



Federated States of Micronesia Aquaculture Management and Development Plan



Federated States of Micronesia (2019–2023)
Chuuk State (2019–2023)
Kosrae State (2019–2023)
Pohnpei State (2019–2023)
Yap State (2019–2023)



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Produced by

**FSM National Government Department of Resources and Development
Fisheries Section
with the assistance of the Pacific Community (SPC)**

2019

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Abbreviations

ADB	Asian Development Bank
BMPs	Best management practices
C and I	Commerce and Industry[Please provide the term in full]
CBOs	Community Based Organization[Please provide the term in full]
CCC	Chuuk Chamber of Commerce
CCS	Chuuk Conservation Society[Please provide the term in full]
COM-FSM	College of Micronesia – FSM
COM-FSM CRE	COM-FSM Cooperative Research and Extension[Please provide the term in full]
COM Land Grant	College of Micronesia Land Grant program
CSP	Conservation Society of Pohnpei[Please provide the term in full]
DOE	Department of Education
DMR	Department of Marine Resources
DREA	Department of Resources and Economic Affairs
EPA	Environmental Protection Agency
FAO	Food and Agriculture Organization of the United Nations
FSM	Federated States of Micronesia
FSMDB	FSM Development Bank
FSM R&D	FSM Department of Resources and Development
FY	Financial year
GDP	Gross domestic product
GIZ	The Deutsche Gesellschaft für Internationale Zusammenarbeit [Please provide the term in full]
JICA	Japan International Cooperation Agency
JNAP	Joint National Adaptation Plan[Please provide the term in full]
KIRMA	Kosrae Island Resource Management Authority
KOICA	Korea International Cooperation Agency
MCT	Micronesian Conservation Trust
MERIP	Marine and Environmental Research Institute of Pohnpei
MMME	Micronesia Marketing and Management Enterprises
MRMD	Marine Resource Management Division
NAC	National Aquaculture Center
NGOs	Non-governmental organizations
ODA	Overseas Development Agency
OEEM	FSM Office of Environment and Emergency Management
OFA	Office of Fisheries and Aquaculture
OFCF	Overseas Fishery Cooperation Foundation of Japan
PIDB	Pacific Island Development Bank[Please provide the term in full]
SEAFDEC	Southeast Asian Fisheries Development Center
SBDC	Small Business Development Center

SBOC	FSM Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management
SPC	The Pacific Community
UOG	University of Guam
US	United States of America
USD	United States dollar(s)
YapCAP	Yap Community Action Program

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Foreword by the Secretary, FSM Department of Resources and Development

It is my pleasure to present the FSM Aquaculture Management and Development Plan for dissemination and use by stakeholders across the nation and our partners around the region.

The plan was developed with the involvement of FSM states and national fisheries officials in close collaboration with private sector, non-governmental organizations and civil society during consultations undertaken in the four states by the Pacific Community (SPC) during 2017. Furthermore, the final draft of the FSM Aquaculture Management and Development Plan was reviewed by SPC, the Food and Agriculture Organization of the United Nations (FAO) and states' representatives attending a national consultation on aquatic biosecurity held in Pohnpei in May 2019.

I take this opportunity to thank all of them for their engagements and input into the FSM Aquaculture Management and Development Plan. I also want to thank SPC and FAO for providing financial and technical assistance towards the completion of the plan.

The FSM Aquaculture Management and Development Plan represents a clear guideline for the future expansion of the aquaculture sector in the FSM and provides a comprehensive pathway to all relevant national stakeholders for long-term sustainability of current and future aquaculture activities.

I trust that the goals, objectives and actions identified in the plan remain relevant and doable over the plan's five-year period.

Thank you very much.

Marion Henry
Secretary
Department of Resources and Development
Government of the Federated States of Micronesia

1. Introduction

1.1 Overview of the Federated States of Micronesia

The small island developing state of the Federated States of Micronesia (FSM) is a young independent nation in the North Pacific region. It was part of the United Nations Trust Territory of the Pacific Islands administered by the United States of America (US). Independence came in 1986, and the two nations signed a Compact of Free Association leading to termination of the trusteeship by the United Nations in 1991. The compact treaty formed a special relationship between the FSM and the US where the US agreed to provide economic assistance, defense and other services to the FSM for 15 years, in exchange for a delegation of the responsibility for security and defense. That assistance has been extended until 2023, after the FSM Congress approved the amended compact in 2004.

The nation is divided into four distinct and highly independent states: Kosrae, Pohnpei, Chuuk and Yap (Figure 1).



Figure 1. Map of the Federated States of Micronesia.

Pohnpei is the location of the capital city Palikir. Each state has considerable autonomy within the federation. The state governments carry out most major governmental functions and, significantly, control and manage fisheries resources, including aquaculture, up to a 19 km limit from shore. Overseeing the four FSM states is the FSM National Government, which is divided among three separate branches of

government: executive, legislative, and judicial. Under their constitutions, the state governments also utilize these three branches. The FSM National Government is the conduit of the nation for income funds, especially those from the compact, issues relating to foreign affairs, fishing outside the 19 km limit, and defense. The FSM National Government does have various departments, which are detailed below, relating to resources and development, emergency management, offshore fisheries and statistics, whose roles are to support and coordinate the activities of similar agencies in the four states.

