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**NATIONAL AQUATIC ANIMAL HEALTH AND BIOSECURITY
STRATEGY – FAO PROJECT TCP/MIC/3603/C2 FOR THE
FEDERATED STATES OF MICRONESIA**

Report of the

NATIONAL AQUATIC ANIMAL HEALTH AND BIOSECURITY STRATEGY – FAO PROJECT
TCP/MIC/3603/C2 FOR THE FEDERATED STATES OF MICRONESIA

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PREPARATION OF THIS DOCUMENT

This report was the outcome of desk work and field activities related to the implementation of the Food and Agriculture Organization of the United Nations (FAO) Project TCP/MIC/3603/C2 – “National Aquatic Animal Health and Biosecurity Strategy” that was implemented in 2019. The project was under the technical oversight of Dr Melba G. Bondad-Reantaso, Project Lead Technical Officer. The project consisted of several activities consolidated into one field mission that was undertaken in Pohnpei, Federated States of Micronesia from 18 to 28 May 2019 by Dr Melba G. Bondad-Reantaso (FAO, Rome) and international consultants Dr Brett MacKinnon (Canada), Dr Celia R. Lavilla-Pitogo (Philippines) and Ms Annaliza A. Vitug (Philippines). Dr J. Richard Arthur (Canada) contributed to the development of the draft National Strategy for Aquatic Animal Health and the technical editing and review of this report.

ABSTRACT

This report documents the accomplishments of the FAO Project TCP/MIC/3603/C2 – “National Aquatic Animal Health and Biosecurity Strategy” that was implemented in 2019 for the Federated States of Micronesia (FSM). These include the following: (i) Round-table discussions on aquaculture development, biosecurity legislation, aquatic animal health and aquaculture biosecurity (21–22 May 2019); (ii) Technical Seminar on Basic Aquatic Animal Health and Aquaculture Biosecurity (23 May 2019); (iii) National Consultation on Aquaculture Development, Biosecurity Legislation, Aquatic Animal Health (24 May 2019); and (iv) Introductory training course on risk analysis within the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) (27–28 May 2019). The various activities undertaken during the field mission provided the basis for drafting the National Strategy on Aquatic Animal Health (NSAAH) and the National Aquatic Pathogen List (NAPL) for FSM. There is a need to conduct another round of national consultations in order to generate feedback prior to finalizing the documents and approval. The next step will be to incorporate them into the government’s policy documents and work with partners for joint resource mobilization to support implementation. The report also contains a list of recommendations that the Government of FSM should consider to improve capacities in aquatic animal health and aquaculture biosecurity.

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ABBREVIATIONS AND ACRONYMS

ADG	Asia Diagnostic Guide to Aquatic Animal Diseases
AHPND	Acute hepatopancreatic necrosis disease
AIS	Alien invasive species
ALOP	Appropriate level of protection
ALOR	Acceptable level of risk
AMR	Antimicrobial resistance
BMPs	Better management practices
CA	Competent Authority
CBD	Convention on Biodiversity
CCPs	Critical control points
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COM-FSM	College of Micronesia – Federated States of Micronesia
COMLG	College of Micronesia Land Grant Program
CSP	Conservation Society of Pohnpei
EEZ	Exclusive economic zone
EPA	Environmental Protection Agency
EUS	Epizootic ulcerative syndrome
FAO	Food and Agriculture Organization of the United Nations
GAPs	Good aquaculture practices
GCF	Green Climate Fund
GEF	Global Environmental Facility
FSM	The Federated States of Micronesia
GMOs	Genetically modified organisms
HACCP	Hazard Analysis and Critical Control Points
IFAD	International Fund for Agricultural Development
IMNV	Infectious myonecrosis virus
IMO	International Maritime Organization
IPPC	International Plant Protection Convention
IT	Information technology
JICA	Japan International Cooperation Agency
KHV	Koi herpesvirus
KORDI	Korea Ocean Research and Development Institute
LMOs	Living modified organisms
MASA	Micronesian Association for Sustainable Aquaculture
MERIP	Marine and Environmental Research Institute of Pohnpei
NAC	National Aquaculture Center
NACA	Network of Aquaculture Centres in Asia-Pacific
NAPL	National Aquatic Animal Pathogen List
NBSAP	National Biodiversity Strategy and Action Plan
NGO	Non-governmental organization
NIFA	National Institute of Food and Agriculture
NORMA	National Oceanic Resource Management Authority
NPC	National Project Coordinator
NSAAH	National Strategy on Aquatic Animal Health
OFCF	Overseas Fisheries Cooperation Foundation
OIE	World Organisation for Animal Health
PCR	Polymerase chain reaction
PICTs	Pacific Island Countries and Territories
PMP/AB	Progressive Management Pathway for Improving Aquaculture Biosecurity
PPPO	Pacific Plant Protection Organization
R&D	Department of Resources and Development

rt-PCR	Reverse-transcription polymerase chain reaction
SDP	Strategic Development Plan
SOPs	Standard operating procedures
SPC	The Pacific Community
SPF	Specific-pathogen-free
SPR	Specific-pathogen-resistant
SPS	Sanitary and phytosanitary
SPREP	Secretariat of the Pacific Regional Environment Programme
SWOT	Strengths, weaknesses, opportunities, and threats
TAADs	Transboundary aquatic animal diseases
TCP	Technical Cooperation Programme (of the FAO)
TiLV	Tilapia lake virus
UoG	University of Guam
UH	University of Hawaii
USAID	United States Agency for International Development
USDA-APHIS	United States Department of Agriculture-Animal and Plant Health Inspection Service
USDA-FSIS	United States Department of Agriculture-Food Safety and Inspection Service
WAHIS	World Animal Health Information System (of the OIE)
WSSV	White spot syndrome virus
WTO	World Trade Organization

1. BACKGROUND

1.1. Introduction

1. Biosecurity, as defined by the Food and Agriculture Organization of the United Nations (FAO), is a strategic and integrated approach that encompasses both policy and regulatory frameworks aimed at analysing and managing risks relevant to human, animal and plant life and health, including associated environmental risks (FAO, 2007). It covers food safety, zoonoses, introduction of animal and plant diseases and pests, introduction and release of living modified organisms (LMOs) and their products (e.g. genetically modified organisms or GMOs), and the introduction of alien invasive species (AIS). Biosecurity thus has direct relevance to the sustainability of aquaculture while ensuring protection of public health, the environment and biological diversity.

2. Subasinghe and Bondad–Reantaso (2005) defined biosecurity in aquaculture as a collective term that refers to the concept of applying appropriate measures (e.g. proactive disease risk analysis) to reduce the probability of a biological organism or agent spreading to an individual, population or ecosystem and to mitigate the adverse impacts that may result. Such analysis is done in a way that incorporates best available information on aspects of good husbandry, epidemiology and good science.

3. In the context of aquatic animal health, the term biosecurity is used to specifically describe the measures used to prevent introduction of unwanted biological agents, particularly pathogens, and to manage adverse effects associated with them. It encompasses both farmed and wild aquatic animals; exotic, enzootic and emerging diseases; and is applied from the farm to the ecosystem, and at national and international levels (Scarfe *et al.*, 2009).

1.1.1. Status of aquaculture development in the Federated States of Micronesia

4. The Federated States of Micronesia (FSM) is one of four countries (with the Marshall Islands, Palau and Nauru) that have developed a regional platform (the Micronesian Association for Sustainable Aquaculture – MASA) for networking and cooperation in sustainable aquaculture. To help these four countries to achieve the objectives of MASA, FAO is currently providing technical assistance under TCP/SAP/3602/C2 for an in-depth aquaculture risk assessment and business investment planning. A subregional meeting (Palau, November 2016) recently discussed further steps and FAO support (to be provided under the current Technical Cooperation Programme (TCP) project).

5. In addition to technological and economic risks associated with production increases, aquaculture in MASA countries also faces threats associated with biosecurity.

1.1.2. Status of aquatic animal health and biosecurity management in the Federated States of Micronesia

6. Recognizing the significant threat of invasive species, the Government of FSM's Department of Resources and Development (R&D) has prepared the National Invasive Species Strategy and Action Plan 2016–2021. A key part of this strategy is to minimize the risk of invasive species moving between different islands within the country. A key goal of the plan is to establish biosecurity (border control, quarantine, eradication and/or management) programmes to protect FSM's biodiversity, livelihoods, sustainable development and resilience to climate change from impacts of invasive species.

7. During in-country consultations conducted in October–November 2016, it was mentioned that following the adoption of the new Biosecurity Act (at that time, under review by Congress), FAO technical support may be drawn upon to support a review of biosecurity regulations, with an up-to-date risk assessment of movement of plant and animal products, including aquatics, with the aim to improve trade between states. Such assistance would be congruent with approaches taken in other Pacific Island

Countries and Territories (PICTs) and take advantage, where possible, of delivery through regional institutions such as the Pacific Community (SPC).

1.1.3. Request for the Food and Agriculture Organization of the United Nation's Technical Assistance

8. An official request for technical assistance on the development of a National Strategy on Aquatic Animal Health (NSAAH) from the R&D Secretary was received in February 2016. The request is pursuant to the implementation of the 2013–2017 Multi-Country Programming Framework (FSM Output 1.4, Priority A).

9. Some of the major constraints to maintaining aquatic animal health and aquatic biosecurity in FSM to support cost-effective and low-risk aquaculture development include the lack of specific policy, dedicated infrastructure, capacity, legislation, enforcement, public awareness and coordination between agencies. Accordingly, the main objectives of the current project are to assess the risks associated with the movement of aquatic animal products and to develop a NSAAH.

1.2. Project purpose

10. The following were identified in the project document as the main outputs:

Output 1: A National Strategy on Aquatic Animal Health and Biosecurity developed including an Implementation Plan

- **Activity 1. Conduct a gap analysis** through updating FSM's FAO self-assessment survey questionnaire on performance and capacity on aquatic animal health and via a Strengths, weaknesses, opportunities, and threats (SWOT) analysis; and consultations with relevant stakeholders.
- **Activity 2. Develop the NSAAH framework** that includes the following: Purpose, Vision Statement, Guiding Principles, suggested Programmes of the NSAAH (each containing a short description, current status, objective and possible projects). These will then be further developed by a small team from FSM consisting of the National Project Coordinator (NPC) and National Consultants and during the state consultations.
- **Activity 3. Review the legal framework on aquatic animal health** (e.g. Competent Authority, compliance with obligatory and voluntary treaties, standards and agreements to which FSM is a signatory).
- **Activity 4. Review the current Biosecurity Act** with the purpose of integrating aquatic biosecurity and aquatic animal health issues.
- **Activity 5. Conduct a preliminary aquaculture sectoral assessment and develop a National Aquatic Pathogen List:** (i) review past aquaculture efforts in the country and subregion and, in consultation with relevant stakeholders, identify and recommend species for which a risk assessment is warranted in FSM; and (ii) based on the relevant FAO Guidelines and on the preliminary aquaculture sectoral assessment, develop a National Aquatic Pathogen List (NAPL).
- **Activity 6. Conduct a two-day risk analysis training course** using potential species to be farmed in the future as case study materials.
- **Activity 7. Assess current aquatic animal health laboratory capacity and conduct a one-day basic training workshop on aquatic animal health management.**
- **Activity 8. Conduct a one-day consultation in each state** to generate input and feedback to the draft NSAAH and implementation plan, including information on species for which a risk analysis is warranted.
- **Activity 9. Conduct a one-day national workshop** to present the findings of the field mission and the final draft of the NSAAH.

1.3. Process

11. Implementation of the TCP facility comprised the following four activities:

- Round-table discussions on aquaculture development, biosecurity legislation, aquatic animal health and aquaculture biosecurity (21–22 May 2019);
- Technical Seminar on Aquatic Animal Health and Aquaculture Biosecurity (23 May 2019);
- National Consultation on Aquaculture Development, Biosecurity Legislation, Aquatic Animal Health (24 May 2019); and
- Introductory training course on risk analysis within the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) (27–28 May 2019).

1.4. Participation

12. Some 30 participants attended all events, including government representatives from fisheries (marine resources), biosecurity/quarantine, environment, food safety, trade, customs, port authority and marine and wildlife; aquaculture operators from Pohnpei and Kosrae; and representatives from the College of Micronesia – FSM (COM–FSM); the Conservation Society of Pohnpei (CSP); the Marine and Environmental Research Institute of Pohnpei (MERIP) and the United States Agency for International Development (USAID). The List of Participants can be found in Appendix 1, while the Group Photograph is presented in Appendix 2.

2. ROUND TABLE DISCUSSIONS ON AQUACULTURE DEVELOPMENT, BIOSECURITY LEGISLATION, AQUATIC ANIMAL HEALTH AND AQUACULTURE BIOSECURITY

13. A gap analysis is a large component of Stage 1 of the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB), which determines the current situation in the country in regard to expertise, capacity and infrastructure in the various relevant areas related to aquatic animal health and aquaculture biosecurity. To assist in establishing this reference point, preliminary assessments of the current status of the three themes (i.e. aquaculture development in FSM, biosecurity legislation and aquatic animal health, and aquaculture biosecurity) were made through round-table discussions, interviews and surveys (via the FAO National Aquatic Animal Health Capacity and Performance Questionnaire) (see Appendix 3). The outcomes of the assessments are described in the sections below and were presented during the National Consultation that was held on 24 May 2019.

2.1. Aquaculture sector assessment

2.1.1. Objectives

14. The Thematic Group on Aquaculture Development was tasked to discuss and agree among key stakeholders on the most relevant aquatic species for current and future aquaculture development, which is key for the development of a national aquatic pathogen list (NAPL). The discussions were aimed at collecting relevant information essential to support the development of the aquaculture sector through healthy production of aquatic species. This assessment was also used to identify major gaps related to aquaculture development and biosecurity.

2.1.2. Participation

15. Representatives of all four states of FSM (Chuuk, Kosrae, Pohnpei and Yap), as well as participants from research, academe and non-governmental organizations (NGOs) were represented in the thematic discussion. Discussion was facilitated by Dr Ruth García Gómez.

2.1.3. Presentations

16. Summaries of the presentations follow:

17. ***Presentation 1. Hatchery-based sandfish sea cucumber (*Holothuria scabra*) farming technology development in Micronesia*** (Dr Manoj R. Nair, Scientist, College of Micronesia Land Grant (COMLG), Pohnpei, FSM)

18. Dr Nair started his presentation by introducing the College of Micronesia Land Grant Program (COMLG). The COMLG is an equivalent of the United States Land Grant University System but is being operated in the United States affiliated Pacific Island Nations of Federated States of Micronesia, the Republic of the Marshall Islands and the Republic of Palau in the western central Pacific Ocean. The funding for the programme comes directly from the United States Department of Agriculture (USDA) under the National Institute of Food and Agriculture (NIFA). The agreement, which ends in 2023, encourages technology development and dissemination so that the countries will gain self-sufficiency in different fields like aquaculture, agriculture, health, and other disciplines. Dr Nair proceeded to discuss aquaculture in the FSM, which has included culture of commercial species of sponges, ornamental fish, live coral, giant clams, trochus shells, pearl oysters and seaweeds. Among these, only the culture of giant clams, corals and sponges are ongoing, although their farming systems are still struggling to become sustainable. Sea cucumber aquaculture is a favoured activity because of its high-value and the non-perishable dried export products. Dried or processed sea cucumbers can fetch up to USD 500 per kg, depending on the grade. These products are also in demand for local consumption and can be developed for domestic businesses. Aside from commanding a high price, sea cucumbers are in demand because they figure significantly in Asian cuisine.

19. Dr Nair then illustrated the operations of the COM Nett Point Hatchery, which produces the larval and juvenile stages. Older juveniles are dispersed into the Nihco Marine Park for further rearing in floating ocean-based hapa nets. The grow-out sites are in Nihco Marine Park and Tamil Yap. The major problems and challenges faced by nursery culture of sea cucumbers are very low survival due to predation, fouling organisms and skin ulcerations. In grow-out facilities in the open ocean, the major problems are predators, human poachers, and harsh environmental conditions during the monsoon season. Climate change causing excessive heat and unusually low tides is also affecting grow-out culture. Dr Nair talked about several controversies faced by sea cucumber culture, such as stocking of imported hatchery-reared juveniles in exchange for harvests of wild stocks, immature technology and dishonest deals. These have led to a movement against the harvesting of wild stocks.

