# Development of a Progressive Management Pathway to assist national and international improvement of biosecurity in aquaculture production

## Draft Working Document[1]

## Summary

The great potential of aquaculture to contribute to food and nutrition security and poverty alleviation has been significantly hampered in many instances by biosecurity and animal disease challenges. During the last three decades, the sector has faced a number of re-emerging and/or newly emerging disease challenges approximately every three to five years. While measures to prevent and reduce the impacts of diseases affecting aquaculture have been launched by affected stakeholders (government, producers, academe), it seems that such efforts have not efficiently addressed the disease problems challenging the sustainability of this fastest growing food producing sector. The required human and infrastructure capacity to address disease challenges did not match the rapid development of the sector. One of the reasons for this mismatch is the great diversity of the aquaculture sector, with more than 500 species farmed in all types of environments (freshwater, brackishwater, marine), systems (pond, cages, recirculating systems, integrated multitrophic aquaculture, polyculture; nursery, grow-out, hatchery, etc.), management strategy (extensive, intensive), and size of the operation (ranging from backyard and subsistence to small-, medium-, and large-scale operations). The stakeholders and enterprises involved in the supply/value chain are also very important, and each segment is a source of risk.

A progressive management pathway (PMP) is proposed as a tool to assist countries to put into place appropriate and sustainable levels of risk management in aquaculture production systems. The PMP for Aquaculture Biosecurity (PMP-AB) is an extension of the "Progressive Control Pathways" (PCP) approach which has been internationally adopted to assist countries as systematic frameworks for planning and monitoring risk reduction strategies for control of major livestock and zoonotic diseases. Most PCPs relate to control of single diseases or disease complexes; in contrast, the PMP focuses on building management capacity through a bottom-up approach with strong stakeholder involvement to promote application of risk management at producer level as part of the national approach.

The initial PMP stages focuses on establishment of national coordination structures that ensure producers and other stakeholders are engaged in the development of strategies (Stage 1), with the application of the strategy at producer level a key expectation in Stage 2. Sufficient levels of producer application of biosecurity action plans (BAP) should then enable, in Stage 3, the attainment of national levels of reduction of specific diseases to give confidence that an effective national biosecurity system is in place. In this stage, the capacity to defend against incursions of a range of diseases should be developed, and in Stage 4, the full range of management competences should be in operation that give national and international confidence to statements of national aquaculture and ecosystem health, and which are able to reducing emergence of new diseases, to prevent, detect and responding to threats. This last stage would enable attaining "One Health" principles of health protection of the ecosystem as well as animal health, and human health, including food security and through sustainable, resilient livelihoods through aquaculture.

[1] This working document, prepared by Keith Sumption (FAO), Melba Reantaso (FAO), Mark Lawrence (MSU), Franck Berthe (WB), and Rohana Subasinghe (ex-FAO) (10 March 2018), is intended to be presented during the Stakeholder Consultation on PMP for Improving Aquaculture Biosecurity, 10-12 April 2018, Washington DC, USA

## Introduction

This draft Working Document on Progressive Management Pathway (PMP) to assist national and international improvement of biosecurity in aquaculture production was prepared to serve as a reference document to be presented during the FAO/MSU/WB Stakeholder Consultation on Progressive Management Pathway (PMP) to Improve Aquaculture Biosecurity that will be held at the World Bank Headquarters, Washington, D.C. from 10-12 April 2018 (referred to in this document as April 2018 PMP-AB Consultation).

## Why develop a Progressive Management Pathway for Aquaculture biosecurity?

The FAO State of World Fisheries and Aquaculture[2] reported that fisheries and aquaculture remain important sources of food, nutrition, income and livelihoods for hundreds of millions of people around the world. Production from aquaculture in 2014 amounted to 73.8 million tonnes, with an estimated value of US$160.2 billion. World *per capita* fish supply reached a new record high of 20 kg in 2014. There is thus a tremendous potential for oceans and inland waters now, and even more so in the future, to contribute significantly to food security and adequate nutrition for a global population that is expected to reach 9.7 billion by 2050. The OECD/FAO Agricultural Outlook 2016-2025[3] forecasted that aquaculture will overtake capture fisheries in 2021 and may reach 52% of total fish production in 2025. The outlook also identified diseases as one of the major uncertainties that will affect productivity gains.

Transboundary aquatic animal diseases (TAADs) are highly contagious/transmissible agents with potential for very rapid spread irrespective of national borders and may cause serious socio-economic and possibly health consequences. Three categories of infectious diseases affecting aquaculture include: (1) exotic diseases that are important to trade (i.e. OIE list of diseases); they are governed by international standards; a set of criteria needs to be met to be included in the list; and they are pathogens/diseases of important traded species (e.g. finfish, crustaceans, molluscs, amphibians); reporting/notification to OIE is recommended during an outbreak; (2) endemic diseases that consistently affect aquaculture production at hatchery, nursery, and grow-out facilities caused by bacteria, parasites, fungal, virus; and (3) newly emerging diseases (which include diseases of known aetiology that are introduced to new geographical areas or new species and diseases of unknown aetiology).

The great potential of aquaculture to contribute to food and nutrition security and poverty alleviation has been hampered by significant biosecurity and animal disease (exotic, endemic and emerging) challenges. During the last three decades, the sector has faced a number of re-emerging and newly emerging diseases approximately every three to five years. Too often, there is a long-time lapse from the time that an emergent disease was observed in the field to the time when the disease was reported, a diagnostic method was developed, an etiologic agent was identified, and finally appropriate disease management or risk management measures were determined and implemented, which can then enable achievement of disease recovery or disease freedom. These time lapses have led to significant production and revenue losses in aquaculture and, in many occasions, seriously collapsing the industry at local and national levels. In a largely non-compensatory commodity production system like aquaculture, such production losses are detrimental to the sustainability of the industry and its future. Aquaculture is the fastest-growing food producing sector, and

[2] FAO. 2016. The State of World Fisheries and Aquaculture 2016. Contributing to food security and nutrition for all. Rome. 200 pp. (http://www.fao.org/3/a-i5778e.pdf)

[3] OECD/FAO. 2016. OECD-FAO Agricultural Outlook 2016-2025, OECD Publishing, Paris. http://dx.doi.org/10.1787/agr_outlook-2016-en

the biosecurity and aquatic animal health management strategies/actions/responses have not kept pace with such rapid development.

## Managing the risks driving emergence and impact of aquatic animal diseases

The recent increase in the emergence and spread of aquatic animal diseases in aquaculture systems, along with their significant impacts, call for a new approach to management that will bring together the required range of stakeholders to develop action plans that are applicable and beneficial both in the short-, medium- and longer-term timeframes, to address the specific attributes/factors (drivers and pathways) contributing to the risk situation.