The FSM is the largest and most diverse part of the greater Micronesian region, lying around the equator and stretching about 2700 km in geographic sequence from west to east. The nation is specifically located in the western Pacific Ocean between the equator and 14°N latitude, and between 136°E and 166°E longitude, and includes 607 islands with land elevation ranging from sea level to the highest elevation of about 760 m. All states but Kosrae State have more than one island. The total land mass of the FSM is 702 km², with a declared exclusive economic zone covering over 1.6 million km². The indigenous population is Micronesian. However, each of the four states have their own distinct culture and traditions, which are strongly tied to society. Micronesian society is based on the extended family, which is responsible for the family's welfare, especially in relation to customary family land. The nation has a total population of about 106,000, as of 2010, with 50% below 20 years of age. Most of the people reside on the four main islands, with approximately half of the total population living in Chuuk State. Under the Compact of Free Association, FSM citizens are allowed to enter the US freely to maintain "habitual residence" and to pursue education and employment, which has stimulated emigration of citizens to the US. More than 15,000 Micronesians are currently living in the US – 7000 in Guam, 3000 in Commonwealth of the Northern Mariana Islands, and the rest in Hawaii or in the 48 contiguous United States.

The economy of the FSM is small and is mostly dependent on foreign aid, mainly through the Compact of Free Association. The currency of the FSM is US dollars. The FSM economy has grown by an average annual rate of 2.5%, as indicated by estimates of gross domestic product (GDP) performance, since financial year (FY) 1987. Economic growth is greatly challenged by the geographical isolation and small population of the nation. The economic performance of each state varied during the period of FY1987 to FY1999, with the highest GDP growing at an annual rate of 3.6% for Pohnpei and Yap states, 2.5% for Kosrae State and 0.3% for Chuuk State. Real GDP per capita for 2010 was USD 2900.

The primary economic activities in the FSM are government services, agricultural production, subsistence farming and fishing, commercial offshore fishing, wholesale, and retail sales. Government services dominate the economy at approximately 42% due to the compact. The nation's second-highest source of revenue is the commercial tuna fishery, with annual revenues between USD 13 and 20 million. Even though the tourism sector contributes only small revenue earnings to the FSM, it is recognized as providing long-term growth potential and a comparative advantage to FSM, with

approximately 14,000 tourists entering the FSM annually (Pohnpei 37%, Chuuk 36%, Yap 15%, Kosrae 12%).

1.2 The need for an aquaculture development plan

The need for aquaculture development plans for the national and state governments of the FSM is timely. During the 3rd FSM Economic Summit held in 2004, 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”.

Significantly, aquaculture is seen as an activity that may help to develop the economy of the FSM. This is especially important as the country nears the end of the Amended Compact of Free Association with the US in 2023. Under the terms of the compact, financial assistance from the US to the FSM decreases by USD 800,000 every year. This money goes into a trust fund for helping to run the country after 2023. However, a 2013 report by the FSM Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management (SBOC) indicates the trust fund will not be adequate to replace compact funding sector grants by 2024. This has put added stimulus on the need for meaningful economic development.

1.3 Structure of the plan and how the data were obtained

A total of five planning workshops were conducted between August and December 2013, one for the FSM National Government and one for each of the states. Key individuals from state and national agencies, non-governmental organizations (NGOs) and private sector companies were invited to attend the workshops. With the exception of the FSM National Government, which does not physically engage in aquaculture projects, participants from each state developed strategic actions for specific aquaculture commodities and also addressed key challenges or constraints to aquaculture development. Strategic actions to overcome key challenges for aquaculture were also developed for the FSM National Government.

1.4 Potential and opportunities for aquaculture

Pristine environment. The waters surrounding the islands of the FSM are some of the cleanest in the world because they are hundreds of kilometers from the nearest industrialized nations and there is no serious land pollution in these islands.

Access to technology and technical assistance. Due to its special relationship with the US, the FSM has access to some of the most advanced agricultural technology in the world. It is also able to seek assistance from many other developed nations.

Large sheltered lagoons. With the exception of Kosrae, which has no lagoon, the FSM is characterized by having large sheltered lagoons, which are perfect for tropical

aquaculture. It should be noted, however, that storm activity in the western states may be a threat.

High biodiversity. The FSM has some of the highest tropical marine biodiversity in the world, making it easy to grow native species.

Increasing demand for seafood and declining world fisheries. As the world population grows, there is increasing demand for seafood and less clean water to grow products.

Market access. Despite its remoteness, the FSM has preferential access to US markets and also has reasonable shipping infrastructure.

1.5 History of aquaculture production in the FSM

The FSM has a recent history of aquaculture development going back to 1985. Prior to that, the Japanese were known to have experimented with aquaculture in the 1930s and 1940s, but efforts are poorly documented. Many of the recent projects have been government or donor driven, and there have been few commercial successes.

The following outlines a brief timeline of major aquaculture developments in the FSM.