20. To address the clamour to support the sea cucumber industry, COM is continuing its research to improve growth and survival in the hatchery, amend nursery and grow-out designs to become more resilient against storms, and open new testing sites for grow-out. Dr Nair informed the participants that COM is increasing awareness among the coastal communities and decision-makers on the potential of sea cucumber aquaculture as an alternative livelihood for coastal communities. COM also helps in ensuring that sandfish aquaculture is not mixed up with issues related to wild harvesting through its programmes that has trained hundreds in the local communities. The Marine Science students have also been given skills to culture black lip oyster and sea cucumber, and COM further aims to develop a curriculum for formal and informal trainings in aquaculture.

21. ***Presentation 2. Activities of the Marine and Environmental Research Institute of the Pacific (MERIP) and biosecurity*** (Mr Simon Ellis, Director, Marine and Environmental Research Institute of the Pacific, Pohnpei, FSM)

22. Mr Ellis introduced the Marine and Environmental Research Institute of the Pacific (MERIP) as a non-profit corporation that operates as a business, but is qualified to apply for grant funding. MERIP focuses on aquaculture products like ornamental marine invertebrates and bath sponges. The organization trains community members in establishing farms, provides needed materials and also assists in marketing. Thus, every project includes a fully integrated three-tier approach to sustainable

development: product development, community training and technology transfer, and marketing and market development. Incorporated in these trainings are elements on conservation and climate change. Mr Ellis gave examples of activities for livelihood such as farming of ornamental corals and giant clams for export, sponge farming for export, and rabbitfish farming for income generation and food security. Currently, MERIP's product list has 36 species grown by self-employed farmers in FSM.

23. Mr Ellis informed the group that prior to export of coral and giant clam products, a Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) permit is obtained from the national government for transport within FSM, and export and certificate of origin are obtained from Pohnpei State. Inspection is conducted by FSM quarantine before export. These procedures do not guarantee that the commodities are not diseased or that the transport water does not contain harmful microorganisms. For sponges, however, no special permit is required for export to most countries because the product is shipped dry. Farming of two species of rabbitfish (*Siganus argenteus* and *S. randalii*) is considered very promising with, so far, no significant health or biosecurity concerns because they are native species that are consumed locally.

2.1.4. Round-table discussion and strengths, weaknesses, opportunities and threats analysis

24. A round-table discussion was held with participants to gather the following information regarding the current aquaculture capacity in FSM and future aspirations:

- 1) Identification of current farmed aquatic species and future potential aquatic species for aquaculture diversification;
 - a. During this session, participants rated the technical feasibility, economic viability and social acceptance of farmed (current and future) aquatic species.
 - b. Special attention was placed on the economic data available for current farmed species, such as volume and value of production, volume and value of exports, etc.
- 2) Identification of major stakeholders involved in aquaculture promotion and development at the national and state levels; and
- 3) Description of importation and exportation activities related to aquatic animal commodities.

The results of the assessment are presented below.

1) Current and future potential farmed aquatic species in FSM: Aquaculture species prioritization based on technical feasibility, economic viability and social acceptance.

Currently farmed	Technical feasibility (1–10)	Economic viability (1–10)	Social acceptance (1–10)
Giant clams ^{1,2}	10	10	10
Giant clams ³	10	5	10
Oysters	10	6	7
Seaweed (various species including <i>Kappaphycus</i> sp. and <i>Caulerpa</i> sp.)	8	4	6
Corals ^{1,2} and sponges ¹	10	10	10
Mangrove crab (trial ¹)	5	10	10
Sea cucumber (various species)	5	10	5
Trochus	5	10	10
Green snail	5	10	10

Potentially farmed in future	Technical feasibility (1–10)	Economic viability (1–10)	Social acceptance (1–10)
Marine finfish (moi, rabbitfish, milkfish, mullet, parrotfish)	4	10	10
Finfish for bait (milkfish)	4	8	10
Ornamental fish	3	10	5
Flagtail	0	10	10
Freshwater prawn	0	9	9

1 = Pohnpei, 2 = Kosrae, 3 =Yap

2) Major stakeholders involved in aquaculture promotion and development in FSM Species prioritization – FSM aquaculture sector

Stakeholder type	Stakeholders present in FSM
International and regional	The Pacific Community (SPC), Secretariat of the Pacific Regional Environment Programme (SPREP), Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), United States Department of Agriculture-Animal and Plant Health Inspection Service (USDA-APHIS), United States Department of Agriculture-Food Safety and Inspection Service (USDA-FSIS)
National and state-level	Customs, Quarantine, Food safety, States fisheries offices, Environmental Protection Agency (EPA)
Academia	College of Micronesia – Federated States of Micronesia (COM-FSM), University of Guam (UoG), University of Hawaii (UH)
Research and education	College of Micronesia Land Grant Program (COMLG), COM-FSM, Marine and Environmental Research Institute of Pohnpei (MERIP), National Aquaculture Center (NAC), Korea Ocean Research and Development Institute (KORDI), local NGOs
Donors	SPC, SPREP, IFAD, United States Agency for International Development (USAID), Green Climate Fund (GFC), Global Environmental Facility (GEF), Overseas Fisheries Cooperation Foundation (OFCF), Japan International Cooperation Agency (JICA)
Private sector	MERIP, NAC
Other	NGOs, local communities

3) Importation and exportation activities for aquatic animal commodities in FSM

Importation of the following commodities:

- Frozen shrimp – United States of America
- Frozen salmon – United States of America
- Frozen tilapia fillets – United States of America
- Frozen sardines – Japan
- Frozen mussels and oysters – United States of America

Exportation of the following commodities:

- Giant clams (ornamental) – United States of America, European Union and Republic of Marshall Islands
- Hard and soft corals (ornamental) – United States of America, European Union and Republic of Marshall Islands
- Marine finfish (ornamental) – United States of America, European Union and Republic of Marshall Islands
- Fresh and frozen reef finfish (human consumption) – various Pacific Island Countries and Territories (PICTs)
- Tuna (human consumption) – various countries

4) Strengths, weaknesses, opportunities and threats analysis for aquaculture development in FSM

25. A SWOT (strengths, weaknesses, opportunities and threats) analysis was also performed, focusing on the aquatic animal health and aquatic biosecurity aspects related to the development of the aquaculture sector in FSM, including laboratory capacities, diagnostic capacities, export and import standards, roles and responsibilities of government officers, etc.

Strengths:

- local knowledge available
- ideal environment
- availability of research institutions and other stakeholders at all levels
- party to and/or member of relevant international conventions, treaties, etc.
- high biodiversity
- high health status
- pristine water environment
- donor presence at national level
- Micronesia Association for Sustainable Aquaculture (MASA)

Weaknesses:

- limited technical capacity
- limited export capacity (geographical isolation, volume of production, etc.)
- absence of post-entry quarantine facilities
- limited laboratory capacity
- outdated policies and regulations
- uncoordinated efforts
- lack of investment and support
- [limited funds
- limited political will
- no aquaculture zoning
- limited communication
- management and marketing
- policies (quarantine protocols for aquatics)
- limited infrastructure
- limited awareness

Opportunities:

- improve national capacities: capacity building, institutional strengthening, etc.
- easy access to donors and other partners
- expanding community involved in aquaculture

- availability of funds and donors
- food safety
- food security
- regional assistance
- research and training opportunities

Threats:

- pollution
- water quality
- introduction of invasive species
- introduction of exotic diseases/pests
- conflicts with other sectors/users
- unsustainable harvesting practices
- dredging/coastal development
- sand mining
- import requirements on aquatic communities “relaxed”
- lack of biosecurity guidelines for aquatics
- limited laboratory capacity

Conclusions:

- small/medium scale aquaculture activities (focused on the aquarium trade)
- many trials but very few success stories
- aquaculture focused on marine water species
- no aquaculture zoning is a limitation
- many national stakeholders involved at all levels (national, state, local, etc.)
- important community involvement – to be promoted
- problems mostly related to market access and socio-economic assessments

General national aspirations:

- maintain existing aquaculture activities
- increase involvement of coastal communities
- develop and promote marine finfish farming for domestic consumption and exports
- facilitate access to inputs (technology, seeds, feeds, etc.)
- promote sustainable and environmentally friendly aquaculture
- improve extension and research national actions related to aquaculture

2.2. Aquatic animal health and aquaculture biosecurity assessment

2.2.1. Objectives

26. The Thematic Group on Aquatic Animal Health and Aquaculture Biosecurity was tasked to assess the current capacity of FSM to implement aquatic animal health and biosecurity programmes. The discussions were aimed at collecting relevant information essential to support the development of the aquaculture sector through healthy aquatic production and sought opinions on the components and activities that could be included in the National Strategy on Aquatic Animal Health (NSAAH).

2.2.2. Participation

27. Representatives of all four states of FSM (Chuuk, Kosrae, Pohnpei and Yap) participated in the thematic discussion (see Appendix 1). Discussion was facilitated by Drs Brett MacKinnon, Celia R. Lavilla-Pitogo and Melba G. Bondad-Reantaso.

2.2.3. Methodology

28. All participants introduced themselves and presented their work in relation to fisheries, aquaculture and conservation of natural resources. The points for discussion were based on FAO's NSAAH Framework that consists of 15 elements: 1) policy, legislation and enforcement; 2) risk analysis; 3) national aquatic pathogen list (NAPL); 4) border inspection and quarantine; 5) disease diagnostics; 6) farm-level biosecurity and health management; 7) use of veterinary drugs and avoidance of antimicrobial resistance (AMR); 8) surveillance, monitoring and reporting; 9) communication and information system; 10) zoning and compartmentalization; 11) emergency preparedness and contingency planning; 12) research and development; 13) institutional structure; 14) human resources and institutional capacity; and 15) regional and international cooperation.

2.2.4. Results

29. The results of the assessment focused on the 15 elements of FAO's NSAAH Framework, as described below. After completion of the round-table discussions, an additional element, "Ecosystem health", was suggested to be included in the framework because of the importance of conservation and preservation of biodiversity to FSM. The information provided by this session has been incorporated into the draft NSAAH, a separate report.

1) Policy, Legislation and Enforcement:

- A Biosecurity Act has been passed in FSM.
- There is a pending aquaculture development plan.

2) Risk Analysis:

- Risk analyses are not being conducted in regard to aquatic animal health or aquaculture biosecurity.
- Preliminary risk analyses are being conducted in FSM for the management of invasive species.
- No impact analyses are being conducted in regard to the implementation of risk management measures.

3) Pathogen List:

- There is no NAPL in effect in FSM.
- FSM may not currently have concerns for aquatic animal pathogens in aquaculture.

4) Border Inspection and Quarantine:

- There is no aquatic animal health quarantine programme in effect in FSM.
- There are pre-border testing requirements for aquatic animals.
- Permits are required for domestic movements of aquatic animals.
- There is a history of illegal imports that have led to the introduction of invasive species into FSM.
- Ballast water is a large concern with regard to the introduction of invasive species.

5) Disease Diagnostics:

- No diagnostic laboratories exist in FSM for the detection of aquatic animal diseases.
- There are existing laboratories for microbial testing in food safety (EPA).

6) Farm-level Biosecurity and Health Management:

- Farm-level biosecurity and health management are not in effect at aquaculture sites.
- There are no aquatic animal health professionals that practice in FSM.

7) Use of Veterinary Drugs and Avoidance of Antimicrobial Resistance (AMR):

- Veterinary drugs are not currently used in aquaculture.

8) Surveillance, Monitoring and Reporting:

- Active or passive surveillance activities are not being conducted in FSM for the detection of aquatic animal pathogens.
- Surveillance activities in the form of surveys are being conducted for conservation purposes to manage invasive species in FSM.
- FSM is an OIE member but is considering ending its membership.

9) Communication and Information Systems:

- There are youth programmes with schools and education for communities regarding conservation.

10) Zoning and Compartmentalization:

- Zoning and compartmentalization programmes are not in effect in FSM.

11) Emergency Preparedness and Contingency Planning:

- Emergency preparedness is not a priority for aquatic animal diseases.
- Contingency plans for the introduction and spread of foreign aquatic animal diseases have not been developed.

12) Research and Development:

- There are many conservation projects in development in FSM.
- No projects focus on aquatic animal health or aquaculture biosecurity.

13) Institutional Structure (Including Infrastructure):

- No institutional structures are in place for aquatic animal health or aquaculture biosecurity.

14) Human Resources and Institutional Capacity:

- No Competent Authority for aquatic animal health and aquaculture biosecurity has been identified.

15) Regional and International Cooperation:

- There are limited collaborative efforts regarding aquatic animal health and aquaculture biosecurity within the region or internationally.

16) Ecosystem Health:

- Invasive species are a large concern in FSM.
- There are conservation efforts currently in effect.
- There are issues arising due to possible climate change.
- There is a decline in the numbers of wild aquatic animals.

2.3. Biosecurity legislation review

2.3.1. Objectives

30. At the inception of the policy review component of the Technical Cooperation Programme (TCP), the main task was to assess the Biosecurity Act, then pending with FSM's 19th Congress, and relevant documents on aquatic animal health and aquatic biosecurity with the purpose of integrating aquatic biosecurity and aquatic animal health issues. Upon commencement of the mission, the bill had already become law, pre-empting the enactment of a more comprehensive legal framework to govern aquatic biosecurity. The remit thus shifted to identifying provisions in the Biosecurity Act that could be made the basis of regulations specific to aquatic biosecurity and evaluating the biosecurity regulatory framework in relation to existing capacities and requirements for effective implementation.

2.3.2. Participation

31. Participants from concerned national and state government agencies and non-governmental organizations (NGOs) from the four states of FSM (Chuuk, Kosrae, Pohnpei and Yap) actively engaged in the round-table discussions (see Appendix 1), which were facilitated by Ms Annaliza A. Vitug.

2.3.3. Methodology

32. The methodology employed in the review consisted of the study of available literature and national framework documents and action plans prior to the discussions. The group discussed a wide range of issues, mostly reflecting concerns indicated in the framework documents, and going forward, determined practical steps in support of the implementation of the Biosecurity Act.

2.3.4. Results

33. The results of the review can be divided into two broad categories: one focusing on the legal and regulatory aspects and the other on the institutional/administrative aspects.

Legal/Regulatory Framework

- The national frameworks of FSM¹ highlighted as a priority, the development and implementation of national and state laws on biosecurity to safeguard the nation's biodiversity from the threats of alien invasive species (AIS) and genetically modified organisms (GMOs). The Biosecurity Act, however, does not make mention of any of these terms, as the biosecurity regime that was legislated primarily aims to control pests and diseases affecting animals, plants and their products in order to avoid adverse effects on the nation's economy and health.

¹Strategic Development Plan (SDP) (2004–2023): The Next 20 Years: Achieving Economic Growth and Self Reliance and the National Biodiversity Strategy and Action Plan (NBSAP) for 2018 to 2023.

- NGO representatives expressed the concern that deliberate or accidental introduction of fish, amphibians and crustaceans may introduce pathogens and can be detrimental to native biodiversity. The issue is vital given the considerable dangers posed by introductions and transfers to fisheries and aquaculture and the responsibilities of FSM as a party to the Convention on Biological Diversity (CBD). Fortunately, there is legal basis to address the gap with the rule-making powers of the Secretary,² through which a subsidiary legislation or regulation may classify AIS and GMOs as among the pests to be regulated, the importation of which is prohibited or restricted under section 409 of the law.³
- Another pathway for the introduction of invasive and potentially harmful marine organisms identified in the National Biodiversity Strategy and Action Plan (NBSAP) is the discharge of ballast water, which while defined in the law, was again overlooked in the legal text. The presence of an unidentified invasive fish in the lagoon of Sokehs municipality in Pohnpei has already been attributed to bilge water discharge.⁴ Noting the importance of protecting native marine biodiversity on the high seas and all coastal ports, the NBSAP indicated the need for legislation to require ships to empty ballast water at sea before entering FSM waters or to take other appropriate precautions to prevent the introduction of invasive and potentially harmful marine organisms. A ballast water management system could be required for foreign and domestic watercraft through an enabling regulation invoking Section 403. Though FSM is not a member of the International Maritime Organization (IMO) or a party to the Ballast Water Management Convention, nothing prevents it from adopting and imposing standards and protocols on ships entering its territorial waters to prevent, reduce or eliminate the transfer of harmful aquatic organisms and pathogens through ships' ballast water and sediments.
- With regard to aquatic animals and aquatic biosecurity, the prospect of crafting a policy specific to aquatic animals and aquatic animal health remains high, with the inclusion of amphibians, fish and molluscs in the law's definition of animals⁵ and with the express grant of power to the Secretary to make rules. Anchored on the application of the precautionary principle that is among the underlying statutory guideposts and on the explicit reference to the Sanitary and Phytosanitary Agreement in the Biosecurity Act, an aquatic animal biosecurity regulation could be developed and implemented considering that fish is not only a cornerstone of the country's food security but also its leading export driver and largest income-earner.
- Above concerns notwithstanding, the Biosecurity Act is a solid piece of legislation, establishing a wide-ranging legal arsenal and giving ample powers (rule-making, enforcement and punitive fixed penalty system in lieu of criminal prosecution) to the Secretary as the Competent Authority and to the Biosecurity Officers, leaving no excuse for nonfeasance. A comparison, however, between the vast powers and responsibilities⁶ of the Biosecurity Officers on the one

²Section 453 of Public Law No. 19-174 of the Federated States of Micronesia Biosecurity Act empowers the Secretary of the Resources and Development Department to make rules for the effective implementation of the law and performance of the biosecurity functions of the national government.

