

One Health – Integrating Aquatic Biosecurity into the Way Forward - A Natural Progression

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In the past decade, 60 percent of emerging infectious disease (EID) events are caused by zoonoses and of those, 72 percent originate from wildlife - a source of EIDs that has increased significantly over the past 50 years. Recent pathogens that have invaded human populations from wildlife sources include Nipah Virus, Severe Acute Respiratory Syndrome (SARS), West Nile Virus and Rift Valley Fever and at the same time, there are a series of important pathogens (Rinderpest, Foot and Mouth Disease, Swine Fever, Peste des Petits Ruminants) that are significant at the livestock-wildlife interface that can affect production, livelihoods, and conservation of wildlife species. Most recently, public and animal health emergencies caused by highly pathogenic avian influenza (HPAI) and pandemic influenza A (H1N1) have led to human sickness and death, and threatened livestock industries, food safety and security. These diseases are highly infectious in nature, and can potentially travel large distances rapidly. Moreover, they demonstrate the link between human, domestic animal and wildlife health, and underline the need for a broader understanding of the ecological settings which are creating the opportunity for these pathogens to emerge, re-emerge, or jump into new hosts.

A set of global factors, including demographic pressure, the availability, use and management of natural resources, climate

change, globalization, increased demand for protein by a growing global middle-income class, and intensification of farming systems and changes in farming practices highlight the two most important pathogen niches - changing natural ecosystems and changing farming ecosystems - where pathogens are evolving and adapting to new opportunities. Unraveling the complexity of these pathogen-host relationships, defining the epidemiology of transmission among livestock, wildlife and people within an ecological context, and identifying the drivers of disease emergence are the foundation of the “One Health” approach. Ultimately, the goal is to prevent disease emergence, or minimize impacts when they do emerge.

Driven by growing concerns about the epidemic nature of such diseases and their pandemic potential, FAO in collaboration with its international partners – the World Organisation for Animal Health (OIE), the World Health Organization (WHO), the United Nations System Influenza Coordination (UNSIC), the United Nations Children’s Fund (UNICEF) and the World Bank (WB) – developed a *Strategic Framework for Reducing Risks of Infectious Diseases at the Animal-Human-Ecosystems Interface* based on the concept of ‘One World, One Health’. This framework was presented and well-received at the inter-ministerial conference in Sharm El Sheik, Egypt in October 2008. It has been further discussed at a series of meetings organized by international agencies and their partners in order to operationalize the strategic framework; and furthermore, develop a coordinated global action plan to monitor pathogens transmissible from animals to humans and vice-versa. These agencies committed to further strengthen this collaboration during the Inter-Ministerial Conference on Animal and Pandemic Influenza (IMCAPI) in April 2010, in Hanoi, Viet Nam and are based on collaborative principles that facilitate the FAO/OIE/WHO Global Early Warning System (GLEWS), the FAO/OIE Network of Expertise on Animal Influenza (OFFLU), Global Framework for Transboundary Animal Diseases (GF-TADs), and Regional Animal Health Centres (RAHCs).

Most recently, within the Food Chain Crisis Management Framework – Animal Health, FAO has created a strategic document entitled “The FAO One Health Programme - A Comprehensive Approach to Health: People, Animals and the Environment.” The *Vision* is improved public and animal health, enhanced food safety and food security, improved livelihoods of poor smallholder farming communities, while protecting ecosystems and the *Goal* is to minimize the local and global impact of epidemics and pandemics caused by highly infectious human and animal diseases, by enhancing disease intelligence and emergency response systems at the national, regional and international levels, supported by strong and



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Integrated duck-fish farming, Viet Nam

stable veterinary and public health services, inter-sectoral collaboration, public-private partnerships, and effective communication strategies. While this strategy is heavily focused on animal diseases, it is clear that the future of “One Health” lies in the integration of multidisciplinary teams to contribute to the larger FAO vision of improving public and animal health, enhancing food safety and food security, and the livelihoods of poor smallholder farming communities, and conservation of natural resources through improved management and protection.