- 1985. Seaweed trials (*Kappaphycus alvarezii*) were conducted in Pohnpei.
- 1990–present. Sponge farming (*Cosinoderma matthewsi*) research and development began in Pohnpei. Sponge farming is still continuing today, with more than 30 small-scale farmers growing two species of sponges on Pohnpei. Pilot-scale farms have also been established in Chuuk and Yap.
- 1991–2005. The National Aquaculture Center (NAC) was constructed in 1991. This facility was operated by the FSM National Government Department of Resources and Development Fisheries Section and carried out giant clam restocking (four species) and small-scale farmer grow-out operations. The center also assisted the Kosrae State Fisheries Department to raise trochus and turbo (green snail) for restocking efforts.
- 1994–present. Research trials begin on Nukuoro Atoll (430 km SSW of Pohnpei). The first pearls from this project were harvested in 1999, and the farm consistently produced pearls until 2006. Production has been dormant since that time.
- 1997–1999. Pacific Water Resources, a Pohnpei-based commercial enterprise, began growing milkfish (*Chanos chanos*) fingerlings as live bait for tuna longliners. Milkfish fry were imported from Taiwan to stock the farm. The company later experimented growing marine shrimp (*Litopenaeus vannamei*), with post-larvae also imported from Taiwan. The company ceased operation in 1999.
- 1999–present. Hard- and soft-coral research trials began in Pohnpei. This project progressed into community-based farming, supported by the Marine

and Environmental Research Institute of Pohnpei (MERIP), which is still ongoing.

- 2002–present. College of Micronesia Land Grant (COM Land Grant) program initiated a pearl oyster hatchery at Nett Point in Pohnpei. This government-backed program initiated a series of small pearl farms around Pohnpei. One farm remains at Pakin Atoll.
- 2002–2010. A mangrove crab (*Scylla serrata*) farming project was run by the Kosrae State Government. A hatchery produced crablets that were stocked into ponds for grow out. The project ended in 2010.
- 2005–present. The NAC in Kosrae was leased to a private company, Micronesia Marketing and Management Enterprises (MMME). MMME continues to farm giant clams (*Tridacna maxima* and *T. crocea*) on a commercial scale for export to the marine ornamental trade. The company also supports small-scale community-based coral farming for export.
- 2007–2011. Two commercial foreign operators constructed small sea cucumber hatcheries in Yap. Neither of these facilities is still in operation.
- 2007–present. The COM Land Grant hatchery began producing sea cucumber (*Holothuria scabra*) seedlings for restocking efforts in Pohnpei. They have also closed the life cycle of the black teatfish (*Holothuria whitmaei*). Sea ranching trials are being conducted with both species.

1.6 Current status of aquaculture in the FSM

Aquaculture in the FSM is presently focused almost exclusively in Pohnpei and Kosrae. In Pohnpei, the COM Land Grant continues to operate the pearl oyster and sea cucumber hatchery at Nett Point. In addition, MERIP is expanding the sponge and marine ornamental aquaculture programs with communities around the island. Nukuoro Black Pearls is working on revitalizing their farm on Nukuoro Atoll, and five small pearl farms continue operations with support from the COM Land Grant program. In Kosrae, MMME is still operating at the NAC facility, exporting giant clams and corals to the marine ornamental trade. This remains the only true commercial aquaculture operation in the country.

1.7 Overseas partners/agencies

- Asian Development Bank (ADB)
- Australian Department of Foreign Affairs and Trade Aid Program (formerly AusAID)
- Center for Tropical and Subtropical Aquaculture (CTSA)
- Food and Agriculture Organization of the United Nations (FAO)
- Japan International Cooperation Agency (JICA)
- Overseas Fishery Cooperation Foundation of Japan (OFCF)
- Secretariat of the Pacific Community (SPC)
- Southeast Asian Fisheries Development Center (SEAFDEC)
- United Nations Development Program (UNDP), Small Grants Programme

(SGP)

- University of Guam (UOG), College of Natural and Applied Sciences
- University of Hawaii, College of Tropical Agriculture and Human Resources (CTAHR), Agriculture Development in the American Pacific (ADAP)
- University of Hawaii Hilo – Pacific Aquaculture and Coastal Resources Center (UHH-PACRC)
- University of Hawaii Sea Grant College Program

1.8 FSM-based organizations with a mandate to serve the entire nation

- College of Micronesia Land Grant program (COM Land Grant)
- Marine and Environmental Research Institute of Pohnpei (MERIP)
- Micronesian Conservation Trust (MCT)

2. FSM National Government Aquaculture Development Plan

2.1 Key FSM National Government agencies involved in aquaculture development and regulation

- College of Micronesia – FSM (COM-FSM)
- FSM Department of Foreign Affairs
- FSM Department of Justice
- FSM Department of Resources and Development (FSM R&D)
- FSM Development Bank (FSMDB)
- FSM Office of Environment and Emergency Management (OEEM)
- FSM Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management (SBOC)

2.2 Challenges to the development of aquaculture at the FSM National Government level and strategies for success

During consultations regarding the FSM National Government Aquaculture Management and Development Plan, participants were asked to list broad challenges to the success of aquaculture in the FSM. The results of these consultations are shown in Figure 2.