³"Section 409. Regulated pests and diseases. (1) The Secretary may by order declare pests or diseases: (a) the importation of which is prohibited for all purposes; or (b) the importation of which is permitted subject to conditions specified under this chapter or the regulations; (2) A person who imports or attempts to import a pest or disease which is prohibited under subsection (1) (a) commits a level five offense. (3) A person who imports or attempts to import a pest or disease which is regulated under subsection (1) (b) in breach of the conditions of import commits a level five offense."

⁴Coastal Fisheries Situation Analysis Report, the Federated States of Micronesia Coastal Fisheries Assessment Pacific Islands Regional Oceanscape Program, May 2018, by Integrated Aquatic Solutions Inc., Australia.

⁵"Animal" means any mammal (other than a human), bird, insect, amphibian, reptile, fish, mollusc, or any other living organism except a plant, whether alive or dead, and includes the egg, embryo, ova or semen and any organic animal tissue from which another animal could be produced, and the hide, skin, hair, feathers, shell, horns, hoof, viscera or any other part or portion of the body of an animal (Sec. 6 (2) of Public Law 19-174 (Sec. 403 of the amended Title 22 of the Code of FSM's) on Definitions).

⁶Powers of Biosecurity Officers include: (1) enter and search any premises, building or area, including a biosecurity holding area, biosecurity quarantine station or biosecurity approved premises and land adjacent to a dwelling house, any store, warehouse, silo, pen or similar premises, or any conveyance, in which regulated articles intended for importation to or exportation from the Federated States of Micronesia are kept; (2) seize anything

hand and existing institutional capacity on the other, reveals a huge disparity, which if not resolved immediately would undermine enforcement and implementation of the law.

Institutional/Administrative Framework

- Biosecurity and all its aspects including quarantine is a federal responsibility. Biosecurity/quarantine officers are assigned in all four states. However, even prior to the passage of the Biosecurity Act, the Strategic Development Plan (SDP) already recognized the need to strengthen enforcement by improving facilities, allocating appropriate budget, training personnel, adopting stringent protocols and augmenting quarantine staff at all ports of entry and deputizing national staff at ports in all states.
- A review of the functions of biosecurity officers and the number of officially designated ports of entry ⁷ to be serviced would demonstrate that the current number of national biosecurity/quarantine officers (seven assigned in Pohnpei, three in Kosrae, and four each in

which: (a) is an uncleared regulated article; or (b) may be used as evidence of the commission of an offense; (3) at the expense of the importer, submit to appropriate biosecurity measures any regulated article seized pursuant to law; (4) inspect documents on or in incoming or outgoing vessels and aircraft, open and inspect at a biosecurity point of entry or departure any incoming or outgoing document, including mail, in order to ascertain whether the document contains or relates to a regulated article; (5) inspect at a biosecurity point of entry or departure any article, which requires biosecurity export/import clearance and in case of refusal break up the consignment or open the container or cause it to be broken or opened; (6) detain the article, and any conveyance, container or baggage in which the article is carried, for biosecurity measures to be taken; (7) with the consent of the importer, owner or custodian, take samples from: (a) any part of an incoming vessel or aircraft that has on board regulated articles; (b) any warehouse containing regulated articles intended for importation; (c) any consignment of incoming regulated articles, wherever located; (d) any incoming container, baggage or thing that the officer reasonably suspects to be or include a regulated article; (8) with the consent of importer, owner or custodian, take samples of any outgoing regulated article if the taking of a sample, is necessary for the issue of a sanitary or phytosanitary certificate; (9) test, or cause tests to be conducted on, any incoming regulated article, in order to ascertain whether the article meets the biosecurity import requirements; (10) require an incoming regulated article to be treated in order to meet the biosecurity import requirements before biosecurity import clearance is granted; (11) order the destruction of an article should the importer fail to have the article treated within the reasonable time; (12) detain an incoming regulated article for reconsignment or destruction if it does not have an import permit or sanitary or phytosanitary certificate; (12) destroy an article below \$2000 found to be infected, infested or contaminated by a regulated pest or disease and appropriate treatment is not available in the Federated States of Micronesia while consent of the Secretary if required for articles above \$2000; (13) if upon examining an animal, the biosecurity officer suspects that the animal is diseased and considers a post mortem examination to be necessary to establish a diagnosis, the officer may, on the written authority of the Secretary, and without the consent of the owner: (a) take or cause to be taken the life of the animal; (b) cause a post mortem examination to be conducted to decide whether the animal is diseased; and (c) obtain specimens from the animal for laboratory examination and diagnosis; (14) If a biosecurity officer is of the opinion that any person: (a) seeking to enter or leave the Federated States of Micronesia; (b) employed at a biosecurity point of entry or departure, in a designated area or quarantine station, or at approved premises; or (c) engaged in importing or exporting regulated articles, is in possession or control of an article that poses a biosecurity threat to the Federated States of Micronesia, the officer may detain and question the person; (15) on suspicion that a person entering or leaving FSM has in his possession an article that if imported or exported constitute an offense under the law, a biosecurity officer may cause the search upon the person and his baggage.

⁷Official ports of entry designated (FSMCode2014Tit18Chap02). The official ports of entry in the Federated States of Micronesia until otherwise provided by regulations are:

- (1) **Yap:** (a) Yap: (i) Tomil Harbor; and (ii) Yap International Airport (b) Ulithi: (i) Ulithi Anchorage; and (ii) Ulithi Airstrip. (c) Woleai Atoll (i) Woleai Anchorage; and (ii) Woleai Airstrip. (d) Satawal.
- (2) **Chuuk:** (a) Weno: (i) Moen Anchorage; and (ii) Chuuk International Airport. (b) Satowan Atoll: (i) Satowan Anchorage; (ii) Satowan Airstrip; and (iii) Ta Airstrip. (c) Faichuk Piannu Harbor: (i) Polle Anchorage Area; and (ii) Tolensom Anchorage. (d) Northwest Harbor: (i) Polowat Anchorage Area; (ii) Pollap Anchorage Area; (iii) Hauk Airstrip; and (iv) Onoun Airstrip.
- (3) **Pohnpei:** (a) Mesenieng Harbor; (b) Pohnpei International Airport; (c) Kapingamarangi Anchorage; (d) Kapingamarangi Airstrip; (e) Temwen Harbor; (f) Sapwuahfik Airstrip; and (g) Oroluk Airstrip.
- (4) **Kosrae:** (a) Lelu Harbor; (b) Okat Harbor; and (c) Kosrae International Airport.

Chuuk and Yap) is simply inadequate. Practical measures to strengthen capacity at the ports include the training, authorization and deployment of other national government officers like Customs Officers and state government officers to enforce national biosecurity laws. Existing intergovernmental memoranda of understanding between the national and state governments on “Cooperation with regard to National Quarantine Inspections”, which were signed in 1998 need to be renegotiated and signed. This is important both in the deputation of state officers and in the designation of biosecurity holding areas, as the Secretary must first secure the consent and written agreement of the Governor of the state where the proposed biosecurity holding area is located before designating it as such. To augment personnel, the Secretary may, in writing, appoint any person to be a temporary biosecurity officer for a period not exceeding six months for a particular purpose or at a particular location. The Secretary can also designate or appoint a public officer from another department provided the relevant Secretary is first consulted, but failure to do so does not invalidate the designation or appointment. Skills enhancement and adequate training in biosecurity control measures of designated biosecurity personnel, particularly relating to the import of aquatic organisms to FSM, is essential. The procurement of equipment, in particular, scanners, is suggested to expedite inspection and monitoring of imports and exports of organic products at the ports.

- Poor or non-existent facilities for quarantine of aquatic products in the four states coupled with the lack of awareness among the public on the dangers of introductions and transfers to biodiversity and aquaculture, further compound the problem of inadequate biosecurity personnel. In addition, there is no detailed quarantine protocol for the import of aquatics to FSM. A revision of the Biosecurity Operations Manual should be prioritized as this is the document that the biosecurity officers will rely upon in the performance of their duties. The Secretary is, in fact, required by law to develop and publish a manual of standard operating procedures (SOPs) to guide biosecurity officers in their duties.

3. TECHNICAL SEMINAR ON AQUATIC ANIMAL HEALTH AND AQUACULTURE BIOSECURITY

34. The Technical Seminar on Basic Aquatic Animal Health Management was conducted to enhance knowledge and understanding on aquatic animal health and aquatic biosecurity. A total of 12 presentations were given that were divided into four sessions, namely:

- Session 1: Why and how do diseases occur in aquaculture?
- Session 2: What diseases can occur in aquaculture and how do you diagnose them?
- Session 3. What can be done to reduce or manage the risk of diseases in aquaculture?
- Session 4. Moving forward to addressing diseases in aquaculture in FSM

35. The detailed programme of the Technical Seminar is given in Appendix 5. The following Sections 3.2–3.4 are summaries of the presentations.

3.1. Session 1: Why and how do diseases occur in aquaculture?

36. *Presentation 1. Factors in the development of disease in aquaculture* (Dr Celia R. Lavilla-Pitogo, International Consultant)

37. Dr Lavilla-Pitogo gave a short introduction to aquaculture and the types of culture practiced in various environments. She illustrated the various degrees by which fish can be isolated from the external environment based on the level of water exchange, therefore affecting the level of biosecurity that can be implemented. Maintaining animal health in the aquatic environment is more difficult compared with terrestrial culture systems because every input goes into the water, changing its quality as the culture progresses. The disease triad of the host, pathogen and the environment, popularly known as Snieszko’s circles, was explained. The development of disease is the result of the complex interaction of the three factors whereby the disease only develops in the presence of a pathogen, a susceptible host and

environmental conditions that bring about either increased virulence of the pathogen or decreased resistance of the host.

38. **Presentation 2. Challenges in managing health in the aquatic environment** (Dr Celia R. Lavilla-Pitogo, International Consultant)

39. Dr Lavilla-Pitogo emphasized that one of the biggest challenges in aquaculture is the occurrence of disease, because it can lead to losses due to mortality or inferior product quality that could be rejected by the market. Challenges in keeping fish healthy during farming include maintaining optimal quality of the culture environment because it directly influences the health status of fish. Management of the rearing system, such as stocking density and biomass, affects water quality because its degradation is influenced greatly by the life support system that is available. The absence of zoning and poor environmental management affect farming areas. When infectious disease is diagnosed, the options for treatment are limited for aquatic animals and would largely depend on compliance to food safety standards, traceability and the dictates of the market. The use of drugs and antimicrobials is largely prohibited. Holistic health management in aquaculture is thus very important and begins with good site selection and physical design of the rearing facility, and implementation of biosecurity and keeping environmental parameters at the optimum. There is also a need for access to genetically improved stocks that are free of specific pathogens or have developed tolerance or resistance to them. Paramount to keeping farmed fish healthy is the availability of diagnostic support and correct interpretation of results as tools in decision making. Even if the role that the environment plays in open culture systems is complicated, it has to be understood to achieve consistent production and sustainability.

3.2. Session 2: What diseases can occur in aquaculture and how do you diagnose them?

40. **Presentation 3. Infectious diseases affecting aquaculture commodities** (Dr Celia R. Lavilla-Pitogo, International Consultant)

41. The presentation of Dr Lavilla-Pitogo started with the list of diseases in aquatic animals that are considered by the OIE for reporting in order to prevent their spread via international trade. Early detection, reporting and control are important elements in the OIE system, which includes diseases affecting amphibians, crustaceans, fish and molluscs. The importance of the *OIE Aquatic Animal Health Code* (the Aquatic Code) (World Organisation for Animal Health, 2019a) and the *OIE Manual of Diagnostic Tests for Aquatic Animals* (the Aquatic Manual) (World Organisation for Animal Health, 2019b) as resources in aquatic animal health was also emphasized. Because of its relevance in the Asian region, the Network of Aquaculture Centres in Asia-Pacific (NACA) *Quarterly Aquatic Animal Disease Report* (Network of Aquaculture Centres in Asia-Pacific, 2019) was also introduced because it covers diseases that are not on the OIE list, but important to the region. For clarity and better understanding of the nature of diseases, a short background on microbiology was given. In addition to the OIE and NACA-listed diseases, the presentation also gave examples of significant diseases in fish and crustaceans that cause economic losses during culture. Bacterial and parasitic diseases in fish and shrimp, as well as their signs, were discussed, accompanied with photos. The importance of selecting good quality and healthy postlarvae and fingerlings for on-growing in aquaculture was highlighted.

42. **Presentation 4. Diseases of giant clams, trochus and other important species in FSM** (Dr Ruth García Gómez)

43. Dr García Gómez enumerated the important cultured molluscs in FSM, which include five species of giant clam (4 *Tridacna* sp. and 1 *Hippopus* sp.). These aquatic animals are traded mainly for the aquarium industry. The presentation gave an overview of the importance of environmental quality for their growth and survival at all stages. The presence of photosynthetic zooxanthellae in their mantle requires rearing in clear water for good light penetration. From spawning to larval rearing and nursery

up to more six months, the molluscs are held in land-based tanks. During this phase of growth, biosecurity is required to ward off predators, prevent bacterial infection and avoid parasitic infestation. Among the OIE-listed diseases, only the parasites *Perkinsus olseni* and *Marteilia* sp. have been reported to infect giant clams. This highlights the need to take precautionary measures when translocating clams between the Pacific islands. While still in land-based tanks, some diseases associated with infections by various bacteria (*Vibrio* spp., *Aeromonas* spp. and *Plesiomonas* spp.) have been observed. Good hatchery management needs to be followed to avoid opportunistic pathogens destroying the stocks. When the clams are transferred to ocean nurseries, problems like bleaching due to the loss of symbiotic zooxanthellae can occur. Winter disease causes high mortalities when water temperature goes below 20°C, showing the vulnerability of these animals to changing climate. Overall, the main disease prevention option, especially for clams that are in ocean nurseries, is site selection to ensure that, throughout the rearing period, optimal water quality parameters are obtained.

44. ***Presentation 5. Transboundary aquatic animal diseases and the need for effective national biosecurity strategy*** (Dr Melba G. Bondad-Reantaso, FAO)

45. Dr Reantaso began her presentation by stating that transboundary aquatic animal diseases (TAADs) are highly transmissible diseases with potential for very rapid spread irrespective of national borders. They cause serious socio-economic impacts and include those that are important to trade (i.e. about 30 are listed by the World Organisation for Animal Health, OIE). These are governed by international standards and have a set of criteria that must be met in order to be listed. These serious diseases affect important traded species (e.g. finfish, crustaceans, molluscs), and for which notification is recommended during an outbreak. Infectious diseases important to aquaculture may be classified as exotic, enzootic or emerging diseases that are of known or unknown aetiology. She discussed the factors that contribute to the occurrence of disease situations, such as intensification that leads to trade and transport of live broodstock and fingerlings, misunderstanding of the health status of stocks, poor biosecurity, use of live feeds, and irresponsible use of veterinary drugs that contributes to the development of antimicrobial resistance (AMR).

46. Dr Reantaso gave the following examples of TAADs: epizootic ulcerative syndrome (EUS), koi herpesvirus (KHV), tilapia lake virus (TiLV), acute hepatopancreatic necrosis disease (AHPND), and infectious myonecrosis virus (IMNV). Koi herpesvirus (KHV) disease is a contagious acute viraemia in common carp and varieties such as koi and ghost carp. It was first reported from Israel and Germany in the late 1990s and spread globally, predominantly with the trade in koi carp. KHV is present throughout Europe, and also occurs in Asia and the United States of America, and it affects all age groups of fish. Diagnosis by Level I and II techniques can be used, but confirmation of the disease is only by Level III methods using polymerase chain reaction (PCR) methods. IMNV is another significant disease that has caused mass mortality of cultured *Penaues vannamei* in farms located in Northeastern Brazil in 2002, East Java, Indonesia in 2006 and India in 2017. Gross signs (Level I) of IMNV are various degrees of skeletal muscle necrosis, visible as an opaque, whitish discolouration in the abdomen or reddened necrotic tails. Confirmation of the disease is by reverse transcription PCR (RT-PCR) and bioassay. Dr Reantaso pointed out that core actions to combat TAADs at the national level entail capacity building for timely assessment of the threats, building risk analysis capacity to identify risk pathways and high-risk organisms, and to implement preborder, and postborder measures to prevent pests and diseases from entering the country. An understanding of international standards to prevent the introduction and spread of TAADs is necessary because their implementation is a big challenge.

