Report of the

SECOND MULTI-STAKEHOLDER CONSULTATION ON THE PROGRESSIVE MANAGEMENT PATHWAY FOR IMPROVING AQUACULTURE BIOSECURITY (PMP/AB)

Paris, France, 29–31 January 2019

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2020

ABSTRACT

This report presents the results of a second multi-stakeholder consultation on the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB), hosted by the World Organisation for Animal Health (OIE) at its headquarters in Paris, France from 29–31 January 2019. Forty one participants from government, the private sector, academe, and international agencies and donors took stock of the drivers of aquatic animal disease emergence and shared experiences in dealing with aquaculture biosecurity challenges. The consultation continued the advocacy and awareness on the PMP/AB concepts and its application, deliberated on draft indicators, checklists and guidelines for rolling out of the PMP/AB and initiating Stage 1.

The four stages of the PMP/AB focus on building aquaculture biosecurity capacity through both bottom-up and top-down approaches with strong stakeholder engagement to promote application of risk management at the producer level as part of a national approach. The PMP/AB initiative is not intended to be prescriptive, and it will be possible to achieve the key outcomes through different combinations of activities. It is essential to address all key outcomes to fully complete a stage and progress to the subsequent stage.

Completion of Stage 1 signifies that the country has identified and assessed its most important aquaculture biosecurity vulnerabilities (which may include pathogens, management practices and/or capacity issues) and determined mitigation measures at the sectoral level, described in Enterprise Biosecurity Action Plans (EBAPs). These mitigation measures are implemented in Stage 2, such that the country enhances its aquaculture biosecurity and reduces the impact of vulnerabilities at the sectoral level. To complete Stage 2, a country develops a National Strategy on Aquatic Animal Health (NSAAH), intended to ensure continued, sustainable progress in improving aquaculture biosecurity. The NSAAH and EBAPs are fully implemented during Stage 3. Completion of Stage 3 demonstrates the success of the country's approach; there is a strong commitment to a national biosecurity management system and evidence of the reduction (or eradication) of pathogens within the country or zone(s). A country in Stage 4 has achieved the development of a sustainable national aquaculture system that is internationally recognized.

The next steps required to move the development and implementation of the PMP/AB forward were presented including the formation of a PMP/AB Steering Committee and a follow-up Technical Working Group meeting. The PMP/AB and its supporting guidance tools will need to be further developed based on comments raised during the multi-stakeholder consultation. Activities include development of the technical aspects of the PMP/AB (i.e. guidance documents, training, self-assessment tool), initial application in pilot countries and refinement, and resource mobilization.

ACKNOWLEDGEMENTS

The Food and Agriculture Organization of the United Nations (FAO) gratefully acknowledges the active participation of the 41 experts who attended the *Second Multi-Stakeholder Consultation on the Progressive Management Pathway for Improving Aquaculture Biosecurity* (PMP/AB2). This consultation was funded by the Norwegian Agency for Development (NORAD) as part of FAO Project GCP/GLO/979/NOR: Improving Biosecurity Governance and Legal Framework for Efficient and Sustainable Aquaculture Production.

FAO acknowledges the World Organisation for Animal Health (OIE) for graciously hosting the consultation at its headquarters. FAO thanks Dr Árni Mathiesen (formerly Assistant Director-General, FAO Fisheries and Aquaculture Department), Dr Magnus Sverre Petersen (Higher Executive Officer, NORAD), Dr Patricia Gaunt (Professor, MSU), Dr Franck Berthe (Senior Livestock Specialist, WB) and Dr Monique Eloit (Director General, OIE) for their opening remarks, and Dr Edgar Brun (Head of Epidemiology Section, NVI) for his closing remarks and their full participation during the consultation. The participants, who came from 18 countries and represented the competent authorities, intergovernmental organizations, the aquaculture industry, academe, service providers, research institutions and donor organizations are thanked for their contributions to a successful consultation and for their expressions of interest to support follow-up activities on the further development and implementation of the PMP/AB.

E. Irde, B. Hao and L. Falcone of the Aquaculture Branch, led by M. Halwart, are gratefully acknowledged for operational and logistics support during the preparation and implementation of the events. M. Reantaso also of the Aquaculture Branch and Lead Technical Officer of the project, provided overall technical oversight to the event.

Special thanks are also due to M. Guyonnet of the Statistics and Information Branch for assistance in the finalization of this document. The staff and management of the FAO Fisheries Division of FAO and especially FI/ADG are sincerely appreciated for administrative support.

1. BACKGROUND

1.1. Introduction

1. The Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) is a step-wise risk management framework that is based on similar frameworks that have been applied by the terrestrial animal production sector, i.e. the Progressive Control Pathway (PCP) used to promote development and self-monitoring of national strategies for important livestock diseases such as foot and mouth disease (FMD), African animal trypanosomiasis (AAT) and peste des petits ruminants (PPR). The approach is risk-based, collaborative and progressive in nature.

2. The first Multi-Stakeholder Consultation on a Progressive Management Pathway to Improve Aquaculture Biosecurity (PMP/AB1) was held at the World Bank (WB) Headquarters in Washington, D.C. on 10–12 April 2018 and is detailed in the *Report of the FAO/MSU/WB Stakeholder Consultation on a Progressive Management Pathway to Improve Aquaculture Biosecurity (PMP/AB)* (FAO, 2019). PMP/AB1 was a milestone event and the consensus reached provided a great impetus to continue the joint efforts towards addressing the enormous biosecurity challenges facing the aquaculture sector.

3. On behalf of the Food and Agriculture Organization of the United Nations (FAO) and in partnership with Mississippi State University (MSU), the WB, the Norwegian Veterinary Institute (NVI) and the Norwegian Agency for Development Cooperation (NORAD), the Second Multi-Stakeholder Consultation on the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB2) was hosted by the World Organisation for Animal Health (OIE) at its headquarters in Paris, France from 29–31 January 2019.

1.2. Purpose

4. The general objective of the PMP/AB2 consultation was to seek feedback from stakeholders on the application of the proposed PMP/AB framework, its adaptability to the diversity of aquaculture production systems across countries and regions, and its potential to make a significant difference in reducing the emergence and/or re-emergence diseases that threaten sustainable aquatic animal production.

5. The specific objectives of PMP/AB2 as outlined in the prospectus were to:

- continue advocacy and awareness on the PMP/AB concepts/principles and application;
- deliberate on draft indicators, checklists and guidelines for rolling out of the PMP/AB; and
- initiate Stage 1 (Risk assessment) of the PMP/AB.

1.3. Process

6. The consultation, which ran for three days, consisted of seven sessions as outlined below. Included were 14 technical presentations that set the scene, informing the participants of recent developments in aquaculture biosecurity as well as recent, ongoing and future work on aquatic animal health. Three Working Group sessions then discussed, elaborated upon and agreed on the guidance and actions points needed to roll out the PMP/AB. The recommendations agreed upon during PMP/AB1 were then revisited and the action points and recommendations to be generated from PMP/AB2 were discussed and established.

7. Prior to arriving in Paris, the participants were provided with a main background document on the stage descriptions of the PMP/AB (see Appendix 4A), which served as a basis for the Working Group discussions. It describes the four Stages, including the overall objective or aim of each Stage and outlines the “key outcomes” (or results) and typical activities necessary to achieve that objective. It also provides

guidance in assessing progress along the PMP/AB in terms of indicator requirements to enter each Stage and the minimum requirements to remain in a stage. The elements or components of a National Strategy on Aquatic Animal Health (NSAAH) are cross-referenced to the key outcomes of each of the four Stages (see Appendix 4B).

8. The seven sessions of PMP/AB2 and their content are listed below (see Appendix 1 for the detailed programme):

Session 1: Opening

- Welcome remarks (FAO, NORAD, MSU, WB, OIE)
- Introduction to objectives, mechanics and expectations
- Self-introduction and group photograph

Session 2: Progressive Management Pathway to Improve Aquaculture Biosecurity (PMP/AB)

- Highlights of PMP/AB1 (Washington D.C., April 2018)
- PMP/AB guidance and monitoring, checklist, indicators and discussion

Session 3: Government, academe and producer sectoral updates

- Steps to set up biosecurity system against shrimp infectious diseases, from farm to country level in China
- Aquaculture biosecurity: a UK Perspective
- Need for more research in microbial management to make intensive aquaculture more sustainable
- MSU/USAID Fish Innovation Lab
- FAO/NORAD improving biosecurity governance and legal framework for efficient and sustainable aquaculture production
- Seaweed aquaculture: biosecurity policy and practice
- Principle and design of biosecurity and quality assurance programme in large-scale hatchery and grow-out shrimp intensive culture operations
- Biosecurity risks in aquafeed
- Good aquaculture practice for improved biosecurity: examples and experiences
- Risk profiling (using hazard analysis and critical control point (HACCP) approach)
- OIE international standards in aquatic animal health; responsibilities of governments re implementation and how other stakeholders participate; and The PVS Tool: Aquatic – an update
- FAO self-assessment survey questionnaires on performance and capacity on aquatic animal health
- Discussions

Session 4: Working Group (WG) session

- Working Group Session 1 (related to Session 2: PMP/AB monitoring, checklist, indicators)
- Working Group Session 2 (related to Session 2: guidance in rolling out of PMP/AB)
- Working Group Session 3 (related to initiating sectoral risk assessment)

Session 5: Working Group presentations

- Working Groups 1, 2 and 3
- Plenary discussion and action points for WGs 1, 2 and 3

Session 6: Plenary discussions on follow-up work

- Recommendations of PMP/AB1 (Washington, D.C., April 2018)
- Recommendations of PMP/AB2 (Paris, January 2019)

Session 7: Conclusions, the Way Forward and Closing

1.4. Participation

9. A total of 41 participants representing government, regional and international intergovernmental organizations, industry, academe and development and aid agencies and foundations participated in the meeting. The list of participants and group photograph can be found in Appendices 2 and 3, respectively.

1.5. Products

10. The main product of PMP/AB2 is this Report, which presents a narrative of the consultation, the major highlights of discussions, and a summary of the decisions that were reached. The expected outcomes as given in the Prospectus were as follows:

- agreement on the final form and main content of the tool for monitoring PMP/AB progress (indicators and checklists);
- agreement on the final form and main content of the Guidelines of Application of the PMP/AB;
- agreement on a timetable for initial application and testing of the PMP/AB in 2019 by partners in pilot countries/settings; and
- recommendations for overall management of the PMP/AB development, including processes for finalization of the tool and subsequent development, and on advocacy.

2. SESSION 1: OPENING AND INSTRUCTIONS

2.1. Welcome remarks

11. Welcoming statements were presented by Dr Árni Mathiesen (Assistant Director-General, FAO Fisheries and Aquaculture Department), Dr Magnus Sverre Petersen (Higher Executive Officer, NORAD), Dr Patricia Gaunt (Professor, MSU), Dr Franck Berthe (Senior Livestock Specialist, WB) and Dr Monique Eloit (Director General, OIE).

2.2. Introduction to objectives, mechanics and expectations

12. Dr Melba B. Reantaso (FAO Headquarters, Rome) began her presentation by noting that PMP/AB1, which was held in April 2018 at the headquarters of the World Bank in Washington D.C., was a milestone event in the initiating the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB). Since then, FAO and its partner agencies have continued their advocacy at various meetings, extended the partnerships and mobilized resources. She stated that PMP/AB will be included in the Biosecurity Agenda during FAO's Committee on Fisheries Sub-Committee on Aquaculture 10th Session, to be held from 23–27 August, in Trondheim, Norway. Ms Reantaso then went on to discuss the "four Ps" of the current PMP/AB2 consultation: Purpose, Participants, Process, and Products (expected outcomes), the details of which can be found in Section 1 of this report.

3. SESSION 2: PROGRESSIVE MANAGEMENT PATHWAY TO IMPROVE AQUACULTURE BIOSECURITY

3.1. Highlights of PMP/AB1 (Washington D.C., April 2018)

14. Highlights of PMP/AB1 were presented by Dr Franck Berthe (World Bank, Washington, D.C.) in a presentation entitled Outcomes of a Multi-stakeholder Consultation on Progressive Management Pathway (PMP) to Improve Aquaculture Biosecurity, World Bank Headquarters, Washington, D.C. 10–12 April 2018.

15. Dr Berthe began by presenting the purpose of PMP/AB1, which was to: (i) take stock of the current aquatic animal health and biosecurity situation in aquaculture with a view to identify the bottlenecks and root causes; (2) introduce a new concept to address aquatic disease problems, the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB); and (3) build consensus on the PMP approach with the aim of developing a global plan of action. He noted that the meeting was attended by 40 participants representing national governments, regional and international intergovernmental organizations, industry, academe, and development aid agencies and foundations.

16. He then reviewed some information on the chronology of several major diseases affecting aquaculture, including epizootic ulcerative syndrome (EUS), white spot syndrome virus (WSSV), acute hepatopancreatic necrosis disease (AHPND) and tilapia lake virus (TiLV) and presented similar information for the emergence of shrimp pathogens in aquaculture. The drivers for disease emergence were then discussed, including trade in live aquatic animals and their products, incomplete knowledge of pathogens and their hosts, ecosystem changes, and aquatic management and health control. Progressive control pathways (PCPs) were then discussed. These were described as stepwise approaches that are increasingly used for the reduction, elimination and eradication of a range of major livestock and zoonotic diseases including: foot and mouth disease (FMD), peste des petits ruminants (PPR), rabies and African animal trypanosomiasis (AAT). PCPs provide systemic frameworks for planning and evaluating field interventions and enable realistic disease control objectives to be defined and achieved. PCPs have been used since 2008 by FAO and become adopted as joint tools with the OIE (FMD, PPR), or developed/owned by global alliances (rabies, AAT).

17. The PMP/AB concept was then discussed in detail, and described as being comprised of four stages, and being a risk-based, collaborative and progressive activity. PMP/AB focuses on building management capacity through combined bottom-up and top-down approaches with strong stakeholder involvement to promote the application of risk management at the producer level as part of the national approach. It is a useful tool to establish a National Biosecurity Management System and is capable of generating early warning information from monitoring and surveillance activities contributing to the notification to OIE (WAHIS). The four stages lead to a sustainable and resilient national aquaculture system. To move from one stage to another, a set of minimum entry requirements must be met and a detailed plan for implementation in the following stage must be prepared. “Gateway passes” are usually in the form of Biosecurity Action Plans. The PMP/AB may be applied at a national level or targeted geographically. Each stage has well-defined outcomes which are achieved through a variety of activities, and an evidence-based and transparent assessment of stage of a country (or zone) is proposed through data collection and audits. A fast-track system can be considered for entry into advanced stages. The various stages of the PMP/AB were then described.

18. Dr Berthe then identified the benefits of the PMP/AB approach as addressing the lack of clear national plans through a focus on national strategy development processes, mid- to long-term planning, and promoting a co-management approach. It will bring stakeholders together with a variety of benefits and build the basis for national, public and private co-management of biosecurity. He then listed the objectives of PMP/AB1 and PMP/AB2 and the status of expected outcomes and achievements, noting that a better understanding of the bottlenecks and root causes of aquatic diseases had been achieved, as well as an understanding of PMP/AB and its ability to be used to address aquatic biosecurity and aquatic

animal health; however, work remains to be done to develop a global plan of action. Dr Berthe concluded by stating there is strong complementarity of PMP/AB with some countries established plans and alignment with progression towards international standards. The opportunity to engage non-aquaculture stakeholders in aquaculture growth is provided. Biosecurity progress at all levels is a good news story. Disease prevention is an asset for the aquaculture sector itself, and also for natural resources and the environment. However, further technical work is required to adapt the PMP framework to aquaculture (PMP/AB).

3.2. PMP/AB guidance and monitoring, checklist, indicators and discussion

19. The presentation entitled Progressive management pathway/aquaculture biosecurity draft guidance was given by Dr Melissa McLaws and Dr Brett MacKinnon (Canadian Food Inspection Agency, Canada).

20. Dr McLaws began by presenting information on the Progressive Control Pathway (PCP) for livestock diseases and its implementation for the control of foot and mouth disease (FMD). The PMP/AB is comprised of four stages that lead to a sustainable and resilient national aquaculture system. Being risk-based, it provides for the best use of limited resources, and focuses on building management capacity through a bottom-up approach with strong stakeholder involvement to promote the application of risk management at the producer level as part of a national approach. She discussed the PMP/AB's over-arching themes of biosecurity, enabling environment, hazards and vulnerabilities, and strategies and plans. The PMP/AB needs to allow for diverse species groups (i.e. finfish, shellfish, seaweeds) with multiple disease issues (endemic, emerging, exotic) in diverse environments. Noting that the focus is on aquaculture biosecurity, she then went on to list the various components of a National Strategy on Aquatic Animal Health (NSAAH) and explained how they fit in the context of the PMP/AB.

21. Dr MacKinnon then gave a detailed overview of the descriptions for all four stages of the PMP/AB (see Appendix 4A). She discussed issues related to the implementation and stage assessment of PMP/AB. A country may progress at any pace. Each stage has well-defined outcomes, which are achieved through a variety of activities and all outcomes for a given stage must be met before proceeding to the next stage. Implementation may start with a limited number of key sectors.

22. PMP/AB may be applied at a national level or targeted geographically; however, national-level involvement is required beyond Stage 2. The purpose of the self-assessment is to: (i) allow countries to identify their own stage of development; (ii) track PMP/AB progress over time; and (iii) measure progress regionally and globally, and for the assessor(s) to learn about the PMP/AB and key activities. The assessment tool should allow countries to identify biosecurity strengths and weaknesses and may be useful for prioritization and identification of where external support could be best targeted. The procedures and tools to be developed for assessment are based on four key principles: (i) the process must be transparent; (ii) the assessment should be evidence-based; (iii) the methods must be standardized so that stages are comparable across regions; and (iv) the process must be user-friendly and not too arduous. In her conclusion, Dr MacKinnon reviewed the minimum requirements to enter the various stages of PMP/AB.