Fish is also the most traded of all food commodities, and indiscriminate trading has contributed to the introduction and spread of pathogens along with host movement. While international standards are meant to assist countries in reducing the risks of TAAD introduction and spread, they are in constant change for many reasons including: 1) emergence of unknown diseases; 2) better understanding on dynamics and epidemiology of disease; 3) improved diagnostic and detection methods; 4) emergence of unknown diseases, and 5) changing trade patterns (political, social, industrial and economic environments). Such standards are also more widely applied by developed countries; developing countries generally face difficulties in its interpretation and mplementation.

Some of the main management challenges[4], from enterprise to international level, relates to the problems associated with:

- intensification of aquaculture, with farms getting bigger and more concentrated
- increased movement of broodstock, post-larvae, fingerlings, and fry for regional and inter-regional trade
- introduction of new species for aquaculture; species diversity, with each species having different risk profiles
- development and expansion of the ornamental fish trade
- use of non-native feed stocks and feeding practices such as live, fresh or frozen materials as well as trash fish (representing the silent sleeper of aquaculture-related invasions)
- enhancement of marine and coastal areas through stocking of aquatic animals reared in hatcheries
- environmental stressors including climate change
- breakdown in general biosecurity responsibilities and responses.

A number of these can be addressed through management, with opportunities including:

- building capacity for risk analysis
- increasing the awareness of emerging diseases and engaging stakeholders in mitigating these risks

[4] Bondad-Reantaso, M.G., Subasinghe, R.P., Arthur, J.R., Ogawa, K., Chinabut, S., Adlard, R., Tan, Zilong & Shariff, Mohammad. 2005. Disease and health management in Asian aquaculture. *Veterinary Parasitology* 132: 249-272; Hall, S.J., A. Delaporte, M. J. Phillips, M. Beveridge and M. O'Keefe. 2011. Blue Frontiers: Managing the Environmental Costs of Aquaculture. The WorldFish Center, Penang, Malaysia)

- greater use of understanding of the immune response of many of the aquaculture species and pathogenesis of many diseases
- greater use of biosecurity measures based on stakeholders/producers understanding of hazards (pathogens), transmission routes, susceptibility to disinfectants and potential carriers;
- effective translation of research findings to farm level application
- better understanding and use of specific pathogen free (SPF) stocks, and addressing the lack of SPF stocks for most cultured species
- innovative measures including effective diagnostics tools and technologies for reducing biosecurity risks at all levels, especially targeting the small-scale producers and farming communities at the grass-roots level – as they present the weakest link

At national level, for progress to be made, management actions may also require to address:

- government commitment - the need for national action plans including national surveillance programs that would define and communicate current exotic, endemic and emerging disease risks for the industry and ensuring that appropriate capacities and competencies on aquaculture biosecurity are established
- stakeholder engagement - through genuine public and private sector partnership, co-management and common understanding to ensure preventive biosecurity measures and public responses are delivered effectively to disease emergencies
- the need for prudent advice, guidance and policy relating to non-native food stocks
- irresponsible and misuse of veterinary medicines that contributes to the development of antimicrobial resistance (AMR) and concerns on residues
- putting farmers in center of the equation as they bear the consequences of disease outbreaks
- responsibilities to compliance with international standards and other regional agreements

Internationally, supporting management will also need acceleration in development of effective and impactful new tools, particularly to increase disease intelligence & communication, education & extension and research & development, early warning & forecasting tools to disease emergence, the availability of vaccines & evidence-based practices that provide an alternative to antimicrobials and national capacities to interpret and implement international standards and other regional agreements on aquatic animal health.

## PMP for Aquaculture Biosecurity (PMP-AB)

Addressing biosecurity challenges in aquaculture requires a holistic approach that takes into consideration all essential components (governance, technical, communication, infrastructure, operations, etc.) of an aquaculture biosecurity programme. All of these programme components (or elements) cannot stand-alone, they are interrelated and interconnected. These components are elaborated in **Annex A.**

The PMP-AB builds on many decades of experience in FAO and its partners, regional and international organizations, national governments, as well as those from producer and academic sectors on the challenges of managing the risks to aquatic animal health. The sheer numbers of cultured species (more than 500 species), stakeholders and enterprises involved in the supply/value chain, the diversity of the aquaculture containment and systems (earthen ponds, tanks, cages; recirculating systems, multitrophic, integrated, polyculture, nursery, grow-out, hatchery), environments (brackishwater, freshwater, marine), size of farming operation (backyard and subsistence to small-, medium- and large-scale commercial operations) and

management (extensive, semi-intensive, intensive), the pathogens themselves (single, multi-infection, cryptic) and the emergence and rapid spread of infections, the multiplicity of pathways for spread, all combine to present an enormous challenge for management, at all levels.

These challenges are recognized in the approach proposed, by the focus on establishment of national biosecurity management systems that are built through active engagement of the stakeholders with the relevant national agencies. The implementation is expected to be through both the stakeholders investment and effort, and that of national agencies that safeguard the health of the sector and the production environment.

Biosecurity actions plans (BAPs) implemented at entrepreneur/producer level are seen as significant ways to advance management competence and ownership of risk management responsibility at stakeholder level. Beyond providing immediate benefits to health and productivity, BAPs should open up greater possibility of recognition of biosecurity compartments for promotion of international trade. The national responsibilities, and management capacity required, differs at each stage, and the initial stages of the PMP do not make heavy demands on national agencies. The strategies developed in Stage 1 should identify the roles of public and private partners in development of the "national pathway", its likely time course, and its milestones and indicators.