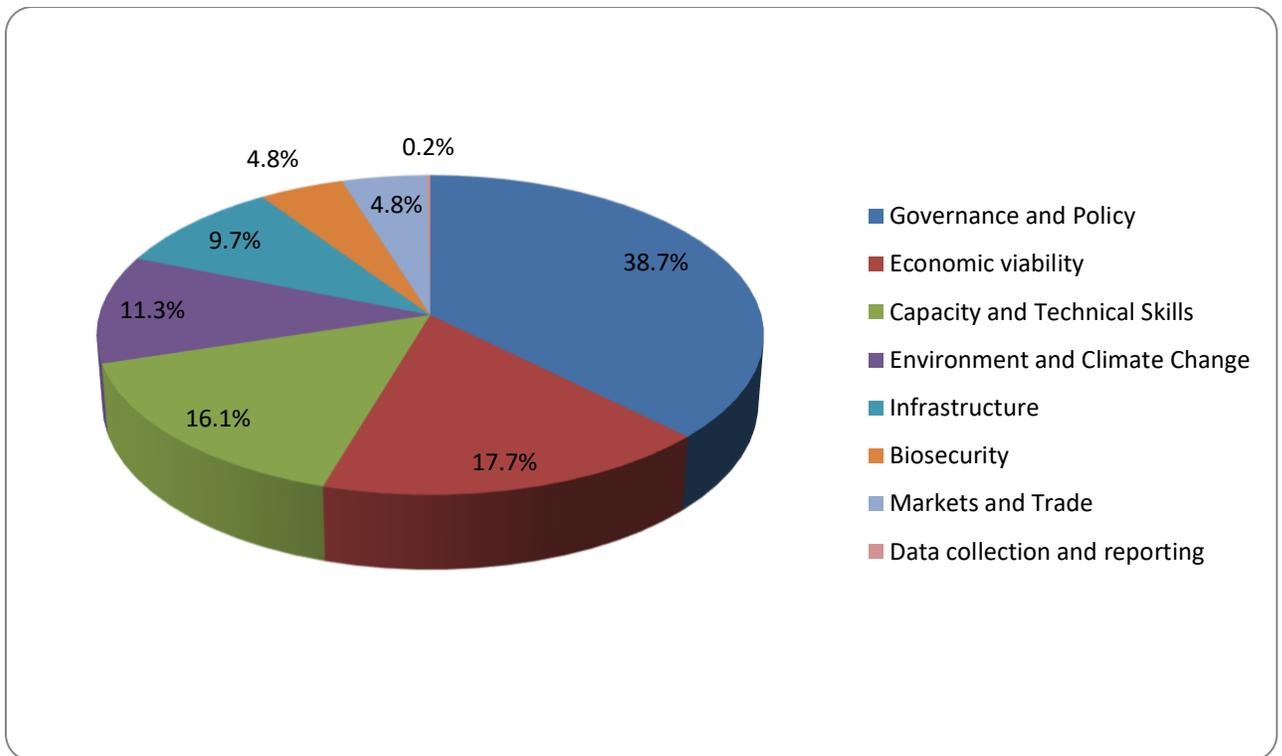


Figure 2. Challenges to successful aquaculture development at the FSM National Government level as prioritized by respondents during consultations (62 responses in total).

2.2.1 Governance and policy

As most activities within the FSM National Government are policy and/or governance driven, there was a majority of respondents (38.7%) who felt this was an area that needed the most attention.

Table 1. Strategies to overcome governance and policy challenges. NB This table also contains objectives that address governance and policy strategies to address markets and trade, environment, climate change, and investment as it relates to aquaculture development

Objective 1: Improve coordination and awareness between national government and donors, state governments, private sector and civil society organizations.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Compile a contact list of all people involved or interested in aquaculture in the FSM, including donors and technical assistance providers. Use this as a tool for sharing and disseminating aquaculture information.	FSM R&D	List completed and disseminated. Interested individuals are able to access information readily	High/1 year

Hold regular stakeholder meetings when traveling to the other FSM states. Consider video conferencing as an alternative if travel funds are limited.	FSM R&D	Meetings completed in each of the states on an annual basis	High/1 year
Expand FSM R&D website to include the aquaculture section. Consistently update with funding opportunities, content and other relevant information. Link to other relevant sites and agencies.	FSM R&D	Website completed and updated. Interested individuals are able to access information readily	Medium/1-3 years
Raise awareness of aquaculture inside and outside the FSM by inclusion in FSM marketing and promotion materials.	FSM R&D	Better awareness of FSM aquaculture potential for stakeholders	Medium/3-5 years
Produce a brochure detailing benefits of FSM aquaculture.	FSM R&D	Brochure produced and disseminated to interested parties. Awareness raised on FSM aquaculture potential	Medium/3-5 years
Objective 2: Develop a strategy for aquaculture development, which will be incorporated into the overall fisheries policy for the FSM National Government. NB This document begins the process of developing the national strategy, which will be refined using the activities below.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Review existing laws, policies and regulations relating to aquaculture at the FSM national level. (This may also include coastal fisheries.)	FSM R&D, FSM Department of Justice	Reviews completed	High/1 year
Seek funding for and source an expert from regional organizations to assist with the final plan development.	FSM R&D, SPC, other regional donors and organizations	Expert sourced and funded	High/1-3 years
Draft plan for adoption and incorporation into the National Fisheries Policy.	FSM R&D and consultant	Strategy completed, published and disseminated	High/1-3 years
Objective 3: Improve the investment climate for aquaculture in the FSM. NB This objective will need to be carried out in close collaboration with the states, who control investment and regulation of aquaculture within the 19 km limit.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Increase transparency of aquaculture laws, regulations and policies on aquaculture development (also see Objective 2 in this section).	FSM R&D, FSM Department of Justice	Reviews completed	High/1 year