4. SESSION 3: GOVERNMENT, ACADEME AND PRODUCER SECTORAL UPDATES

23. Session 3 consisted of 12 expert presentations given to update the participants on various aspects of aquaculture biosecurity and aquatic animal health. Short summaries of the presentations are given below:

- ***Steps to set up biosecurity system against shrimp infectious diseases, from farm to country level in China (Dr Huang Jie and Dr Xuan Dong, Yellow Sea Fisheries Research Institute, People's Republic of China)***

24. Dr Huang began by presenting data on Chinese shrimp production, and the chronology of important shrimp diseases in China. He then presented the results of passive disease surveillance for the period 2013–2018, and then gave information on the targeted surveillance programme, which is organized by the National Fisheries Technology Extension Center (NFTEC).

25. Surveillance started for white spot syndrome virus (WSSV) in 2007, infectious hypodermal and hematopoietic necrosis virus (IHHNV) in 2015, and *Enterocytozoon hepatopenaei* (EHP) and shrimp hemocyte iridescent virus (SHIV) in 2017; 15 provinces participated for WSSV, 12 for IHHNV, 12 for EHP and 13 for SHIV. The study is looking at the occurrence of these pathogens in wild shrimp, hatcheries, seed, and grow-out facilities. It was found that there is a higher risk of reinfection in infected farms, the recurrence rate of positives in farms in subsequent years being 2.2 times that of the overall positive rate, while the percentage of farms that became positive in the year following a positive finding was 1.4 times that of the overall positive rate.

26. Dr Huang then looked at the complexities of biosecurity for disease control, health management and biosecurity, and the complex framework for a national/global biosecurity system. He listed the key issues for biosecurity studies as being, for scientific issues, the fundamental theory for biosecurity, the prevalent mechanism of disease in a system, the elements and pathways of disease risks, and the effects of aquaculture processes on pathways of disease risks; while the key technological issues were considered to involve methods and protocols of biosecurity, disease surveillance scheme for aquaculture system, assessment of disease risks in aquaculture systems, determination of critical control points of disease risks and the control measures, standard operating procedures (SOPs) of biosecurity plans for aquaculture establishments, and "intelligentization platform" for biosecurity.

27. The implementation of biosecurity at the farm level and for shrimp hatcheries was then presented in detail, including the large number of SOPs needed for hatchery biosecurity. The major problems in implementing farm-level biosecurity were listed as difficulties in: (i) sampling and testing for low incidence and weak positive of risks in hatcheries; (ii) disinfection of live animals and live feed; (iii) identification of critical control points and establishing control measures; and (iv) setting up full SOPs for each farm to address all details in operations and make them active and updatable. Each of these was then discussed in detail. In closing, Mr Huang Jie listed the various components of a national/local biosecurity plan. These were grouped under the following major headings: law and planning, technical standards, surveillance and control system, development for aquatic animal health strategy, expertise and communication, official certification system, and products and technologies.

- ***Aquaculture biosecurity: a UK Perspective (Dr Nick Taylor, Centre for Environment, Fisheries and Aquaculture Science (CEFAS), United Kingdom)***

28. Dr Taylor began by stating that good biosecurity relies on the industry and government working in partnership. Biosecurity plans need to be effective against all biohazards, not just limited to specific agents. Understanding the hazards, host response, environment, site management, industry and trading practices is key. A national regulatory framework and Competent Authority ensures that standards are met and are consistent for all. In the pyramid of partnership, at the base are the local stakeholders (e.g. dealers, traders, farms and fisheries), who are guided by codes of practice. In the middle, and at the national level, are national government agencies (e.g. CEFAS), who are guided by national legislation; while at the top are regional and global organizations (e.g. the World Trade Organization (WTO) and the OIE), assisted by regional legislation and international agreements and guidelines.

29. Dr Taylor then turned to the activities of the CEFAS and noted that a holistic approach to aquatic animal health includes an understanding of pathogens, hosts, environment and practices. He explained that the statutory services include authorizations of fish farms and registration of fisheries; import/export checks and advice, and certification; annual visits and biosecurity plan review; sampling, testing and data collection; outbreak investigation and contact tracing; and enforcement and prevention of illegal activity. The role of the Fish Health Inspectorate in providing advice and information was then discussed (see https//www.gov.uk/government/groups/fish-health-inspectorate).

30. The CEFAS maintains a national database (Apple mobile operating system (iOS) interface) containing relevant information on aquaculture facilities, including site and business details, species held, biosecurity plan, live fish movement service, mortality and medicines records, inspection visit history, testing and laboratory results, and risk-based surveillance tools. He noted that understanding networks is important. Important questions include: "where are the hosts?"; "how do they interact?"; "what connects them?"; and "what is the whole network?"

31. Effective monitoring and surveillance are key to preventing the spread of aquatic animal diseases. Models to evaluate the impact of surveillance and control efforts are useful. These include network simulator, host/pathogen population models, statistical analysis, quantitative risk assessment, geographic information systems (GIS) and spatial models, and socio-economic modelling. Contingency planning is necessary to test preparedness for an outbreak. This may be a national exercise or cross border and should involve multiple policy groups, agencies and stakeholders. The exercise plays through an outbreak scenario to determine the response and identify issues with procedures, processes and communications. Bottlenecks and challenges can be identified and the impacts of controls to different sectors evaluated.

32. Dr Taylor stressed that research and development (R&D) underpins both models and policy. In conclusion, he presented five key points: (i) biosecurity measures should be effective against all existing and emerging biohazards; (ii) a holistic approach to biosecurity is needed, including partnership between sites and regulators; (iii) a strong surveillance programme and communications strategy is central to biosecurity; (iv) modelling and contingency planning should be applied to evaluate plans and response; and (v) measures and policy decisions should be underpinned by R&D, include stakeholder views, and be reviewed regularly.

- ***Need for more research in microbial management to make intensive aquaculture more sustainable (Dr Patrick Sorgeloos, University of Ghent, Belgium)***

33. Dr Sorgeloos began by saying that already in 2010 among the different key areas in which knowledge increase was needed, microbial management was identified as one of the top priorities. Indeed, people have become conscious of the fact that we are not only culturing fish or shrimp in our systems but also a lot of microbes. But still in many cases, they are cultured without adequate control, so we are culturing pathogenic bacteria as well as good bacteria, and that is the reason why disease outbreaks are abundant and problematic. Thus, we need to install approaches for real microbial management rather than trying to kill all bacteria in the system, because this does not work.

34. The creation of a better knowledge of the microbial dynamics is crucial, as it will allow the development of more effective microbial management. Recently, important scientific progress was reported on the critical role of bacteria in larviculture systems. This new knowledge has allowed us to confirm or reject hypotheses and give better advice about how to manage bacteria in aquaculture systems to better prevent disease outbreaks of mainly opportunistic pathogens. This will allow an eventual understanding and explanation of several of the successful empirical applications practiced through trial and error developments.

35. Quorum sensing in aquaculture, whereby bacteria communicate via extracellular signal molecules, allows for genes coding for virulence to be switched on. In aquaculture systems, neutral or beneficial bacteria are wanted, while obligate and opportunistically pathogenic bacteria are not. Biosecurity is the key to avoiding the presence of obligate pathogens, but upon disinfection all bacteria are eliminated. Recolonization then starts, with feeding and fertilization stimulating bacterial growth. At the microbial level, there is a succession of r-strategists and k-strategists, until there is no space left for new r-strategists. Animals are typically stocked at the peak of massive microbial growth, when r-selection is at its peak. The solution is to stock animals only after the growth of r-strategists has peaked, as this will minimize exposure to opportunistically pathogenic bacteria.

36. Dr Sorgeloos then discussed quorum sensing regulated vibriosis and gave some empirical observations of the strategy of microbial-matured water in grow-out systems, including algae-rich green water systems, tilapia co-culture, probiotic bacteria and prebiotics (substrate to promote probiotics), biofloc systems, zero-exchange systems and recirculation systems/integrated systems with extractive non-fed species such as tilapia and seaweed. He then discussed good aquaculture practices, including aspects of water quality and treatment; seed performance; food/feed quality and safety; and overall hygienic conditions. The estimated costs of some shrimp diseases were then presented.

37. Finally, a proposed world-wide microbiome study of shrimp gut and culture water was then described, which would include international cooperation with farmers and academia, application of the latest tools in genome sequencing and flow cytometry, and the different culture systems as previously mentioned. This study would be conducted in the main shrimp production regions in the world, would correlate with abiotic and biotic parameters, and would have strong bioinformatics support.

- ***MSU/USAID Fish Innovation Lab (Dr Patricia Gaunt, Mississippi State University, United States of America)***

38. Dr Gaunt began her presentation entitled "Overview: Feed the Future Innovation Lab for Fish" by noting that fish is among the most traded agriculture commodities in the world. Almost 200 000 people are employed directly or indirectly by the fishery industry in developing countries. Fish is rich in both micronutrients (e.g. vitamin A, B12, iron) and macronutrients (e.g. proteins, docosahexaenoic acid); and more than 2.6 billion people depend on fish for over 20 percent of their animal protein. Fish affects the nutrition and livelihoods of small-scale producers and vulnerable households, making equitable access to fish a vital part of the United States' commitment to end global hunger and poverty.

39. The mission of the United States Agency for International Development (USAID) is to alleviate poverty and improve nutrition in vulnerable populations through the reliable and inclusive provision of fish, a nutrient-rich animal source food. Dr Gaunt then described the MSU/USAID Project, which has a lifespan from September 2018–2023. Its focus is on research that will generate actionable evidence to improve food security and nutrition, with the initial target countries being Bangladesh, Nigeria, Kenya, Uganda and Zambia. The overall approach will consider both fisheries and aquaculture systems; blend multiple research disciplines (integrated systems approach); focus on supporting small-scale producers and fishers; leverage private industry partnerships and mobile digital technologies; and incorporate cross-cutting themes in project development.

40. She then described the approaches, impact pathways, and goals of the project. Impact Pathway 1: Improve Productivity will include research that will identify and develop scalable technologies and practices that will sustainably increase fish production; prioritize natural resource conservation and the needs of fishers and producers; and inform policies that increase the productivity and profitability of fisheries and aquaculture sectors in developing countries. Sample research topics include improved fish feed enhanced techniques for selective breeding and improved fish genetics; improved aquaculture technology; reduced pre- and post-harvest losses; and sustainable management of fisheries.

41. Impact Pathway 2: Reduce and Mitigate Risk will identify and develop scalable technologies and practices to reduce and mitigate risks to fish production systems; identify best practices for effective food safety and food security to prevent industry losses from fish contamination and diseases; and be adapted for small-scale, medium, and large aquaculture producers. Sample research topics include improved fish health, prevention of losses from disease, and enhanced food safety and processing.

42. Impact Pathway 3: Improve Human Outcomes will include research that will generate actionable evidence on how fish production systems can equitably improve economic opportunity and nutrition among vulnerable households; prioritize impacts for youth and women; and foster more equitable access to high-quality fish, business ownership, and market access. Sample research topics include improved understanding of socio-economic factors that affect behaviour changes needed to implement best practices; enhanced market access for small-scale producers; and enhanced nutrition of vulnerable

groups. The cross-cutting themes of nutrition, resilience, gender and youth, and capacity are incorporated into each funded research project to enhance the development impact of Fish Innovation Lab (FIL) research. Experts in each theme are part of the FIL team and will review all projects and awards to ensure the theme's inclusion. Projects will include specific monitoring, evaluation, and learning (MEL) indicators for each theme. The approaches include for research: commissioned research, competitive subawards, research collaborations, and associate awards; for capacity-building: joint-degree training, curriculum development, and training programmes; and for innovation and scale-up: information dissemination, knowledge sharing, adoption of technologies, and scale-up interventions.

43. After presenting the anticipated funding cycle, Dr Gaunt noted that quick start projects include:

- Bangladesh: Sequence high-quality genome of rohu and identify rohu's genome-wide SNP markers for improved broodstock selection programmes. Collaborators: Bangladesh Agricultural University, Bangladesh Fisheries Research Institute, WorldFish.
- Kenya: Inventory and market analysis of coastal marine fish for food that maintain ecosystem functioning and address micronutrient deficiencies in vulnerable groups. Collaborators: Pwani University, Egerton University.
- Nigeria: Analysis of the aquaculture post-harvest chain to better understand the fate of harvested fish from production to consumption. Collaborators: WorldFish.

- ***FAO/NORAD Project GCP/GLO/979/NOR: improving biosecurity governance and legal framework for efficient and sustainable aquaculture production (Dr Melba B. Reantaso, FAO, Italy)***

44. Dr Reantaso began by stating that the need for aquaculture biosecurity has been stimulated by serious socio-economic losses, environmental impacts and rising investment costs, such that aquatic animal health management has recently assumed high priority in many aquaculture-producing regions of the world. Countries have improved their laboratory facilities, diagnostic expertise, and control and therapeutic strategies in order to handle disease outbreaks more effectively, including increasing awareness, creating effective policy and legislation, and enhancing research and manpower development. However, this progress has not matched that of the rapidly developing aquaculture sector.

45. She then went on to briefly describe the FAO/NORAD Project GCP/GLO/979/NOR: improving biosecurity governance and legal framework for efficient and sustainable aquaculture production. The project's goal is to support sectoral sustainability. Competent, knowledge-based governance and policy, including legislation are becoming essential pillars: i.e. governance that equitably provides an enabling environment to both private-sector entrepreneurs and small-scale producers that are involved in the aquaculture industry. This project, which is desired to be part of a bigger programmatic vision on aquaculture biosecurity over a longer term (at least three to five years), will focus on specific outputs that can be delivered within one year.

46. The overall objective of the project is to support countries in the sustainable development of aquaculture through improving systems and practices in biosecurity, enhanced and enabling legal frameworks, and promoting responsible and sustainable aquaculture practices. The project is funded by NORAD, in close collaboration with the NVI and focus countries and in partnership with interested relevant stakeholders. Ms Reantaso then listed the project's expected outputs as being:

- Output 1: Aquaculture biosecurity governance: Selected countries understand, adapt and implement the Progressive Management Pathway for Improving Aquaculture Biosecurity including antimicrobial resistance (AMR)
- Output 2: Legal frameworks on aquaculture are strengthened to promote responsible and sustainable aquaculture production

- Output 3: Capacity to strengthen biosecurity governance at different levels (e.g. policy, legal, technical and farm levels) developed
- Output 4: Knowledge learned will be shared and disseminated.

47. As an example, Dr Reantaso then presented the activities to be undertaken under Output 1, which were listed under three headings. Under Aquaculture Biosecurity Governance, these were: (i) organization of the Second PMP/AB Consultation; (ii) rolling out/initial implementation of PMP/AB in selected countries; (iii) co-organization and/or attendance to scientific fora; and (iv) awareness-raising on antimicrobial resistance (AMR) and aquatic component of national action plans (NAPs) on AMR.

48. Under surveillance, activities include: (i) expert consultation on further development of the FAO 12-point checklist in designing and implementation of a surveillance (especially for non-specialists); (ii) pilot testing of surveillance; and (iii) capacity development on disease awareness, farm-level biosecurity and emergency preparedness and response to aquatic animal diseases. Finally, activities under animal health economics include: (i) expert consultation to develop a methodology for systematic assessment of the socio-economic impacts of aquatic diseases; and (ii) pilot testing of the socio-economic impact assessment methodology.

49. She then presented the 12 Point Surveillance Checklist for Non-specialists, which includes the following elements: (i) defining surveillance objective/purpose; (ii) definition of population; (iii) clustering of disease; (iv) case/outbreak definition; (v) sampling; (vi) diagnostics/laboratory testing; (vii) study design and data analysis methodology; (viii) data flow and management; (ix) validation; (x) quality assurance; (xi) human and financial requirements; and (xii) putting surveillance in the bigger picture (biosecurity, animal health, aquaculture, food safety/security, One Health).

50. Dr Reantaso concluded by stating that the overall aspiration of this project is to develop a longer term programmatic approach (three to five years) on aquaculture biosecurity based on a good understanding of the drivers and pathways; building on what has been achieved that effectively contributed to reducing disease risks (experience from other countries/regions) and considering successful strategies and lessons learned, in parallel with the needs of the aquaculture sector and especially focussing on small-scale producers.

- ***Seaweed aquaculture: biosecurity policy and practice (Prof Elizabeth J. Cottier-Cook, University of the Highlands and Islands, United Kingdom)***

51. Prof Cottier-Cook began her presentation by introducing the GlobalSeaweedSTAR Biosecurity Team that includes herself and experts from the Scottish Association for Marine Science, the University of Philippines Visayas, the University of Dar es Salaam, the University of Malaya and the Overseas Development Institute. She stated that seaweeds have the second-highest volume in global aquaculture at 30 million tonnes and support an industry that was valued at USD 6 billion in 2014.

52. Some 95 percent of global seaweed production originates from developing countries, and the thus the sector provides income for millions of families. As with other aquaculture sectors, seaweed culture is very diverse in terms of the number of species cultured and the techniques used, which include using long lines, rafts, ponds, open waters, and both shallow and deep-water culture techniques. She then presented an example of the biosecurity challenges faced by the carrageenan industry. Forty-five percent of global seaweed production is used for direct food consumption and carrageenan extract, with production largely taking place in Indonesia, Malaysia, the Philippines and Tanzania.

53. After a few years, disease typically worsens due to intensification, sometimes leading to a collapse of the local industry, as was the case in Tanzania, where production dropped from some 1 000 tonnes in 2001 to less than 100 in 2012. Biosecurity challenges include both diseases and epiphytes. In the Philippines alone, for example, more than 15 percent of the yield is lost, amounting to some USD 310 million in value. As with other farmed species, seaweeds have often been moved internationally, resulting not only in the introduction of new species, but also their accompanying epiphytes and diseases.