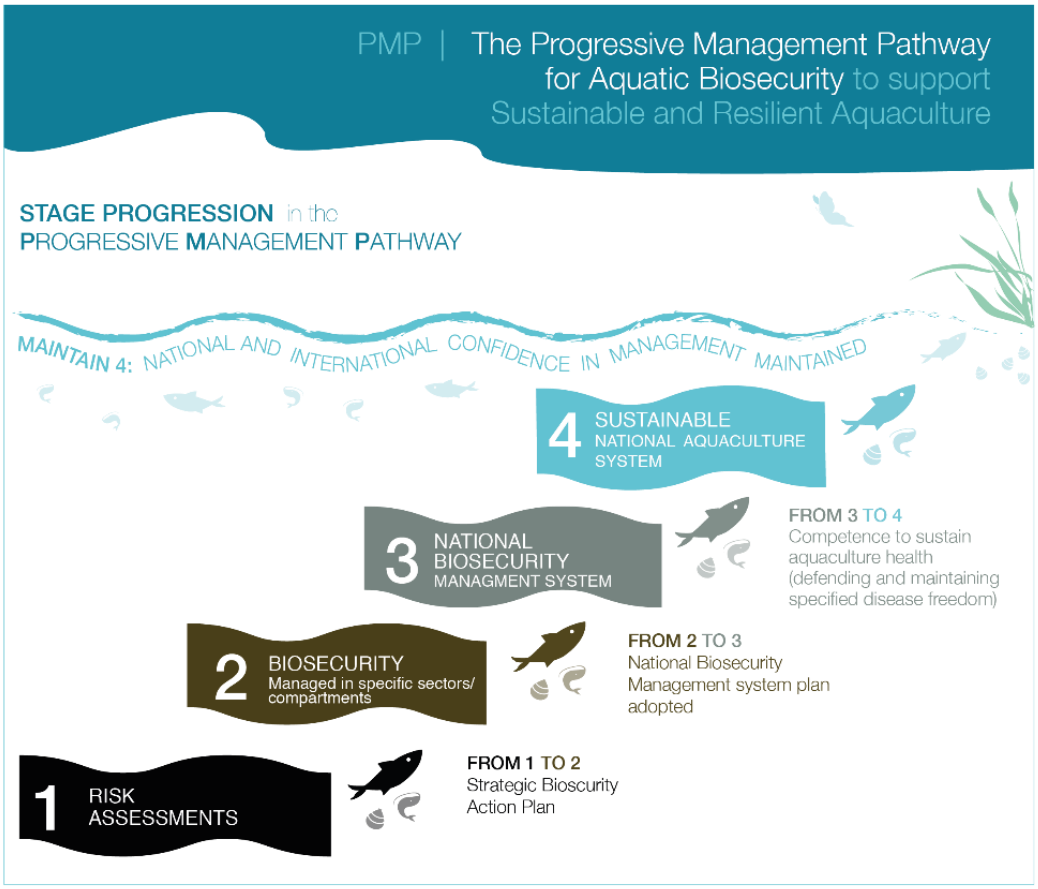
The role of national agencies in safeguarding progress is more critical at later stages when policy and capacity will be important for managing the risks of emerging diseases and international incursions where co-ordination of surveillance and response is critical. At the last stage, it is expected that the challenges of pathogen emergence, protection of ecosystem health, and public safety (including risk of AMR), will require an ever evolving management that has public and private stakeholders working in mature and sustainable partnerships with clear commitment to sustaining the system.

The PMP-AB should be useful as a tool to promote and safeguard investment by both public and private stakeholders. The use of indicators and milestones, at producer as well as national levels, should assist in development of national plans and in setting measurable and smart indicators for progress. Internationally, the approach allows peer-to-peer comparisons, and management capacity developed in one country may provide powerful advocacy and example to support other countries with a similar starting point. The PMP-AB is not a set of new international measures, but a tool to improve management and its ability to meet principally the needs of national stakeholders. In doing so, the capacity to both generate early warning information and benefit from this system should also rise, with evidence from monitoring and surveillance contributing to the world animal health information system (WAHIS) of the OIE.

## Stages in the PMP for Aquatic Biosecurity (PMP-AB) to support sustainable, healthy and resilient aquaculture

The PMP-AB includes four stages as seen in **Figure 1** below.

**Figure 1**. Description of Progressive Management Pathway for Aquaculture/Aquatic Biosecurity (PMP-AB) to support sustainable, healthy and resilient aquaculture




A regular step-wise progression is the rule, from Stage N to Stage N+1, but a fast-track system is under consideration, by which countries would be expected to provide the evidence for meeting the critical entry requirements for having fulfilled the lower stages and directly be recognized as being in Stage 3 (for example). To move from one stage to another, a set of minimum requirements must be met, and a detailed plan for implementation in the following stage must be prepared. These “gateway passes” are usually in the form of strategic **Biosecurity Action Plan (BAP)** as indicated in **Figure 1**.

### *Laying the foundations: Stage 1 of the Pathway*

In Stage 1, the focus is upon creating the necessary environment for developing a national strategy that has the confidence and support of the key stakeholders in public and private sectors, and which addresses the principal hazards and risks that affect aquaculture health and production. The priorities of stakeholders will be diverse, and it may take some time to develop the common understanding and commitment needed to move forward with practicable biosecurity plans that can be adopted, with clear benefit, by the principal actors and stakeholders. The focus of attention may be upon aquaculture production and food security, or may be upon specific sectors or commodities; each country will differ in this. What should be common is the agreement on the longer term vision, and what needs to change over time to achieve this. Each country will differ in the time it needs to complete its strategic BAP, the "gateway pass" for entry into Stage 2.

### *Building biosecurity at every level: Stage 2 of the Pathway*

The focus of Stage 2 is upon implementation of the national biosecurity management plans at the producer (or sector or commodity) level for the priorities agreed in the national strategic plan. The co-management of the plan, between public and private stakeholders, is expected to be continued and strengthened by the processes of reviewing evidence on implementation and evaluating improvements to adoption and application. During this stage, if the strategy is to move higher in the PMP, it should develop the allied capacities needed to ensure the progress is safeguarded, which includes the ability to assess internal and external threats to progress, and establish the capacity (which may include additional efforts on biosecurity at ports and borders) to mitigate risks. To move to Stage 3, evidence of sufficient implementation of the BAPs at producer level is expected, together with the commitment, evidenced through an adopted plan, for a **"National Biosecurity Management System**" (**Figure 2**).

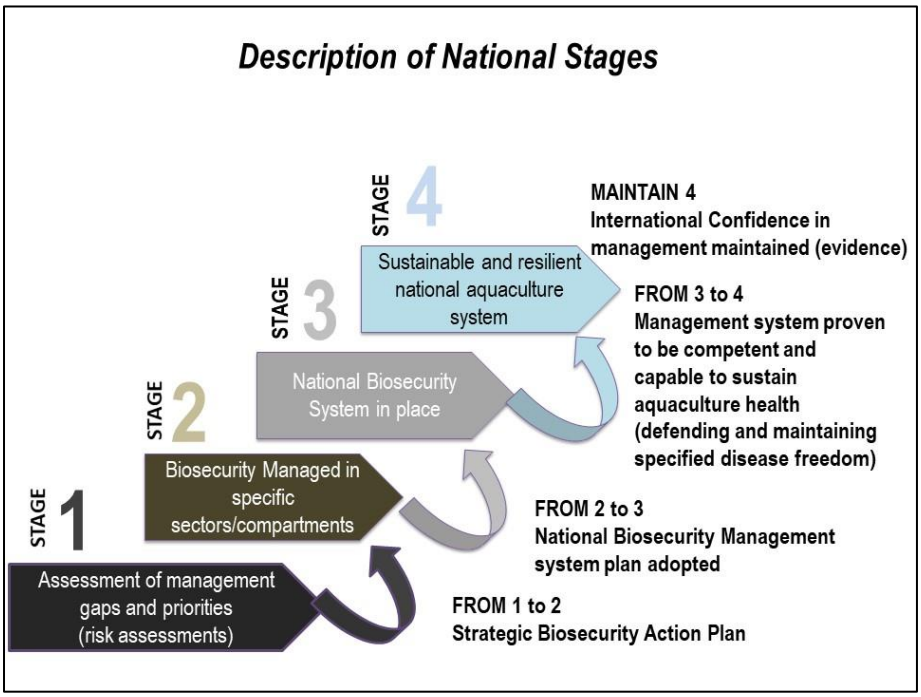



**Figure 2**. Description of National Stages, at Stage 2, for example, National Biosecurity Management system plan adopted.