Assist states to streamline procedures of approval of investment permits and licenses for aquaculture.	FSM R&D, state departments of marine resources and foreign investment	Aquaculture businesses are able to begin operations more easily	Medium/1-5 years (ongoing)
Undertake marketing and promotional activities (see also Objective 1 in this section).	FSM R&D and Trade	Materials completed and interest from investors rises	Medium/1-5 years (ongoing)
Facilitate access to physical infrastructure for aquaculture businesses. NB This was considered to be the responsibility of the states.	State offices with support from FSM R&D	Aquaculture businesses in the states are better able to access infrastructure	Low/1-5 years (ongoing)
Determine potential investor incentives. NB This was considered to be the responsibility of the states.	State offices with support from FSM R&D	Potential aquaculture businesses are encouraged to start in the states	Low/1-5 years (ongoing)
Objective 4: Protect the biodiversity of the FSM and the environment and traditional livelihoods practices from harmful disease.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Develop a national legal framework for aquatic biosecurity.	FSM R&D, SPC and other regional donor/partners	Enactment of National Biosecurity Act covering aquatic species	High/1 year
Develop national guidelines relating to the introduction of non-native species.		National guidelines for introduction of non-native species implemented	High/1 year
Improve capacity on risk analysis.		Existing staff trained and additional staff recruited	Medium/2-3 years
Strengthen monitoring capacity for aquatic biosecurity.		Existing staff trained and additional staff recruited	Medium/2-3 years
Promote awareness of low input, environmentally friendly aquaculture (see also Objective 1 in this section).	FSM R&D, MERIP, COM-FSM CRE	States promote low input, environmentally friendly aquaculture	Medium/1-3 years
Develop theoretical guidelines for environmentally friendly aquaculture to present to the states and deliver training on this topic in the states.	FSM R&D, MERIP, COM-FSM CRE	States promote low input, environmentally friendly aquaculture	Medium/1-3 years
Objective 5: Incorporate climate change considerations into national aquaculture activities.			
Priority: Medium			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Develop climate change policy for aquaculture development.	FSM R&D, OEEM, GIZ, SPC, COM-FSM CRE	Policy completed and implemented	Medium/1-5 years
Raise awareness of climate change issues as they relate to aquaculture.		Stakeholders educated in climate change issues	Medium/1-5 years

Promote use of alternative energy/low-carbon technology in aquaculture.		Carbon emissions relating to aquaculture reduced	Low/1-5 years
Cross training between OEEM and FSM R&D marine staff on relevant aquaculture and climate change issues.		Staff better informed on relevant cross-cutting issues	Medium/2-3 years
Objective 6: Promote trade and investment in aquaculture in the FSM states both internationally and domestically. NB This objective will need to be carried out in close collaboration with the states, who control investment and regulation of aquaculture within the 19 km limit.			
Priority: Low			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Provide information on viable species and commodities for the FSM. Address issues such as food security, healthy living, and subsistence and import substitution.	FSM R&D, State Marine Resource and SBDCs, COM-FSM CRE	Information packages and fact sheets produced and disseminated	Low/1-3 years
Coordinate with stakeholders for better participation in markets and trade.		Aquaculture marketing and trade enhanced	Low/1-5 years (ongoing)
)		Compliance with international trade agreements improved	Low/1-5 years (ongoing)
Objective 7: Improve strategies for access to capital and funding for aquaculture in the FSM.			
Priority: Low			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Clarify roles between the states and the FSM National Government with respect to funding. NB This may be partly addressed through SPC consultations with the states as part of this report.	SPC with FSM R&D	Improved understanding of roles and responsibilities for funding of aquaculture projects in the FSM	Low/1 year
Promote private sector development of aquaculture at the state level.	State offices with support from FSM R&D	More private sector farms in the FSM are able to be funded	Low/1-5 years (ongoing)

Note. FSM = Federated States of Micronesia; FSM R&D = FSM Department of Resources and Development; SPC = Pacific Community; MERIP = Marine and Environmental Research Institute of Pohnpei; OEEM = FSM Office of Environment and Emergency Management; SBDC = small business development center.

2.2.2. Capacity building

Human capacity and technical skills and infrastructure were combined into one thematic area during consultations. Human capacity was ranked as important by 16.1% of respondents and infrastructure ranked as important by 9.7% of respondents.

Table 2. Strategies to overcome challenges to human and infrastructure capacity limitations in the FSM

Objective 8: Increase human and infrastructure capacity for aquaculture in the FSM.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Evaluate training needs for formal and non-formal farmer education.	FSM R&D, COM-FSM, COM-FSM CRE, outside consultant	Evaluation report published	High/1 year
Provide cross training in technical aspects of aquaculture within the Pacific.	FSM R&D, COM-FSM, COM-FSM CRE, SPC	Staff better trained in key aquaculture commodities	Medium/2–3 years
Assess existing human and physical infrastructure for aquaculture in the FSM.	FSM R&D, state marine resource offices	Report published on existing infrastructure	High/1 year
Identify research and development needs specific to aquaculture.	FSM R&D, COM-FSM, COM-FSM CRE, SPC	Research and development needs identified	Medium/2–3 years
Implement curriculum assessment and improvement on existing educational programs.	FSM R&D, COM-FSM, COM-FSM CRE, FSM DOE	Improved curricula	High/2–3 years
Offer internships and on-the-job vocational training for aquaculture in high schools and colleges.	FSM R&D, COM-FSM, COM-FSM CRE, FSM DOE	Students better trained	Medium/1–5 years (ongoing)
Objective 9. Promote best management practices (BMPs) for aquaculture in the FSM.			
Priority: Medium			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Identify existing aquaculture BMPs relevant to the FSM.	FSM R&D, MERIP, COM-FSM CRE, regional partners	National code of conduct and BMPs are developed for aquaculture and capacity increased for using such guidelines	Medium/2–3 years
Research and adapt current FAO regional/international codes of conduct for responsible aquaculture.			Medium/2–3 years
Develop BMPs and codes of conduct into an FSM code.			Medium/3–5 years

Note. FSM = Federated States of Micronesia; FSM R&D = FSM Department of Resources and Development; COM-FSM = College of Micronesia – FSM; SPC = Pacific Community; DOE = Department of Education; BMPs = best management practices; MERIP = Marine and Environmental Research Institute of Pohnpei; FAO = Food and Agriculture Organization of the United Nations.