Prof Cottier-Cook then noted that seaweed farming in most seaweed-producing countries is unable, on its own, to generate sufficient income to keep farmers above the international poverty line. Interviews in the Philippines and Tanzania show farmers diversifying away from seaweed farming to secure more resilient livelihoods. However, understanding gender dynamics is important: male seaweed farmers may find it easier to diversify than women. As an example, for the nori (Pyropia) industry in Korea, at any point in time approximately 20 percent of crop is infected by one of three diseases. Control measures equate to up to 50 percent of farm costs, and these pathogens are only just being described.

54. The Global Seaweed STAR team is studying biosecurity policy and practice. Understanding of baseline biosecurity practices is being gained through the use of a Knowledge, Attitude and Practice (KAP) survey tool. This tool has already been widely used to assess communities involved in managing different biosecurity risks and has now been adapted to compare current management of biosecurity across top seaweed-producing countries. To understand policy, comparative analysis of biosecurity frameworks in which seaweed aquaculture is included, international and regional frameworks for vertical integration (guidelines from overarching organizations), and national policy assessments for horizontal integration (country to country information and industry guideline sharing) are being done.

55. The spectrum of national seaweed biosecurity regulation was found to differ markedly between countries such as Malaysia, the Philippines and Tanzania. For international regulation, international sanitary and phytosanitary standards for biosecurity in the seaweed industry are those of the International Plant Protection Convention (IPPC), which has recently published recommendations for "aquatic plant" inclusion. Ms Cottier-Cook then posed the following questions to participants: "should the PMP-AB plan include seaweed aquaculture? If so, will IPPC be included as standard holders?"

56. In closing, she described the Research Travel Grants available under the Global Challenge Research Fund (GCRF) GlobalSeaweedSTAR Fund, noting that these grants are open to anyone based in a developing country or the United Kingdom and engaged in research and development (R&D) in seaweed production; provide funding for approximately 20 research projects (GBP 5 000–50 000) directly relevant to United Nations Sustainable Development Goals (UN SDGs); and funding for 100 travel grants (GBP 2 000) to provide researchers in developing countries opportunity to participate in conferences, etc.

- ***Biosecurity risks in aquafeed (Dr Jose R. Villon, Nutreco N.V., The Netherlands)***

57. Dr Villon began by noting that the aquaculture industry faces many challenges, including issues related to pollution from farms, destruction of habitat, antibiotic use, consumer health and pressure on wild fisheries. He then presented a quotation by Knut Nesse, former CEO of Nutreco, given at a high-level United Nations meeting on antimicrobial resistance: "with a holistic approach based on farm, feed and health management, antibiotic use can be reduced significantly on a global scale with equal or even improved productivity."

58. He then stated that biosecurity should always be part of a holistic approach to animal health and welfare. Issues related to the use of manufactured feeds vs trash feed include traceability and sustainability, control over nutritional profile and quality, disease transmission, economics, environmental impacts and ease of handling. Nutrition must be adapted based on a number of factors: farming conditions, production cycle, environment and health. The development of functional feeds requires disease knowledge, R&D partners, new methodologies, and functional ingredients. Functional nutrition guards aquaculture populations by strengthening inherent fish defences, reducing pathogen replication, limiting pathogen excretion and subsequent challenge pressure, with the ultimate goal being herd protection.

59. The product ProtecTM was assessed in collaboration with five research partners that included in vitro studies on 32 ingredients, 4 pathogenic bacteria, and 3 beneficial bacteria; while in vivo studies involved 17 ingredients and 42 diets, giving positive results from 4 independent facilities. Thirteen Streptococcus challenges were performed. Growth and survival were promoted in all studies. Nutreco

and its partners have developed innovative technologies to support health. The manufacturing of medicated feed is tightly controlled. This includes strict quality control of final product, use of good manufacturing practices, quality assurance, and assuring feed stability and feed intake.

60. Dr Villon then concluded by describing Project Pincoy and independent validation of functional nutrition under the Global Salmon Initiative.

- ***Principle and design of biosecurity and quality assurance programme in large scale hatchery and grow-out shrimp intensive culture operations (Dr U Win Latt, Aqua Global Environs Co., Ltd., Myanmar)***

61. Dr Latt began by stating that he would present only the main parts of quality assurance (QA) and biosecurity as it relates to culture operations, and that the rest of the whole programme would be omitted. Since the international, regional and national levels are derived from the basic farm level, the farm-level programme is assumed to be the fundamental level. More importantly, this programme was developed and implemented for vertically integrated aquaculture operations in which micro-level operations (though public-private partnership) resemble those of common small-farm operations. It is mostly based on activities conducted between 2008 and 2016. Regarding QA in large-scale aquaculture operations, he noted that such operations (i.e. hatchery and grow-out) are capital intensive and sensitive to various internal and external factors; thus, QA is vital.

62. Large-scale operations could range from a couple of thousand hectares to tens of thousands of hectares; thus, it is imperative to have appropriate and effective operating systems to implement sustainable business policy and programmes. QA programme designs are developed to ensure the success of operations and biosecurity is imbedded within such programmes. If a quality control (QC) system is obsolete, it can no longer support either production success or business sustainability. Aquaculture operations need to ensure quality output at every phase, and unit operation in production is controlled so that the quality of final-stage outputs is not rejected (cost effective). Large-scale operations are comprised of two main groups: production (including directly related groups such as R&D and QA) and support (engineering, finance and accounts, logistics, etc.).

63. All unit operations are linked together and implicate one another. QA design for aquaculture production is therefore considered holistically. The principle is based on the concepts of sustainability, risks, threats, hazard analysis critical control points (HACCP), production objectives, and financial aspects. Common issues in biosecurity and QA in aquaculture operations include poor understanding of biosecurity and its linkage to production management; unclear definition and process, objective, function, duty and responsibility at various management and working levels; confusion and misconceptions in QA and biosecurity principles and objectives, as well as personal competency; right person to right job: needs vs. reality (job function, level etc.); and lack of proper and effective QA-specific human resource development. QA components have for their main objective the minimizing of risk and maximizing of quality output. These include such activities as conducting periodic and on-demand programme reviews, revision and implementation; standardizing of all inputs and inline QC standards; monitoring and assessment (external: environment, water source, pollution source, weather, etc.; internal: on-farm/hatchery); conducting inspections, conducting QC: input (feeds, seeds, probiotics, chemicals, etc.) and inline (operation); conducting auditing on quality management systems (QMS), standard operating procedures (SOPs), operation (technical audit); compliance analysis; and analysis of overall programme and reporting.

64. The steps in implementing a biosecurity and QA programme are as follows: (i) risks of every unit operations are identified and assessed, and standard values and schedules established; (ii) monitoring and assessment is conducted and users informed; (iii) user groups act based on analysis and assessment outcomes (preventive measures, modify/adjust treatment system); (iv) the QA team conducts inspection and audits on inline QC and informs results to user groups; (v) the production team makes necessary adjustments and corrective actions based on the QA results; (vi) QA conduct re-inspection on outcomes of corrective actions; and (vii) proceed with plan if passed.

65. Dr Latt then presented diagrams and flow charts for information and reporting, QA function in hatchery, and in farm. He then turned to monitoring, analysis and assessment of the external environment (routine and on-demand). This includes the water source, surrounding farms and impact sources and addresses physicochemical and microbial parameters; the water, aquatic animals and plants (wild and cultured) and the sediment; and abnormalities in the physicochemical and microbial parameters. He then presented some detailed information on disease monitoring at the levels of the external farm environment and the entire country, and the results of disease surveillance.

66. Monitoring of the internal environment was then discussed, including water (incoming water, treated water, pond water, wastewater, and water discharged from farm); aquatic animals and plants (both wild and cultured, including pathogens and algae) and sediment, and weather parameters. The importance of monitoring and assessment of quality of inputs (e.g. seed, feed, chemicals and probiotics) was also stressed, as well as parameters for equipment used in production and movements of personnel. The monitoring and assessment of post-harvest products and activities is also important (e.g. products such as shrimp or fish; harvesting processes and methodology, SOPs, harvesting equipment, ice, etc., and methods of transporting to the processing plant). Various sample documents and graphs for recording and tracking changes in the various parameters were then presented, as well as examples of QA standard forms.

67. In closing, Dr Latt listed some key considerations made from a production economic perspective: the need for a cost efficiency strategy (short, intermediate and long term, in combination); that lowering production costs does not mean compromising seed quality; that the costs and limitations at each stage of production need to be identified; that possible reduction points need to be weighed against limits (consequences); and the pros and cons of proposed actions need to be weighed for both the short term and long term.

- ***Risk profiling – CODEX (Dr Iddya Karunasagar, Nitte University, India)***

68. Dr Karunasagar began his presentation on CODEX risk profiling by stating that risk assessments may be done at different levels: at the national level, to guide development of standards, policies or programmes, or at the farm level, to develop disease management activities. The key CODEX guidance for risk assessment for antimicrobial resistance is the Codex Alimentarus International Food Standards document Principles and guidelines for the conduct of microbial risk assessment. CAC/GL 30-99. Adopted 1999, Amendments 2012, 2014, which is a joint FAO/World Health Organization (WHO) document. These guidelines for risk analysis of foodborne illness define a hazard as "a biological, chemical or physical agent in, or condition of, food with potential to cause an adverse health effect"; risk as "a function of the probability of an adverse effect and the magnitude of that effect, consequential to a hazard(s) in food"; and risk analysis as "a process consisting of three components: risk assessment, risk management and risk communication."

69. He then presented the generalized structure of a risk analysis as comprising risk assessment (hazard identification, hazard characterization, exposure assessment, risk characterization), risk management (risk evaluation, option assessment, option implementation, monitoring and review), and risk communication. A generic framework for risk management was then presented, followed by diagrammatic overview of the microbiological risk management framework.

70. After showing completed risk assessments for cholerogenic *Vibrio cholerae* in warm-water shrimp in international trade and *V. parahaemolyticus* in seafood, he then listed the sources of information that may be needed for identification of a food safety issue. These include surveillance data, epidemiological reports, case reports, studies on interaction of the microorganisms with the environment through food production to consumption continuum, studies on dissemination of AMR determinants in the environment, and science-based expert opinion. The elements for consideration in a foodborne AMR risk profile were then presented as including:

- Description of an AMR food safety issue: AMR hazard of concern, antimicrobial agent to which resistance is expressed, food commodity with which AMR is associated.
- Information on AMR microorganism(s) and/or determinant(s): source, transmission route, pathogenicity, virulence, linkage to resistance, growth and survivability, distribution, frequency and concentration in food chain, inactivation in foods- pH, D-value.
- Characteristics of resistance: mechanism, location, cross-resistance, co-resistance, transferability between microorganisms.
- Information on the antimicrobial agent(s) to which resistance is expressed – non-human use: class, non-human uses, formulation, distribution, cost and availability; purpose - feed, food animals, food processing, sector, routes of administration - individual, mass medication, systemic; frequency, potential for extra-label use, potential role of cross- and co-resistance on food production, trends in use, trends in relation between use and occurrence of AMR.
- Information on the antimicrobial agent(s) to which resistance is expressed – human use: spectrum of activity, indications of treatment, is it in the critically important antimicrobial list?, distribution, cost, availability, availability of alternative agents, trends in use in humans, information on emerging diseases due to micro-organisms resistant to the antimicrobial agent or its class.
- Information on food commodities: source (domestic, imported), volume of production, frequency and per capita consumption, description of food production to consumption continuum (primary production, processing, storage, handling, distribution and consumption), characteristics of food that may impact risk management (pH, $a_{W,}$ cooking).
- Information on adverse public health effect: characteristics of the disease caused by AMR microorganism, trends in foodborne disease, frequency, severity, hospitalization rate and long-term complications, susceptible population, risk factors, epidemiological patterns, regional, seasonal, ethnic differences, consequences of AMR on disease outcome, loss of treatment options, increased frequency, severity of infection, prolonged duration, hospitalization requirement, mortality.
- Risk management information: identification of management options to reduce AMR hazard in food production to consumption continuum, measures to reduce the risk of selection and dissemination of AMR, measures to minimize contamination, cross-contamination with AMR microorganism, effectiveness of current management practices based on surveillance or other data.
- Evaluation of available information and major knowledge gaps: uncertainty in available information, identification of knowledge gaps that could hamper risk management, including, if warranted, the conduct of risk assessment.

71. Dr Karunasagar then discussed the criteria for ranking bacteria associated with aquaculture for development of an AMR risk profile. These include the importance in aquatic animal health (global distribution, affecting different aquaculture systems, causing serious economic losses, antibiotic treatment of fish known, data availability) and the importance in human infections (foodborne infection, likely to be treated with antibiotics, affects normal healthy individuals, data availability).

72. In conclusion, Dr Karanasagar presented the results of a recent ranking exercise for bacterial pathogens and Website captures for New Zealand Food Safety showing links to risk profiles for various human foods, and a United States Food and Drug Administration Draft Risk Profile: Pathogens and Filth in Spices.

- ***OIE and the PVS Tool: Aquatic (Dr Gillian Mylrea, OIE, France)***

73. In this presentation, Dr Mylrea provided the participants with some background on the OIE. She began by stating the OIE Global Vision, which is the economic prosperity, social and environmental welfare of populations, protecting animals and preserving our future. The OIE accomplishes this by delivering timely and high-quality information and services that allow the

management of risks to terrestrial and aquatic animal health and welfare, minimize associated dangers to human health, and protect the environment and biodiversity in a "One Health" approach.

74. The World Assembly of Delegates, which is the highest authority of the OIE, is composed of all national Delegates of the OIE; it convenes at least once a year in May. It adopts the OIE Standards published in the OIE Codes and Manuals. The Delegate is the national representative to the OIE and is thus appointed by the national government (and is usually the country's Chief Veterinary Officer). The Delegate is responsible for notification to the OIE of the national animal disease situation (through the World Animal Health Information System, WAHIS) and for the implementation of OIE standards at the national level.

75. The OIE currently has 182 Member Countries, 301 Reference Centers and 75 partner organizations. In addition to OIE headquarters in Paris, there are 12 Regional and Subregional Representations. The OIE has permanent institutional cooperation with 12 global public organizations (among them the FAO and WB), and technical and scientific cooperation with a large number of private-sector bodies, non-governmental organizations (NGOs) and regional public organizations. Donors and partners (though the OIE World Animal Health and Welfare Fund) include many national governments as well as private foundations.

76. The OIE Standards include the Aquatic Animal Health Code and the Manual of Diagnostic Tests for Aquatic Animals, which, as with other OIE standards, are developed through OIE's standard development process. Partner organizations may attend technical sessions of the General Session in an observer capacity, but they do not have the right to participate in the adoption of standards. Discussion and decisions of the Assembly on the adoption of standards are recorded in a report presented for adoption at the end of the General Session. This report is provided to Delegates and is placed on the OIE Website accessible to the public. In March of each year, as part of the meeting report of the Specialist Commissions that have met by February, all texts proposed for adoption at the General Session (held in May) are sent to Member Countries for consideration prior to presentation to the Assembly in May for adoption. Twice yearly, following distribution of Specialist Commission reports, OIE Member Countries have the opportunity (normally during a 60-day period) to submit written comments. Although there is no provision for written comments to be presented to the General Session, there is opportunity to make oral statements and to request clarification of texts before adoption. In-country consultations are held through the Delegate and Chief Veterinary Officer and may include consultations with the focal point, universities and research institutions, private veterinarians, and the private sector, as well as with the Regional Commissions and OIE Headquarters.

77. In conclusion, Dr Mylrea stated that OIE activities are a global public good, benefiting the international community, and contributing to building a healthier future and protecting animals.

- ***The OIE PVS Pathway and Aquatic Animal Health Services (Dr John Stratton, OIE, France)***

78. Dr Stratton first explained the principles behind the OIE Performance of Veterinary Services (PVS) Pathway. The PVS is a continuous process to improve national veterinary services and/or aquatic animal health services sustainably. It is an external independent process that involves experts trained and certified by the OIE (a 2 to 4-member team, with a process of 2 to 3 weeks). Evaluation is based on facts and evidence, not on impressions, and thus includes central and field visits. A PVS is initiated by an official request from an OIE national Delegate, with missions being voluntary.

79. The purpose of such missions is to assess national compliance with OIE standards (i.e. Section 3 of the Aquatic Code); and identify strengths, weaknesses and areas for improvements. The report is country property, and includes peer review, country comments and confidentiality of results, unless agreed. The report is supportive, not directive, and provides a strong platform for planning and advocacy. It includes strong evidence of real impacts in budgets, staffing, infrastructure, governance arrangements, and technical capacity etc. Its scope is the veterinary/aquatic animal health domain.

80. Dr Stratton then presented several flow diagrams illustrating the various pathways for import risk analysis, border inspection and quarantine; relationship to the PVS tool; and the structure of the PVS tool. The latter is comprised of four fundamental components: human, physical and financial resources; technical capability and authority; interaction with stakeholders; and market access (with 45 critical competencies and five levels of advancement). As examples, details were then presented for levels of advancement for the assessment in the areas of physical resources and epidemiological surveillance and early detection. Mr Stratton reported that new versions of updated guidance for the PVS tool will soon be available.

81. The PVS pathway was then illustrated, the components being: (i) orientation, evaluation, planning, and targeted support, the OIE collaborating with governments, donors and stakeholders in completing the PVS process. For the terrestrial sector, some 140 countries have requested PVS assistance from the OIE. For the aquatic PVS, some 18 countries have done so (e.g. Belize, Brazil, Chile, Colombia, Costa Rica, Côte d'Ivoire, Ghana, Lesotho, Maldives, Mozambique, Nicaragua, Panama, Peru, Philippines, Saudi Arabia, Seychelles, Turkey, and Viet Nam). The above includes 11 PVS missions implemented, 1 gap analysis piloted, and 1 follow-up mission.