### *National safeguarding and sustaining progress: Stage 3 of the Pathway*

In Stage 3, the management capacity should be sufficient to safeguard the level of investment made by private and public entities and enable confidence that specific agents, diseases, or risks can be managed by the combination of public efforts, policies, legislation, and producer interest and engagement. In this stage, confidence should be built through monitoring and surveillance systems, and by producer support, that specific diseases are under levels of control within the country. Sufficient attention and action should be demonstrable for management of diseases that pose the greatest threats. It should be evident that producer level biosecurity, national certification, and surveillance systems are trade enabling, and that the system allows for awareness and changes in action as threats are recognized.

### *Sustainable, healthy and resilient aquaculture systems: Stage 4 of the Pathway*

For entry into Stage 4, a body of evidence from Stage 3 (maturity of the system for monitoring aquaculture health, including specific diseases, and evidence of stakeholder support and participation in achieving progress) is required, as well as an **adopted plan** with national commitment of all relevant agencies to safeguard the **national aquaculture system. The plan here refers to the overarching national policy and plans for aquaculture, which considers its role and responsibilities in safeguarding the environment.** There must be evidence of the capacity and commitment to prevent, detect, and respond to new threats to the system, in both cultured species and in the wider environment. Maintenance of the "final stage", with its range of coordinated activities and processes, may be vulnerable to changing political and economic factors, and if substantial loss of management capacity occurs, "downgrading" of the PMP status may result.

### *Ownership and Outcomes of each stage*

Risk ownership is an important principle as described in the ISO Standard 31000 on "risk management frameworks". The PMP is broadly in line with ISO 31000 and has a set of principles to establish the Risk Management Framework at national level. It establishes risk ownership and promotes the "plan-do-check-act" cycle of quality management to emphasize the central role for M&E that will enable problems or progress to be considered and actions taken. The main changes in risk ownership are illustrated in **Figure 3** and **Table 1.**

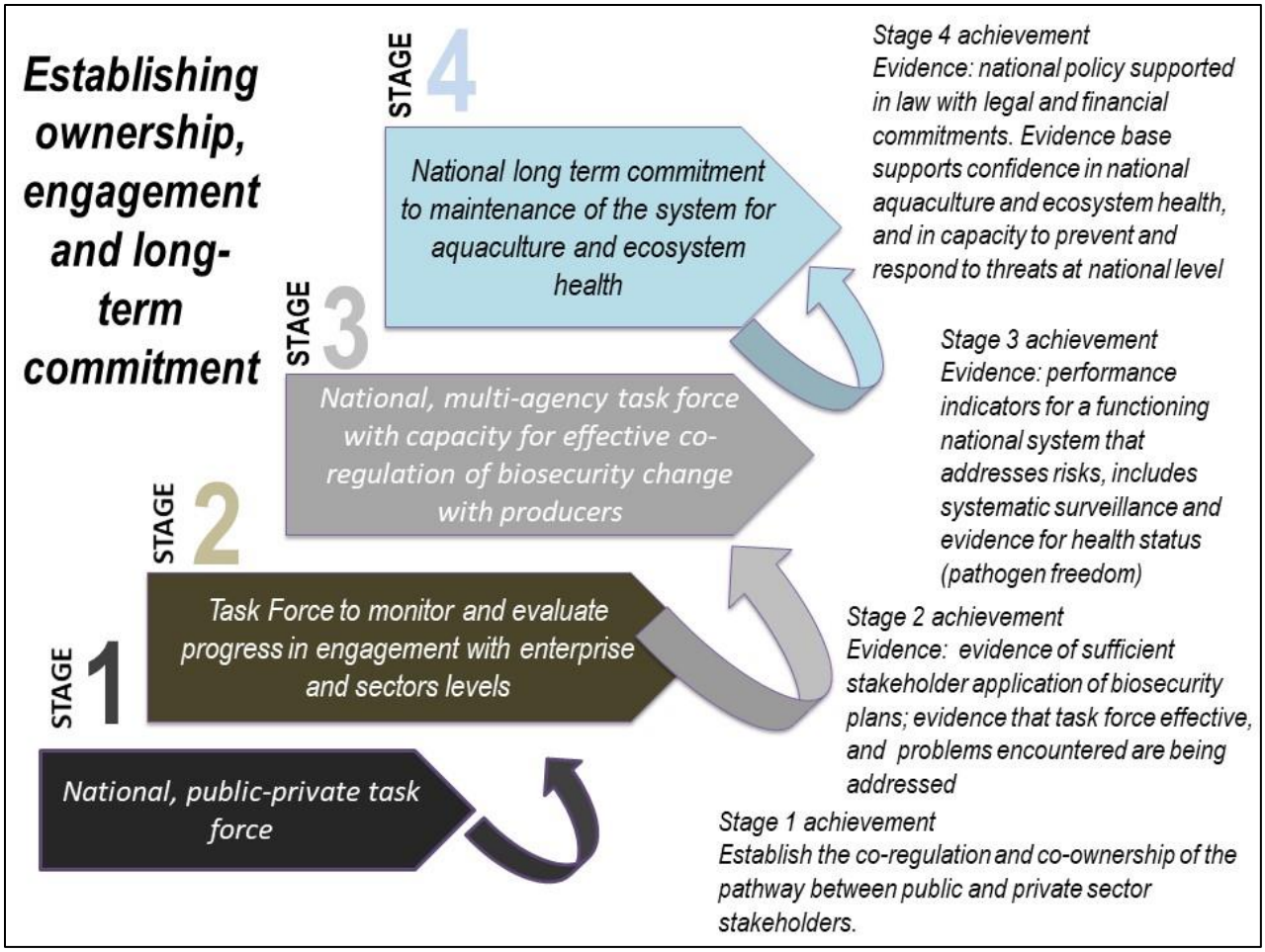



**Figure 3**. Main changes in risk ownership at the different stages

**Table 1**.Risk ownership level and evidence of achievement.

| Stage | Risk ownership level | Evidence of achievement |
|---|---|---|
| **4** | National system for long term commitment to maintain aquaculture and ecosystem health | • National policy supported in law with legal and financial commitments.<br>• Evidence base supports confidence in national aquaculture and ecosystem health.<br>• Proven capacity to prevent and respond to threats at national level. |
| **3** | National, multi-agency task force with capacity for effective co-regulation of biosecurity change with producers | • Evidence of meeting performance indicators for a functioning national system that addresses risk, including systematic surveillance and evidence for claims regarding health status |
| **2** | Task Force with mandate to to monitor and evaluate progress in engagement with enterprise and sector levels | • Evidence for sufficient stakeholder application of biosecurity plans;<br>• Evidence that task force is effective in addressing the engagement and implementation challenges |
| **1** | National, public-private task force | • Establishment of the task force for co-regulation/co-ownership of the pathway; principles, procedures, and practices for public and private stakeholder engagement agreed and practiced |

A "Stage" should be considered a development step; on entry, the management capacity will need to develop depth and competence through application to achieve the intended OUTCOME of a stage. PMP support projects may therefore be described as assisting countries to implement a Stage and measured by the achievement of the outcome – as well as the various performance indicators (not described here).