2.2.3. Economic viability

Economic viability (prioritized by 17.7% of respondents), investment aspects of markets and trade (prioritized by 4.8% of respondents) and data collection (prioritized by 2% of respondents) were combined into this thematic area.

Table 3. Strategies to overcome economic challenges to aquaculture development in the FSM

Objective 10: Improve knowledge of costs and benefits of aquaculture projects in the FSM. NB This was considered to be a more passive activity where the FSM National Government would respond to requests for assistance on a case-by-case basis.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Create a database of existing current information on aquaculture economics relevant to the FSM.	FSM R&D, regional partners, SPC, COM	Database completed and regularly updated	High/1 year
Prepare terms of reference when a request for economic assessment is received.	FSM R&D, Trade, regional partners, SPC, COM	Terms of reference completed	High/case-by-case basis
Seek funding for feasibility studies using prepared terms of reference.	FSM R&D, Trade, regional partners, SPC, COM	Funding secured	High/case-by-case basis
Conduct studies and make results available to businesses and states.	FSM R&D, Trade, regional partners, SPC, COM	Report completed and FSM aquaculture businesses more viable	High/case-by-case basis
Objective 11: Enhance access to capital and funding for aquaculture through capacity building for banks and farmers. NB This objective will need to be carried out in close collaboration with the states, who control investment and regulation of aquaculture within the 19 km limit.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Educate lenders on aquaculture as a priority sector for the FSM National Government and the need to provide credit line where feasible. Stress the need for economic viability assessments (see Objective 10 in this section) and environmental sustainability (see Objective 4).	FSM R&D, Trade, COM-FSM CRE	Banks are better able to determine viable loans. Aquaculture businesses are better able to succeed	High/case-by-case basis
Make farmers aware of funding and loan opportunities (see Objective 1 activities).		Banks have a better selection of potentially viable clients	High/1-5 years (ongoing)
Train farmers in how to apply for loans through business plan training.	State offices with support from FSM R&D	More farmers apply successfully for loans or grants	Medium/1-3 years
Conduct training of trainers workshops.	State offices with support from FSM R&D	State-level offices are better equipped to train farmers in how to obtain capital	Medium/1-3 years
Clarify roles between the states and the FSM National Government with	SPC with FSM R&D Marine	Improved understanding of roles	Low/1 year

respect to funding. NB This may be partly addressed through the consultations of SPC with the states as part of this report.		and responsibilities for funding of aquaculture projects in the FSM	
Promote private sector development of aquaculture at the state level.	State offices with support from FSM R&D	More private sector farms in the FSM are able to be funded	Low/1–5 years (ongoing)
Objective 12: Collect and disseminate aquaculture statistics for the FSM.			
Priority: High			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Priority/Time frame</i>
Request assistance from SBOC on setting up a database for collecting aquaculture information for the FSM.	FSM R&D, SBOC	Database is designed	High/1 year
Collect data on types of aquaculture, values and volume.	FSM R&D, SBOC, state marine resource offices, SPC	Data are collected and entered into the database	High/1–3 years
Request SBOC to archive and serve the data.	FSM R&D, SBOC	Data are made widely available and are stored safely	High/1–3 years
Link data to the R&D aquaculture website.	FSM R&D, SBOC	Data are made available to all parties interested in FSM aquaculture statistics	High/1–3 years

Note. FSM = Federated States of Micronesia; FSM R&D = FSM Department of Resources and Development; SPC = Pacific Community; SBOC = FSM Office of Statistics, Budget and Economic Management, Overseas Development Assistance and Compact Management.

2.3 Facilities

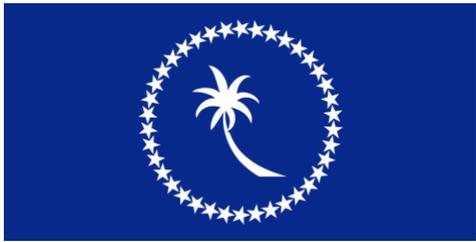
The FSM National Government constructed and ran the NAC in Kosrae from 1991 until 2005. As a result of a high-level review of all public sector activities and enterprises in the FSM, conducted under ADB TA 3201 in early 2000, the NAC in Kosrae State was listed as a potential candidate for private ownership. The privatization master plan developed by the FSM National Government lists the NAC as a “competitive enterprise” and identified it as one of three pilot projects to be worked on during the first round of private sector reform. Assistance was sought from SPC to conduct a study with the specific goal of transforming the NAC into a quasi-private, income-generating organization. From 2005 onward, the facility has been leased to MMME, a private sector company that grows giant clams and corals on site and in partnership with local farmers. In addition, this company now also conducts a wild-caught marine ornamental fishery for export to the aquarium trade.