82. The PVS results formally feed into OIE official recognition procedures. PVS results input into Global Strategies and related Progressive Pathways in terrestrial animal health; are there similar opportunities for synergies in aquatic animal health services (AAHS) (e.g. PMB/AB or self-evaluations)? Challenges for PVS-AAHS include the need for funding support for missions in parts of the world, and the need for additional OIE programme staff and support, to take it to the next level. Many countries and international agencies are part of the OIE World Fund. PVS has outcomes focus and assists a country to improve its AAHS irrespective of whether the AAHS is within the Veterinary Authority or within another government authority. As such, PVS respects the independence of the AAHS in a Member Country.

83. In conclusion, in looking forward, OIE PVS Advanced Experts training will be offered in March in Paris, with a dedicated aquatics session; experience of twin PVS missions will take place in Colombia/Peru, and the OIE Global Conference will be held in Chile.

- ***FAO self-assessment survey questionnaires on performance and capacity on aquatic animal health (Dr J. Richard Arthur, International Consultant, Canada)***

84. Dr Arthur commenced his presentation by describing the FAO survey as a self-assessment by participating countries that provides an overview of their current situation and helps FAO identify strengths and weaknesses (gaps), both nationally and on a regional basis. The purpose of the survey is to: (i) obtain information on national capacity and agencies mandated to implement aquatic animal health programmes for the participating countries; (ii) use strengths and gaps to identify the components and activities that might be included in national and regional aquatic animal health strategies and to identify national areas of strength and expertise that might be shared regionally; and (iii) to guide regional and national strategic planning for improving aquatic animal health and assuring adequate and rational support services to achieve sustainable aquaculture development. The survey can be thought of as a "stepping stone" leading towards the development of a national strategy for aquatic animal health (NSAAH).

85. Dr Arthur then briefly presented the history of the survey. As early as 1996 during the incursion of epizootic ulcerative syndrome (EUS) to Africa, the question of the status of biosecurity in that region was raised. The answer to the question was "we don't know"; thus, an initial survey questionnaire was developed by Dr Ramesh Perrera (Biosecurity Australia) and Dr Melba Reantaso (FAO) to understand the biosecurity situation and the emergency preparedness capacity in Africa. The survey was further developed by an FAO team (Dr Richard Arthur, Dr Melba Reantaso and Mr Alessandro Lovatelli) for use at a meeting of Regional Commission for Fisheries (RECOFI) countries held in Jeddah, Kingdom of Saudi Arabia in April 2008. The basic format has now been used for self-assessment surveys by some 65 countries globally, representing about 36 percent of FAO's total member countries.

86. Dr Arthur then went on to describe the survey process, which involves: (i) survey design and revision (by FAO); (ii) circulation of the survey to national focal points (NFPs) for review and revision to fit national circumstance, if appropriate; (iii) NFPs consult with national experts and other relevant respondents to obtain data and information; (iv) the NFP completes the survey and submits it to FAO; (v) FAO reviews the completed survey form for accuracy and completeness and if needed, returns it to the NFP for revision/clarification; (vi) for projects involving many countries, FAO edits, compiles and analyzes the survey data by region; and (vii) analyses and summaries are then presented at FAO project meetings and finally published.

87. The structure and components of the major components of the survey was then presented. These include 17 major sections: Section 1. International Trade in Live Aquatic Animals and National Border Controls; Section 2. Control of Domestic Movements of Live Aquatic Animals and Other Domestic Activities that May Spread Pathogens; Section 3. Policy and Planning; Section 4. Legislation; Section 5. Disease Surveillance/Monitoring; Section 6. Disease Diagnostics; Section 7. Emergency Preparedness/Contingency Planning; Section 8. Extension Services; Section 9. Compliance and Enforcement; Section 10. Research; Section 11. Training; Section 12. Expertise; Section 13. Infrastructure; Section 14. Linkages; Section 15. Funding Support; Section 16. Current Challenges and Constraints; and Section 17. Additional Information. Problems encountered during conducting of the surveys were then mentioned as: (i) completing the survey is a lot of work and may be difficult for some countries; (ii) NFPs for some countries are not very knowledgeable; and (iii) NFPs have other demands and priorities, and may not provide accurate or comprehensive answers to the survey questions (survey is not regarded as important or of high priority).

88. However, without a complete picture of where you are at, nationally and regionally, in terms of aquatic animal health capacity, it is difficult to determine where you want to be in five or 10 years, and how you will get there. Dr Arthur then concluded by illustrating the relationship between the NSAAH and the current PMP/AB initiative. The FAO self-assessment survey provides the information needed to make key decisions to develop the NSAAH. Together, the survey data and the NSAAH address many of the areas required for Stage 1 of the PMP/AB. If a country has completed the self-assessment survey and developed and adopted a NSAAH, it has already done most of the preparatory work for initiating the PMP/AB process. In closing, Dr Arthur noted that in the course of its projects and as assistance to development of NSAAH, FAO has produced many guidance documents that have direct relevance to PMP/AB. These can be accessed through the FAO Website.

5. SESSION 4: WORKING GROUP SESSION

89. The participants were divided into three Working Groups and tasked with considering the following questions related to the PMP framework and approach:

- Working Group Session 1 “PMP/AB Stages and Assessment”
- Working Group Session 2 “Rolling out of the PMP/AB”
- Working Group Session 3 “Initiating sectorial risk assessment”

90. Instructions given to the Working Groups by the leaders of each session are provided in Appendix 4C.

6. SESSION 5: WORKING GROUP PRESENTATIONS

91. The following sections summarize (in point form) the results of the Working Group discussions.

6.1. Summary of working group session 1 "PMP/AB stages and assessment"

PMP/AB Stage 1

- Key threats to biosecurity:
  - Biosecurity is a useful concept that needs to take into consideration many factors. The farm, sector or country should develop a list of drivers, including pathways, practices, trade and environment. The following were noted as threats and contributing factors:
    - direct pathways such as seed, animals and feed;
    - indirect pathways such as ballast water, vectors etc.;
    - lack of capacity, awareness and willingness;
    - the environment (e.g. rainfall, temperature);
    - pathogen attributes, such as specificity and latency;
    - host factors such as genetics;
    - the presence of neighbours and their status and proximity; and
    - aquaculture practices such as density, physiological thresholds, monitoring, system types and welfare actions.

- Review of outcomes within Stage 1
  - Identification of stakeholders and networks is necessary, but diagnostic laboratories should also be identified.
  - It is not clear whether the best approach is multisectoral or regional.
  - Vulnerabilities were addressed above, but should also include:
    - Interactions with other sectors;
    - Enzootic, exotic, emerging and other threats; and
    - Enabling the environment for good biosecurity.
  - Incentives for compliance (e.g. compensation, quality mark, legal consequences) need to be discussed.
  - Communication and networking mechanisms are needed.

- Comments
  - "Risk hotspots" need to be prioritized. This is a confusing term and could be replaced by priorities, critical control points or something else?
  - Biosecurity action plans; replace "enterprise" with site or sector?
  - Is this a plan or checklist? – it can only be a framework at this stage.

- Assessment
  - The Working Group was not sure that the stepwise approach works fully. There are pros and cons to the matrix – maybe steps 2 and 3 should run in parallel.
  - What is stage 4? It may differ between sites, sectors or regions. It should be defined at the start and reviewed as needed.
  - Evidence for Stage 1:
    - Responsible group appointed (by whom?);
    - Competent Authority, if it exists;
    - Meeting with report;
    - Questionnaire and responses; and
    - Sector or national action plan or road map.
  - What is a sector? Finfish, cyprinids, ornamental cyprinids etc. Examples:
    - United Kingdom:
      - trout and carp = Stage 4
      - Aquaculture production businesses = 4
      - fisheries = 3
      - ornamental = 2

- South Africa:
  - abalone = 3,
  - finfish = 1 (trout higher, tilapia lower)
- New Zealand:
  - salmon = 4

PMP/AB Stage 2

- The focus of PMP/AB Stage 2 should be:
  - implementation of the biosecurity plans developed in Stage 1;
  - monitoring the level of implementation and success;
  - providing evidence of pathogen reduction and improvement in biosecurity practices at the producer level;
  - providing further development of an enabling environment through strengthening partnerships and enhancing capacity to manage risks at the national level; and
  - based on the common framework developed in Stage 1, the country will develop a national aquatic biosecurity strategy that focuses on safeguarding progress and securing aquaculture sustainability and ecosystem health.

- If Stage 1 is biosecurity ground zero, and Stage 2 is implementation…where does an initiation phase fit?
  - Farmers won't wait for a biosecurity strategy at the enterprise level, and in many cases, enterprises may already be running farm-level biosecurity.
  - With regard to development of a national pathogen list:
    - Stage 1 is identifying the criteria for the pathogen list, while Stage 2 includes the development of the list. Shouldn't this be drafted in Stage 1 to allow for implementation at Stage 2?

- What is "sector" implementation? The definition of a sector is required to consider how it might be implemented.
  - Is a sector defined as "all species" in the national aquaculture production? Or is it at the farm level?
  - Is this where we could use the value chain to frame what a "sector" is within the national industry? But the value chain might draw focus away from the farm level by including the post-harvest processes, for instance? A sector could be a farm (unit of cultivation), all national aquaculture activities, or the production of a commodity (a product or species). Depending on which one, they could be at different stages?

- Key outcomes:
  - Enterprise-level biosecurity action plans (EBAPs) developed in Stage 1 are implemented by enterprise under the national framework.
    - Who does the activities required to meet this outcome, enterprise or government? For example, the development of vaccines can sometimes happen within farms or from pharmaceutical enterprise, outside of government. For small-scale farmers the capacity may be low and will require government support.
    - These are often already included iod aquaculture practices (GAP) for national industries, sectors or commodities. Within these GAP/better management practices (BMPs), there are already biosecurity components. Are the EBAPs separate to the components already included in the plans, or is the EBAP a component of a GAP?
    - Some regional GAPs are being implemented (e.g. in Thailand, Indonesia and Viet Nam). Such countries already have general aquaculture standards with already implemented biosecurity components. Is an EBAP a separate entity?

- The management of biosecurity vulnerabilities and occurrence of important hazards is monitored.

- With regard to surveillance, some level of surveillance is already happening at the farm level through general vigilance. Does there have to be government implementation of surveillance in order to monitor the national impact? This is another example of the requirement for a coherent link between enterprise and government, in that samples and results must flow from the farm to the government. In Stage 2, it seems it is possible to be building capacity and conducting surveillance?
  - Development of a plan for a national strategy on aquatic health:
    - Should this be in Stage 1?
    - Can we be asking implementation of EBAPs at Stage 2, while the government continues to develop a national strategy?
    - Will there be buy-in from enterprise if there is no national strategy?

- The current stage minimum requirements concerning a national plan are:
  1 = development of a national plan
  2 = national pathogen list is established
  3 = evidence the national strategy is being implemented
  4 = following international standards (global strategy)

- The following new minimum stage requirements concerning a national plan are suggested:
  0 = identification of components of national strategy (what's there and what's not?)
  1 = development of a national plan
  2 = co-implementation of a national strategy and review
  3 = evidence the national strategy is being implemented successfully
  4 = following international standards (global strategy)

PMP/AB Stage 3

92. The country should now have a National Strategy in Aquatic Biosecurity and implementing the National Biosecurity Plan, emergency plan etc. Countries have already done their risk assessment (Stage 1) and identified biosecurity issues in each sector.

- Examples of key threats at the national perspective are:
  - any "emerging" diseases or pathogens – new, exotic species or strains and their associated pathogens from exporting countries, specifically countries that do not report to OIE or report no existence of the disease;
  - countries are very focused on OIE-listed diseases, but some may need to be encouraged to horizon scan and to build this into their national strategy and to develop a national pathogen list;
  - certain countries with limited transparency or competence on health status;
  - countries establishing new enterprises and commodities;
  - countries with limited national capacity and/or resources for identifying and responding to outbreaks; and
  - countries having difficulty in enforcement of their national strategy, applying emergency plans, or maintaining the active involvement or engagement of industry in delivering the national strategy.

- Review of the objective and outcomes for Stage 3:
  - Title – a national biosecurity management system is in place to safeguard One Health, the environment, and the sector economy…;
  - Objective – needs to be referenced to economic impact; and

  - Outcomes – need to include integration with customs and border authorities, academia etc.
    - Outcome 5 – include engagement of key stakeholders and communication strategies (e.g. Chile (4), Japan (4) Norway (4), Saudi Arabia (4)).

- PMP/AB Tool Kit
  - Kingdom of Saudi Arabia – enforcement tool;
  - Chile – Continuous Assessment Performance (National Surveillance Program), but this needs to be flexible dependent on season, emerging species etc.;
  - Norway – Fish Health Services System to evaluate performance (but only on disease and not biosecurity); and
  - Surveillance – if no disease then this is working, health status of stocks and unaffected trade.

- Assessment
  - Discussion centred on having national strategy development at Stage 1 and then a re-assessment at Stage 4. The national strategy needs to provide a structure to help the small-scale farmers access resources at the outset of the process. Each sector will then be able to develop its own plans in terms of biosecurity.
  - A gateway system is not realistic for most countries, so the stage-based concept needs to be more flexible, for example based on pillars. Keep the four stage headings, but countries should not have to complete each pillar before moving on to the next. Components could be considered more of an idea (e.g. essential vs desirable). It is proposed to have "outcomes" instead of evidence. The key objective is to show that the country has reduced the impact of disease, i.e. instead of evidence points, having your system based on outcomes.
  - In each stage, an indication of which requirements are more critical than others are needed. Requirements thus need to be ranked or maybe based on a point-system. Indicators need to be simplified.
  - Some examples of outcomes that are proposed instead of evidence include ratios (rather than final figures), mortality rates, tonnage production, final national numbers related to volume of production; each country refers to its own system and this has to be related to biosecurity indicators. In the European Union, for example, existing knowledge, disease reports, different categories – disease status; Quality Assurance – introduction of certification procedures (e.g. evidence of successful submission to OIE).

- Sustainable national aquaculture system is in effect
  - Remove "sustainable" from the title; the title needs to be related to the main objective/outcomes. Maintain status without exotic diseases, reduction in enzootic disease, reduction in antimicrobial treatments per volume produced (need ratios), eradication of exotic diseases. Or be more specific; for example, improving market access due to improvement in biosecurity provision.

PMP/AB Stage 4

- Key vulnerabilities
  - loss of the engagement (confidence) of stakeholders (no visible benefits);
  - economic: lack of sufficient resources; no reporting by companies (information sensitive to the stock market for large companies);
  - political: political instability, lack of priority for the sector (governmental support), lack of recognition of biosecurity issue at national level for fear of implications to trade; and
  - natural: calamities.

- Review of objectives and outcomes of Stage 4
  - Key outcomes are appropriate:
    - activities are sustained and improved by learning through experience;
    - an enabling environment is maintained and continuously improved;
    - national and international stakeholders have confidence in national aquaculture and ecosystem health system (national stakeholders to see benefits); and
    - contribution to reducing the risk of transboundary diseases at global level.
  - Examples of countries at Stage 4: Norway, United Kingdom, Ireland (for salmonids), Kingdom of Saudi Arabia (shrimp).
  - PMP Toolkit
    - Tools applied in Stages 1–3 should be maintained.
  - Assessment
    - Gateway Pass: written report on NSAAH, endorsed by stakeholders (self-assessment or external assessment?).
    - Minimum requirements:
      - all previous indicators continue to be achieved;
      - transparent reporting;
      - consideration of pathogen emergence, ecosystem health and public safety. Evidence of contribution to reducing transboundary disease transmission and sustainability as a sector; snd
      - risk-based import controls following international standards.

- General comments and questions
  - The PMP should be a pillar approach (with stages within pillars), especially when there different species in one country. Species should be grouped by pathogens or group of species.
  - Allows countries to focus on the main economically important species (trade or food security).
  - Government to be committed from Stage 1.
  - Important role of the private sector. Very often the private sector is the initiator.
  - Who is going to verify/evaluate/recognize? Reporting? Peer review?
  - What's the objective or benefit for the country or industry? (easier trade?, relationship with certification? extra value when marketing? or just reducing disease and transboundary disease problems?
  - What are the incentives for small holders?

6.2. Summary of working group session 2 "Rolling out of the PMP/AB"

Working Group A: Initiation, adoption and incentives

- Initiation
  - Initiation is a joint process, and this is a key to success.
  - A sector association approach is required. The approach will differ from country to country.
  - At the national level, FAO, governments, regional organizations and industry associations (chambers of commerce) may be involved. FAO and government may not be the most active but can push participants from the beginning. FAO can choose the participants from their profiles for the inception meeting.
  - At the enterprise level there is a need for all key stakeholders, particularly the producers, to be led by the most competent.
  - Difficulties to be faced include motivating country and industry, and a lack of trust, transparency, competency, interest, political will, and funding.
  - To support the initiation, clear, convincing communication of evidence-based benefits is needed.

- Biosecurity Task Forces – National/Enterprise Level
  - Full stakeholder involvement is needed, but government support will be essential. FAO facilitation (e.g. technical support) would be desirable, if required.
  - An external advisory group is desirable.
  - The process needs to be flexible; e.g. hold a stakeholder workshop, identify key partners who show willingness and the competence to be involved and then proceed from there.