These outcomes are therefore NOT in place at the start of a stage, but should be evident at the end, and are described in **Table 2** and **Figure 4** below.

**Table 2**. Stage outcomes and evidence of achievement

| Stage | Stage OUTCOME level | Evidence of achievement |
|---|---|---|
| **4** | International confidence in national aquaculture biosecurity system | • Performance indicators of the system support confidence in national aquaculture and ecosystem health<br>• Evidence base for systematic capacity to prevent, detect and respond to threats at national level, and to reduce risk of disease emergence. |
| **3** | Effective national biosecurity system in place | • Evidence of meeting performance indicators for a functioning national biosecurity system,<br>• Credible evidence of meeting **Biosecurity Action Plan** (BAP) targets for implementation at producer level;<br>• Evidence of absence of specific pathogens, supported by evidence for capacity to prevent and respond |
| **2** | **Biosecurity Action Plans** (BAP) adopted and implemented at enterprise and sector level | • Evidence for sufficient stakeholder application of BAPs at enterprise level in one or more sectors |
| **1** | Strategic Action Plan developed and agreed by national, public-private task force | Action Plan that addresses<br>• national and sectoral hazards, disease presence and impacts;<br>• policy and governance weaknesses,<br>• short-, medium-, and term-term opportunities for improvement in management enterprise at sector and national level<br>• priorities and tactics for engaging enterprises in biosecurity management (BAPs) |

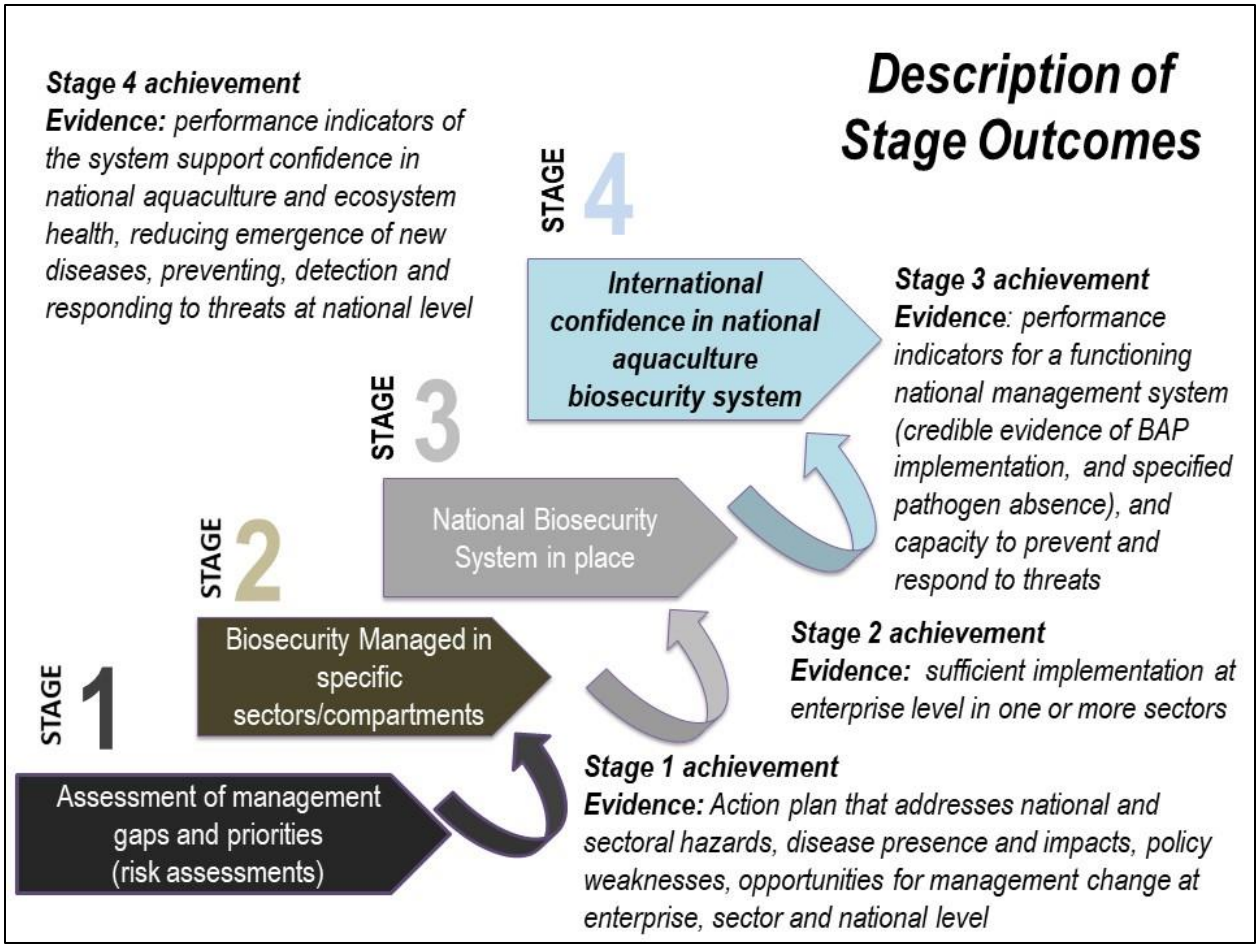



**Figure 4.** Description of stage outcomes

## Benefits of the PMP approach

At the national level, the PMP approach should address a lack of clear national plans by enabling a focus on national strategy development processes, mid- to long-term, and by promoting the co-management approach. The greater use of planning processes that bring stakeholders together should have a variety of benefits in itself, and it should build the basis for national public and private co-management of biosecurity.

From Stage 2, sufficient adoption of appropriate BAPs at the producer level in participating countries should begin to reduce the incidence and impact of those disease/s targeted as priorities in the countries, and it should build a much greater awareness among stakeholders of the role biosecurity can play. From Stage 2, compartments operating at higher biosecurity levels may enjoy benefits of negotiating trade arrangements based on the recognition of their management competencies.

From Stage 3, greater benefits at the national level should be realized through the evidence from monitoring and from the national biosecurity system performance indicators, both of which support greater confidence in health status of traded aquaculture commodities.

In Stage 4, societal and international confidence in the aquaculture system should provide benefits not only for trade but for national recognition of achievement and of the safeguards for the environment and public health.

**Each stage** should therefore provide a tangible benefit to stakeholders, and it will be part of the work within each stage to demonstrate, communicate, and advocate for activities and solve the challenges inherent in retaining commitment. Co-management principles at each stage should ensure the problems are well recognized and management solutions are identified.