Contributing to One Health Goals by Improving Biosecurity Capacity in Aquaculture

Aquaculture’s importance as a source of protein food fish, livelihoods and foreign earnings is widely recognized. It bridges the gap between stagnating yields from many capture fisheries and an increasing demand for fish and fishery products. One of two food fish consumed in the world is farmed. Farmed or wild, fish is good for the health. One-sixth of humanity derive one-fourth of their animal protein from fish, giving them a wealth of health benefits. Recent estimates place a global aquaculture employment figure of over 23 M full-time employment (see pages 24-25); for every person employed in the primary sector, there could be four in the support services. It also offers opportunities to alleviate poverty, develop communities and reduce overexploitation of natural resources, thus creating social and generational equity, particularly in developing countries. From a production of 3 M tonnes during the 1970s, production in 2009 exceeded 50 M tonnes, placing aquaculture as the fastest growing food producing sector. While aquaculture offers a solution to many of the food security issues facing the growing human population, the sector is also in direct conflict with other users of the aquatic habitat and the adjacent coastal and riparian ecosystems, including economic, environmental and social interests. An effective and integrated way to manage the various business, environmental and social risks will be a necessity for its sustainable growth. These include both risks to the environment and society from aquaculture and to aquaculture from the environmental, social, and economic settings in which it operates¹.

A number of major biosecurity concerns affecting modern aquaculture² have important relevance and implications to the One Health programme. **Trans-boundary aquatic animal diseases (TAADs)** are now recognized as an important aquaculture sustainability issue where domestic and international trade, are considered as important pathways. If done in a haphazard manner, trade increases pathogen and disease introduction and spread to new areas, associated with host movements. Many examples

of pathogens exist, demonstrating different goals for aquatic animal movements involving different pathways – and thus, presenting different levels of risks of pathogen transfers. Three good examples are that of OIE-listed pathogens, e.g., epizootic ulcerative syndrome (EUS) affecting more than 50 species of fresh and brackish water finfish, white spot syndrome virus (WSSV) of shrimp, and koi herpesvirus (KHV) affecting the important food fish, common carp and the high value ornamental fish, koi carp. These pathogens affect both farmed and wild species, causing significant mortalities of up to 100 percent, now with wide geographic distribution and no possibility for treatment.

The **use of veterinary medicines in aquaculture**, while recognized as having important benefits to a wide range of applications in aquaculture (e.g. treatment of ongoing/emerging/re-emerging diseases, new species culture development, alternative to other failed preventative strategy, development of culture technology and animal welfare) also have limitations. Use of these substances/agents can lead to bacterial resistance, antimicrobial agent residues in products or run-off into natural ecosystems, potential transfer of resistance genes and possibility of these genes reaching human pathogens. In some cases, chemotherapy may trigger toxicity, and occasionally cause public health and environmental consequences. In addition, their efficacy under certain aquatic environments is questionable, both with regard to treatment goals and the potential cost of untargeted effects. There are also ongoing concerns on the perceived widespread and irresponsible use (e.g. use of banned products and misuse based on incorrect diagnosis) of antimicrobial agents in aquaculture, the lack of approved antimicrobial agents for certain aquaculture species and diseases, and significant variations in regulatory frameworks and enforcement in different countries.

These could have implications for the environment, ecosystem health, human food safety, and the development of antimicrobial resistance; and these can have further impact on free trade. Concurrently, the concern is likely to be higher when regulatory processes for aquatic veterinary medicinal products are not well developed (see also pages 46-47).

The **threat of biological invasions or bioinvasions**, one of the top five drivers of global biodiversity loss, is increasing due to tourism and globalization. Risks to aquaculture from both freshwater and marine bioinvasions from other sources (including other aquaculture operators) include pathogens, parasites, biofouling and harmful algal blooms. The global spread of many marine organisms by shipping has been one of the major biosecurity concerns during the last decade. Accidental widespread movements occurred internationally, from the hulls of large ships and vessels of all sizes. Ballast water may transport all groups of marine organisms, whereas hull fouling is by encrusting organisms, such as macro-algae, bivalve molluscs, barnacles, bryozoans, sponges and tunicates. The apparent transport of toxic algae in ballast water has had a profound effect on aquaculture activities because of the necessity of farm closures during blooms. Encrusting organisms may also introduce novel pathogens; however, their biggest impact is fouling of ports, coasts and aquaculture facilities. Invasive alien species are a multi-faceted problem in the importation and culture of aquatic species for commercial, recreational and hobby pursuits. Just as many intended introductions have had economically beneficial outcomes, a number of species introductions have contributed to ecosystem disruption from escapes and establishment of exotic species in the wild. In addition, environmental disturbances can also weaken aquatic ecosystems making them vulnerable to invasions.