- Incentives to participate in the PMP/AB at the national level
  - Benefits need to be felt at all stages of the value chain, not just at the national level.
  - Types of incentive include:
    - reduction of pathogens and transmissible diseases, decrease in use of antimicrobial treatments (AMT) etc.;
    - increased production;
    - trade incentives;
    - social licence/acceptance – the aquaculture industry showing a willingness to address issues such as biosecurity, job security, environmental benefits and gender equality;
    - financial incentives, e.g., access to a budget, loans at national level (e.g. World Bank); and
    - certification guidelines; the possibility that biosecurity could be incorporated as an extra tickbox; benefits for buyers and suppliers - part of good production practices.
- Incentives to participate in the PMP/AB at the enterprise level
  - Incentives through public or financial sector initiatives, such as:
    - tax credits or other benefits;
    - compensation for loss of stock (country specific);
    - access to preferential bank rates;
    - preferential insurance rates/access to insurance for cover disease in the marine sector;
    - needs incentive so that everyone in a particular area (e.g. river catchment area, bay, zoned area) is working to the same system/cluster system;
    - additional training in biosecurity; and
    - intangible assets for enterprises with successfully implemented biosecurity plans.

- Setting targets
    - Depends on levels of support and available resources, and what stage you are entering the PMP/AB.
    - If the PMP/AB is an assessment of where the country is now, this could probably be done in approximately 3 months.
    - If a change of legislation is required, then it could take longer, depending on the context, country and political will.

Working Group B: Sustaining the PMP/AB at the global level

- The Working Group started by defining the question and agreed that given that the PMP/AB is still in the development stage and not yet final, it would focus on sustaining its "development".
- The Working Group agreed that a clear, coordinated approach is essential for the next phase of development and then implementation. This needs to be a small group of people willing to do the work (or having the resources to delegate it) to finalize the tool and then develop an implementation plan.
- Some of the discussions raised more questions than answers, given that folks could not easily visualize what the tool itself will look like or how it will be implemented. It will be hard for donors to commit while this is unclear.
- It was agreed that the PMP/AB needs to be owned by a body; however, what that is was not clear. Some thought was given to the idea that an independent body with funding (e.g. a centre) would be good, while others thought it should be an international body.
- However, given that the PMP/AB is an FAO initiative, it was agreed that at this stage that it should continue to be co-ordinated by FAO; however, FAO needs to explore a governance structure that includes key players, is not too big and is more like a steering committee but still acting like a working group, given that a lot of work is still required.
- A clear road map is needed so that the next steps will be more attractive to donors and for folk to justify their ongoing participation (e.g. over the next two years).
- The Working Group discussed how to use the NORAD/FAO project and avoid duplication
- Dr Subasinghe indicated that the FAO process for approving such a tool or expert centre is long. The Global Framework for the Progressive Control of Transboundary Animal Diseases (GF-TADS) was raised as a possible simpler mechanism that would provide a joint FAO/OIE secretariat and structure.
- It is important that recipient countries get to contribute to the development and ensure that the PMP/AB meets their needs. This will also ensure their buy-in.
- The need to have official endorsement of progression through stages to provide motivation to country was discussed, but no agreement was reached as to whether this was necessary and if done, by whom?

Working Group C: Capacities to implement the PMP/AB

- Need for experts
    - A roster of experts is needed. International organizations like FAO and OIE, regional organizations like the Network of Aquaculture Centres in Asia-Pacific (NACA), and professional societies like the Asian, European, and American Fisheries Society (AFS) could also play a role.
    - Experts could be veterinary or aquaculture specialists with additional training in fish health management. A certification programme like the one implemented by the AFS would be useful. Experts should have practical experience in the aquaculture species.
    - The team should be multidisciplinary, involving pathology, microbiology, epidemiology, toxicology etc.

- The number of experts needed will be based on the number of farms and extent and intensity of aquaculture area. The number of trainers could be limited, but the trainee number should be adequate to serve the sector.

- National capacities and skills
  - A multidisciplinary team is needed, with expertise in aquaculture species of concern, hatchery, larval culture and pond culture. Areas of importance are pathology, microbiology, water chemistry, disease diagnosis, toxicology etc.
  - The experts could come from either the public or private sector. National experts are preferable. International experts should be from the region and have practical experience with the aquaculture species.
  - Skills in delivery of training in different formats would be important. This may vary in different countries. Language skills would be important.

- National capacities: training
  - Training could be in different formats, e.g. e-learning, on-farm training, face-to-face training etc. E-learning could be in broad areas. Face-to-face training could be in more focused areas.
  - There should be sufficient funding for training activities, which should be sustainable.
  - Training can be in different modules.
  - International organizations like FAO and OIE, and regional bodies could play a role in the delivery of training.
  - It will be good to establish regional training centres. Universities could play a role.

- Networks for capacity building
  - The existing networks of FAO, OIE, NACA and other regional organizations and professional societies could support capacity building.
  - A consortium of universities, professional societies and producer associations could form a network to support training.

6.3. Summary of working group session 3 "Initiating sectoral risk assessment"

93. The following section integrates and summarizes in point form the results of the Working Groups' deliberations on initiating sectoral risk assessment.

- Risk assessments at different levels
  - Risk assessments are needed to guide national biosecurity policies and programmes and for farm-level biosecurity.
  - At the national level, these should be formal risk assessments for importing new species and for first-time importation of stock.
  - At the farm level, it is important to understand that simplified, not highly sophisticated risk assessments are required. Part of farm-level biosecurity is knowing where the stock is coming from and having a good understanding of its health status.
  - At the farm level, it is important to understand and assess parameters of control efforts in order to manage risk, so that the critical control points in the HAACP approach can be identified.
  - Risk assessment should be seen as a dynamic process. With new knowledge, there is a need to see where readjustment is required (e.g. effects of disinfection on microbial perturbation).
  - Risk assessment can be used to decide where to focus efforts, rather than as an operational procedure, e.g. from details in the PMP/AB documentation.
  - Additional key points:

        - There are a wide variety of farms – some small, some large, and clusters. Farm level risk analysis should be based on the operational aspects of these systems.
        - Country-level risk assessment should depend on the objective, e.g. policy development, trade facilitation.

- What process to follow?
    - A combined approach is needed that includes both IRA and farm-level risk assessment.
    - Assessment of national vs farm-level risks will require different processes. Risk assessments can use qualitative or quantitative approaches.
    - International standards should be followed, where required. The risk assessment process to be applied will depend on the type of risk identified. For food safety risks, the CODEX risk profile guidelines are applicable, while the OIE's import risk analysis (IRA) guidelines are appropriate for assessing pathogen risks for movements of live aquatic animals (i.e. trade). There may also be industry-led risk assessments designed to meet corporate objectives.
    - At the country level, risk analyses may be needed not only for pathogens, but also for other risk sectors – food safety, genetics, environmental/ecological, and social/financial, etc.
    - For genetic, environmental and other risks, there are no universal standards, so country-level practices for these risk assessments will be needed.

- Who should be involved and what commitments are needed?
    - Countries may need to have relevant in-house expertise; decisions need to be made as to who should be involved and what commitments are needed. Experts can be drawn from government, academia and industry, as appropriate.
    - Expertise is needed throughout the whole production system and if national expertise is not available, then it will need to be imported (can be expensive!).
    - Producers, including their surveillance teams, biosecurity officers and transport service providers (e.g. well boats, feed barges) are all involved in the value chain.
    - Expertise could include local veterinarians, Competent Authority veterinarians and outside expertise (when needed).
    - Border countries' expertise could also be involved, if there are shared value chains (shared systems = shared risks).
    - A national-level risk assessment would require broad expertise in different areas such as microbiology, disease diagnosis, pathology, disease management, toxicology, epidemiology and statistical modelling. The expertise needed would depend on whether the risk assessment is qualitative or quantitative, the latter needing much broader and deeper expertise.
    - A farm-level risk assessment would need experts with practical experience in farm operations.
    - Timelines**:**
        - There are too many variables to establish firm timelines.
        - Six weeks to three months would be required to do a straight-forward risk assessment, but the time required depends on the level of existing knowledge and local beliefs and culture. For example, in Chile, when a risk assessment is completed, it must be published on a website giving 30 days for comments.
    - Coordination and decision making:
        - At the farm level this is the responsibility of farm management, with decisions made by the chief executive officer (CEO) and advisors.
        - At the national level, coordination and decision making for a national risk assessment would be at the government level and would be the responsibility of the Competent Authority.

- For import risk analysis (IRA), politicians will make the final decision based on the results of IRA and other factors.
- The resources and time required would depend on whether the risk assessment is qualitative or quantitative.
- A farm-level risk assessment may have an internal system of risk assessment and risk management.

- Application of HACCP principles
  - HACCP provides a good framework for planning and implementation of biosecurity in a farm. Since it is logical, it can be used at the farm-level by non-experts.
  - In some instances, at the farm level, the use standard operating procedures (SOPs) may be more appropriate.
  - Depends on the objective of the PMP/AB. If trade focused, then use CODEX, OIE IRA framework, etc.
  - To conduct HAACP, one must:
    - Conduct a hazard analysis (know your pathogens);
    - Determine the critical control points (know your contamination pathways);
    - Establish critical limits (at the farm level, these could be the biosecurity practices and how they are to be implemented. Critical limits could also be in terms of water quality parameters like dissolved oxygen, ammonia and nitrite levels that can be tolerated by the species cultured);
    - Establish a system to monitor critical control points (monitoring, for example, disinfection of intake water, nets and equipment; hygienic practices adopted by personnel; movement of stock etc.);
    - Establish corrective action when monitoring indicates that a critical control point is not under control (establishing corrective action when any failures in biosecurity are detected should be a part of the biosecurity plan. Corrective action in a farm needs to be taken when water quality deteriorates or when any abnormal behaviour in fish is noticed);
    - Establish procedures for verification that the HACCP system is working effectively (establishing procedures for verification that biosecurity is working properly is also an important aspect of biosecurity plan); and
    - Establish documentation regarding all procedures and records appropriate to these principles and their application.

- General Comment: The name for Stage 1 should probably not be “Risk Assessment,” as it relates to identification of national and/or sectoral priority areas.

6.4. Plenary discussion and action points for the working groups

94. A summary presentation on the results of the discussions on the PMP/AB through Working Group sessions 1 and 2 was given by Dr Melissa McLaws. This included:

- General comments:
  - PMP is a framework to develop or enhance a biosecurity system. The incursion of a new pathogen should not cause a downgrade in PMP/AB stage.
  - The concept of biosecurity vulnerabilities is useful. Many will be identified in Stage 1 (the focus of this stage), but they will continue to emerge throughout the pathway.
  - For a PMP/AB risk-based approach, focus should be on the key drivers and biosecurity vulnerabilities.
  - Several risk assessment frameworks can be useful; the main point is the systematic approach.

- Summarized important issues raised by the Working Groups:
    - What is the objective of the PMP/AB: is it biosecurity to reduce the burden from disease or is it more? Is the PMP/AB a tool or a programme?
    - Should the PMP/AB approach be stepwise or pillar, or combination of both (a matrix approach)?
    - Should the approach be national or sectoral or pathogen based?
    - Terms need to be defined (e.g. biosecurity, risk hotspot, national strategy, sector/enterprise, risk assessment).
    - At what point should a national strategy be developed? In some countries the industry will lead (EBAP) while in others the government must go first. Some countries may not ever develop a national strategy.
    - For the PMP/AB assessment process, a 3rd party or international-body coordinated assessment (GF-TADs) may provide incentive to participate.
    - Initiation must be flexible and should be done as a joint effort (sector, national, enterprise).
    - Incentives need to be identified at both the national and enterprise levels, and must be ongoing in order to sustain efforts.
    - A "road map" is needed to move forward. It begins with further development of a pilot phase. FAO as coordinator and leader of the pilot phase is appropriate, because of the organization's obligation to improve food security.
    - Projects and funding should be long-term: support from the WB may be possible? Need to explore existing international mechanisms.
    - A training plan will be needed and should include training at the international, national and farm levels. Training of trainers may be useful.
    - Multidisciplinary expertise will be needed, and should be via multiple modalities (e.g. e-learning, workshops etc.).

- Recommendations:
    - Present the PMP/AB as a side-event at the FAO Subcommittee on Aquaculture in August.
    - Proceed with piloting the PMP/AB within the next 12 months in conjunction with further development of the tool.
    - Form a steering committee for further development of the tool.

95. The outcomes of Working Group session 3 were presented by Dr Iddya Karunasagar:

- Under the title of sectoral risk assessments, he noted that the Codex Alimentarius Commission has provided a decision tree on the use of the risk analysis process in standard development. Risk profiling is part of the preliminary risk management activity. The output from a risk profile may lead to management measures or may identify the need for a risk assessment and identify data gaps.
- A risk assessment can be qualitative, semi-quantitative or fully quantitative. The resources and time required for risk assessment will vary. Qualitative assessments require low resources and can be done quickly, but the resolution provided will be low.
- Risk assessments may be done at different levels; for example, at the national level to guide policy development, or at the farm level to develop a biosecurity plan.
- HACCP is a logical framework that is widely used in the food processing sector, and this approach may be applicable in the development and implementation of aquatic biosecurity plans.

96. Prof Elizabeth J. Cottier-Cook then briefly presented on the structure of the PMP/AB stages. She suggested the PMP/AB allow for the progression of the national and enterprise levels to occur independently and concurrently (i.e. pillar approach), starting from Stage 1 (see Figure 1).

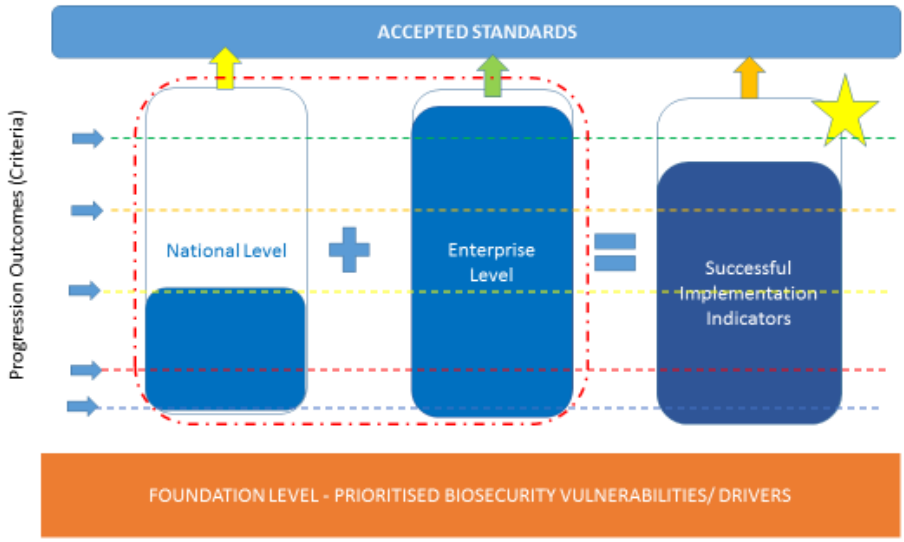

Figure 1. Proposed outcome progression of the stages of the PMP/AB at the national and enterprise levels.

7. SESSION 6: PLENARY DISCUSSIONS ON FOLLOW-UP WORK

7.1. Recommendations from PMP/AB1

97. The recommendations arising from PMP/AB1 were summarized by Dr Franck Berthe as being: "to develop further and implement the PMP/AB approach." This included:

- Developing the technical aspects of the PMP/AB framework, including: a vision, goals and objectives
    - Ideas for a **Vision Statement** included:
        - Aquatic biosecurity for social and economic development;
        - Control of economically important diseases by 2030;
        - Aquaculture for sustainable rural livelihoods;
        - Increasing production by decreasing the risk of disease through risk-based, progressive, collaborative processes;
        - Preventing new diseases from spreading and controlling the impact of the global spread of disease over the next 30 years;
        - Achieving biosecurity for aquaculture growth and increased production; and
        - Establishing biosecurity plans in all countries.

98. **The Mission Statement** was put forward as: "Increase global fish health and production by increasing biosecurity and decreasing the global spread of new and emerging diseases."

- A sectoral approach was agreed upon. This included:
    - Indicators (these were deliberated, and the contents/scope/some details were agreed upon at PMP/AB2);
    - Assessment criteria and procedures;
    - Linkages with OIE; and
    - Strong consideration of OIE aquatic animal health standards (mandatory reporting), and inclusion of the PVS tool in the PMP/AB.

- Building a wider consensus and promotion and advocacy, including:
    - Presentation to FAO COFI 10th Session for endorsement in August 2019 (this was already agreed as an agenda during COFI/SCA10);
    - Stakeholders to make their respective quarters aware of the PMP/AB initiative;
    - FAO presentations to be delivered at several scientific fora (e.g. US Congressional Briefing, April 2018; World Aquaculture Society (WAS) AQUA 2018, Montpellier, France, August 25–29 (already completed); The Southeast Asian Fisheries Development Center (SEAFDEC) Thailand August 2018); and St Kitts Aquatic Veterinary Conference November 2018);
    - WB to consider incorporating the PMP/AB framework into its portfolio of investments with client countries;
    - A resolution or other appropriate mechanism to be put forward at the OIE General Assembly in May 2019;
    - Presentations to be given by participants from regional and international intergovernmental organizations at relevant government council meetings;
    - Full presentations uploaded (http://www.fao.org/fishery/nems/41063/en);
    - Development of regional approaches; and
    - Pre-stage 1 advocacy.

- A self-assessment tool would need to be developed so that countries can assess where they are on the biosecurity development pathway. This should be voluntary and have no market access applicability.

- Initiation of "prototype" trials with the PMP/AB approach for projects that are already underway with FAO, WB, NORAD, MSU and others, in support of aquaculture development, to try applying the concept in their relevant projects and programmes. Examples include:
    - FAO/NORAD/NVI GCP/GLO/979/NOR: Indonesia, Vietnam (2019);
    - FAO/Cefas: EU True Fish Project: Lake Victoria countries: Uganda, Kenya and Tanzania (2019-2024);
    - FAO/AfDB: Zambia Aquaculture Project (2019-2024); and
    - Countries that have expressed interest and willingness to be PMP/AB rollers include Chile, the Kingdom of Saudi Arabia and Norway.