## How will the PMP approach be rolled-out to the national level? The Global Plan of Action

The approach taken by other pathways (*e.g.*, Progressive Control Pathway for Foot and Mouth Disease, PCP-FMD) is to promote national uptake, often through regional meetings, at which a "Regional Roadmap" is developed. Countries assess their likely rate of change over a 15-20 year period. For example, *The Global Strategy for FMD* foresaw that countries would progress 2 stages over a 15 year period, ensuring that after 15 years, all countries would be at least in Stage 3, which would be a significant increase in level of control.

An example of PMP-AB application to a region, or a multi-country roadmap, is shown in **Figure 5**. In this illustration, Country B estimated its problems to complete Stage 1 as being significant and did not expect Stage 2 to be completed within 10 years. Greater international support to countries in Stage 1 might accelerate the process; however, because this is a key strategy development phase, time must be given to allow for national processes of consultation and adoption by those who will be implementing the plan.

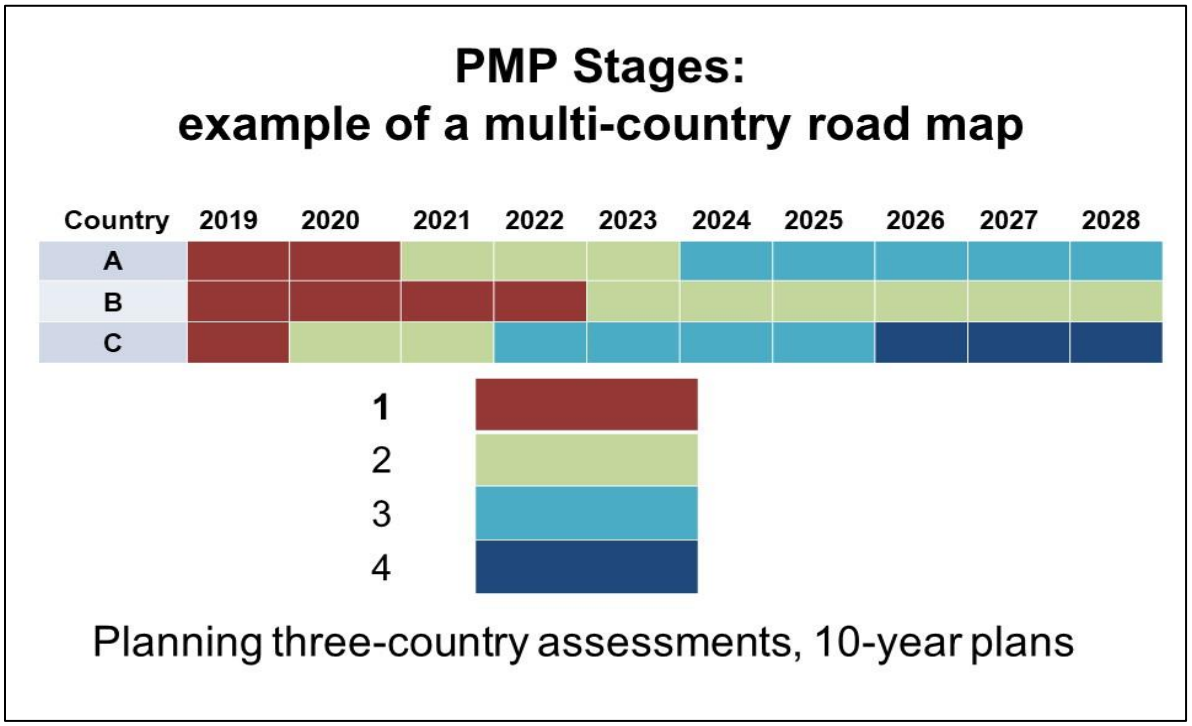



**Figure 5**. Example of application of PMP-AB to countries A, B, C.

For roll-out of the PMP, a "**Global Plan of Action**" is proposed in which the PMP-AB is the principal tool for application at the national level, and partners in the regional and global aquaculture health community would promote and support the country efforts.

Not every country will feel it needs to participate, and the adoption of the PMP approach could be purely voluntary. This is not a fundamental issue; the PMP approach may still provide a useful means to promote management under national and/or donor-funded initiatives, making use of the tools for measuring performance and achievement.

**Figure 6** below shows the relationship of PMP-AB stages to the programme elements/components described in **Annex A**.

**PMP Stages: relationship to programme components in Aquaculture Biosecurity Strategy**

| | Components essential to stage achievement or maintenance | | | | | | | | | | Components enabling and sustaining change | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PMP Stage | PC 8 | PC 2 | PC 1 | PC 11 | PC 3 | PC 4 | PC 5 | PC 6 | PC 7 | PC 9 | PC 12 | PC 13 | PC 14 | PC 15 |
| 1 | +++ | ++ | + | +++ | +++ | + | +++ | +++ | +++ | key | Support stage progress and create new options | | | +++ |
| 2 | ++ | ++ | + | +++ | ++ | + | key | key | ++ | + | Support stage progress and create new options | | | +++ |
| 3 | ++ | + | + | +++ | + | key | key | 1 | | | Support stage progress and create new options | | | share compare |
| 4 | key | + | key | + | | | | | | | Support stage progress and create new options | | | support |

## How will stage progression be evaluated?

The assessment system by which a country is accepted as being in a PMP stage will be discussed at the April 2018 PMP-AB Consultation. In other PCPs, **self-assessment** is an essential part of the process of national ownership of the principles, responsibilities, and coordination with other activities required for management. Therefore, the PMP-AB is likely to focus on self-assessment processes. International acceptance in other PCPs usually involves a standard process of assessing evidence, which is mediated with the technical support of the FAO and OIE (under the GF-TADS Framework). The potential for **Joint Evaluation (JE),** undertaken through a mission or consultation process between international experts (trained and accredited) and the national responsible PMP-team, needs to be explored. This approach has become the accepted norm for uptake and application of the global health security agenda (GHSA) at the

national level, and it has advantages of bringing attention to areas of weakness and strength that assist commitment of national authorities. There are important lessons in the JE evaluation in the livestock sector that can guide its application to the aquatic sector.

## Supporting tools and guidance for the PMP approach

For adoption at the national level, guidance documents and resources for advocacy and training at the national level will be needed. These will be developed following the April 2018 PMP-AB Consultation if the approach is widely supported.

Guidance to national authorities, and assistance in the initial steps of the PMP process, will be assisted by having a cadre of experts with expertise in aquaculture and in risk management. Familiarity with institutional change processes enables them to guide countries and help design projects. International partners should be able to identify these experts and certify/train them for this role, subject to funding availability.

For Stage self-assessment, check-lists and guidance are needed.

Online forum and training for PMP-practitioners are a cost effective means to train people in the approach and share experience and tactics to achieve better engagement. It also enables gaining online support. This system works well with other PCP/PMP.

### Global Governance of the PMP tool and its application in the Global Plan of Action

As with any new tool, the PMP-AB and its associated guidance and training materials will require a period of testing through national application, and adaptation will be made as a result. The April 2018 PMP-AB Consultation should help identify the level of global interest in the tool and develop a plan of action. It will also identify the appropriate governance mechanisms to ensure the development of both the tool and the support system.