47. ***Presentation 6: Climate change dimension: environmental and other risk factors impacting aquatic animal health*** (Dr Melba G. Bondad-Reantaso, FAO)

48. Dr Reantaso commenced her presentation by highlighting the FAO Fisheries and Aquaculture Technical Paper 627 on *Impacts of Climate Change on Fisheries and Aquaculture*. In the development of disease, environmental conditions play a role in the presence of a viable pathogen and susceptible host, given a viable transmission pathway. The environment may increase the virulence of the pathogen or decrease the resistance of the host. Environmental conditions may provide situations for the pathogen

to replicate in huge numbers. They may also induce stress on the hosts. Treatment or eradication of pathogens has little or no possibility once a pathogen is introduced and becomes established in the natural environment.

49. Dr Reantaso discussed the climate conditions prevailing during outbreaks of parasitic oyster diseases (bonamiosis, marteilosis and perkinsosis), fungal disease in finfish (EUS), bacterial disease in shrimp (*Vibrio parahaemolyticus* strain of AHPND), and viral disease in shrimp (white spot syndrome disease). Bonamiosis and perkinsosis are diseases that occur during seasons with warm water temperature, while marteilosis occur during cold seasons. EUS is a fungal disease that is one of the most serious affecting finfish. It causes high losses due to mortalities and market rejection because of the presence of ugly lesions on affected fish. Outbreaks in the wild and in farms have often occurred during periods of low temperatures in the tropics (18 to 22°C), but EUS has been observed across a broad temperature range. It has been known in Asia since 1971 and in the United States of America in 1978. Its spread into southern Africa since 2006 has caused concern because more than 25 species are susceptible. Dr Reantaso reviewed the environmental and other risk factors for the spread of EUS. These include shipping movements and release of ballast water, fish migration, ocean currents, heavy rainfall, acidified run-offs from acid sulphate soil areas, and low temperature that favours fungal sporulation. AHPND is currently the most important non-viral disease threat for cultured shrimp. This disease is unlike most diseases affecting farmed penaeid shrimp in that it is caused by the ingestion of toxins (PirA and PirB) generated by a specific plasmid carried by certain strains of *Vibrio parahaemolyticus*, a bacterium that is ubiquitous in marine and brackish water environments. Environmental conditions such as temperature, salinity, zooplankton abundance, dissolved oxygen and tidal flushing may affect the survival, establishment and growth of this bacterium.

50. **Presentation 7. Levels of aquatic animal disease diagnosis in Asian aquaculture** (Dr Melba G. Bondad-Reantaso, FAO)

51. Dr Reantaso presented to the group the *Asia Diagnostic Guide to Aquatic Animal Diseases* (ADG) (Bondad-Reantaso et al., 2001), one of the most important outcomes of an FAO Regional TCP Project in 1998 – “Assistance for the Responsible Movement of Live Aquatic Animals”, with the participation of 21 countries from throughout the region. Diagnostics is important to screen healthy animals to ensure they do not carry subclinical infections by pathogens of concern. Pre-shipment diagnostic screening will reduce the risk that animals are carrying opportunistic agents that might proliferate during shipping, handling or change of environment; and it also reduces the risk of resistant or tolerant animals transferring a significant pathogen to a population which may be susceptible to infection. Disease diagnosis is important for animals showing signs of health deterioration (e.g. spawning failure, growth or behaviour) or clinical disease (deformities, morbidity or mortality). Accurate and rapid diagnosis is essential for applying appropriate and effective management measures. Diagnosis relies on a broad array of techniques ranging from gross observation to molecular probes and genetic sequencing. The choice on which tool to use for any diagnostic application relates to the *sensitivity* (ability to detect infections) and *specificity* (ability to distinguish one disease agent from another) of each technique.

52. Dr Reantaso clearly emphasized that the ADG presents the levels of diagnosis, their associated requirements and responsibilities. This classification emphasizes the need to recognize the continuum of observations whereby outcomes of each level of diagnostics contribute to an accurate and over-all diagnosis and ensure meaningful interpretation of the disease situation. For example, surveillance of healthy animals by gross observation for clinical signs may be ineffective, requiring more sensitive tests to detect low levels of infections in subclinical animals. Only a few diseases have unique visible manifestations that allow diagnosis by the naked eye.

53. Level I diagnosis involves observation of the animal and its environment and only requires knowledge of normal behaviour of stock through frequent observation and consistent record-keeping. This is mainly the responsibility of farm workers and managers, and is also useful for fishery extension officers and fishery biologists. Emergence of the disease in an area or population where it has not

previously been observed warrants further investigation. In such a situation, gross observations would be considered presumptive, and would require further analyses to be confirmed and considered as a conclusive diagnosis. Level I diagnosis needs to be brought to the attention of laboratories with capability for Level II diagnosis by sending samples. Evidence gathered from farm observations through to the high-tech laboratory results is essential for accurate diagnosis, especially for previously unknown diseases (in an area/country or in aquaculture internationally).

54. Level II diagnosis is conducted in laboratories with capability in parasitology, bacteriology, mycology and histopathology. These methods need basic equipment and personnel who are trained in aquatic animal pathology. In addition, it also requires the ability to preserve specimens for optimal Level III diagnosis and knowledge of where to send them.

55. Level III diagnosis involves the use of techniques for virology, molecular biology, immunology, and electron microscopy in a highly equipped laboratory with specialized and trained personnel. The continuum required for the three levels of diagnosis is essential for correct diagnosis, because outcomes of each level contribute to an accurate diagnosis.

3.3. *Session 3: What can be done to reduce or manage the risk of diseases in aquaculture?*

56. ***Presentation 8. Responsible movement of live aquatic animals*** (Dr Melba G. Bondad-Reantaso, FAO)

57. Dr Reantaso started her presentation with some facts on the transboundary movements of live aquatic animals that have accompanied the global growth of aquaculture and trade in many commodities. The risks involved in movements of live aquatic animals and their products have increased dramatically during the past 50 years. In addition to aquaculture, aquatic animals are also moved for ornamental and sports purposes, to enhance capture fisheries, for biological control and for research. The significant growth of aquaculture and its contribution to world food supplies led to brisk trade of commodities spurred by trade liberalization and globalization, and growing global consumer demand. The growth of the aquaculture sector has also increased demands for new species.

58. Trade in aquatic animal commodities is risky because of the extremely high volume of trade and the high frequency of new and emerging diseases. The poor knowledge base on basic biology, ecology, reproduction, etc. of exotic organisms and the need to transfer them requires information on pathogens and their biology, completed risk analyses, quick and accurate diagnostic tests for many pathogens, and specialized expertise in these fields (including risk analysis). Movements of aquatic animals require sufficient government policy and planning, considering that such movements can involve a diverse range of finfish, crustaceans, molluscs, amphibians and aquatic plants. These commodities are traded throughout in diverse life-cycle stages (broodstock, juveniles, fry and fertilized eggs), as well as processed or frozen products that are sold whole, eviscerated or filleted. Dr Bondad-Reantaso also emphasized that domestic movements of aquatic animal commodities happen, and this may endanger areas of the country that are free from a particular disease due to geographical barriers or because of different management practices. The central problem is that all movements of live aquatic animals involve an element of pathogen, genetic and/or ecological risk. Some ways to reduce the risk include knowing the species being imported, its origin, evaluation of the exporting country, and assessment of presence of diseases.

59. Dr Reantaso gave an example of recommendations to reduce the risk spread within countries of tilapia lake virus (TiLV) through prohibition of live tilapia movement, installing basic biosecurity practices at the farm level, preparing a national emergency disease response system targeting TiLV, immediate notification of unexplained mortalities to competent authorities, and TiLV surveillance of all major dissemination centres for broodstock, fry and fingerlings. For reducing the risk of international spread of TiLV, there is a need to prohibit live imports of tilapia based on risk assessment, allowing

importation only for populations that are certified free from TiLV, quarantine, surveillance of establishments with imported fish, and immediate surveillance of all major breeding facilities and fry/fingerling dissemination centres.

60. Dr Reantaso ended her presentation with the message that responsible movement is key because a “zero risk” policy is not realistic. Risk analysis can be used to aid decision making and examine ways to reduce risk to an “acceptable” level.

61. **Presentation 9: Prevention through good practices: aquaculture and aquaculture biosecurity** (Dr Celia R. Lavilla-Pitogo, International Consultant)

62. Dr Lavilla-Pitogo discussed practical best practices during production to promote biosecurity and prevent diseases. These best practices include knowing your fish and the pathogens affecting it, the contamination pathways, sources of healthy seed, maintaining good husbandry, and managing stock health. In addition, respect for food safety and the environment are essential. The ultimate goal of biosecurity is to avoid rather than react to problems. This is done by preventing entry of, or reducing the overall numbers of, disease-causing organisms, risk identification and management and control of pathogen transmission. At the national level, all aquaculture stakeholders should know the diseases to keep out, and an agreement on a disease list is important. Corresponding to this, knowledge of enzootic diseases and their impacts on production is vital because, at the farm level, pathogen exclusion is costly.

63. Dr Lavilla-Pitogo also informed that biosecurity in shrimp culture systems focused on viral diseases for a long time, and shrimp farmers were unprepared for the onslaught of bacteria and parasites. Although AHPND is not a case of simple vibriosis, some control measures for vibriosis could work. For example, formation of biofilms on tanks and other surfaces should be avoided and regular facility dry-out schedules should be implemented. Since *Vibrio* spp. have positive affinity to chitin, an abundant material on and in shrimp, farmers should ensure that shrimp are kept healthy to cope with regular molting. Delayed molting leads to the build-up of bacterial plaques that become sources of bacterial pathogens. For the rearing environment, microbial ecological management is a key measure to control vibriosis, and this could be done by application of probiotics, use of green-water from fish-rearing systems, disinfection of water by chlorination, use of microbially mature water by ageing, control of feeding and prevention of sludge accumulation.

64. Dealing with viruses, like white spot syndrome virus, entails carrier eradication through filtration, application of crustacide, disinfection of water, installation of bird-nets, and control of staff and equipment movement. Stocking specific-pathogen-free (SPF) or specific-pathogen-resistant (SPR) postlarvae is a very important biosecurity measure, and such quality is assured by following postlarval selection criteria and testing for viruses and fungal parasites by PCR.

65. **Presentation 10: Quarantine as a risk management measure** (Dr Melba G. Bondad-Reantaso, FAO)

66. Dr Reantaso highlighted the document on *Procedures for the quarantine of live aquatic animals* published by FAO (Arthur, Bondad-Reantaso and Subasinghe, 2008). She explained that quarantine refers to maintaining a group of aquatic animals in isolation with no direct or indirect contact with other aquatic animals, in order to undergo observation for a specified length of time, and, if appropriate, for testing and treatment, including proper treatment of effluent waters. Quarantine is an important risk management measure and a key activity that should be considered when developing national strategies for aquatic animal health. It can be used effectively to increase biosecurity at the farm production level.

67. Quarantine at the international level aims to minimize the risk of introducing and transmitting pathogens into importing countries. It is aimed at preventing the introduction of potentially harmful species that may come with the shipment. At the subnational level, quarantine aims to prevent the spread of pathogens between different river systems, watersheds, islands, disease zones or political units.

Quarantine can also be practiced in production facilities like hatcheries, nurseries and grow-out systems to prevent the spread of diseases, but it needs understanding and well-trained staff.

68. In the past, quarantine was viewed as a separate activity and a procedure that needed to be applied for all imports of live aquatic animals. That thinking has changed by application of several risk management measures, singly or in combination, to reduce the risk of disease. The decision to quarantine or not should be done on a case-by-case basis and should be based on a risk analysis. Complementary approaches to reduce disease risks include pre-border procedures through good cooperation between importing and exporting countries, certification at production source, use of SPF stocks, zoning, restriction of movements of life-cycle stages, list of approved species, list of approved exporting countries, on-site inspection of exporting facilities, evaluation of Competent Authority (CA), international health certificates, pre-border quarantine, and pre-shipment treatment. Post-border complementary procedures include restriction on initial use to observe for diseases prior to the general release of animals into the natural environment, monitoring programme to understand if pathogens have spread to the new environment or there have been escapes, and contingency plans in case of escapes or failure to detect disease during quarantine.

69. ***Presentation 11: Breaking the disease transmission pathways*** (Dr Brett MacKinnon, International Consultant)

70. Dr MacKinnon discussed that biosecurity is very important for disease prevention, as it involves management practices, procedures, and policies to prevent introduction and spread of pathogens. In the context of the PMP/AB, biosecurity refers to the cost-effective management of risks posed by pathogens to aquaculture through a strategic approach at the enterprise, national and international levels with shared public-private responsibilities. In this context, it is important to recognize the purpose of biosecurity in animal, pathogen and people management.

71. Dr MacKinnon emphasized that risk-based biosecurity principles require understanding of the situation and the pathogens of concern, including their epidemiology, transmission, and factors for disease expression. Risks on the pathogen's introduction pathway, spread and potential negative impacts should be known in order to plan control measures and how they can be implemented. Animal management starts with obtaining healthy stocks and maintaining good husbandry to optimize health and immunity. Pathogen management entails reduction of risk of pathogen and disease introduction by providing barriers for elimination of pathogens. It is also important to know if the pathogen is vertically or horizontally transmitted, introduced by vectors, comes in with water and fomites, or is present in feed. The use of infected live or frozen feed and contaminated pellets facilitates pathogen entry into the system. Disinfection methods for water and fomites should be implemented. Control measures for vectors, animals and visitors include restriction of movement, sanitation and compliance. Dr MacKinnon concluded her presentation by stressing that biosecurity control measures will help to decrease the risk of disease introduction and spread in farms. They also contribute to protecting aquatic animal health and welfare and promote sustainable aquaculture by improving success of aquaculture businesses and operations.

72. ***Presentation 12: Legal dimension of aquatic animal health management*** (Ms Annaliza A. Vitug and Ms Ariella D'Andrea, International Legal Consultants)

73. Ms Vitug began her presentation by describing what aquatic animals are, as defined in the OIE *Aquatic Animal Health Code* (the Aquatic Code). The term covers fish, molluscs, crustaceans and amphibians in all life stages, including eggs and gametes, originating from aquaculture establishments or removed from the wild for farming purposes, for release into the environment, for human consumption or for ornamental purposes. She emphasized that by the explicit mention of fish, molluscs and amphibians in the definition of animals, there is clear intent in FSM's Biosecurity Act to include aquatic animals in the law's biosecurity regime, albeit the mechanisms and measures specific to aquatic animals and aquatic animal health can be further elaborated in subsidiary legislation or regulations.

74. She then stressed the importance of aquatic animals to FSM's economy. In the last five years, aquatic animals, collectively, have been the country's consistent export earner and largest export commodity, valued at USD 128 808 000 in 2018. The bulk of exports originate from tuna fisheries. To ensure and maintain its market access, she said it is crucial for FSM to align its sanitary and phytosanitary (SPS) measures with those of its five major export markets in 2018, Thailand, People's Republic of China, Japan, the Philippines and Mexico, who are all members of the OIE and World Trade Organization (WTO).

75. While noting that FSM is not a WTO member, she explained the ramifications of the direct reference to the SPS Agreement in the Biosecurity Act, which could be construed as a unilateral or voluntary adoption of measures or principles in the agreement in its territory to ensure food safety and to prevent the entry and spread of pests or diseases. FSM is a member of the OIE and a signatory to the International Plant Protection Convention (IPPC) which set the standards for animal and plant health, respectively and a member of the regional Pacific Plant Protection Organization (PPPO). Thus, she pointed out a member's commitment to adhere to or at least harmonize its measures with international and regional standards, guidelines and recommendations.

76. For aquatic animal health, the standards, guidelines and recommendations are contained in the OIE's Aquatic Code, which are based on the most recent scientific and technical information. The Secretary of the R&D, who is mainly responsible for the implementation of the Biosecurity Act and the performance of the biosecurity functions of the national government, may use the standards in the Aquatic Code to develop measures for early detection, internal reporting, notification, control or eradication of pathogens in aquatic animals and prevention of their spread through international trade or movement in aquatic animals and aquatic animal products. Ms Vitug suggested that the standards be adopted in the form of a regulation, which the Secretary can enact through the rule-making powers conferred by law, to make them obligatory upon stakeholders.