- The report of the consultation and supporting documentation were to be finalized for presentation to participants to share with industry associations and government authorities for information prior to tabling to the COFI Sub-Committee on Aquaculture, and the OIE General Assembly in 2019. In this regard:
    - All participants were to send comments on the Draft Report of PMP/AB1 to FAO by the end of June (later extended to the end of January 2019). Five comments were received, all saying that the report was good and captured the discussions points; only one comment with actual changes requested.
    - FAO was to prepare the final version of the Report of the Consultation by January 2019 and that this should be finalized in the 12-step Publications Workflow System (PWS) of FAO by the end February 2020.

- FAO/WB/MSU will look at a second joint consultative meeting to be held in Paris, from 29 to 31 January 2019 to assess progress with a draft business case, a country self-assessment checklist/tool, and any results from "prototype" testing in countries that have aquaculture development projects underway with Norway, FAO or other organizations with an interest in volunteering "field-testing" opportunities in 2019.

- The linking of government laboratory expertise to academic expertise (e.g. University of Exeter, Sustainable Aquaculture Program), as with extension services linking academia to industry, would be a "good news" story; as per the PMP/AB approach. A short, 1 500-word

piece for the front of *Science* (Policy Forum page) could also be a useful launch pad for this initiative.

- FAO will work with funding agencies for support to engage the expertise needed to build as comprehensive a cost-benefit analysis as possible for the PMP/AB approach.

- The core coordination team, led by FAO, WB and MSU will keep the participants updated on progress as the above strategy rolls out over the summer and fall of 2019.

7.2. Recommendations of PMP/AB2 (Paris, January 2019)

99. General recommendations arising from PMP/AB2 include the following:

- The purpose of the PMP/AB is to develop or enhance a biosecurity system in a country. The incursion of a new pathogen should not result in the downgrade in PMP/AB stage.

- For a PMP/AB risk-based approach, focus should be on the key drivers and biosecurity vulnerabilities.

- The seaweed sector prioritizes biosecurity and should be considered during PMP/AB development.

- There are several risk assessment frameworks that may be useful for the PMP/AB. A systematic approach should be used.

- For the PMP/AB assessment process, a third party or international body coordinated assessment may provide incentive to participate.

- Initiation of the PMP/AB must be flexible and should be done as a joint effort (sector, national, and enterprise levels).

- Incentives need to be identified at both the national and enterprise levels, and must be ongoing in order to sustain efforts.

- A "road map" is needed to move forward. It begins with further development of a pilot phase. FAO as coordinator and leader of the pilot phase is appropriate, because of the organization's obligation to improve food security.

- Projects and funding should be long-term: support from the WB may be possible? Need to explore existing international mechanisms.

- A training plan will be needed and should include training at the international, national and farm levels. There should be training of trainers.

- Multidisciplinary expertise will be needed and should be available via multiple modalities (e.g. e-learning, workshops etc.).

100. The following needs to be further defined and/or developed in the PMP/AB:

- The concept of the PMP/AB – it is not clear whether it is a programme, tool, or framework.

- What are the main objectives of the PMP/AB and its expected results?

- The approach of the PMP/AB – should it be stepwise or pillar, or a combination of both (matrix approach)? Should the approach be national, or sectoral, or pathogen based? At what point should a national strategy be developed?

- Terminology such as "biosecurity", "risk hotspot", "national strategy", "sector/enterprise", "risk assessment" should have definitions available in a glossary.

8. SESSION 7: CONCLUSIONS, THE WAY FORWARD AND CLOSING

8.1. Conclusions

101. The Second Multi-Stakeholder Consultation on the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) resulted in further consensus that the PMP/AB may be a way forward to addressing biosecurity challenges in aquaculture. The feedback received from stakeholders during the consultation will lead to a better understanding of the principles, application and benefits of the PMP/AB.

102. The consultation highlighted recent developments in aquaculture biosecurity, the various sectors, as well as recent, ongoing, and future work on aquatic animal health. The PMP/AB will be applicable to improve biosecurity for all forms of aquaculture production scope and objectives – small to large; local to international traders.

103. The main objective of the consultation was to deliberate the draft indicators, checklists and guidelines for rolling out of the PMP/AB. The main background document on the stage descriptions was highlighted and served as a basis of great discussion and information gathering to improve clarity in the PMP/AB approach. Comments or concerns raised during the consultation will serve to further develop the PMP/AB guidance and supporting tools.

104. Because the PMP/AB is a risk-based approach, risk analysis is a very important component of the indicator requirements, especially in Stage 1. Several risk assessment frameworks may be applicable to the PMP/AB, but emphasis should be placed on a systematic approach. The PMP/AB looks at establishing risk ownership and promotes active engagement and long-term commitment to risk management.

105. Self-assessment is an essential part of the process of national ownership of the principles, responsibilities, and coordination with other activities required for management. Self-assessment of a country's progress through the PMP/AB stages will be further developed, based on recommendations raised during the consultation. The OIE Tool for the Evaluation of the Performance of Veterinary Services and/or Aquatic Animal Health Services (OIE PVS Tool: Aquatic) can be used by countries (voluntarily) to identify and build upon strengths and weaknesses to move towards a position of robust international recognition. The potential overlap of the PMP/AB and PVS help a country to work towards a PVS evaluation for the aquaculture sector.

106. Initiation of the PMP/AB needs to be a joint effort with a strong public-private partnership. PMP/AB implementation plans should be developed between industry stakeholders and governance authorities to ensure buy-in and best-fit for country. There should be a degree of consistency in PMP/AB implementation between participating countries or regions.

8.2. The way forward

107. The next steps required to move the development and implementation of the PMP/AB forward are:

- Form a PMP/AB steering committee for further development of the tool.

- Organize a follow-up technical working group meeting to further development of the PMP/AB, including stage descriptions, indicators, self-assessment tool, governance, and other guidance documents and/or tools necessary for roll-out of the PMP/AB in pilot countries.

- Proceed with piloting the PMP within the next 12 months in conjunction with further development of the tool.

- Present the PMP/AB to the FAO COFI Sub-Committee on Aquaculture 10th Session for endorsement scheduled in August 2019.

- Raise awareness on the PMP/AB during the next OIE General Assembly.

8.3. Closing

108. Remarks closing PMP/AB2 were given by Dr Edgar Brun on behalf of the Norwegian Veterinary Institute (NVI), Dr Patricia Gaunt on behalf of Mississippi State University (MSU), and Dr Melba B. Reantaso on behalf of the FAO. All three expressed thanks to the OIE for hosting the consultation and thanked the participants for their efforts in the further development of the PMP/AB.

109. A number of the participants then expressed their deep appreciation to the organizers of the consultation and their strong support for future activities.

9. REFERENCES

FAO. 2018. *Consensus reached by multistakeholders to support a risk-based, progressive and collaborative pathway/tool to improve aquaculture biosecurity* [online]. [Cited 16 February 2020]. http://www.fao.org/fishery/nems/41063/en

FAO. 2019. *Report of the FAO/MSU/WB First Multi-Stakeholder Consultation on a Progressive Management Pathway to Improve Aquaculture Biosecurity (PMP/AB), Washington, D.C., United States of America, 10–12 April 2018*. Rome, FAO Fisheries and Aquaculture Report No. 1254. 76 pp. (also available at http://www.fao.org/documents/card/en/c/ca4891en/).

APPENDIX 1

Draft programme

Date and time	Activity
Day 1 (Tues) 29 January 2019	
08.30-09.00	Registration
Session 1	**Opening**
09.00-09.30	Welcome remarks • FAO (Árni Mathiesen) • NORAD (Magnus Sverre Petersen) • WB (Franck Berthe) • OIE (Monique Eloit)
09.30-09.40	Introduction to objectives, mechanics and expectations (Melba Reantaso)
09.40-10.20	Self-introduction and group photo
10.20-10.45	Coffee
Session 2	**Progressive Management Pathway to Improve Aquaculture Biosecurity (PMP/AB)**
10.45-11.00	Highlights of the PMP/AB 1 (Washington D.C., April 2018) (Franck Berthe)
11.00-12.30	PMP/AB guidance and monitoring, checklist, indicators and discussion (Melissa McLaws, Brett MacKinnon)
12.30-13.30	Lunch
Session 3	**Government, academe and producer sectoral updates**
13.30-13.50	Steps to set up biosecurity system against shrimp infectious diseases, from farm to country level in China (Huang Jie)
13.50-14.10	Aquaculture biosecurity: a UK Perspective (Nick Taylor)
14.10-14.30	Need for more research in microbial management to make intensive aquaculture more sustainable (Patrick Sorgeloos)
14.30-14.50	MSU/USAID Fish Innovation Lab (Patricia Gaunt)
14.50-15.10	FAO/NORAD improving biosecurity governance and legal framework for efficient and sustainable aquaculture production (Melba Reantaso)
15.10-15.30	Coffee
15.30-15:50	Seaweed aquaculture: biosecurity policy and practice (Elizabeth Cottier-Cook)
15.50-16.10	Principle and design of biosecurity and quality assurance programme in large-scale hatchery and grow-out shrimp intensive culture operations (Win Latt)
16.10-16.30	Biosecurity risks in aquafeed (Jose Villalon)
16.30-17.00	Discussions
Day 2 (Wed) 30 January 2019	
Session 3 continued	**Government, academe and producer sectoral updates (continued)**
08.30-08.50	Good aquaculture practice for improved biosecurity: examples and experiences (Rohana Subasinghe)
08.50-09.10	Risk profiling (using HACCP approach) (Iddya Karunasagar)
09.10-09.30	OIE international standards in aquatic animal health; responsibilities of governments re implementation and how

Date and time	Activity
	other stakeholders participate; and The PVS Tool: Aquatic – an update (Gillian Mylrea)
09.30-09.50	FAO self-assessment survey questionnaires on performance and capacity on aquatic animal health (Richard Arthur)
09.50-10.00	Discussions
10.00-10.15	Coffee
Session 4	**Working Group session (guidelines will be presented prior to the WG sessions)**
10.15-12.15	Working Group Session 1 (related to Session 2: PMP/AB monitoring, checklist, indicators)
12.00-13.00	Lunch
13.00-15.30	Working Group Session 2 (related to Session 2 – guidance in rolling out of PMP/AB)
15.30-15.45	Coffee
15.45-17.30	Working Group Session 3 (related to initiating sectoral risk assessment)
Day 3 (Thurs) 31 January 2019	
Session 5	**Working Group presentations (1,2,3)**
08.30-09,00	Preparation of WG presentations
09.00-09.30	WG 1
09.30-10.00	WG 2
10.00-10.15	Coffee
10.15 -10.45	WG 3
10.45-12.15	Plenary discussion and action points for WG 1, 2 and 3
12.15-13.30	Lunch
Session 6	**Plenary discussions on follow-up work**
13.30-14.30	Recommendations of PMP/AB 1 (D.C., April 2018)
14.30-15.30	Recommendations of PMP/AB 2 (Paris, January 2019)
15.30-16.00	Coffee
Session 7	**Conclusions, the Way Forward and Closing**
16.00-16.45	The Way Forward and plenary discussion (R Subasinghe)
16.45-17.00	Closing remarks • NVI (Edgar Brun) • MSU (Patricia Gaunt) • FAO (Melba Reantaso)

APPENDIX 2

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APPENDIX 3

Group photographs

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High level officials graced the Opening Session of the PMP/AB2 meeting. Left to right: Dr Árni Mathiesen (Assistant Director-General, FAO), Dr Magnus Sverre Peterson (Higher Executive Officer, NORAD), Dr Franck Berthe (Senior Livestock Specialist, World Bank), and Dr Monique Eloit (Director General, OIE).

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Group photo: Forty-one delegates representing government, regional and international intergovernmental organizations, industry, academe and development and aid agencies and foundations participated in the meeting.

APPENDIX 4

Consultation background documents

4A. The Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) Stage Descriptions.

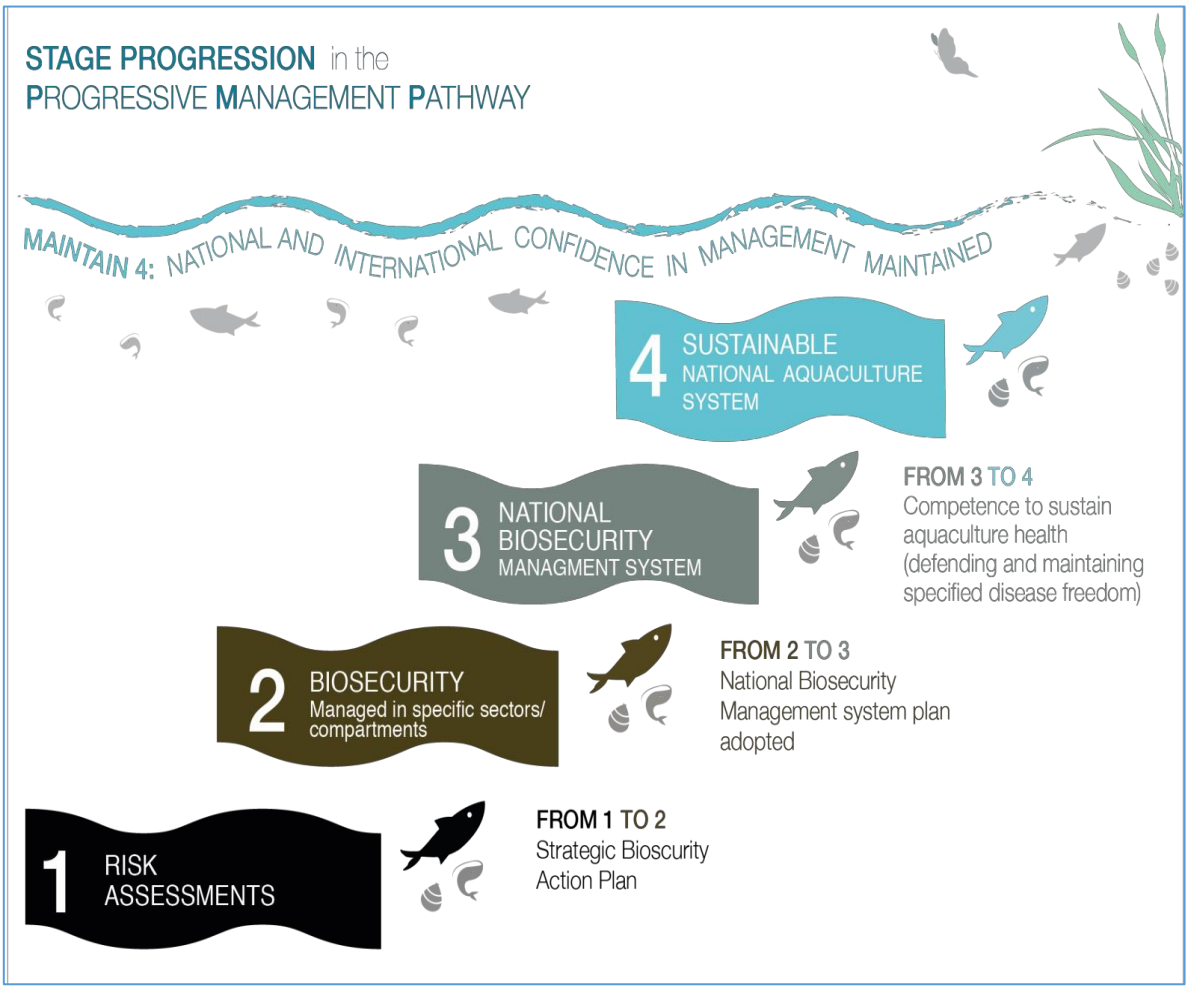
4B. National Strategy on Aquatic Animal Health (NSAAH) Programme Components Addressed in the PMP/AB.

4C. Instructions for Session 4 – Working Group Discussions.

APPENDIX 4A

The Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB)

Stage Descriptions



Glossary

Aquaculture	Farming of aquatic organisms with some sort of intervention in the rearing process to enhance production.
Aquatic Animal Health Professional	Experts/specialists with academic degrees and professional experience in various aspects of aquaculture biosecurity and aquatic animal health.
Biosecurity	A strategic and integrated approach that encompasses the policy and regulatory frameworks (including instruments and activities) for analysing and managing relevant risks to human, animal and plant life and health, and associated risks to the environment.
Commodity	Aquatic organisms, aquatic organism products, aquatic organism genetic material, feedstuffs, biological products and pathological material.
Compartment	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 purposes of international trade[1].
Competent Authority	The Veterinary Authority or other Governmental Authority of a Member Country having the responsibility and competence for ensuring or supervising the implementation of aquatic animal health and welfare measures, international health certification and other standards and recommendations in the whole territory[1].
Hazard	A biological, chemical or physical agent in, or a condition of, an aquatic animal or aquatic animal product with the potential to cause an adverse effect on aquatic animal health or public health.
Risk Assessment	The scientific evaluation of the likelihood and the biological and economic consequences of entry, establishment and spread of a hazard[1].
Risk hotspots	Risk-hotspots are points in the value-chain where biosecurity is most vulnerable; they may be a geographic location, a management practice or an action by a stakeholder that decreases capacity to manage health risks.
Surveillance	A systematic series of investigations of a given population of aquatic animals to detect the occurrence of disease for control purposes, and which may involve testing samples of a population[1].
Zone	An area in one or more countries containing an aquatic animal population with a specific aquatic animal health status with respect to a disease, in which surveillance and control measures and basic biosecurity conditions are applied[1].