At present, the FSM National Government has no plans to take over operation of the NAC again or to construct any further nationally run facilities, preferring to promote aquaculture through facilities within the states or COM-FSM when necessary. However, due to a collaborative arrangement between MMME and the FSM National Government, on-site aquaculture training can still be conducted at the NAC facility at the request of the FSM National Government.



Fig. 3 National Aquaculture Center

3. Chuuk State Aquaculture Development Plan



3.1 Introduction

Chuuk State lies centrally in the FSM between Pohnpei and Yap states stretching from 151°E to 154°E longitude and 5°N to 9°N latitude. The main group of islands sits within one of the world's largest lagoons, Chuuk Lagoon. The two major geographical and dialectical divisions of Chuuk Lagoon are Faichuuk to the west and Namoneas to the east. The state also has several less populated outer island groups as follows: the Mortlocks to the southeast, Hall Islands to the North, Pattiw region to the west, and Namonuito Atoll to the northwest. Nearly all of the islands of Chuuk State, and especially Chuuk Lagoon, are ideal for mariculture due to their large sheltered lagoons. These islands are more commonly struck by typhoons than their neighbors to the east, Pohnpei and Kosrae. At 2.2 m per year, the rainfall received by Chuuk State is the lowest in the FSM.

Chuuk State is the most populated state in the FSM and had 48,654 people in 2010, most of whom live within Chuuk Lagoon. With a land area of only 127.2 km², it is also the mostly densely populated per square kilometer. The real per capita GDP for Chuuk, in 2010, was USD 1477, the lowest in the nation. All land in Chuuk, including submerged lands, is privately owned, giving a high degree of discretion to land owners regarding aquaculture development.

3.2. Key Chuuk State Government agencies involved in aquaculture development and regulation

- Chuuk State Department of Resources and Development – Marine Resources Division
- Chuuk State Environmental Protection Agency (EPA)
- Chuuk State Foreign Investment Board
- Chuuk State Small Business Development Center (SBDC)

3.3 Priority commodities

A list of priority commodities was developed through consultations with Chuuk stakeholders and resource personnel. These were scored by participants on two main criteria: feasibility and impact. Feasibility was defined by how appropriate the technology was for Chuuk and how well the commodity might be grown and marketed. Impact was defined by how widespread the benefits would be and how the commodity would affect local culture, society and the environment.

Table 4. Commodity priorities for Chuuk State

		Impact		
		Low	Medium	High
Feasibility	High		Marine food fish	Sponge Corals Trochus Pearls Sea cucumbers
	Medium		Seaweed Milkfish Tilapia	Post-larval collection and capture Giant clams Mangrove crabs
	Low			

3.3.1 Sponge Commodity Development Plan

Sponges were ranked high for impact and high for feasibility. Two species of sponge occur in Chuuk Lagoon with proven potential for aquaculture: *Cosinoderma matthewsi* and *Spongia matamata*.

Immediate actions (1 year)

- Conduct training for communities and marine resource personnel in sponge farming techniques.
- Identify funding to initiate sponge farming.
- Resource survey for areas to farm sponges, including identification of farm sites and broodstock collection sites.
- Identify communities/groups interested in sponge farming. Raise awareness of sponge farming with communities and government.

In 2–3 years

- Develop management plan for sponge farming that would include farm sites, collection areas and regulations on collection.
- Implement pilot farms.
- Conduct market assessment.
- Initiate first harvest of sponges.

In 3–5 years

- Test marketing of sponges for export conducted.
- Sponge management plan reassessed.
- Farms are operating sustainably.
- Training of trainers for sponge farming and replication where possible.

3.3.2 Coral Commodity Development Plan

Corals were ranked high for impact and high for feasibility. They would be grown for mitigation in areas that have been impacted by explosives fishing.

Immediate actions (1 year)

- Identify one or two communities to be involved in coral restoration project.
- Rebuild sites that have been damaged and find sites to source coral broodstock.
- Raise awareness with selected communities to make sure they are involved and in agreement with the project.
- Identify funding sources for the project.

In 2–3 years

- Provide training for local coral farming.
- Develop livelihood alternatives for communities to support management of coastal fisheries.
- Identify private sector partner who would buy corals from community farmers for export.
- Initiate farms.
- Begin restocking of corals in affected areas.

In 3–5 years

- Begin monitoring program in replanted areas.
- Initiate private sector partner buying and exporting of corals.
- Raise awareness and investigate ecotourism projects.
- Identify some kind of branding for Chuuk corals.
- Replicate restocking projects and expand export farms to other sites.

3.3.3 Trochus Commodity Development Plan

Trochus was ranked high for impact and high for feasibility. It is a valuable export product for Chuuk, and the Department of Marine Resources (DMR) manages periodic harvests.

Immediate actions (1 year)

- Undertake a resource survey for trochus resources.
- Identify sites for restocking and sanctuaries.
- Raise awareness with communities on restocking efforts.
- Engage private sector trochus hatchery to grow seed for restocking.

In 2–3 years

- Revisit the management plan for trochus restocking and management, including enforcement of regulations.
- Implement restocking of trochus seed.
- Start monitoring program for restocked areas.

In 3–5 years

- Continuous production of trochus seed and restocking of seed in the sanctuaries.
- Harvest trochus for export market.
- Reassess the trochus management plan.



3.3.4 Sea Cucumber Commodity Development Plan

Sea cucumbers were ranked high for impact and high for feasibility. The purpose of culturing this commodity would be solely for restocking efforts.