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VAC system in Hai Dong Province in Viet Nam (VAC in Vietnamese language is *vuon, ao, chuong* which means garden/pond/livestock pen)

Salmonella contamination of aquaculture products, while accounting for less than 5 percent of food-borne salmonellosis, is still a major problem resulting in a large number of import rejections in some major markets. Human sewage is an important source of *Salmonella*; however, domestic and wild animals (e.g. birds, frogs, rodents and reptiles), may also bring in *Salmonella* into aquaculture systems. **Zoonotic aquatic pathogens**, e.g. liver fluke *Opisthorchis viverrini*, affect 10 million people in Thailand and Lao PDR alone. The parasite enters the aquaculture environment through fecal contamination of waters and even in areas where human infections are very rare; the parasite's life cycle can be maintained in fish eating animals such as cats, dogs and pigs.

Riparian and coastal ecosystems in which many aquaculture operations occur will be vulnerable to **climate change scenarios** such as sea level rise, increased incidence of storm surges and land-based run-offs, as well as extreme weather events resulting in flooding and drought and perturbations such as rise in sea temperature. Land-based run-off provides a mechanism by which nutrients, pollutants and pathogens are flushed into waterways and eventually end up in coastal ecosystems. Increased run-off can precipitate harmful algal blooms that can be toxic to invertebrates,

fish, birds, mammals and humans as well as increasing the emergence of water-borne diseases such as *Cryptosporidium* infection and cholera (*Vibrio cholerae*).

In the tropics, warmer global temperatures and rising water levels may mean increased evaporation that will increase coastal salinity, thus posing particular difficulty to coastal shrimp farming. Furthermore, climate change will lead to new habitat becoming available for species from tropical regions to move into historically sub-tropical regions. Such species movement has the potential to cause **range extension of diseases, especially of relatively non-host-specific pathogens**. This expansion will also likely expose many immunologically naïve species to new pathogens making the ensuing relationship between hosts and pathogens difficult to anticipate, but likely, severe. While climate change remains highly unpredictable, the incidence of storm events resulting in loss of stocks and infrastructure is likely to increase, resulting in higher financial, genetic and social risks. **Increased temperatures may lead to greater likelihood of pathogen, food safety, public health risks and the impacts are likely to be greatest on ecosystems and poor people in developing countries where health care, access to food, water, and other resources are somewhat limited.**

The Department of Fisheries and Aquaculture (FI) has a number of ongoing work (both normative and field programmes) and interdepartmental cooperation with other FAO departments (Agriculture and Consumer Protection Department, Natural Resources Management and Environment Department, Technical Cooperation Department, the Legal Office as well as regional and sub-regional offices) to assist FAO members improve their capacities in dealing with biosecurity risks

(Sustainable management and use of fisheries and aquaculture resources) and Strategic Objective B02 (Reduced animal disease and associated human health risks). The Fourth session of the COFI Sub-Committee on Aquaculture (COFI/SCA IV, Chile, 6-10 October 2008) (para 54) emphasized the need for a regional approach concerning disease outbreaks and the need to establish an aquatic biosecurity framework and requested FAO to provide technical assistance through a regional technical cooperation

reporting, emergency preparedness and response, development of national strategies on aquatic animal health and biosecurity, risk analysis, etc. targeting various groups, e.g. farmers, extension officers, laboratory personnel, researchers/students and policy-makers; (b) laboratory capacity support through practical training and provision of small laboratory equipment; (2) organization of expert consultations to support the preparation of technical guidelines, disease diagnostic guides, quarantine manuals, surveillance manuals, risk analysis manual, veterinary inspector's manuals, parasite checklists, etc.; (3) various technical publications as in (2); (4) technical assistance to members in investigation of disease epizootics, improving compliance to international standards on aquatic animal health, etc. and (5) support to continuing professional educational programmes (e.g. distance/online courses, scientific conferences/symposia, etc.).