[1] OIE *Aquatic Animal Health Code* (2018).

PMP/AB Stages and Key Outcomes

The four stages of the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) are described in this document. The title of each stage represents the overall objective or aim of the stage; the numbered points outline the "key outcomes" (or results) necessary to achieve that aim. The key outcomes in each stage are not meant to be completed in chronological order, as certain activities may have considerable overlap.

The PMP/AB approach is not intended to be prescriptive and particularly in the lower stages it is usually possible to realize the key outcomes through different activities or combinations of activities. Therefore, "typical activities" are listed below each key outcome, along with a description of quality indicators that are intended both to better define the key outcome, and also to facilitate the transparent assessment of achievement of each outcome. It is essential to address all of the key outcomes to fully complete the stage and progress to the subsequent stage.

Countries decide themselves how far, and how fast, it is appropriate for them to progress along the PMP/AB, since priorities will vary; a country may not always endeavour to progress to the next stage.

Completion of Stage 1 signifies that the country has identified and assessed their most important aquaculture biosecurity vulnerabilities (which may include pathogens, management practices and/or capacity issues) and determined mitigation measures at the sector level, described in Enterprise Biosecurity Action Plans.

These mitigation measures are implemented in Stage 2, such that the country enhances its aquaculture biosecurity and reduces the impact of vulnerabilities at the sector level. To complete Stage 2, a country develops a National Strategy on Aquatic Animal Health (NSAAH), intended to ensure continued, sustainable progress in improving aquaculture biosecurity.

The NSAAH and EBAPs are fully implemented during Stage 3. Completion of Stage 3 demonstrates the success of the country's approach; there is a strong commitment to a national biosecurity management system and evidence of the reduction (or eradication) of pathogens within the country or zone(s).

A country in Stage 4 has achieved the development of a sustainable national aquaculture system that is internationally recognized.

Assessing Progress along the Progressive Management Pathway

In order to complete a stage and move to the next, a country must be able to demonstrate that it has achieved all of the outcomes in that stage. These achievements are usually described in an endorsed strategic document which may be considered a "Gateway Pass".

Countries can determine their current position on the Pathway through a self-assessment checklist, based on the outcomes described in this document. While the details are still being elaborated, the minimum requirements to remain in each stage are described below.

The assessment of progression along the PMP/AB stages should be consistent globally, such that a country would be recognized in the same PMP/AB stage no matter where they are located. The assessment must be transparent and based on evidence. The mechanism for international recognition of PMP stage achievements is under development.

PMP/AB stage	Indicator requirement to enter each Stage	Minimum requirements to remain in a PMP/AB stage
1	None	Evidence of ongoing work in at least one of the following areas: *Key commodities and stakeholders are identified* *Threats to biosecurity (vulnerabilities) identified* *National public-private aquaculture biosecurity task-force* *Competent Authority on aquatic health clearly identified* *Risk-hotspots and current mitigation measures are described*
2	Enterprise Biosecurity Action Plan (EBAP)	*Evidence that EBAPS are being implemented* *Current information about occurrence of priority hazards* *Evidence that the impact of hazards is being reduced* *A national pathogen list is established*
3	National Strategy on Aquatic Animal Health (NSAAH)	*Evidence that EBAPS are being implemented* *Evidence that the NSAAH is being implemented* *Contingency plans and early detection and response system for priority hazards* *Environment impact assessments* *Prudent use of veterinary drugs and treatments* *Evidence that priority hazards are reduced or eliminated* *Stakeholders have committed resources to ongoing implementation of the NSAAH*
4	Written report on the implementation and impact of the NSAAH, endorsed by stakeholders	*All previous indicators continue to be achieved* *There is transparent reporting* *Consideration of:* *Pathogen emergence* *Ecosystem health* *Public safety* *Risk-based import controls following international standards*

STAGE 1: "Define risk-based approaches to support aquaculture health and production"

In Stage 1, key stakeholders in all aquaculture sectors are identified and the different aquaculture production systems in the country are described. All threats and vulnerabilities (i.e. pathogens, management practice and/or capacity issues) that impact (or potentially impact) aquaculture biosecurity are identified. The enabling environment is developed through co-operation between key stakeholders and establishment of the risk mitigation capacity. The country will conduct risk assessments to prioritize points in the value chain where biosecurity is most vulnerable. The end-goal of this Stage is the development of risk-based biosecurity action plans at the enterprise level that share a common framework.

Key Outcomes (Results):

1. ***Key stakeholders are identified and production systems, marketing network and associated socio-economic drivers are well described and understood for all aquaculture sectors (value-chain analysis) (activities under Components 11, 13 and 14[2]).***

A list is available of all aquaculture sectors and relevant key stakeholders in each, including producers, aquatic animal health professionals (AAHPs), industry partners (i.e. feed manufacturers, suppliers, etc.), and government officials (local/state or provincial/national).

There is a descriptive overview of the systems involved in producing aquaculture commodities from suppliers, through producers, to the marketing system, processors and consumers. The importation/exportation of relevant commodities should be included. As these systems are dynamic, the information available should be regularly reviewed and updated in subsequent PMP/AB Stages.

Typical activities: Participatory rural appraisal; stakeholder consultation workshops; national expert consultation; analysis of existing data and assessment of production systems.

2. ***Key aquaculture biosecurity vulnerabilities are identified (activities under Components 2 and 5[2]).***

The achievement of good biosecurity can be threatened by many factors, including hazards (pathogens), management practices, legal and informal trade, and lack of capacity in public and private institutions.

Important biosecurity vulnerabilities are identified for the key sectors in the country.

Hazards are identified that have a potential or real impact on production, wild populations, ecosystems and/or human health; and/or have the potential to spread to other farms/areas. A comprehensive hazard list should be created, inclusive for all relevant commodities and wild species. This list should originate from both a national perspective (i.e. trade-limiting and/or important to public health) and producer-level perspective (i.e. enzootic diseases that impact production).

Available knowledge about the occurrence and distributions of pathogens and other vulnerabilities is collated and summarized.

Typical activities: Participatory rural appraisal; stakeholder consultation workshops; national expert consultation; analysis of existing data.

3. ***An enabling environment for enhanced aquaculture biosecurity is developed (activities under Components 1, 2, 4, 11, 13, 14 and 15[2]).***

There is an aquaculture biosecurity task-force, which includes representation from key stakeholders in industry and government.

The current legal framework regarding aquaculture and aquatic health should be reviewed and the Competent Authority on aquaculture and aquatic health is clearly identified.

Criteria are clearly established using internationally accepted methods to define the National Pathogen List (NPL) based on identified hazards of concern.

There is laboratory capacity to diagnose and monitor the priority hazards.

The country may be a member of the World Organisation for Animal Health (OIE), and if so, should assess to what level it is currently fulfilling the obligations of this membership, particularly with respect to disease reporting.

[2] See Annex A. "Components of an Aquaculture Biosecurity Strategy".

AAHPs should be qualified and adequately trained to understand the risks of each hazard and potential impacts of disease management options.

Typical activities: Conduct gap analysis to assess existing national capacity and needs; OIE Tool for the Evaluation of Performance of Veterinary Services and/or Aquatic Animal Health Services (OIE PVS Tool: Aquatic); evaluation of competencies of AAHPs; provide adequate training to AAHPs and stakeholders as required to enhance competencies, in particular to support risk assessment; national expert consultation.

4. ***Risk hotspots are described and prioritized (activities under Components 8, 10 and 12[2]).***

Risk-hotspots are points in the value-chain where biosecurity is most vulnerable; they may be a geographic location, a management practice or an action by a stakeholder that decreases capacity to manage health risks.

Risk hotspots should be described and prioritized at the sector level.

Current risk mitigation practices are described. Common veterinary drug use and/or treatment practices in all aquaculture sectors are identified. Gaps in knowledge related to mitigating the risk of introduction and spread of hazards should be identified for each production system. Prioritized risk hotspots should be current and updated periodically (i.e. biannually).

Typical activities: Analysis of data collected through key outcomes 1-3 regarding the epidemiology of hazards and description of production systems; conduct preliminary risk assessment to identify potential risk hotspots; develop risk pathways for risk hotspots and define potential mitigation measures; national expert consultation.

5. ***Enterprise Biosecurity Action Plans (EBAPs) are developed with the aim of enhancing biosecurity; this is supported by a national framework (activities under Components 3, 8 and 14[2]).***

Enterprise Biosecurity Action Plans (EBAPs) should be developed to enhance biosecurity, based on risks and disease management practices identified through key outcomes 1-4. They are usually developed at the producer (or sector or commodity) level by the private sector, with support from the public sector and task-force as appropriate. Measures included in the EBAPs should be selected based on expected impact and feasibility. The EBAPs should be endorsed by the Competent Authority.

A national public-private task force should lead development of a framework that provides context to and ensures coherence of EBAPs. Stakeholders discuss the national vision and goal with respect to aquaculture and the roles and responsibilities of key stakeholders are defined. Enterprises are increasingly engaged in EBAP development and implementation.

Typical activities: Stakeholder consultation workshops; national expert consultation.

Stage 2: "Take action to enhance biosecurity in aquaculture sectors"

The focus of Stage 2 is on implementation of the biosecurity action plans developed in Stage 1 and monitoring their level of implementation and success. The country will have evidence of pathogen reduction and improvement in biosecurity practices at the producer level. The enabling environment is further developed through strengthened partnerships and enhancement of the capacity to manage risks at the national level. Based on the common framework developed in Stage 1, the country will develop a national aquatic animal biosecurity strategy that focuses on safeguarding progress and securing aquaculture sustainability and ecosystem health.

Key Outcomes (Results):

1. ***EBAPs developed in Stage 1 are implemented by enterprises, under the national framework (activities under Components 3, 8 & 12[2]).***

Efforts should be targeted at risk hotspots; activities will likely be focused on reducing the impact of specific pathogens (e.g. treatments, vaccination) as well broad measures to improve biosecurity (e.g. quarantine).

Typical activities: validate and further develop risk assessments, targeted surveillance, and targeted research studies to address knowledge gaps; development of vaccines; stakeholder consultation workshops to enhance awareness of practices; improve biosecurity at critical points along the market chain (i.e. movement controls, cleaning and disinfection).

2. *The management of biosecurity vulnerabilities and occurrence of important hazards is monitored (activities under Components 2, 4, 5 & 12[2]).*

There is evidence that activities described within the EBAPs are being carried out; audits may be performed, coordinated by the industry, task-force and/or the Competent Authority.

The occurrence of important hazards should be monitored.

Surveillance information regarding reported outbreaks and diagnostic test results should be current (i.e. collected within the previous 12 months).

Each enterprise should stay current with data analyses as required; critical gaps in understanding should be identified and addressed, with emphasis on acquiring knowledge that could assist in more effective implementation of mitigation measures.

Typical activities: Audit EBAP activities; active surveillance; participatory epidemiological studies; sampling and laboratory testing for hazards; primary data collection and analysis; analysis of existing data; key informant interviews.

3. *There is evidence that the implementation of the EBAPs strengthens biosecurity and reduces the impact of the hazards within aquaculture sectors (activities under Components 3, 5, 8 and 11*2*).*

Monitoring activities, described in Key Outcome 2, are analyzed to determine the impact of the actions described in the EBAPs.

The results from auditing and monitoring should be evaluated to determine areas in need of improvement; this information should be reported to key stakeholders.

Typical activities: stakeholder consultation workshops to address biosecurity measures in need of improvement; farm certification.

4. *Enabling environment is reviewed and co-operation between sectors is further developed (activities under Components 1, 2, 4, 11, 13, 14 and 15*2*).*

Current legal framework is strengthened as needed. National policies for aquatic health and biosecurity are developed.

A National Pathogen List (NPL) is established based on criteria developed in Stage 1.

AAHPs should be adequately trained and certified by Competent Authorities to enhance competencies.

Laboratory capacity is sufficient to support surveillance activities.

A National Aquatic Animal Health Information System (AAHIS) is developed.

Mechanisms and incentives to develop and strengthen public-private partnerships are in place.

Outbreaks involving notifiable diseases should be reported to the Competent Authority and/or OIE as required.

If the country intends to progress to Stage 3, the legal framework is adequate to support full implementation of disease detection and response activities.

Typical activities: Audit current competencies of AAHPs; audit laboratory capacity; training; raising awareness; stakeholder engagement.

5. *Development of a plan for a National Strategy on Aquatic Animal Health (activities under Components 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14 and 15[2]).*

The National Strategy on Aquatic Animal Health (NSAAH) should be written from the national perspective and be endorsed by the Competent Authority. The NSAAH formalizes the framework developed at the end of stage 1, and shifts the focus from the producer (or sector or commodity) level to the country (or zone) level, and provides evidence of the country's commitment to developing a biosecure, sustainable aquaculture sector.

Roles and responsibilities of public and private sectors are defined in the NSAAH, including the legal authority when applicable. Specific, measurable, performance indicators are defined within the plan, and there should be provisions for:

- rapid detection and response to outbreaks of listed pathogens for the whole country, including all aquaculture sectors and wild populations;
- port and/or border controls (including quarantine);
- import risk analysis
- contingency plans for incursions of exotic hazards;
- prudent use of veterinary drugs and/or treatments;
- maintenance and/or improvement of ecosystem health; and
- zoning and/or compartmentalization (if applicable).

Typical activities: Review priorities and risk hotspots identified in Stage 1; stakeholder workshops.

STAGE 3: "A national biosecurity management system is in place to safeguard progress and the environment"

In Stage 3, the national strategy developed in Stage 2 is implemented, in conjunction with the enterprise biosecurity action plans. There is confidence that sufficient capacity has been developed to support sustainable aquaculture and safeguard the country against enzootic, exotic and emerging pathogens. Through surveillance and monitoring systems, there is evidence that pathogens that pose the greatest threats to cultured and wild populations have been controlled or eradicated. The enabling environment is strengthened and capacity for safe trade is enhanced through the legislative framework and increased support and commitment from public, private and international stakeholders.

Key Outcomes (Results):

1. The NSAAH developed in Stage 2 is implemented in conjunction with the EBAPs (activities under Components 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 152).

The Competent Authority should systematically audit the implementation of the NSAAH. Results from auditing should be evaluated and gaps in compliance should be addressed.

The country should demonstrate transparency and commitment to ensuring that hazards are managed at critical risk control points. If applicable, zoning and/or compartmentalization are implemented.

There is capacity to defend against incursions of exotic diseases, through risk-based import restrictions as well as border and/or port controls.

Contingency plans should be in place for control and/or eradication of hazards that have a high national priority. Early detection and rapid response systems are in place for these hazards, and may include culling, movement restrictions, strategic vaccination.

The environmental impacts of aquaculture are assessed and mitigated.

The country should demonstrate that prudent use of veterinary drugs and/or treatments is being enforced.

Typical activities: Activities from Stages 1 and 2 are maintained with enhanced disease reporting and response; active engagement with stakeholders; public awareness campaigns; import risk analyses to address knowledge gaps and manage biosecurity at zones, ports and/or borders.

2. Existing, exotic and emerging hazards are under continuous surveillance (activities under Components 2 and 5[2]).

Reporting of listed pathogens through continuous surveillance should be in place. The surveillance system also includes provisions for emerging diseases.

Surveillance activities should take into account hazard characterization and be based on national standards for listed diseases.

Typical activities: Targeted, active and passive surveillance activities; raising awareness; horizon scanning.

3. There is evidence of reduction or eradication of hazards within the country or zone(s) (activities under Components 2 and 5[2]).

There is evidence to support absence of some hazards, and evidence that others have been reduced in susceptible populations, including wildlife.

The Competent Authority should regularly monitor the impact of the NSAAH to provide evidence that the reduction or elimination of hazards is being attained in susceptible populations and biosecurity measures are effective. Results from monitoring should also be evaluated to determine areas in need of improvement; this information should be reported to key stakeholders.

Gaps in understanding should be identified and addressed, with emphasis on acquiring knowledge that could assist in more effective risk mitigation.

Typical activities: Targeted surveillance activities on a systematic basis; programs are regularly evaluated and adapted as appropriate; participation in national and/or independent certification programs, stakeholder consultation workshops.

4. Enabling environment is strengthened and capacity for safe trade is enhanced (activities under Components 1, 4, 9, 11, 13, 14 and 15[2]).

A national, multi-agency task force should be formed, with capacity for public-private co-regulation of biosecurity practices.

Legal framework supports full implementation of NSAAH. National legislation is in place to facilitate enforcement of policies related to aquatic health and biosecurity.

NSAAH is shared with international stakeholders and strategies are compared.

The Competent Authority should have the capability to sustainably carry out their duties with autonomy and free from commercial, financial, hierarchical and political influences that may affect technical decisions.

Laboratory capacity is sufficient to support rapid detection. The Competent Authority should have the resources and competency to respond to emergencies. A procedure for accurate commodity identification and movement controls should exist.

Typical activities: Training activities; stakeholder engagement workshops; task-force meetings; public awareness campaigns.

5. There is evidence of improvement, and commitment from key stakeholders to safeguard progress (activities under Components 5, 11, 13 and 14[2]).

A written report describing the performance of the NSAAH is available, including objective evidence of progress according to the performance indicators identified in the plan.

Key stakeholders have endorsed this report, and publicly committed to safeguarding progress through the commitment of financial, infrastructure and human resources.

Typical activities: Stakeholder workshops.

STAGE 4: "A sustainable national aquaculture system is in effect"

In Stage 4, the biosecurity action plans are still in place under the framework of the national strategy, with a clear commitment to support aquaculture health, human health and ecosystem health. There is evidence of a sustainable and evolving system as management practices improve and partnerships mature. The end-goal of Stage 4 is to have confidence from national and international stakeholders in national aquaculture to enable sustainable production and safe trade whilst maintaining ecosystem health.