77. Ms Vitug then briefly discussed standards for each of the biosecurity measures applicable to aquatic animals. As OIE member, FSM should comply with the notification requirements through the World Animal Health Information System (WAHIS) or by fax or email within 24 hours of any of the following events: first occurrence or recurrence of a listed disease; first occurrence of a new strain of a pathogenic agent of a listed disease; sudden and unexpected change in the distribution or increase in incidence or virulence of, or morbidity or mortality caused by the pathogenic agent of a listed disease or occurrence of a listed disease in a new host species. For this to happen, a surveillance and early warning and detection system should be in place.

78. She then focused on certain requirements in the Biosecurity Act, the minimum standards for which are prescribed in the Aquatic Code. One of these is the sanitary measures, which may take many forms, such as adopting a list of prohibited or restricted pests and diseases and regulated articles; requiring products to come from a disease-free area, inspection of products, specific treatment or processing of products, setting allowable maximum levels of pesticide residues or permitting the use of only certain additives in food. Ideally, prior to allowing importation of aquatic animals, FSM should have sanitary measures in place, that must contain: the infrastructure such as the legal basis (e.g. aquatic animal health law), that sets the level of protection FSM deems appropriate in relation to human and aquatic animal life and health in its territory, and administrative systems (e.g. organization of Veterinary Services or Aquatic Animal Health Services); programme design and implementation, including documentation of systems, performance and decision criteria, laboratory capability, and provisions for certification, audit and enforcement; and specific technical requirements, including requirements applicable to the use of secure facilities, treatment, specific tests and procedures (e.g. pre-export inspection). She reminded that in determining the appropriate level of protection (ALOP), risk assessment principles are the standard OIE guideline.

79. On the sanitary certificate, Ms Vitug enumerated the elements that the Biosecurity Act requires: (1) it is the international health certificate relating to an animal or animal product issued by the biosecurity or agricultural director of the country of origin or re-exporting country, (2) it certifies that

the animal or animal product is substantially free from animal pests and diseases and (3) in other respects meets the animal health import requirements of the receiving country and complies with relevant requirements of the SPS Agreement or the exporting country. As for exports, equivalence, an SPS principle adopted in the Aquatic Code, is allowed through bilateral agreement that may be entered into under Section 426 of the Biosecurity Act.

80. Ms Vitug then informed about the conditions specific to the sanitary certificate or the international health certificate in the Aquatic Code. Ideally, the measures prescribed in the certificate should consider the health status of both the exporting and importing countries and be based upon the standards set forth in the Aquatic Code. This includes identification of the diseases that FSM seeks protection from because of its aquatic animal health status (i.e. those given in List A of the NAPL).

81. As regards the other standards in the Aquatic Code that may be applicable as aquaculture becomes more robust, Ms Vitug explained that regulations should be issued and should contain among others: the establishment, maintenance and evaluation of aquatic animal health services; measures for the prevention and control of pathogens, including zoning, compartmentalization, disinfection, contingency planning, fallowing, disposal of aquatic animal waste and control of pathogens in aquatic animal feed; measures for the responsible and prudent use of antimicrobials in aquatic animals; and measures to prevent the pathogens causing OIE-listed diseases from being introduced into an importing country.

82. Ms Vitug concluded her presentation by discussing the issue of compensation. In general, compensation in the Aquatic Code relates to specified exposures to a biological agent that directly causes adverse health or environmental consequences, which may lead to socio-economic consequences. In the Biosecurity Act, unless malice or negligence is proven, no compensation may be claimed for damage, loss or destruction to goods arising either from the wilful or negligent act or omission of the person claiming the compensation or from the application of biosecurity measures such as sampling, detention, reconsignment, search, seizure, inspection, examination, treatment, quarantine or authorized destruction.

3.4. Session 4: Moving forward to addressing diseases in aquaculture in the Federated States of Micronesia and closing

83. *Discussion on requirements to start a programme on aquatic animal health in FSM (e.g. National list of pathogens)* (Dr Celia R. Lavilla-Pitogo, International Consultant)

84. After completion of the three sessions of the Technical Seminar of Aquatic Animal Health and Aquaculture Biosecurity, a short discussion was held to review why and how diseases occur in aquaculture, what these diseases are and the methods of diagnosis, and what can be done to reduce or manage the risk of diseases in aquaculture. The background presentations were impressed upon all participants as they move forward to addressing aquatic animal diseases and biosecurity in aquaculture in FSM. The knowledge will guide all participants towards starting a programme on aquatic animal health and the development of a National Strategy for Aquatic Animal Health (NSAAH), including a National Aquatic Pathogen List (NAPL), and their associated implementation plans.

4. NATIONAL CONSULTATION ON AQUATIC ANIMAL HEALTH AND AQUACULTURE BIOSECURITY IN THE FEDERATED STATES OF MICRONESIA

85. The National Consultation on Aquatic Animal Health and Aquaculture Biosecurity in FSM was held on 24 May 2019 (for Programme, see Appendix 6). The outcome of the assessment of the status of aquaculture in FSM, as well as stakeholders' presentations were delivered by representatives from Yap and Pohnpei states. Summaries of the introductory presentations are given below:

86. *Presentation 1. FSM Aquaculture Assessment (Outcome of Assessment during Event 1)* (Dr Ruth García Gómez, The Pacific Community)

87. Dr García Gómez presented the outcomes of the Aquaculture Assessment Group that ranked the species important for aquaculture in the FSM, namely: marine ornamental species that include giant clams, corals and sponges; black-lip oyster, seaweeds, mangrove crab, sandfish, top shell (*Trochus*); and marine finfishes like moi, rabbitfish, milkfish, mullet and parrotfish. These commodities were assessed according to technical feasibility, economic viability and social acceptance. Culture of marine ornamentals and black-lip oyster is already technically feasible, but the techniques for other commodities still need to be enhanced or developed.

88. The group also deliberated on the strengths, weaknesses, opportunities and threats (SWOT) of aquaculture in FSM. The following strengths of FSM were highlighted: a) there is available local knowledge and an ideal environment for aquaculture; b) this is supported by the availability of research institutions and other stakeholders in the country; c) FSM is a party to and a member or signatory of relevant international conventions and treaties that promote the development of aquaculture; d) there is significant donor presence at the national level; e) high marine species biodiversity and relatively high health status of animals in pristine aquatic environment gives aquaculture in FSM an edge; and f) the existence of the Micronesia Association for Sustainable Aquaculture (MASA) is considered as a big factor in promoting the development and sustainability of aquaculture in FSM.

89. Acknowledged weaknesses are the limited human and infrastructure capacities in aquaculture. There is generally limited awareness about the benefits of aquaculture, and efforts to develop it are uncoordinated, while the policies and regulations are outdated. Export capacity is limited due to the country's geographical isolation and low volume of production. No significant amount of investment and support has, so far, been committed to aquaculture and its development. The current patchy effort is reflected by a lack of aquaculture zoning. Given the situation, Dr Gómez, stressed on the opportunities for aquaculture that will require improvement of national capacities through research and training. This can be achieved by engaging regional assistance and mobilization of funds from donors. The recognition that aquaculture development for food security is a worthy endeavour will encourage more participation by private investors and expand the community involved in aquaculture. However, aquaculture also comes with its own threats through pollution, disturbance of natural habitats, environmental changes, and introduction of invasive species, exotic diseases and pests. There is, therefore, a need to rationalize import requirements to protect aquatic communities, and to institutionalize biosecurity guidelines for aquaculture. Aquaculture also needs to be protected from externalities such as conflict with other sectors and users, dredging for coastal development, and sand mining. There is also a need to consider the possible effects of climate change on the target commodities.

90. Among the national aspirations of FSM for aquaculture are sustainability of existing aquaculture activities and diversification of farmed species. An important sector to develop and promote is marine finfish farming for domestic consumption and exports. This plan needs support in broodstock development, seed production, nursery, grow-out culture techniques, feed development and aquatic animal health. Most of all, these developments should consider sustainability and respect for the environment. FSM needs to improve extension and national actions on research to support aquaculture.

91. ***Presentation 2. Current Status of Aquaculture in Yap*** (Mr James Y. Pong, Office of Fisheries & Aquaculture, Yap State Government, FSM)

92. Mr Pong presented the status, potentials and aspirations of the State of Yap, FSM. There is currently interest in sandfish culture, seed production and grow-out culture of mangrove crab, and giant clam research. The total land area of Yap is only 434 km², but its potential for aquaculture is enormous given the state's 4467 km² of lagoons and an exclusive economic zone (EEZ) of over 2.8 million km². Yap's coral reef cover, estimated at 14 517 km², is home to nearly 1 000 species of fish and over 350 species of hard coral. Marine biodiversity in the FSM is among the highest in the tropical world. This gives the opportunity to grow native species easily. Yap's large sheltered lagoons are perfect for tropical aquaculture, although it should be noted that storm activity in the western states may be a threat. The waters surrounding the islands of FSM are some of the cleanest in the world because of their distance

from industrialized nations. At present, there is no serious pollution due to run-off water in these islands. FSM has good access to technology and technical assistance due to its special relationship with the United States of America. It is also able to seek assistance from many developed nations.

93. According to Mr Pong, Yap's aquaculture can significantly contribute to the global demand for seafood. Despite its remoteness, the FSM has preferential access to United States markets and also has reasonable shipping infrastructure. The aquaculture aspirations of FSM were discussed during the 3rd FSM Economic Summit in 2004, where the nation adopted a strategic goal to "Increase aquaculture activities to supplement and enhance marine stocks for subsistence and marketing". One of the required actions for this goal was to "formulate national and state aquaculture development plans that encourage private sector development." At present, the draft National and State Aquaculture Development Plan has been formulated. The draft document has identified high-interest commodities, recognized the challenges in the development of aquaculture and identified strategies to overcome them. A National Workshop on Aquaculture Business Investment Planning and Development to increase resilience and improve food security was planned for December 2019. This will be matched by the National Biosecurity Strategy and Action Plan (NBSAP), one of the outputs of the present project.

94. **Presentation 3. Aquaculture Activities in Pohnpei** (Mr Itaia Richard Fred, Office of Fisheries & Aquaculture, Pohnpei State Government, FSM)

95. Mr Fred presented that aquaculture in Pohnpei is still in the development stage. It is supported by basic research activities with the ultimate aim of integrating science-based information into traditional practices for good aquaculture practices. The following are considered important: the mollusc, *Trochus niloticus*, is valued for its shell; the black lipped oyster, *Pinctada margaritifera*, for its pearl; the giant clam, *Tridacna deresa*; the mangrove crab, *Scylla serrata*; various species of sandfish (sea cucumber); and the seaweed, *Eucheuma cottonii*. The aquaculture aspiration of Pohnpei is clearly stated in its mission statement: "To promote the conservation and sustainable management of the marine resources employing leading edge technologies while incorporating traditional Pohnpeian knowledge and practices.

96. **Presentation 4. Review of Biosecurity Policy and Legal Framework** (Annaliza Vitug, International Consultant)

97. Ms Vitug presented the outcome of the review of FSM's biosecurity policy and legal framework. She explained that the results and recommendations can be broadly divided into two categories: one dealing on the legal and regulatory aspects and the other on the institutional and administrative aspects. On the legal and regulatory aspects, basing from the policy objectives contained in national policy frameworks and action plans, she noted that some issues may have been overlooked in the crafting of the law. The national frameworks of the FSM highlighted as a priority, the development and implementation of national and state laws on biosecurity to safeguard the nation's biodiversity from the threats of alien invasive species (AIS) and genetically modified organisms (GMOs). The Biosecurity Act, however, does not make mention of any of these terms, as the biosecurity regime that was legislated primarily aims to control pests and diseases affecting animals, plants and their products, in order to avoid adverse effects on the nation's economy and health.

98. Ms Vitug relayed the concern of stakeholders that the deliberate or accidental introduction of fish, amphibians and crustaceans may introduce pathogens and can be detrimental to native biodiversity. The issue is vital given the considerable dangers posed by introductions and transfers to fisheries and aquaculture and the responsibilities of FSM as a party to the Convention on Biological Diversity (CBD). She observed there is an opportunity and legal basis to address the gap, with the rule-making powers of the Secretary, through which a subsidiary legislation or regulation may classify AIS and GMOs as among the pests to be regulated, the importation of which can either be prohibited outright or restricted under section 409 of the law.

99. She further pointed out another pathway for the introduction of invasive and potentially harmful marine organisms identified in the NBSAP, the discharge of ballast water, which while defined in the law, may have again been overlooked in the legal text. Noting that the NBSAP recognized the importance to FSM of protecting native marine biodiversity on the high seas and all coastal ports, Ms Vitug reiterated that legislation was identified among the actions to be taken in the NBSAP, requiring ships to empty ballast water at sea before entering FSM waters or to take other appropriate precautions to prevent the introduction of invasive and potentially harmful marine organisms. Thus, she recommended that a ballast water management system be required for foreign and domestic watercraft through an enabling regulation invoking Sections 403 and 453 of the law. Though recognizing that FSM is neither an International Maritime Organization (IMO) member nor a party to the Ballast Water Management Convention, Ms Vitug emphasized that nothing prevents it from adopting and imposing standards and protocols on ships entering its territorial waters to prevent, reduce, or eliminate the transfer of harmful aquatic organisms and pathogens through the ships' ballast water and sediments.

100. As regards aquatic animals and aquatic biosecurity, Ms Vitug highlighted the prospect of crafting a policy specific to aquatic animals and aquatic animal health, citing as basis, the inclusion of amphibians, fish and molluscs in the law's definition of animals, the express grant of power to the Secretary to make rules, the application of the precautionary principle that is among the underlying statutory guideposts and on the explicit reference to the Sanitary and Phytosanitary Agreement in the Biosecurity Act. She recommended that an aquatic animal biosecurity regulation be developed and implemented considering that fish is not only a cornerstone of the country's food security but also its leading export driver and largest income-earner.

101. Ms Vitug then presented how the Biosecurity Act establishes a wide-ranging legal arsenal, giving ample powers (rule-making, enforcement and punitive through a fixed penalty system in lieu of criminal prosecution) to the Secretary as the CA and to the Biosecurity Officers, leaving no excuse for nonfeasance. She pointed out however the huge disparity between the vast powers and responsibilities of the Biosecurity Officers on the one hand and existing institutional capacity on the other, which if not resolved immediately would undermine enforcement and implementation of the law.

102. Ms Vitug said that the law categorically stated that biosecurity and all its aspects including quarantine is a federal responsibility. She noted that while biosecurity/quarantine officers are assigned in all four states, the urgent need was already recognized in the Strategic Development Plan (SDP), even prior to the passage of the Biosecurity Act, to strengthen enforcement by improving facilities, allocating appropriate budget, training personnel, adopting stringent protocols and augmenting quarantine staff at all ports of entry and deputizing national staff at ports in all states.

103. Outlining the functions of Biosecurity Officers vis-à-vis the number of officially designated ports of entry to be serviced, she demonstrated that the current number of national biosecurity/quarantine officers with seven assigned in Pohnpei, three in Kosrae, and four each in Chuuk and Yap, is simply inadequate. She relayed the suggestions made during the group discussions consisting of practical measures to strengthen capacity at the ports including the training, authorization and deployment of other national government officers like Customs Officers and state government officers to enforce national biosecurity laws. Existing intergovernmental memoranda of understanding between the national and state governments on "Cooperation with regard to National Quarantine Inspections", which were signed in 1998 need to be renegotiated and signed.

104. Ms Vitug emphasized the law's requirement of the need to coordinate, both in the deputation of state officers and in the designation of biosecurity holding areas, as the Secretary must first secure the consent and written agreement of the Governor of the state where the proposed biosecurity holding area is located before designating it as such. To augment personnel, the Secretary may, in writing, appoint any person to be a temporary biosecurity officer for a period not exceeding six months for a particular purpose or at a particular location. The Secretary can also designate or appoint a public officer from another department provided the relevant Secretary is first consulted, but failure to do so does not invalidate the designation or appointment. She further stressed the law's requirement of skills

enhancement and adequate training in biosecurity control measures prior to designating biosecurity personnel.

105. Ms Vitug relayed the observation of inadequate or non-existent facilities for quarantine of aquatic products in the four states coupled with the lack of awareness among the public on the dangers of introductions and transfers to biodiversity and aquaculture that compound the problem of insufficient number of biosecurity personnel. She mentioned the suggestion that equipment be procured, in particular, scanners, and the employment of information technology (IT), to expedite inspection and monitoring of imports and exports of organic products at the ports.

