export of live aquatic organisms and their products for use in aquaculture, for human consumption, or other purposes. Generally, these laws and regulations are in conformity with the rules of the World Organization for Animal Health (OIE) and WTO-SPS. (Kalaimani and Ponniah, 2007).

Role of International agreements and policies

Several procedures and guidelines developed by different agencies, organisations or nations deal with the components of biosecurity issues and strategies. The common objectives include aspects of protecting animal populations, environment, food and the humans itself. Many instruments falling under the terms such as policies, codes, agreements, plans, conventions, regulations and treaties has been made to achieve the objectives of biosecurity (Table 11.3).

Table 11.3 International or multinational policy instruments containing elements pertinent to aquaculture biosecurity. Dates are years of initial adoption (from Scarfe, 2003)

Lead Organization	Title
World Trade organization (WTO)	• Agreement on the application of Sanitary and Phytosanitary Measures (SPS Agreement), 1995 • Convention on Biological Diversity (CBD), 1992, and its Cartegena Protocol on Biosafety, 2000
Food and Agricultural Organization of the United Nations (FAO)	• Organization of the United Nations (FAO) • Codex Alimentarius (Codes of Hygienic Practice for the Products of Aquaculture), 1981-1999 • Code of Conduct for Responsible Fisheries, 1995 • Code of Conduct for the Import and Release of Exotic Biological Control Agents, 1995 • International Plant Protection Convention (IPPC), 1997 • International Council for the Exploration of the Sea (ICES)
International Council for the Explorations of the Sea (ICES)	• Code of Practice on Introduction and Transfer of Marine Organisms, 1994
International Maritime Organizations (IMO)	• Guidelines for Control and Management of Ships' ballast Water to Minimize the Transfer of Harmful Organisms and Pathogens, 1997
United Nations (UN)	• Biological Weapons and Toxins Convention, 1972
International Union for the Conservation of Nature	• Guide to Designing Legal and Institutional Frameworks on Alien Invasive Species, 1999

WTO and after

With the liberalization of international trade through the General Agreement on Tariffs and Trade (GATT), the establishment of the World Trade Organization (WTO) and its Agreement on the Application of Sanitary and Phytosanitary Measures(SPS Agreement), WTO member countries are required to use widely accepted scientific procedures including risk analysis as a means to justify any restrictions on international trade based on risks to human, animal or plant health (WTO 2012). The Uruguay Round (the eighth GATT round - 1986 to 1994) which transformed the GATT into the WTO and came into existence in 1995 with 123 signatories, was termed the biggest reform of the world's trading system since GATT was created at the end of the Second World War.

Two agreements negotiated during the Uruguay Round, having significant impacts on aquaculture and trade are The Agreement on the Application of Sanitary and Phytosanitary Measures - also known as the SPS Agreement which deals with food safety and animal and plant health standards andThe Technical Barriers to Trade Agreement (TBT) which ensure that regulations, standards, testing and certification procedures do not create unnecessary obstacles. Key SPS principles include Harmonization; Scientific risk assessment; Appropriate level of protection; Equivalence; and Transparency. Technical Barriers to Trade Agreement provides guidelines to ensure that standards are genuinely useful and not arbitrary or an excuse for protectionism in trade.

Exotics Vs biodiversity

Under the 1992 **Convention on Biological Diversity**under the United Nations Environment Programme (UNEP), signatory nations are committed to developing national strategies, plans or programs for the conservation and sustainable use of biological diversity (CBD 1992). While **The Cartagena Protocol on Biosafety**, a supplementary agreement to the CBD adopted in 2000, seeks to protect biodiversity from the potential risk posed by Genetically Modified Organisms (GMOs) (UNEP 2009).

World Organisation for Animal Health (*Office International des Epizootices*- OIE) and the Network of Aquaculture Centres in Asia-Pacific (NACA)

The OIE with 178 member Countries in 2011 is the intergovernmental organisation responsible for improving animal health worldwide. Issues regarding aquatic animal health are usually referred to the OIE, whose mission is to inform governments of the occurrence and course of diseases throughout the world and of ways to control these diseases, to co-ordinate studies devoted to the surveillance and control of animal disease, and to harmonize regulations for trade in animals and animal products among its member countries (OIE, 2012). World Animal Health Information Database (WAHID) interface provides access to all data held within OIE's World Animal Health Information System (WAHIS). It provides information on the country-wise animal health situation, complete information on various diseases, disease control measures, assessment of sanitary situation including potential trade hazards in various countries along with notifications and alerts on diseases. The OIE***Aquatic Animal Health Code***(OIE. 2011) sets the standard and outlines the necessary basic steps that should be followed. Similarly, guidelines for preventing accidental introductions and transfers of live aquatic organisms through ballast water of ships or on their hulls has been given by ICES, the International Maritime Organization (IMO) and others.

NACA is an intergovernmental organisation with 18 member countries in the Asia-Pacific aimed at promoting rural development in the region through sustainable aquaculture. NACA conducts development assistance projects throughout the region in partnership with governments, donor foundations, development agencies, universities and a range of non-government organisations and farmers (NACA 2012).