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VAC system in Hai Dong Province in Viet Nam

and emergencies in aquaculture. FI also supports aquatic animal health and biosecurity initiatives by other relevant regional and international organizations.

Aquatic biosecurity is one of the agenda items in the forthcoming Fifth session of the Committee on Fisheries Sub-Committee on Aquaculture (27 September-1 October 2010). Biosecurity is also one of 18 themes that will be elaborated during the FAO Global Conference on Aquaculture 2010 (22-25 September 2010). Under the Medium-Term Programme 2010-2013/Programme of Work and Budget 2010-2011, aquatic animal health management, biosecurity frameworks and risk assessments are among the primary tools under Organizational Result C04 of Strategic Objective C

programme. The Twenty-eighth Session of COFI (COFI 28, Rome, 2-6 March 2009) under Global Policy and Regulatory Matters for the Attention of the Conference, para (xviii) considered as a priority the establishment of a regional programme towards improving aquatic biosecurity in southern Africa (para 40). It is refreshing to note the increasing attention and recognition given to aquaculture biosecurity as a sustainability issue that will further affect the further growth of this vital food producing sector³.

The range of activities being implemented by the FI Department include: (1) capacity development activities through training course/workshops on areas such as basic aquatic animal health management, surveillance and

The FI Department has also been active in promoting good governance frameworks such as ecosystem approach to aquaculture (EAA) and the application of risk analysis to aquaculture. The ecosystem approach to aquaculture is a strategy for the integration of the activity within the wider ecosystem in such a way that it promotes sustainable development, equity, and resilience of interlinked social and ecological systems⁴. Risk analysis can be an important decision-making tool for assessing the potential impacts of all types of aquaculture, including impacts of aquaculture operations on environmental, socio-political, economic and cultural values as well as the impacts to aquaculture from outside influences. Assessing risks to society (human health) or to the environment due to hazards created through the establishment or operation of aquaculture enterprises are some of the practical application of risk analysis to aquaculture⁵. ■

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This integrated, multidisciplinary approach is fostering closer collaboration within FAO, across departments and programmes, and among international partners, national governments, regional economic organizations, NGO's, universities, local communities, and farmers. It is recognised that anthropogenic-driven disease emergence is one of the most salient global health challenges of the future, but the solution also lies in innovative approaches of people. Research alone will not change people but education and innovative approaches to managing development, food and water security and safety, and livestock, wildlife, environmental, and public health will require social and cultural sensitivity. The way forward is through collaboration and integration - the approach being supported and fostered through the **“The FAO One Health Programme - A Comprehensive Approach to Health: People, Animals and the Environment”**. ■

¹Arthur, J.R., Bondad-Reantaso, M.G., Campbell, M.L., Hewitt, C.L., Phillips, M.J. & Subasinghe, R.P. 2010. Understanding and applying risk analysis in aquaculture: a manual for decision-makers. *FAO Fisheries and Aquaculture Technical Paper*. No. 519/1. Rome, FAO. 2009. 113p.

²Working Document COFI/AQ/V/2010/5 – Aquatic biosecurity: a key for sustainable aquaculture development (prepared for the Fifth Session of the COFI/SCA, 27 September – 1 October 2010 (<http://www.fao.org/docrep/meeting/019/k7580e.pdf>))

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⁵Arthur, J.R., Bondad-Reantaso, M.G., Campbell, M.L., Hewitt, C.L., Phillips, M.J.& Subasinghe, R.P. 2010. Understanding and applying risk analysis in aquaculture: a manual for decision-makers. *FAO Fisheries and Aquaculture Technical Paper*. No. 519/1. Rome, FAO. 2009. 113p.