The strengths of different partners will be important to support the system, including government competent authorities, experts for national training and (joint) evaluations (if adopted) and leading international scientific laboratories and research centers for technical support.

## Annex A. Components (or Elements) of an Aquaculture Biosecurity Strategy[5]

**Component 1. Policy, legislation, and enforcement**.

*Policy* refers to a national long-term government programme outlining what is to be achieved in broad terms. It includes the government's major goals and objectives for the sector and recommendations for its sustainable development. In contrast, a *strategy* is typically a mid-term (5–15 year) plan and outlines **how** the national policy is to be achieved. It contains specific objectives and outputs, a time frame, indicators of performance, and provision for monitoring and review. *Legislation* is, of course, the sum total of laws, regulations, and other legally binding documents issued by the government to enforce its policies. The inclusion of a National Aquatic Animal Health Strategy (NAAHS) as a component of national biosecurity policy and aquaculture development may be new to some authorities, and policy-makers may not realize the urgency of formulating effective regional and national aquatic biosecurity strategies and acting on the respective programme activities needed to implement them. To have an effective national policy for aquatic animal health and biosecurity, identification of the Competent Authority on aquaculture and aquatic animal health is essential. The advantages of harmonizing aquatic animal health policy among countries belonging to the same region or subregion are many and include facilitated trade in live aquatic animals and their products and increased aquatic biosecurity for all countries. To address aquatic biosecurity adequately and to support improved national aquatic animal health policy, the national legislation should be reviewed and where necessary, updated and/or revised. In some cases, new legislation should be drafted to support aquatic animal health and aquatic biosecurity.

**Component 2. National list of pathogens**.

National pathogen lists (NPLs) are essential for health certification, disease surveillance and monitoring, emergency response planning, prevention and control of diseases in aquaculture facilities, etc. Clearly established criteria for listing/delisting of diseases (based on internationally accepted methods) should be established. OIE-listed diseases that are relevant to national conditions form a good starting point; however, the OIE-listed diseases are those of internationally traded commodities, while NPLs must also consider other serious diseases of national concern. NPLs need to be founded on a thorough knowledge of a country's disease status, which can only be obtained through passive and active disease surveillance programmes, generalized disease/pathogen surveys, adequate disease record keeping and reporting, and a national disease database.

**Component 3: Farm-level biosecurity plan**

Farm-level biosecurity and health management plans are essential to sustain any aquaculture endeavour. A biosecurity plan should: (1) apply to a defined epidemiological unit or area (compartment) or geographical zone; (2) identify specific disease hazards (infectious pathogens); (3) evaluate the risk of these hazards to the unit; (4) evaluate critical points where diseases can enter or leave the unit; (5) evaluate and monitor disease status of the unit; (6) have contingency plans in place if disease does break out; (7) have written records for third-party auditing and certifying, particularly where markets require live animals or their products to be certified as free of disease or specific pathogens; and (8) be transparent and credible. The

[5] Revised from FAO. 2007. *Aquaculture development. 2. Health management for responsible movement of live aquatic animals.* FAO Technical Guidelines for Responsible Fisheries. No. 5, Suppl. 2. Rome, FAO. 2007. 31p. http://www.fao.org/docrep/010/a1108e/a1108e00.htm

plan should include such aspects as farm registration programmes, development of standard operating procedures (SOPs) and best management practices (BMPs), certification programmes for broodstock and postlarvae or fry, pond-side diagnostic techniques, disease reporting, farm-level-contingency planning for disease outbreaks, staff training, promotion of farmer associations, etc.

**Component 4. Diagnostics**

Adequate disease diagnostic capability is an essential component of any national or regional aquatic biosecurity programme. Disease diagnostics plays two significant roles in health management and disease control. The first role of diagnostics is to ensure that stocks of aquatic animals that are intended to be moved from one area or country to another are not carrying infection by specific pathogens at subclinical levels, and is accomplished through screening of apparently healthy animals. The second equally important role of diagnostics is to determine the cause of unfavourable health or other abnormalities and to recommend measures appropriate to a particular situation. The accurate and rapid diagnosis of an outbreak of disease in a cultured or wild population is essential to preventing further losses through correct treatment. It is also critical for disease containment and, where possible, eradication. Diagnostics is also a key supporting element of quarantine and health certification, surveillance and monitoring, zoning (including demonstration of national freedom from a disease), etc. Diagnostics includes both simple, pond-side methods and more advanced laboratory-based techniques requiring a high level of expertise and infrastructure.

**Component 5: Surveillance, monitoring and reporting**

Surveillance and monitoring programmes are essential for the detection and rapid emergency response to significant disease outbreaks and form the basis for early warning of exotic incursions or newly emerging diseases. They are also increasingly demanded by trading partners to support statements of national disease status and are the basis for disease zonation. Surveillance also provides the building blocks of information necessary to have an accurate picture of the distribution and occurrence of diseases relevant to biosecurity and international movement of aquatic animals and their products. Surveillance can be passive (reactive and general in nature) or active (proactive and targeted). In both cases, there must be adequate reporting mechanisms so that suspected cases of serious disease are quickly brought to the attention of the Competent Authority. Surveillance and monitoring efforts must be supported by adequate diagnostic capability (including appropriately trained expertise, suitably equipped laboratory and rapid-response field diagnostics, and standardized field and laboratory methods), information system management (i.e. a system to record, collate and analyze data and to report findings), legal support structures, and transport and communication networks. In addition, they must be linked to national and international (OIE) disease reporting systems (e.g. pathogen list or list of diseases of concern, disease notification and reporting procedures). Surveillance to demonstrate freedom from a specific disease requires a well-designed active surveillance programme that meets the standards outlined in the OIE *Aquatic Animal Health Code, 2017*.

**Component 6: Zoning and compartmentalization**

Zoning and compartmentalization are mechanisms that allow a particular geographical unit (e.g. sub-region, drainage basin, coastal area, cluster of aquaculture establishments, or even a single establishment) to establish and maintain officially recognized freedom from a specified disease or diseases, even though surrounding units may be infected. A *zone* is a portion of one or more countries comprising either: 1) an entire water catchment from the source of a waterway to the estuary or lake, 2) more than one water catchment or part of a water catchment from the source of a waterway to a barrier that prevents the

introduction of a specific disease or diseases, or 3) part of a coastal area with a precise geographical delimitation or an estuary with a precise geographical delimitation that consists of a contiguous hydrological system with a distinct health status with respect to a specific disease or diseases. A *compartment* is one or more aquaculture establishments under a common biosecurity management system containing an aquatic animal population with a distinct health status with respect to a specific disease or diseases for which required surveillance and control measures are applied and basic biosecurity conditions are met for the purpose of international trade (see the OIE Aquatic Animal Health Code, 2017). In addition to contributing to the safety of international trade, zoning and compartmentalization may assist disease control or eradication.