FAO Code of conduct for responsible fisheries (1995) sets out the principles and international standards of behaviour for responsible practices with a view to ensure effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. Article 9.3.3 while dealing with aquaculture development says that – "States should, in order to minimize risks of disease transfer and other adverse effects on wild and cultured stocks, encourage adoption of appropriate practices in the genetic improvement of broodstocks, the introduction of non-native species, and in the production, sale and transport of eggs, larvae or fry, broodstock or other live materials. States should facilitate the preparation and implementation of appropriate national codes of practice and procedures to this effect"(FAO, 1995).

ICES Code of Practices addresses the issues and concerns related to global translocation of species. The Code of Practice on the movement and translocation of non-native species for fisheries enhancement and mariculture purposes (1973) was subsequently revised/upgraded in 1979, 1990 and 1994. The present ICES Code of Practice on the 'Introductions and Transfers of Marine Organisms' 2005 (ICES, 2005) follows the precautionary approach adopted from the FAO principles (FAO, 1995), with the goal of reducing the spread of exotic species.

Biosecurity & HACCP

Biosecurity principles serve as the cornerstone in the implementation of SPS agreement and OIE guidelines and provide an overall management strategy for aquatic animal health. **HACCP (**Hazard Analysis and Critical Control Point) is a systematic and preventive mechanism presently used for the assurance of quality and food safety to the consumer. It functions as a preventive system which would require control over the raw materials, processes, environment, personnel, storage, and distribution early in the system. Presently HACCP plans are increasingly being applied in aquaculture rearing systems to ensure the quality and traceability right from the aquaculture produce to the processor and finally the consumer.

Rights and obligations under WTO

All these international agreements require that signatories should be aware of their rights and obligations and act responsibly when considering the international movement of aquatic organisms and their products and every member country is bound to abide by these agreements. The "zero risk" approach by prohibiting the total movement of aquatic animals and their products is no longer practicable in the current era of globalisation.

Importance of regional co-operation

Many countries in a region can share common social, economic, industrial, environmental, biological and geographical characteristics, and in this situation a regionally adopted health management programme is considered a practical approach. An Asia-Pacific Regional Strategy better known as "Asia Regional Technical Guidelines on Health Management for the Responsible Movement of Live Aquatic Animals" has been developed through an FAO/NACA initiative involving the participation and agreement of 21 regional countries (FAO/NACA. 2001; Subasinghe and Bondad-Reantaso, 2008). It outlines an agreed-upon general approach and framework that countries in the region should use in developing and implementing programmes to reduce the risk of pathogen spread via movements of live aquatic animals and their products. It contain a set of fifteen guiding principles pertaining to the movement of live aquatic animals, the role and scope of health management, importance of risk assessment, implementation of the guidelines, harmonization of procedures, transparency in reporting, technical cooperation, collaboration among all stakeholders and sharing of responsibilities and benefits. The regional Quarterly Aquatic Animal Disease (QAAD) reporting system, a joint activity between NACA, FAO and OIE, provides an excellent mechanism for sharing aquatic animal disease information between the participating countries in the Asia-Pacific region.

Similarly the European Union (EU) has a comprehensive programme for the region to assure health standards for aquatic animals traded between EU Member Countries. The Animal Health Law (AHL) proposed by the EU will provide rules for the movement of animals and products, requirements for their introduction into the Union, provisions for identification and registration of animals, traceability of germinal products, surveillance and other disease control measures, thereby bringing the animal health rules for terrestrial and aquatic animals under one roof (Europa 2012).

Strategies for aquatic animal health Management at national level

Each country should develop a national strategy which includes short, medium and long-term action plans, for the implementation of the guidelines. Strong national coordination, good leadership, involvement of stakeholders and appropriate monitoring and review systems are essential for its successful implementation (Subasinghe&Bondad-Reantaso 2006).

Legislation has an important role in enhancing responses to aquatic animal health emergencies. It should enable and guide those involved in fish health related activities and should clearly define the duties of various authorities involved at the national, provincial and district levels and promote effective coordination, power-sharing and communication between all those involved. Australia has developed and implemented a health management system (AQUAPLAN) which has successfully protected its waters from most of the disease epidemics which have created havoc in aquaculture world over and the country was able to translate its efforts into economic benefits.

Legislation with respect to the Indian Fisheries sector - Where do we stand now

According to the Indian constitution, the power to make laws and regulations with respect to fisheries is vested with the states and hence regulations and control of exotic organisms and diseases have to be enforced by the respective states. At the central level, the Indian Fisheries Act (1897) which is a century-old is still in existence. A draft legislation on "Live aquatic organisms importation Act 2006" has been proposed (Lakra*et al* 2006). Based on the existing international agreements and codes of practices for the trans-boundary movement of aquatic animals, the recommendations made in various consultations on invasiveness, disease diagnostics, risk analysis, emergency preparedness, capacity building etc., and existing legal provisions adopted by different countries, an act becomes inevitable to strictly implement the provisions needed in safeguarding the existing conservation and management of aquatic animal diseases and biodiversity in Indian fisheries (Kalaimani and Ponniah, 2007).

Way forward

What is required is an integrated plan for maintaining aquatic animal biosecurity and health, where all levels from border to the farm, including the environment need to be developed and implemented through a central – state mechanism. Such a working system would enable us to promote aquaculture in a sustainable and economically viable mode in tune with the international frame work.

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