Key Outcomes (Results):

1. Activities are sustained and improved by learning through experience (activities under Components 1, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15[2]).

The sectors continue to implement EBAPs, in the framework of the NSAAH, which are regularly evaluated and refined as risks evolve and understanding of the most effective mitigation and preventive measures improves.

Public and private stakeholders work together in mature and sustainable partnerships to mitigate hazard-specific risks as well as to address the challenges of pathogen emergence, protection of ecosystem health, and public safety (including risk of AMR).

Typical activities: Activities from Stages 1-3 are maintained; stakeholder workshops; engagement with researchers.

2. Enabling environment is maintained and continuously improved *(activities under Components 1, 4, 6, 11, 13, 14 and 15[2]).*

Stakeholders demonstrate a clear commitment to sustaining the system, as illustrated through financial and legal commitments and institutions.

National legislation is reviewed and updated and/or revised when necessary; in some cases, new legislation is drafted to support aquatic health and biosecurity.

Zones and/or compartments are recognized by the OIE (if applicable).

A One Health approach, considering animal health, human health and ecosystem health, is able to thrive due to the institutions and co-regulation mechanisms developed in Stages 1-3.

The country supports international stakeholders in the development of national aquaculture biosecurity.

Typical activities: Stakeholder workshops.

3. National and international stakeholders have confidence in national aquaculture and ecosystem health *(activities under Components 11 and 15[2])*.

The country engages in sustainable and safe trade, where appropriate, with risk-based import controls following international standards.

There is transparent reporting of performance indicators (as defined in the NSAAH), which constitutes an evidence base of the country's ability to prevent, detect and respond to a variety of threats.

Typical activities: Audit trade negotiations and reporting of performance indicators.

APPENDIX 4B

National Strategy on Aquatic Animal Health (NSAAH) Programme Components Addressed in the PMP/AB

Components of an Aquaculture Biosecurity Strategy[3]

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 Strategy for Aquatic Animal Health (NSAAH) 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 plan should include such aspects as farm registration programmes, development of standard

[3] From FAO PMP Draft Working Document (Washington DC, April 2018) (available at: http://www.fao.org/fishery/static/news/MultistakeholderConsultation/Item1.pdf

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, 2019.

Component 6: Zoning and compartmentalization

Zoning and compartmentalization are mechanisms that allow a particular geographical unit (e.g. subregion, 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, 2019). 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 antibiotics that are 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 NSAAH. 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.

APPENDIX 4B

National Strategy on Aquatic Animal Health (NSAAH) Programme Components Addressed in the PMP/AB

(Unless otherwise specified, anything included in a stage is continued in consecutive stages)

PMP Stage	PC 8 Risk Analysis	PC 2 National Pathogen List (NPL) *(consider merging with PC5)*	PC 1 Policy, legislation, enforcement	PC 11 Info, education, communication, and AAHIS	PC 3 Farm level biosecurity plan	PC 4 Diagnostics
1	✔ Preliminary sector-level risk analyses; Identify hotspots; Mitigation measures defined; Risk-based Enterprise Biosecurity Action Plans (EBAPs) developed	✔ Criteria established to define NPL	✔ Current legal framework reviewed	✔ Communication with all stakeholders; Expert consultation	✔ EBAPs developed	✔ Laboratory capacity to diagnose
2	✔ Validate and further develop industry-level risk analyses; Implement EBAPs Bio-security Management System formulated and described in the NSAAH	✔ NPL is established	✔ NSAAH developed; National policies developed; Strengthen legal framework according to review	✔ National Aquatic Animal Health Information System (AAHIS) is developed	✔ EBAPs implemented NSAAH is developed	✔ Laboratory capacity sufficient for surveillance; Testing for screening & during outbreaks; Development of NSAAH (including diagnostics)
3	✔ Biosecurity management system is implemented (NSAAH); Risk analysis continues to be an important activity, and there may be further emphasis on risk related to imported commodities and emerging risks	✔ Continued surveillance & reporting of outbreaks on NPL	✔ NSAAH implemented; Legal framework supports full implementation of NSAAH	✔ Transparent reporting both nationally & internationally; Stakeholder engagement	✔ NSAAH implemented in conjunction with EBAPs for priority hazards Participation in certification programs	✔ Implementation of NSAAH diagnostics for rapid detection, border controls, zoning
4	✔ EBAPs evaluated/refined as risks evolve; Ongoing review & validation	✔ Reporting/ response to threats; Safe trade	✔ Ongoing full implementation and periodic evaluation	✔ Continual stakeholder engagement & reporting	✔ Ongoing full implementation and periodic evaluation	✔ Ongoing full implementation

National Strategy on Aquatic Animal Health (NSAAH) Programme Components Addressed in the PMP/AB

PMP Stage	PC 5 Surveillance, monitoring, reporting	PC 6 Zoning & compartmentalization	PC 7 Border inspection, quarantine	PC 9 Emergency preparedness, response, contingency	PC 10 Use of veterinary drugs, avoiding AMR	PC 12 Research
1	✔ Collation of existing information (previous hazard reports/studies)				✔ Review what current veterinary drugs are being used in industry	✔ Critical gaps in understanding identified
2	✔ Active surveillance to determine disease status and distribution in regions/zone/country for listed pathogens; sufficient laboratory capacity for surveillance; adequately trained staff; monitoring activities	✔ Plan for zoning and compartmentalization within the NSAAH (if applicable)	✔ Plan for border/port controls/quarantine within the NSAAH	✔ Legal framework adequate to support full implementation of disease detection and response; NSAAH development (includes contingency plans, rapid detection & response)	✔ Include prudent use of vet drugs within NSAAH	✔ Ongoing identification of knowledge gaps; Address knowledge gaps with targeted research studies
3	✔ Maintain surveillance in previous stages; Enhanced disease reporting; Targeted systematic surveillance and monitoring (based on national standards)	✔ NSAAH is implemented (with zoning or compartmentalization if applicable); Hazards monitored for evidence of reduction/eradication within country or zone	✔ NSAAH implemented with biosecurity enforcement at zones/ports/borders; Hazards managed at critical risk control points	✔ NSAAH implemented (contingency plans, early detection, and rapid response systems in place); Competent Authority has resources and competency to respond to emergencies	✔ NSAAH is implemented with prudent use of veterinary drugs being enforced	✔ Ongoing research: Gaps in understanding identified and addressed, with emphasis on acquiring knowledge in risk mitigation
4	✔ Transparent national/ international reporting of performance indicators	✔ Zones or compartments recognized by OIE (if applicable)	✔ Ongoing full implementation	✔ Ongoing full implementation, and periodic evaluation	✔ Public and private stakeholders work together in mature and sustainable partnerships to address public safety (i.e. AMR)	✔ Ongoing full implementation

National Strategy on Aquatic Animal Health (NSAAH) Programme Components Addressed in the PMP/AB

PMP Stage	PC 13 Human resources, institutional capacity	PC 14 Institutional structure (and infrastructure)	PC 15 Regional & International cooperation
1	✔ OIE Aquatic PVS evaluation, AAHP competency evaluation; training to AAHP & stakeholders to enhance competencies, in particular to support risk assessment	✔ Aquaculture biosecurity task-force (representation from private/public stakeholders)	✔ If OIE member country, assess current level of fulfilment of the obligations with the OIE
2	✔ Ongoing training as required; AAHP are trained to understand risks of hazards and impacts of disease management options AAHP adequately trained and certified by Veterinary Authorities to enhance competencies; Audit current competencies of AAHP and provide training	✔ Develop and strengthen public-private partnerships	✔ Outbreaks involving notifiable diseases reported to Competent Authority and/or OIE Participates in regional meetings and initiatives relevant to aquaculture biosecurity
3	✔ Ongoing training as required	✔ National multi-agency task force; Key stakeholders endorse NSAAH and public commitment of financial, infrastructure and human resources	✔ Share NSAAH with international stakeholders and compare strategies and performance indicators
4		✔ Stakeholders have mature partnerships and demonstrate commitment to sustaining the system through financial and legal commitments and institutions	✔ Support other countries to achieve national biosecurity

PMP/AB Stages: Relationship to programme components in the NSAAH:

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	+			Support stage progress and create new options			Share Compare
4	Key	+	Key	+							Support stage progress and create new options			Support

APPENDIX 4C

Instructions for Session 4 – Working Group Discussions

Working Group Session 1: "PMP/AB Stages and Assessment"

Purpose: To validate stage descriptions and key indicators and identify existing tools and needs for development.

Process: A short presentation will be provided prior to the WG breakout. Participants will be divided into 4 groups with group tasks described below. Each group will elect a Chairperson and a rapporteur/presenter.

Product: WG A, B, C, D presentations pertaining to the four major questions below; elaboration of the gateway passes for each of the PMP/AB stages in terms of minimum requirements to remain in PMP/AB stages 1–4, including evidence and supporting tools. Each group should present on assigned stage (with other groups to add and comment on each)

4 groups: **A** – Stage 1; **B** – Stage 2; **C-** Stage 3; **D** – Stage 4

- Start with the assigned stage and progress sequentially

Please discuss the proposed content of PMP Stages. The following questions may guide your discussion. You may use the table provided to help record your answers.

1. Describe examples of "key threats to biosecurity (vulnerabilities)" Is this a useful concept?
    a. Review the objective and outcomes for the stages.
    b. Are the "Key Outcomes" appropriate and together do they meet the overall objective of the Stage?
    c. Can you think of different countries that would be in each stage?

2. PMP Toolkit:

    a. What existing tools are relevant and/or should be applied at each stage?
    b. What needs to be developed?

3. Assessment:

    a. Are the suggested Gateway passes (2nd column below) and minimum requirements to remain in each stage appropriate?

Can you think of examples of 'evidence' to support PMP stage achievement?

GATEWAY PASS TO ENTER EACH STAGE	***MINIMUM REQUIREMENTS TO REMAIN IN A PMP/AB STAGE***	***EVIDENCE***	***SUPPORTING TOOLS***
PMP/AB STAGE 1: NATIONAL BIOSECURITY			
Should there be a stage 0? If so, what should be included here?			
PMP/AB Stage 1 Risk Assessment			
NONE	Evidence of ongoing work in at least one of the following areas: ✓ Key commodities and stakeholders are identified ✓ Threats to biosecurity (vulnerabilities) identified ✓ National public-private aquaculture biosecurity task-force ✓ Competent Authority on aquatic health clearly identified ✓ Risk-hotspots and current mitigation measures are described		
PMP/AB STAGE 2: BIOSECURITY AT ENTERPRISE LEVEL			
ENTERPRISE BIOSECURITY ACTION PLAN (EBAP)	✓ Evidence that EBAPs are being implemented ✓ Current information about occurrence of priority hazards ✓ Evidence that the impact of hazards is being reduced ✓ A national pathogen list is established		

GATEWAY PASS TO ENTER EACH STAGE	*MINIMUM REQUIREMENTS TO REMAIN IN A PMP/AB STAGE*	*EVIDENCE*	*SUPPORTING TOOLS*
PMP/AB STAGE 3: NATIONAL BIOSECURITY			

National strategy on aquatic animal health (NSAAH)	✓ Evidence that EBAPs are being implemented
	✓ Evidence that the NSAAH is being implemented
	  ✓ Contingency plans and early detection and response system for priority hazards
	  ✓ Environment impact assessments
	  ✓ Prudent use of vet drugs and treatments
	✓ Evidence that priority hazards are reduced or eliminated
	✓ Stakeholders have committed resources to ongoing implementation of the NSAAH		

PMP/AB STAGE 4: SUSTAINABLE PRODUCTION			

Written report on the implementation and impact of the NSAAH, endorsed by stakeholders	✓ All previous indicators continue to be achieved
	✓ There is transparent reporting
	✓ Consideration of:
	  ✓ Pathogen emergence
	  ✓ Ecosystem health
	  ✓ Public safety
	✓ Risk-based import controls following international standards		

Working Group Session 2: "Rolling out of the PMP/AB"

Purpose: To discuss and elaborate on three main aspects of rolling out PMP/AB namely: 1) initiation, adoption and incentives; 2) sustaining PMP at global level; and 3) capacities to implement.

Process: A short presentation will be provided prior to the WG breakout. Participants will be divided into 3 groups with group tasks described below. Each group will elect a Chairperson and a rapporteur/presenter.

Product: Each of the three breakout groups will prepare a brief presentation reporting the outcome of their discussions pertaining to the questions listed in the next pages under each main discussion topic (i.e. 1. initiation, adoption and incentives; 2. sustaining PMP at global level; and 3. capacities to implement).

3 groups:

A – Initiation, adoption and incentives

B – sustaining PMP at global level

C – capacities to implement

- Start with the assigned topic to each group and discuss the questions listed.
- Please add other related and relevant questions that are essential and have not been listed.
- Brief report back to plenary on assigned topic (with other groups to add and comment on each).

Group A: Initiation, adoption and incentives. Considering both National and Enterprise level application

1. Initiation
    a. Who is best to initiate the PMP/AB at national or enterprise level?
    b. What difficulties will they face, and what can be done to support them?

2. Biosecurity task forces at national and enterprise level
    a. What would be a good process to establish these if they do not currently exist, in a sustainable manner?

3. Incentives to participate in the PMP/AB at national level
    a. Should the benefits of the PMP/AB at national level be the only incentive?
    b. What forms of incentive might also be needed to get national PMP/AB started?

4. Incentives to participate in the PMP/AB at enterprise level
    a. What are the incentives for small and large-scale producers to engage in the PMP/AB on a voluntary basis?

5. Setting targets
    a. What rate of PMP/AB progress at national level might be expected in a 12-24 months?
    b. What are the likely sequence of activities in this period for different countries the group is familiar with?

Group B: Sustaining the PMP/AB at global level

1. Sustaining development and supporting application of the PMP/AB
    a. What issues might arise if the PMP/AB does not have co-ordinated support, development or application?
    b. How could these issues be avoided?
    c. What forms of governance (steering committees, support groups, technical working groups) might be needed in near future?

2. How might this best coordinate or relate to other bodies (global or regional)?

3. Public and private co-management of the PMP/AB
    a. At what levels should the private-sector stakeholders be involved in the governance committees mentioned above?
    b. Are there good practices to encourage and manage their involvement/support?

4. Roles and responsibility of international organizations
    a. What will be possible roles & responsibilities of international organizations such as OIE and FAO in these governing bodies for the PMP/AB?

5. PMP/AB Stage endorsement or recognition
    a. Is a working group needed on how to manage this between the organisations? (this is the case with other PCP/PMPs).

6. Supporting PMP/AB: tools and communication
    a. How could this be best managed, one organization or a separate platform that is between organizations (perhaps managed by a contractor with regular performance review)?

7. Funding
    a. What are the types of funding needs sustain the overall PMP/AB, its meetings, technical working group and communications?

Group C: Capacities to implement PMP/AB

1. PMP/AB is likely to need experts in regional as well as national organizations, in public and private sectors to utilize the approach in project development or implementation.
    a. Would a roster of experts trained and familiar in the PMP/AB and allied tools be helpful?
    b. What profiles of person should be priorities for training to enter a roster?
    c. What number of persons to be trained would make an impact, in each region?
    d. Should a working group for training be established to develop proposals on how to do this?

2. National capacities for the PMP/AB: Skills
    a. What skills sets or competences are likely to be critical at national level to successful implementation?
    b. Are these technical skills, management skills, competences in working with sectors and stakeholders, epidemiology and economics?
    c. Alternatively, is it preferable to have a mix of skills on the training agenda at national level?

3. National capacities for the PMP/AB: Training
    a. What forms of training are needed at this stage of the PMP?
    b. What would be the most effective training formats?
    c. Do regional or national training centers in aquaculture have a potential role in training on the PMP/AB and its application at national level?

4. Networks for capacity building
    a. Could existing aquaculture networks play a role, both in communicating the PMP/AB and supporting capacity building?
    b. Which ones are most likely to have a good impact?

Working Group 3: Initiating sectorial risk assessment

1. Risk assessments at different levels
    a. Risk assessments to guide national biosecurity policies and programmes
    b. Risk assessments at farm level

2. What process to follow (bearing mind the objective of PMP/AB):
    a. Codex risk profile guidelines (food safety)
    b. OIE Import risk analysis guidelines (trade)
    c. Industry-led risk assessment (corporate objectives)
    d. FAO process for developing National Pathogen List (as part of NSAAH)
    e. Country-level practice for doing risk analysis (not only pathogen, but as well as other risk sectors – food safety, genetics, environmental/ecological, social/financial, etc.)
    f. Others

3. Who all should be involved and what commitments are needed
    a. Expertise
    b. Resources
    c. Timelines
    d. Coordination and decision making

4. Application of HACCP principles

Hazard analysis critical control point (HACCP) has been widely used effectively in food safety sector as a preventive measure. HACCP involves the following seven principles:

1. Conduct hazard analysis (know your pathogens).
2. Determine critical control points (know your contamination pathways).
3. Establish critical limits (At farm level, the critical limits could be the biosecurity practices and how they are to be implemented. Critical limits could also be in terms of water quality parameters like dissolved oxygen, ammonia, nitrite levels that can be tolerated by the species cultured).
4. Establish a system to monitor critical control points (monitoring e.g. disinfection of intake water, disinfection of nets and equipment, hygienic practices adopted by personnel, movement of stock and so on).
5. Establish corrective action when monitoring indicates that a critical control point is not under control (Establishing corrective action when any failures in biosecurity are detected, should be a part of the biosecurity plan. Corrective action in a farm needs to be taken when water quality deteriorates or when any abnormal behaviour in fish is noticed).

6. Establish procedures for verification that the HACCP system is working effectively (Establishing procedures for verification that biosecurity is working properly is also an important aspect of biosecurity plan).
7. Establish documentation regarding all procedures and records appropriate to these principles and their application.