**Component 7. Border inspection and quarantine**

Border inspection includes all those activities regulating the importation and exportation of live aquatic animals and their products that are conducted by the national Competent Authority and national customs officers at international airports, land border posts and sea ports of international entry. *Quarantine* is the holding of aquatic animals under conditions that prevent their escape, and the escape of any pathogens or "fellow travellers" they may be carrying, into the surrounding environment. Quarantine may be conducted pre-border (in the exporting country), border (at the border post of the importing country) or post-border (at a quarantine facility operated directly by the Competent Authority or by the private sector, under the standards and supervision of the Competent Authority). Quarantine is one of a number risk mitigation measures that may be applied to shipments of live aquatic animals to reduce the risk of introducing serious pathogens and pests.

**Component 8. Risk analysis**

Risk analysis is a structured process that provides a flexible framework within which the risks of adverse consequences resulting from a course of action can be evaluated in a systematic, science-based manner. Risk analysis at the farm facility level is important to minimize risk of disease to producers. Import risk analysis (IRA) is an internationally accepted method for deciding whether trade in a particular commodity (a live aquatic animal or its product) poses a significant risk to human, animal or plant health and, if so, what measures, if any, can be applied to reduce that risk to an acceptable level. All countries having international trade in live aquatic animals should have a minimum level of capacity to assess possible risks due to pests (invasive aquatic alien species) and pathogens.

**Component 9. Emergency preparedness and response capacity and contingency plans**

Emergency preparedness is the ability to respond effectively and in a timely fashion to disease emergencies (e.g. disease outbreaks, mass mortalities). The capability to deal with emergency disease situations requires a great deal of planning and coordination (including establishing operational, financial and legislative mechanisms) and making available required resources (i.e. skilled personnel and essential equipment). As long as there is importation of live aquatic animals, the possibility of serious disease outbreaks due to exotic pathogens will exist. Even under the best of circumstances, pathogens will occasionally escape detection, breach national barriers, become established, spread and cause major losses. The extent to which losses occur often depends on the quickness of detection (which depends on the effectiveness of disease surveillance, diagnostics and reporting programmes) and the rapidity and effectiveness with which governments recognize and react to the first reports of serious disease. As quick and effective reaction (containment and/or eradication) is largely dependent upon contingency planning; all countries need to develop such plans for key cultured species and diseases.

**Component 10: Use of veterinary drugs and avoidance of antimicrobial resistance (AMR)**

Access to safe and effective veterinary drugs is essential to the success of semi-intensive and intensive aquaculture, as in some instances entire stocks may be lost if such drugs are not available. However, veterinary drugs, if inappropriately used, may be ineffective or may lead to unacceptable residue levels in aquaculture products. The presence of residues in exported aquaculture products that are above the importing country's acceptable levels may lead to bans on importation, with severe impacts on a country's aquaculture industry. It is thus essential that countries establish mechanisms (e.g. laws, regulations, guidelines, standard operating procedures) to ensure the safe use of veterinary drugs, along with testing and monitoring programmes to assure trading partners that national aquaculture products are safe and meet importing country standards. Antimicrobial resistance (AMR) is the development of bacterial strains that are resistant to antibiotics. AMR can result from inappropriately used in aquaculture and other farming systems, or it can result from inappropriate use in humans. AMR is a growing problem because the development of "superbugs" resistant to multiple antibiotics can reduce the effectiveness of some essential antibiotics in treating human infections.

**Component 11: Information, education and communication (IEC) and aquatic animal health information system (AAHIS)**

Communication includes activities that increase the flow of information between and among national policy-makers, producers, researchers, Competent Authorities, regional bodies and international agencies and experts. Communication activities assist with problem solving and keep national experts, who may be working in relative isolation, up-to-date with regard to the regional and global aquatic animal health situation. It is especially important to an effective national aquatic animal biosecurity programme to establish and promote good communication and linkages between national veterinary services and national fisheries authorities. Communication may include development of national and regional aquatic animal health information systems that can be used for disease forecasting, early warning and risk communication.

**Component 12. Research and development, extension and other studies**

Research capacity in aquatic animal health is necessary to the successful expansion of aquaculture development. Targeted and basic research can lead to better disease management, better understanding of national aquatic animal health status, support to risk analysis, improved diagnostic methods, etc. Where specific research capacity is lacking, countries must rely, to a large extent, on research conducted by scientists in other nations. Often, such “borrowed” research may not be directly applicable to local situations and experimental testing must be undertaken to adapt these findings. In other cases, little or no relevant information on the specific problem may be available. There are many mechanisms to improve access to research capacity. These include development of national aquatic animal health research laboratories, supporting linkages and research programmes within universities and the private sector, contracting of targeted research with foreign institutions, and development of a regional aquatic animal health centre. Targeted national research needs to be supported to allow a better understanding of those aquatic diseases that have recently been introduced into national territory. The impact and spread of such diseases among indigenous species and the spread of such diseases among widely divergent catchments is often poorly studied. A better knowledge of such transboundary aquatic animal diseases (TAADs) under local conditions is vital for the sustainable development of national aquaculture production and the maintenance of aquatic

biodiversity. Effective translation of research findings to farm level application and dissemination to fish farming communities are essential.

**Component 13. Human resources and institutional capacity development**

Human resources and institutional capacity development refers to having the correct number of staff with the appropriate expertise to accomplish the essential tasks that have been identified as part of a NAAHS. This requires the hiring and/or training of scientists, veterinarians and other staff possessing critical expertise and training in the key areas of aquatic animal health (often at the PhD, MSc and DVM with specialized training in aquatic pathology). Examples of important expertise include disease diagnostics, aquatic biosecurity, aquatic veterinary medicine, risk analysis, aquatic epidemiology, emergency preparedness, extension services, enforcement, border control, information services, etc. In addition, a programme of continuing professional education to maintain and upgrade expertise through short-term and other training, attendance at international conferences and meetings, international collaboration, etc. must be established.

**Component 14. Institutional structure (including infrastructure)**

Infrastructure for aquatic animal health encompasses the essential facilities and systems serving a country and thus includes dedicated physical structures such as buildings for office space, diagnostic and other laboratories, quarantine facilities, tank rooms, experimental ponds, etc. Adequate and appropriate infrastructure is essential to the success of any national aquatic biosecurity programme. Institutional structure includes the organizational hierarchy and inter- and intra-organizational relationships between the Competent Authority and other relevant governmental agencies. In some instances national organizational structures, hierarchies, and lines of reporting and communication may need to be restructured to achieve efficient and effective national biosecurity.

**Component 15. Regional and international cooperation**

Cooperation refers to the sharing of effort and resources (e.g. staff, infrastructure, funding) between and/or among countries, government agencies, universities, the private sector and other stakeholders to achieve common objectives or goals. Cooperation in research and training is possible via international agencies such as the FAO and OIE and with foreign universities and experts. There is great potential for regional cooperation and networking in almost all areas of aquatic animal health at national, regional and international levels.