106. She concluded by recommending a revision of the Biosecurity Operations Manual, prescribing a more detailed quarantine protocol for the import of aquatics to FSM, which should be prioritized, as this is the document that the biosecurity officers will rely upon in the performance of their duties. The Secretary is, in fact, required by law to develop and publish a manual of standard operating procedures (SOPs) to guide Biosecurity Officers in their duties.

107. ***Presentation 5. Aquaculture Biosecurity in FSM: Moving Forward*** (Drs Celia R. Lavilla-Pitogo, Brett MacKinnon and Melba G. Bondad-Reantaso, International Consultants and FAO)

108. The dynamic and complex attributes of aquaculture were discussed by Dr Celia Lavilla-Pitogo. The sector cultures about 580 species worldwide (362 finfish, 104 molluscs, 62 crustaceans, 6 frogs and reptiles, 9 aquatic invertebrates, and 37 aquatic plants). Only a few are of interest to FSM, including giant clams, corals, sponges, sea cucumber, mangrove crab and seaweeds.

109. Dr Reantaso proceeded to discuss examples of chronology of disease and pathogen emergence in aquaculture from the 1970s to present affecting mainly finfish and crustaceans. The largest aquaculture-related epizootics that have occurred are epizootic ulcerative syndrome (EUS) in many finfish species (1970s), white spot syndrome virus (WSSV) in shrimp (1980s), koi herpesvirus (KHV) in carp (late 1990s), acute hepatopancreatic necrosis disease (AHPND) in shrimp (2009) and tilapia lake virus (TiLV) in tilapia (2009). The occurrence of these diseases caused enormous production losses leading to loss of livelihoods, export earnings and threatened food supply. It also resulted in more money spent to cover diagnostics, surveillance, containment, compensation, research, training and education, etc. These events required that actions need to be done.

110. Dr MacKinnon briefly discussed the four main factors, drivers and pathways to aquatic animal disease emergence in aquaculture: trade in live animals and their products, knowledge of pathogens and their hosts, aquatic management and health control, and ecosystem change. She explained that the large number of commodities, diverse range of aquatic animal species, and variety in life stage (i.e. germplasm, larvae, fry, adults) being traded internationally may lead to aquatic animal disease emergence. Lack of knowledge of pathogens and their hosts is also an important factor for disease emergence. Especially for unknown diseases and even known diseases, there are still significant knowledge gaps regarding transmission, immunity and genetics. Diagnostics are focused on known and/or listed diseases. Breeding strategies are not in place for many species, and there is limited availability of efficacious and affordable vaccines. In terms of aquatic management and health control, there are multiple institutions involved in aquatic animal health management. There is an apparent inadequacy for emergencies, and biosecurity measures are poorly implemented. There is also inconsistent or weak implementation of international standards, and sometimes the interpretation of standards seems problematic. There is also low incentive for disease reporting, weak regulatory framework and private-public sector partnership. What needs to be emphasized, particularly in developing countries, is that use has to be made of all expertise available, and links should be made to optimize the chances of controlling disease by a team approach. Dr MacKinnon then explained how ecosystem change is a driver or factor to aquatic disease emergence. The physico-chemical conditions in aquaculture are often suboptimal for aquatic hosts that are cold-blooded and therefore highly responsive to stressors. The aquatic medium is pathogen rich, and diversity changes with environmental conditions. Pathogens evolve and spill over and spill back relative to wild populations.

111. Dr MacKinnon presented on the PMP/AB and stated that the pathway is aimed at enhancing aquaculture biosecurity capacity by building on existing frameworks, capacity and appropriate tools using risk-based approaches and public-private partnerships. She then listed the expected results of the pathway, once implemented in a country, which include sustainable: reduction of burden of disease, improvement of health at farm and national levels, minimization of global spread of diseases, optimization of socio-economic benefits from aquaculture, attraction of investment opportunities into aquaculture, and achievement of One Health goals. In the context of PMP/AB, aquaculture biosecurity is defined as “the cost-effective management of risks posed by infectious agents to aquaculture through a strategic approach at enterprise, national and international levels with shared public-private responsibilities.” Dr MacKinnon then briefly highlighted the four stages of the PMP/AB, which are risk-based, collaborative and progressive. In Stage 1, the national and sector-level biosecurity strategies are defined. In Stage 2, biosecurity systems are implemented. Biosecurity and preparedness are enhanced during Stage 3, and the national aquaculture sector is supported by sustainable biosecurity and health management systems by Stage 4. Dr MacKinnon finished the discussion on the PMP/AB by describing four scenarios that may be country entry points for implementation of the PMP/AB. This ranged from countries with no aquaculture biosecurity strategy or NSAAH to countries with advanced biosecurity strategies.

112. Dr MacKinnon very briefly discussed the 15 elements of the NSAAH within the PMP/AB. She also stated that “ecosystem health” was included as an additional element for FSM due to the large concern with invasive species and conservation in the country.

113. Dr MacKinnon concluded by emphasizing that good biosecurity will protect against AIS and TAADs while allowing international trade in aquatic animals at a level of acceptable risk. Disease prevention and/or management is an aquaculture strength that benefits the sector itself, wild resources and environment. The PMP/AB is a new initiative to enhance aquaculture biosecurity and it will require a period of testing through national application, and adaptation.

114. Dr Reantaso discussed the short-term and medium to long-term plans for FSM in regards to development of FSM’s aquaculture biosecurity strategy within the PMP/AB. In the short-term, the draft NSAAH will be completed, there will be another round of stakeholder consultation, final review by FAO, and government approval by the end of 2019. The next steps will be to raise awareness about the NSAAH and develop a plan for its implementation. The NSAAH will need to be integrated into government development, economic and policy documents. Concept notes or proposals for resource mobilization will also need to be developed in the short-term. In the medium to long-term, any plans previously developed should be implemented. FSM is currently in Stage 1 of the PMP/AB. There is a “moving target” that the country will move to Stage 2 of the pathway within the next 3 to 5 years.

5. INTRODUCTION TRAINING COURSE ON RISK ANALYSIS WITHIN THE PROGRESSIVE MANAGEMENT PATHWAY FOR IMPROVING AQUACULTURE BIOSECURITY

5.1. Introduction

115. This activity was part of the project focusing on enhancing the capacity on biosecurity. This introductory training course provided an overview of risk analysis as applied to the aquaculture sector in the context of the Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB). It is designed for government decision-makers and those who will oversee and/or participate in the conduct of risk analyses for aquatic animals and it emphasizes managing risks associated with pathogens affecting aquaculture production.

116. The “Introductory Training Course on Risk Analysis within the PMP/AB” delivered during the FAO mission was based on a risk-based approach, which facilitated piloting of the PMP/AB in FSM. This risk-based approach is based on concepts from FAO (2011), hazard analysis and critical control

points (HACCP) (MacLehose, 2003), Palić, Scarfe and Walster (2015), and Arthur and Bondad-Reantaso (2012), and is comprised of the following six steps:

1. Situational Analysis
2. Hazard Identification
3. Biosecurity Vulnerability Analysis
4. Risk Pathway Analysis
5. Critical Control Points
6. Monitoring and Corrective Actions

117. The course consisted of introductory lectures focusing on aquaculture biosecurity and risk analysis, in addition to lectures focusing on the risk-based approach within the PMP/AB, based on the six steps listed above. Lectures contained embedded working group exercises.

5.2. Participants

118. The Introductory Training Course on Risk Analysis within the PMP/AB was attended by 15 participants, including government representatives from fisheries (marine resources), biosecurity/quarantine, environment, food safety, trade, customs, port authority and marine and wildlife. The training schedule and list of participants are found in Appendix 7 and Appendix 8, respectively. Photographs taken during the training course are presented in Appendix 2.

5.3. Products

119. The products of the Introductory Training Course on Risk Analysis within the PMP/AB are as follows:

1. Participants trained in the introductory skills required for qualitative risk analysis applied to the aquaculture sector (in the context of the PMP/AB), which includes the ability to conduct:
 - a. A situational analysis
 - b. Preliminary identification of hazards
 - c. A biosecurity vulnerability analysis
 - d. Risk pathway mapping
 - e. Identification of critical control points along the pathways
 - f. Identification of risk management measures
 - g. Monitoring and implementation of corrective actions
2. Recommendations from the participants of the National Consultation, the Introductory Training Course on Risk Analysis within the PMP/AB, and the International and National Consultants.

5.4. Presentations

120. Due to time constraints, two introductory lectures that focused on Aquatic Animal Movements and Risks in Aquaculture were delivered during the Technical Seminar on Aquatic Animal Health and Aquaculture Biosecurity (See Section 3). The nine lectures given during the Introductory Training Course on Risk Analysis within the PMP/AB are briefly described below.

121. Working group exercises were given during lectures 3 to 8 to provide a better understanding of the concepts taught; they are described within their corresponding lecture. Participants were divided into two to four groups to work on the exercises and present their answers to the course instructors (Dr Melba Bondad-Reantaso and Dr Brett MacKinnon) and other participants.

122. *Lecture 0: Introduction* (Dr Melba G. Bondad-Reantaso, FAO)

123. Dr Reantaso introduced the course, including its purpose and objectives. She noted that the introductory training course provides an overview of risk analysis as applied to the aquaculture sector in the context of the PMP/AB. She explained that the course is designed for government decision-makers and those who will oversee and/or participate in the conduct of risk analysis for aquatic animals. The course emphasizes managing risks associated with pathogens affecting aquaculture production. She then presented the course programme, expectations and limitations.

124. ***Lecture 1: Overview of risk analysis*** (Dr Melba G. Bondad-Reantaso, FAO)

125. Dr Reantaso presented on some background information on risk and risk analysis terminology. She discussed the definition and concept of risk analysis and its application in aquaculture. The different approaches to risk analysis were briefly described (i.e. qualitative and quantitative). She then presented the risk analysis framework and how it fits in with the PMP/AB. Based on the OIE Aquatic Code, the following steps were described: 1) hazard identification; 2) risk assessment; 3) risk management, and 4) risk communication. It is important to start with a clear risk question that includes the specific hazard of concern, the vector/vehicle(s) of the hazard of concern, the specific risk we want to assess, and the particular time frame of interest. Dr Bondad-Reantaso explained that risk analysis is a decision-making tool that contributes to protecting national aquatic animal health. It can contribute to sustainable aquaculture and success of operations. She then concluded that risk analysis cannot stand alone, and it supports and is supported by other components of a NSAAH.

126. ***Lecture 2: Risk Analysis & the PMP/AB*** (Dr Brett MacKinnon, International Consultant)

127. Dr MacKinnon introduced how risk analysis fits within the application of the PMP/AB. She explained the concept of “risk-based approach” and the key outcomes for Stage 1 of the PMP/AB. She then concluded by describing the six steps of the risk-based approach within the PMP/AB: 1) situational analysis; 2) hazard identification; 3) biosecurity vulnerability analysis; 4) risk pathway analysis; 5) critical control points; and 6) monitoring and corrective actions.

128. ***Lecture 3: Situational analysis*** (Dr Brett MacKinnon, International Consultant)

129. Dr MacKinnon began by introducing the four objectives of the situational analysis: 1) identify all aquaculture sectors; 2) identify all key stakeholders in each sector; 3) involve stakeholders in the risk analysis process; and 4) conduct a value chain analysis for all aquaculture sectors.

130. She explained that aquaculture is a very dynamic and complex industry in terms of systems – there are open-water culture; environment – marine and freshwater; high and low-value species, local and exportable products; industrial and small scale. In addition to that there are more than 500 species (compared to about more than 150 in agriculture and livestock combined), which adds to the complexity from the viewpoint that each species presents different risks. A country should consider what new species the national aquaculture sector is likely to want to introduce for aquaculture development in the next 5–10 years. Global trends in aquaculture production, new species being cultured, and aquatic species that neighbouring countries have introduced and attempted to culture should be considered. The country’s special circumstances should also be considered, including geographical (i.e. land-locked country with no seacoast and no possibility for culture of marine species) and climate (i.e. tropical zone unsuitable for culture of temperate-climate species) constraints.

131. Dr MacKinnon explained that stakeholders are those involved in or affected by a course of action. Potential key stakeholders include producers (i.e. small-scale farm holders, suppliers, large corporations), aquatic animal health professionals (aquaculture specialists, veterinarians, biologists, extension workers), industry partners (i.e. feed manufacturers, drivers, traders), and government officials (i.e. local, state/provincial, national). Stakeholders with a high level of power and interest in aquaculture biosecurity need to be managed closely and be involved in development of the strategies (informed, consulted and engaged). Other stakeholders may need to be kept satisfied and given regular

updates on strategy development. Stakeholders with little power or interest do not require much time or effort to be spent on them.

132. She then described the concept of a value chain analysis, which consists of a descriptive overview of the systems involved in producing aquaculture commodities from suppliers, through producers, to the marketing system, processors and consumers. Value chain analysis describes places where each process occurs and the stakeholders involved and can include seasonal trends, product volumes/values, and numbers of enterprises or livelihoods supported at each point. This analysis provides a good starting point for risk analysis and promotes risk communication.

133. The following working group exercises were provided during this lecture:

1. Objective: Identification of all aquaculture sectors

134. Create a list of all aquaculture sectors present in the country and any new sectors that may be introduced in the future (within 5–10 years).

- Rank sectors by level of production or value (\$).
- Describe their geographic distribution in the country.

2. Objective: Identification of all key stakeholders in aquaculture sectors

135. Identify/describe relevant stakeholders (e.g. farmers, vets and aquatic animal health professionals, industry suppliers, traders, dealers, exporters, banks/creditors, international organizations, government officials) for sectors present in the country and complete the following table.⁸

Stakeholder	Stake in Aquaculture Biosecurity	How Can They Help Improve Aquaculture Biosecurity?	How Should They Be Engaged?
Name & brief description	What is of interest to them? What do they want to see happen? How are they affected? How motivated are they? Etc.	What skills, attributes do they have to bring to the project?	What level of engagement do you need to consider, and what processes of engagement would suit? Are there conflicts among some stakeholders?

⁸Table has been adapted from the European Commission for the Control of Foot-and-Mouth Disease's (EuFMD) training course materials.

3. Objective: Understand how to involve stakeholders in the risk analysis process

Plot stakeholders you identified based on their perceived “Power and Interest” below⁸:

Power	High			
	Medium			
	Low			
		Low	Medium	High
		Interest in issue		

4. Objective: Productive chain analysis for all aquaculture sectors

136. Sketch out the production chain(s) related to each aquaculture sector you previously identified. Indicate: Place or movements; Product or animal sector; and People involved. (Hint: Start at product (consumer) and work backwards)

137. *Lecture 4: Hazard identification* (Dr Brett MacKinnon, International Consultant)

138. Dr MacKinnon began by introducing the four objectives of the hazard identification: 1) identify all hazards (pathogens) for all key aquaculture sectors, from a national and producer-level perspective; 2) define a National Aquatic Pathogen List; 3) summarize knowledge about basic epidemiology of hazards/diseases of concern; and 4) summarize local and regional patterns of hazard/disease occurrence.

139. She explained that identified hazards should be appropriate to the aquatic species present in the country (farmed or wild) and present or potentially present in the country. These hazards may lead to exotic, emerging or enzootic diseases. NAPLs include hazards that are established in the country but have not yet spread to all geographical areas, are under national control and/or eradication programmes, or are exotic but whose entry and spread may pose serious risks to national aquatic resources. The NAPL should include pathogens and diseases listed by the OIE (as appropriate), as well as other pathogens of national significance. These pathogens should merit the efforts required to control their entry, establishment or spread within the country or region. Compilation of the NAPL should be a consultative process, involving state policy-makers, experts and relevant representatives from the

aquaculture sectors. The process should be transparent to enable understanding and acceptance by potential exporting countries. The NAPL needs to undergo periodical review based on changing global, regional and national situations. If there are hazards/diseases that are present in the country that are important to national aquaculture or wild fish stocks but do not cause catastrophic losses, these hazards/diseases should be considered for inclusion on the “Other Pathogens of National Importance List”. These hazards may be ubiquitous, cause serious losses to national aquaculture, have control programmes in place, or may not be a concern for international trade.

140. Dr MacKinnon noted that fundamental knowledge about the hazards/diseases of concern (i.e. basic epidemiology, hazard characteristics) should be gathered. Local and regional patterns of disease occurrence should be known via passive or active surveillance (i.e. incidence/prevalence of disease, temporal/spatial patterns of outbreaks, production systems/species affected, morbidity/mortality rates).

141. The following working group exercises were provided during this lecture:

1. Objective: Identification of hazards for aquaculture sectors

142. Determine which OIE-listed diseases can affect the species/sectors you identified during the Situation Analysis. Compare each species on your list with listings of susceptible species that are given under each disease in the OIE Aquatic Code and Manual (<http://www.oie.int/en/standard-setting/aquatic-code/access-online/>) (Hint: Also look for other susceptible species within the same genus/family).

2. Objective: Identification of hazards for aquaculture sectors

143. Identify other diseases that are not listed by the OIE but may be of national importance to your country – complete the Criteria Matrix provided below:

- literature search (Google, Google scholar) for records of pathogens, parasites, diseases for the aquaculture sectors/species you listed in the Situation Analysis.
- consult regional pathogen lists (i.e. NACA disease list for Asia) and NAPLs of neighbouring countries.
- consult with national/international experts in aquatic pathogens/diseases.

Disease/ Pathogen			
OIE listed? (yes/no)			
Infectious etiology? Or infectious agent strongly associated with disease, but etiology not yet known? (yes/no)			
Pathogenicity / Socioeconomic impact (low, medium, high)			
Repeatable and robust means of detection/ diagnosis exists? (yes/no)			
Affects species cultured in country or likely to be cultured? (yes/no)			
Affects wild aquatic animal species present in country? (yes/no)			
Already present in country? (yes/no) If yes, limited distribution? (yes/no)			
National control programme present for this pathogen/ disease?			
Concern to international trade? (yes/no)			
Should be included on NAPL? (yes, no) If no, should be included on “Other Diseases of National Important List”?			

144. *Lecture 5: Biosecurity vulnerability analysis* (Dr Brett MacKinnon, International Consultant)

145. Dr MacKinnon began by introducing the three objectives of the biosecurity vulnerability analysis: 1) identify important biosecurity vulnerabilities (“risk hotspots”) for key aquaculture sectors in the country; 2) determine distributions of vulnerabilities (risk hotspots) in the country; and 3) prioritize risk hotspots within the value chains.

146. She explained that aquaculture sectors are constantly evolving to meet changing needs of globalized society. This can introduce new and changing disease risks. Risk analysis can provide a basis for studying disease risk and risk mitigation in aquaculture value chains. In the context of the PMP/AB, “aquaculture biosecurity” refers to the cost-effective management of risks posed by pathogens to aquaculture through a strategic approach at enterprise, national and international levels with shared public-private responsibilities.

147. 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. “Risk hotspots” are points in the production chain where biosecurity is most vulnerable and can be related to a geographical location, management practice, or action by a stakeholder that decreases capacity to manage health risks. They are points in the value chain where the combined effect of the probability of pathogen entry/spread and the consequences of pathogen entry/spread are greatest. Diseases in aquaculture are spread by movements of input materials (i.e. feed, water), animals, animal products, people, equipment, and other fomites during transport. Movements in value chains are driven

and controlled by people. The use of value chain analysis with risk analysis allows identification and characterization of risk hotspots in the aquaculture sector.

148. The following working group exercises were provided during this lecture:

1. Objectives: Identify important biosecurity vulnerabilities (risk hotspots) and their distribution for key aquaculture sectors in the country

149. We will be identifying Risk Hotspots within the production chain you mapped out during the Situation Analysis. Determine where important pathogens can enter the chain, survive, and spread to infect other points (in same or other production chains).

2. Objective: Prioritize “risk hotspots” within the value chain

150. What is the probability (likelihood) of the pathogen entry/spread occurring at that point in the production chain? What is the impact of infection at that point on stakeholders (consequences) – high, moderate, low, or very low?

- Rank the Risk Hotspots in order of greatest risk to lowest risk.

Production chain sector	Risk hotspot	Probability of pathogen entry or spread (high, mod, low, very low)	Consequences (high, mod, low, very low)	Overall Ranking

151. **Lecture 6: Risk pathway analysis** (Dr Brett MacKinnon, International Consultant)

152. Dr MacKinnon began by introducing the two objectives of the risk pathway analysis: 1) develop risk pathways for risk hotspots; and 2) assess the probability (likelihood) for the occurrence of each step in the pathways.

153. She explained that the risk pathways should focus on the most important risk hotspots and describe each stage in the disease transmission process as it occurs in the value chain. When developing the risk pathway, all of the steps necessary for the disease outbreak to occur should be identified. To make an assessment of risk, the likelihood (probability) of each of these steps to occur should be assessed either qualitatively or quantitatively. Risk pathways are a useful tool for determining risk factors in the value chain, which are the most important factors that affect the level of risk at risk hotspots (can increase or decrease the level of risk).

154. The following working group exercises were provided during this lecture:

Objectives: Develop risk pathways for risk hotspots and assess the probability of this occurring:

1. Develop a risk pathway for a key risk hotspot you identified during the Biosecurity Vulnerability Analysis.
2. For each step in the risk pathway, assign a qualitative probability (likelihood) for that to occur (i.e. negligible, very low, low, moderate, high).

3. Are there any gaps in knowledge?

155. **Lecture 7: Critical control points** (Dr Brett MacKinnon, International Consultant)

156. Dr MacKinnon began by introducing the two objectives of the critical control points (CCPs) step: 1) identify CCPs; and 2) determine risk mitigation practices that can be used to address critical control points and reduce the risk of disease introduction.

157. She explained that CCPs are points in the risk pathway where control measures exist and these control measures provide an opportunity to prevent, eliminate or reduce risk to an acceptable level (as determined by the risk manager). Risk reduction may be achieved by a combination of several control measures (or management practices). She then briefly described the five main pathogen introduction pathways in aquaculture: introduced animals, water, fomites, vectors and feed. Control measures (or management practices) should be based on limiting or preventing pathogen introduction through these pathways. Examples include using specific-pathogen-free (SPF) stock, egg disinfection, water treatment, cleaning and disinfection of fomites, movement restrictions of people, and using feed from trusted suppliers.

158. She explained that branching value chains are “riskier” and therefore, risk management should aim to reduce the number of steps within production chains if at all possible. This results in fewer opportunities for disease introduction and spread between sectors. Control measures should be focused upstream in value chains because if material entering the chain is lower risk, then the whole chain is lower risk (i.e. hatcheries, markets). Surveillance is a line of defence against the spread of disease since a sensitive surveillance system can detect the presence of disease early on. Good surveillance and quick response can reduce the impact of disease outbreaks and lower risk. If control measures cannot be identified along a risk pathway, surveillance is a legitimate risk management response.

159. The following working group exercises were provided during this lecture:

Objectives: Identify critical control points and describe risk mitigation practices that can be used to address them.

1. From the risk pathways you mapped, can you determine any Critical Control Points (CCPs)?
2. List potential risk-reducing control measures you can implement at the CCPs. Which ones are most feasible? Are any of these currently being used in your country?
3. What is the likely impact of the control measure on stakeholders?

160. **Lecture 8: Monitoring and corrective actions** (Dr Brett MacKinnon, International Consultant)

161. Dr MacKinnon began by introducing the three objectives of the monitoring and corrective actions step: 1) understand what can affect compliance; 2) determine what strategies can be used for the monitoring process; and 3) determine corrective actions that can be implemented.

162. She explained that for some stakeholders, the benefit of decreased incidence of disease may not outweigh the cost of the control measures. Therefore, control is not always economical for all, which affects compliance. Compliance can be increased through consultation with all stakeholders in the value chain that would be affected by the control measures. There may be a need for incentives, research, education, subsidies, compensation, sanctions, and/or legislation/enforcement.

163. She described different monitoring activities that exist, such as site inspections or audits, and explained how they provide evidence that control activities are being implemented. Monitoring also gives risk managers evidence that the control measures being implemented are effective via disease surveillance on farms (evidence that disease prevalence is reduced), and analysis of farm records, diagnostic testing records, and/or aquatic animal health professional records. She then explained that the results from monitoring activities (i.e. audits, surveillance) can be analysed to determine the impact

of the control measures and whether they are being properly implemented. The results should be evaluated to determine areas in need of improvement. Corrective actions should be established when monitoring indicates that a CCP is not under control. Corrective actions ensure compliance with local, state/provincial and national regulations.

6. SUMMARY OF RECOMMENDATIONS ARISING FROM THE PROJECT

6.1. Aquatic animal health and aquaculture biosecurity

164. The following are recommendations related to aquatic animal health and aquaculture biosecurity:

- The Government of FSM should consider appointing Quarantine Services of the Department of Resources & Development to be the Competent Authority (CA) for aquatic animal health and/or aquaculture biosecurity.
- The lead agency for development of the National Strategy on Aquatic Animal Health (NSAAH) should be designated by the CA of FSM. A Progressive Management Pathway for Improving Aquaculture Biosecurity (PMP/AB) public-private taskforce should be formed, involving the CA, state government officials and industry stakeholders with a strong interest in aquaculture biosecurity or building aquaculture capacity. This taskforce should have the expertise and experience required, and have a clearly defined mandate, deliverable products and time schedule. FAO has developed a draft NSAAH for FSM (FAO, 2020, in preparation) and will work with the CA of FSM to further develop and implement the strategy.
- Because conservation is a high priority in FSM, “Ecosystem Health” should be included within the NSAAH as a new Programme. This will address the high priority of invasive species, conservation efforts and climate change.
- There should be high priority for the CA to further develop the draft National Aquatic Pathogen List (NAPL) (see Appendix 7A and 7B) within the NSAAH upon consultation with FAO.
- Aquaculture biosecurity should be included within the Government of FSM’s Aquaculture Development Plan.
- A decision and formal statement by the Government of FSM setting the appropriate level of protection (ALOP) is desirable. A similar level of risk tolerance (acceptable level of risk, ALOR) should be consistently applied across plant, terrestrial animal and aquatic animal importations. This process should consider invasive species and pests in addition to pathogens.
- As international collaboration and awareness are essential to good national biosecurity, FSM should remain a World Organisation for Animal Health (OIE) member country. The CA of FSM (i.e. Quarantine Services staff of the Department of Resources & Development) should become familiar with the OIE’s World Animal Health Information System (WAHIS) and have an in-depth familiarity with the OIE’s *Aquatic Animal Health Code*. If OIE membership is not possible, increased communication with the Pacific Community (SPC) regarding national aquatic animal health concerns should occur, so that SPC, as an OIE Observer, can communicate these concerns to the OIE.
- FSM should take appropriate measures to ensure that only aquatic animals that are healthy and free of serious pathogens are distributed by government and industry hatcheries.
- Import requirements should be enhanced by the CA in FSM. Introductions and transfers of live aquatic animals (both legal and illegal) are highly unsafe and have unnecessarily put future aquaculture development and local biodiversity at risk due to the possibility of introducing serious exotic pathogens and the possible genetic and ecological impacts of introduced and transferred species. All introductions and transfers of live aquatic animals should be prohibited until such time as the draft Aquatic Biosecurity Regulations have been enacted and such species have been considered through the mechanisms contained therein. The CA should base import requirements for aquatic animals (germplasm, eggs, live) and/or their products on OIE standards, if possible. FSM should consider the health situation in the exporting country and in

FSM before determining the import requirements. This will facilitate international trade without incurring unacceptable risks to human and aquatic animal health.

- Ballast water is of huge concern in FSM and this should be addressed in import conditions to reduce the risk of pathogen introduction via this route.
- There is expressed interest of exporting aquatic animals internationally by industry in the future. Import requirements and implementation of the NSAAH (including NAPL) should be enhanced to better facilitate international trade negotiations.
- There is a need for further risk analysis to find effective solutions for the risk management of invasive species. Risk profiling should also be conducted for priority cultured species in FSM.
- Once aquaculture development has further progressed in FSM, active surveillance should be used to determine the disease status of FSM via targeted surveys in key aquaculture species (wild and farmed).

6.2. Capacity building

165. Recommendations for capacity building include:

- Aquaculture biosecurity should be improved by building on existing mechanisms in the country.
- The capacity and expertise of the CA in FSM should be strengthened on emergency preparedness, since it is not currently a priority for aquatic animals.
- Contingency plans (including hazard-specific plans) should be developed for priority pathogens.
- Training in aquatic animal health and aquaculture biosecurity should be provided to staff of the CA (potentially Quarantine Services) that are keen to learn and have had previous training in biology, veterinary medicine, or a similar field. Staff to be considered for training include existing biosecurity officers and animal health professionals (with existing terrestrial or aquatic animal expertise). This training will help to build capacity in farm-level biosecurity and health management. This training should involve both lectures and hands-on laboratories, so skills are adequate for risk analysis and the diagnosis and treatment of diseases on site. This should include training on basic aquatic animal health (pathogenesis of disease, clinical signs, treatments), surveillance strategies, on-farm and import risk analysis, farm-level biosecurity, and diagnostics (on-farm and laboratory). Certification programmes may be used to ensure aquatic animal health professionals are adequately trained.
- The Government of FSM should build on national, regional and international partnerships. Collaborative research can be organized with regional or international organizations (e.g. SPC, WorldFish).
- As there is no diagnostic capacity currently available for aquatic animal diseases in FSM government laboratories, laboratory capacity should be established by building on existing infrastructure/mechanisms. Level I diagnostics can be developed based on existing laboratories, methodologies, and technologies used by the Government of FSM for microbial testing in Food Safety (EPA). More advanced diagnostic tools (i.e. level II and III diagnostics) can be outsourced to international laboratories until sufficient capacity exists in FSM.
- Quarantine capacity for aquatic animals can be based on existing capacity for terrestrial animals in FSM.
- As surveillance activities are currently being performed for conservation activities in FSM, disease surveillance for aquatic animal populations in FSM can be adopted, with adequate basic training in aquatic animal health and epidemiology.
- A record keeping, database system for aquatic animal diseases should be developed for use in data collection and analysis. This will be useful for the implementation of epidemiological studies, including risk analyses and surveillance. This database will allow the sharing and communication of data/information with other governmental departments, private stakeholders and the public.

6.3. Biosecurity legislation

166. Recommendations regarding biosecurity legislation are listed below:

- While there are provisions in the Biosecurity Act that can be implemented outright without need of regulations (for example, the designation in writing of biosecurity clearance agents by an exporter or importer), enabling regulations should be promulgated to fully implement the law. These should specify the details, procedures, and requirements, *inter alia*, for the conduct of pest risk analysis, results of which would be the basis of the Secretary's order declaring which are prohibited or permitted and the conditions of the biosecurity import clearance; for classification of articles as prohibited or regulated and biosecurity specifications for regulated articles; for the designation and management of biosecurity points of entry and departure and biosecurity holding areas, biosecurity approved premises and formulation of the Biosecurity Emergency Response Plan.
- Regulations establishing procedures and requirements should be issued by the Secretary: (i) for vessels and aircraft entering and departing FSM; (ii) for biosecurity import and export procedures, including for the inspection and clearance of regulated articles, biosecurity import or export specifications and access arrangements, and for the application, issuance and revocation of biosecurity import or export permits; (iii) for procedures and requirements for biosecurity quarantine, including for the management of biosecurity quarantine stations; (iv) for collection of fees and charges for the biosecurity services provided by the R&D; (v) for the method of taking and analysing samples, recording of results and disposing of samples; (vi) for the manner of disposal of abandoned goods under regulation; (vii) for claiming compensation, and the rates payable, pursuant to regulation; (viii) for the de-ratting of vessels, and the form of de-ratting certificate; (ix) for the disposal of garbage and waste and second-hand clothing and bedding so as to minimize any biosecurity risk; (x) for the electronic filing of declarations and applications required by law and the electronic keeping of registers; (xi) for the manner and language of markings on containers of incoming and outgoing regulated articles; (xii) for the methods of handling, sealing, treating and disposing of containers of regulated articles; (xiii) for the placing and use of amnesty bins or other containers for regulated articles at points of entry; (xiv) for, subject to the approval of the civil aviation and maritime authorities, requiring a video film about biosecurity to be shown on all aircraft and vessels arriving in the FSM and carrying passengers; (xv) for the required treatment to be applied in respect of a vessel or aircraft before it arrives in the FSM; (xvi) for additional measures to implement in the FSM the standards and requirements relating to biosecurity of the IPPC, the OIE (terrestrial animals) and the PPPO. Regulations issued may create level one, two, three, four, and five offenses.
- Aquatic animal health regulations should be adopted in the exercise of the rule-making powers granted to the Secretary, providing the legal framework for the key activities of the CA and defining the responsibilities and structure of the units or organizations in charge of traceability and control of aquatic animal movements, aquatic animal disease surveillance, control and reporting systems, epidemiological surveillance and communication of epidemiological information. AIS and GMOs should be included in this regulation. The regulations could be separate from the plant and animal biosecurity regulations, which should be revised and aligned with the Biosecurity Act.
- The Secretary in coordination with the Secretary of the Department of Transportation, Communication and Infrastructure and the National Oceanic Resource Management Authority (NORMA) should enact a ballast water management regulation applicable to foreign and domestic watercraft requiring them to empty ballast water at sea before entering FSM waters or to take other appropriate precautions to prevent the introduction of invasive and potentially harmful marine organisms.
- The Biosecurity Manual of Operations should be aligned with the provisions of the new law. This will guide Biosecurity Officers in the performance of their wide-ranging responsibilities.

- The enabling instruments should be drafted, negotiated and agreed upon (memorandum of understanding with other Departments or with state governments) to strengthen capacity to include provisions on the training, authorization and deployment of other national government officers like Customs Officers and state government officers to enforce national biosecurity laws. This is important both in the deputation of national (Customs) and state officers and in the designation of biosecurity holding areas. To augment personnel, a pool of trained individuals should be developed, from which ranks the Secretary may in writing appoint a temporary biosecurity officer for a period not exceeding six months for a particular purpose or at a particular location.

7. CONCLUSIONS AND THE WAY FORWARD

167. The short consultancy mission and subsequent work by the FAO Team, to a large extent, successfully achieved the Project Outputs, as outlined in Section 1.2 of this report.

168. The various activities undertaken during the field mission provided the basis for subsequent preparation of a draft National Strategy on Aquatic Animal Health (NSAAH) (FAO, 2020, in preparation) and National Aquatic Pathogen List (NAPL) (see Appendix 7A and 7B).

169. There is a need for the Government of FSM to organize another round of national consultations in order to generate feedback from stakeholders prior to finalizing the documents and their adoption as official policy documents.

170. Once the NSAAH has been adopted as official policy, a detailed Implementation Plan will need to be developed and resources mobilized to support implementation.

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APPENDIX 1

General list of participants

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Ruth García Gómez
AB Specialist

**UNITED STATES AGENCY FOR
INTERNATIONAL DEVELOPMENT
(USAID)**

Patterson Shed
USAID Climate Ready

APPENDIX 2

Group photographs



APPENDIX 3

Programme of the technical seminar on aquatic animal health and aquaculture biosecurity
 TCP/MIC/3603/C2: National Aquatic Animal Health and Biosecurity Strategy
 Technical Seminar of Aquatic Animal Health and Aquaculture Biosecurity
 Island Palms Hotel, 23 May 2019

23 May 2019, Wednesday	Activity
08.30–08.45	Welcome remarks
08.45–09.15	Introduction of participants
09.15–09.30	Introduction (Purpose, process, products) (Celia L. Pitogo)
09.30–10.00	Session 1: Why and how do diseases occur in aquaculture? Presentation 1. Factors in the development of disease in aquaculture (Celia L. Pitogo)
10.00–10.15	Coffee break
10.15–11.00	Presentation 2. Challenges in managing health in the aquatic environment (Celia L. Pitogo) Discussion
11.00–12.00	Session 2: What diseases can occur in aquaculture and how do you diagnose them? Presentation 3. Infectious diseases affecting aquaculture commodities (Celia L. Pitogo) Presentation 4. Diseases of giant clams, trochus and other important species in FSM (Ruth García Gómez) Discussion
12.00–13.15	Lunch break
13.15–15.00	Presentation 5. Transboundary aquatic animal diseases and the need for effective national biosecurity strategy (Melba B. Reantaso) Presentation 6: Climate change dimension: environmental and other risk factors impacting aquatic animal health (Melba B. Reantaso) Presentation 7. Levels of aquatic animal disease diagnosis in Asian aquaculture (Melba B. Reantaso) Discussion
15.00–15.30	Coffee
15.30–17.00	Session 3: What can be done to reduce or manage the risk of diseases in aquaculture Presentation 8. Responsible movement of live aquatic animals (Melba B. Reantaso) Presentation 9: Prevention through good practices: aquaculture and aquaculture biosecurity (Celia L. Pitogo) Presentation 10: Quarantine as a risk management measure (Melba B. Reantaso) Presentation 11: Breaking the disease transmission pathways (Brett MacKinnon) Presentation 12: Legal dimension of AAH management (Annaliza Vitug and Ariella D'Andrea) Discussion
17.00–17.30	Session 4: Moving forward to addressing diseases in aquaculture in FSM and closing Discussion on requirements to start a program on AAH in FSM (e.g. National list of pathogens) (Celia L. Pitogo) Closing

APPENDIX 4

Programme of the national consultation on aquatic animal health and aquaculture biosecurity

	Activities
24 May 2019 (Friday) 08.30–17.30	National Consultation on Aquatic Animal Health and Aquaculture Biosecurity in FSM
08.30–09.15	Welcome remarks Introduction to the objectives and expected outcomes Introduction of participants Group photo
09.15–10.15	Stakeholder presentations
10.15–10.45	Coffee break
10.45–11.45	Presentation of outcomes and conclusions of round table discussions <ul style="list-style-type: none"> • Aquaculture development • Biosecurity legislation • Aquatic animal health and aquaculture biosecurity
11.45–12.00	Plenary discussions
12.00–13.00	Lunch break
13.00–14.00	Presentation: Drivers, Factors and Pathways to Disease Emergence in Aquaculture Presentation: Progressive Management Pathway to Improving Aquaculture Biosecurity (PMP/AB)
14.00–14.30	Plenary discussions
14.30–15.15	Presentation: Draft National Strategy on Aquatic Animal Health within the PMP/AB
15.15–15.45	Coffee break
15.45–16.30	Plenary discussions on NSAAH and PMP/AB
16.30–17.30	Conclusions and moving forward

APPENDIX 5

Programme for the introductory training course on risk analysis within the Progressive Management Pathway for Improving Aquaculture Biosecurity

25 May 2019 (Saturday) 08.30–11.00	Final consultation with Competent Authority officials
13.00–17.00	Introductory Training Course on Risk Analysis within the Progressive Management Pathway for Improving Aquaculture Biosecurity
13.00–13.30	Welcome remarks Introduction: objectives, mechanics and expected outcomes Group photo
13.30–15.00	Session 1: Introductory presentations <ul style="list-style-type: none"> • Overview of biosecurity and risks in aquaculture • Overview of risk analysis • Risk analysis and the PMP/AB Plenary discussions
15.00–15.30	Coffee break
15.30–17.00	Session 2: RA/PMP Presentations and Working Group Exercises (WGE) <ol style="list-style-type: none"> 1. Situation analysis
17.00–17.15	Wrap-up and tasks for next day
26 May 2019 (Sunday) 08.30–17.00	Introductory Training Course on Risk Analysis within the Progressive Management Pathway for Improving Aquaculture Biosecurity
08.30–10.00	Presentation of WGE 1 and discussions
10.00–10.30	Coffee break
10.30–12.00	Session 2: RA/PMP Presentations and Working Group Exercises <ol style="list-style-type: none"> 2. Hazard identification
12.00–13.00	Lunch break
13.00–15.00	Presentation of WGE 2 and discussions
15.00–15.30	Coffee break
15.30–17.00	Session 2: RA/PMP Presentations and Working Group Exercises <ol style="list-style-type: none"> 3. Risk pathway analysis and critical control points
17.00–17.15	Wrap-up and tasks for final day
27 May 2019 (Monday) 08.30–12.30	Introductory Training Course on Risk Analysis within the Progressive Management Pathway for Improving Aquaculture Biosecurity
08.30–10.00	Session 2: RA/PMP Presentations and Working Group Exercises <ol style="list-style-type: none"> 4. Risk management 5. Monitoring and corrective actions
10.00–10.15	Coffee break
10.15–11.15	Presentation of WGEs 3, 4, and 5
11.15–12.30	Session 3: Plenary discussions, conclusions and moving forward
12.30–13.30	Lunch

APPENDIX 6

List of participants in the risk analysis training course

Participant	Agency
1. Lucas Pernes	Department of Resources and Development, FSM
2. Claralyn Lekka	Food Safety
3. Angel Jonathan	Conservation Society of Pohnpei
4. Anderson Peter	Department of Resources and Development, FSM
5. John Wichep	Department of Resources and Development, FSM
6. Valentin Martin	Department of Resources and Development, FSM
7. Enjoy Rain	Chuuk Department of Marine Resources
8. Dave Mathias	Department of Resources and Development, FSM
9. Andy George	Kosrae Conservation and Safety Organization
10. Ceasars Immanuel	Department of Resources and Development, FSM
11. Bruno Ned	Kosrae Department of Marine Resources
12. Bejay Obispo	Yap State Marine Resources Management Division
13. James Y. Pong	Yap State Marine Resources Management Division
14. Stanley Raffilman	Department of Resources and Development, FSM

APPENDIX 7A

Draft national aquatic pathogen list for the Federated States of Micronesia

Description: A national aquatic pathogen list (NAPL) is 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 the NAPL must also consider other serious diseases of national concern. The NAPL needs 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. A decision matrix providing the rationale for the inclusion of each of the pathogens/diseases included in Lists A and B is presented in Appendix 8B.

Criteria for Listing of a Pathogen or Disease – List A

The criteria for the placing of a pathogen or disease on the NAPL List A shall be the following:

- The pathogen or disease causes significant losses to aquaculture at a national or multinational level, is known or likely to cause significant morbidity or mortality in wild aquatic animal populations, or is of public health concern.
- The infectious aetiology of the disease is proven or an infectious agent (pathogen) is strongly associated with the disease, but the aetiology is not yet known.
- There is likelihood of the disease being spread to FSM via the importation of live aquatic animals, aquatic animal products or biological products.
- A repeatable and robust means of detection/diagnosis exists.

Criteria for Listing of a Pathogen or Disease – List B

There are many diseases that may be important to national aquaculture and/or wild aquatic animal stocks that are not included on the World Organisation for Animal Health's (OIE) list or on a country's NAPL List A. Often these diseases may be ubiquitous (very widely distributed) and thus already present in the country. Still these diseases may cause serious losses to national aquaculture, and thus countries may have control programmes for aquaculture facilities (e.g. via better management practices (BMPs), good aquaculture practices (GAPs) and/or standard operating procedures (SOPs)) that include measures to prevent the occurrence and spread of these pathogens both within and between aquaculture operations. These pathogens/diseases can be placed on the List B and should be addressed by measures to control their domestic spread, but are not of concern for international trade.

Importantly, a pathogen or disease should be included in the NAPL List B if it:

- has a broad geographic range, making control of entry/spread difficult to impossible (i.e. it is ubiquitous or widely spread);
- is an opportunistic pathogen whose pathogenicity is reduced by improved husbandry or handling; or
- is difficult or impossible to distinguish from related established pathogens, using available diagnostic screening techniques.

The following diseases are suggested for inclusion on FSM's NAPL – List A:

Diseases of Fish

- OIE-listed Diseases of Fish

- Epizootic ulcerative syndrome (*Aphanomyces invadans*)
- Koi herpesvirus disease (Koi herpesvirus)
- Red sea bream iridoviral disease (Red seabream iridovirus)
- Spring viraemia of carp (Spring viraemia of carp virus)
- Other Important Diseases of Fish
 - Tilapia lake virus disease (Tilapia lake virus)
 - Viral encephalopathy and retinopathy (Betanodaviruses)

Diseases of Crustaceans

- OIE-listed Diseases of Crustaceans
 - Acute hepatopancreatic necrosis disease (*Vibrio parahaemolyticus*)
 - Infectious hypodermal and haematopoietic necrosis (Infectious hypodermal and haematopoietic necrosis virus)
 - Infectious myonecrosis (Infectious myonecrosis virus)
 - Taura syndrome (Taura syndrome virus)
 - White spot disease (White spot syndrome virus)
 - Yellow head disease (Yellow head virus genotype 1)
- Other Important Diseases of Crustaceans
 - Hepatopancreatic microsporidiosis (*Enterocytozoon hepatopenaei*)

Diseases of Molluscs

- OIE-listed Diseases of Molluscs
 - Infection with *Perkinsus olseni*

The following diseases are suggested for inclusion on FSM's NAPL – List B:

Diseases of Fish

- Vibriosis (*Vibrio* spp.)

APPENDIX 7B

Decision matrix for inclusion of diseases/pathogens in the draft national aquatic pathogen list

Disease/ Pathogen	OIE listed? (yes/no)	Infectious etiology? Or infectious agent strongly associated with disease but etiology not yet known? (yes/no)	Pathogenicity / Socioeconomic impact (low, medium, high)	Repeatable and robust means of detection/ diagnosis exists? (yes/no)	Affects species cultured in country or likely to be cultured? (yes/no)	Affects wild aquatic animal species present in country? (yes/no)	Already present in country? (yes/no) If yes, limited distribution? (yes/no)	National control programme present for this disease/pathogen?	Concern to international trade? (yes/no)	Listing Decision (yes, no) If yes, List A or List B?
Epizootic ulcerative syndrome (<i>Aphanomyces invadans</i>)	Yes	Yes	High	Yes	Yes, mullet etc.	Yes, affects many finfish species	No	No	Yes	Yes, List A
Koi herpesvirus disease (Koi herpesvirus)	Yes	Yes	High	Yes	Yes, Cyprinids may be imported in future	No	No	No	Yes	Yes, List A
Red sea bream iridoviral disease (Red sea bream iridovirus)	Yes	Yes	High	Yes	Yes, parrotfish, grouper etc.	Yes, affects many finfish species	No	No	Yes	Yes, List A
Spring viraemia of carp (Spring viraemia of carp virus)	Yes	Yes	High	Yes	Yes, Cyprinids may be imported in future	No	No	No	Yes	Yes, List A
Tilapia lake virus disease (Tilapia lake virus)	No	Yes	High	Yes	No	Yes, affects tilapia	No	No	No	Yes, List A
Vibriosis (<i>Vibrio</i> spp.)	No	Yes	High	Yes	Yes,	Yes, affects many finfish species	Yes, likely	No	No	Yes, List B

APPENDIX 7B

Decision matrix for inclusion of diseases/pathogens in the draft national aquatic pathogen list

Disease/ Pathogen	OIE listed? (yes/no)	Infectious etiology? Or infectious agent strongly associated with disease but etiology not yet known? (yes/no)	Pathogenicity / Socioeconomic impact (low, medium, high)	Repeatable and robust means of detection/ diagnosis exists? (yes/no)	Affects species cultured in country or likely to be cultured? (yes/no)	Affects wild aquatic animal species present in country? (yes/no)	Already present in country? (yes/no) If yes, limited distribution? (yes/no)	National control programme present for this disease/pathogen?	Concern to international trade? (yes/no)	Listing Decision (yes, no) If yes, List A or List B?
					affects many finfish species					
Viral encephalopathy and retinopathy (Betanodaviruses)	No	Yes	High	Yes	Yes, tilapia, mullet etc.	Yes, affects many finfish species	No	No	No	Yes, List A
Acute hepatopancreatic necrosis disease (<i>Vibrio parahaemolyticus</i>)	Yes	Yes	High	Yes	No	Yes	No	No	Yes	Yes, List A
Hepatopancreatic microsporidiosis (<i>Enterocytozoon hepatopenaei</i>)	No	Yes	High	Yes	No	Yes	No	No	No	Yes, List A
Infectious hypodermal and haematopoietic necrosis (Infectious hypodermal and haematopoietic necrosis virus)	Yes	Yes	High	Yes	No	Yes	No	No	Yes	Yes, List A
Infectious myonecrosis (Infectious myonecrosis virus)	Yes	Yes	High	Yes	No	Yes	No	No	Yes	Yes, List A

APPENDIX 7B

Decision matrix for inclusion of diseases/pathogens in the draft national aquatic pathogen list

Disease/ Pathogen	OIE listed? (yes/no)	Infectious etiology? Or infectious agent strongly associated with disease but etiology not yet known? (yes/no)	Pathogenicity / Socioeconomic impact (low, medium, high)	Repeatable and robust means of detection/diagnosis exists? (yes/no)	Affects species cultured in country or likely to be cultured? (yes/no)	Affects wild aquatic animal species present in country? (yes/no)	Already present in country? (yes/no) If yes, limited distribution? (yes/no)	National control programme present for this disease/pathogen?	Concern to international trade? (yes/no)	Listing Decision (yes, no) If yes, List A or List B?
Taura syndrome (Taura syndrome virus)	Yes	Yes	High	Yes	No	Yes	No	No	Yes	Yes, List A
White spot disease (white spot syndrome virus)	Yes	Yes	High	Yes	Yes, mud crabs	Yes	No	No	Yes	Yes, List A
Yellow head disease (yellow head virus genotype 1)	Yes	Yes	High	Yes	No	Yes	No	No	Yes	Yes, List A
<i>Perkinsus olseni</i>	Yes	Yes	High	Yes	Yes, giant clams and oysters	Yes	No	No	Yes	Yes, List A

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