Immediate actions (1 year)

- Review sea cucumber aquaculture in the region (i.e. successes and failures).
- Seek assistance to undertake a sea cucumber resource survey.
- Review past surveys and recommendation for development of a sea cucumber management plan.
- Investigate public–private partnership investment in sea cucumber aquaculture (i.e. Korean Institute or others).

In 2–3 years

- Develop a sea cucumber management plan that would include key species for aquaculture and methodologies for ranching.
- Conduct training attachment for marine resource and college staff at COM Pohnpei hatchery.

- Make recommendation for COM Pohnpei to provide seedlings to undertake trials in Chuuk.
- Work with other identified private sector partners to provide seedlings.
- Identify pilot sites for ranching.
- Undertake community awareness and training on sea cucumber ranching and management.

In 3–5 years

- Establish monitoring program on growth and survival.
- Identify potential buyers and work to establish an equitable pricing strategy.
- Revisit management plan and enforcement of regulations.

3.3.5 Black Pearl Commodity Development Plan

Black pearls were ranked high for impact and high for feasibility. Chuuk Lagoon has a healthy population of pearl oysters, and research trials have been successfully conducted on pearl production in the state.

Immediate actions (1 year)

- Undertake training in pearl farming.
- Engage public–private partnership in pearl farming.
- Undertake a review of pearl farming in Chuuk State by finding an expert on pearl farming and reviewing past experiences on pearl farming in the region.
- Conduct study tour to Pohnpei pearl farm.

In 2–3 years

- Set up pilot pearl farms.
- Trial spat collection or hatchery production in Chuuk and possibly outer islands.
- Identify suitable sites for pearl farming.
- Look towards half pearl or round pearl production.

In 3–5 years

- Investigate seeding technicians training in an established farm setting.
- Harvest pearls.
- Identify markets for the product.
- Involve the banks (e.g. FSMDB) in investing in pearl farming.



3.4 Challenges to the development of aquaculture in Chuuk State and strategies for success

During consultations, participants were asked to list broad challenges to the success of aquaculture in Chuuk. The results of these consultations are shown in Figure 6.

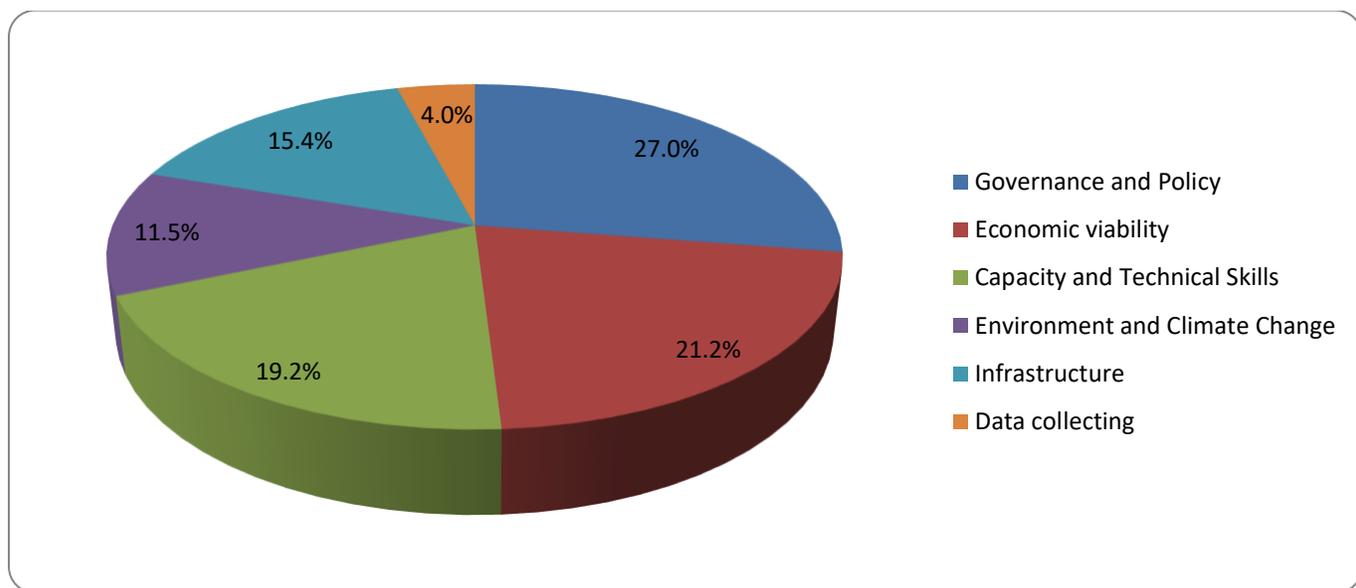


Figure 6. Challenges to successful aquaculture development for Chuuk State as prioritized by respondents during consultations (52 responses in total).

3.4.1 Capacity building and technical skills

This thematic area garnered the most responses as a major challenge to successful aquaculture in Chuuk. In particular, 19% of respondents felt technical skills and access to technical assistance was a limiting factor.

Table 5. Strategies to overcome challenges to human capacity limitations in Chuuk State

Objective 1: Provide aquaculture technical skills training and facilitate access to aquaculture technical assistance for stakeholders in Chuuk.			
Priority: High (19.2% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Seek funding for training and technical assistance.	Chuuk DMR, JICA, COM Land Grant, MCT, ADB, PIDB, FSMDB, FSM R&D	Funding is secured	1 year
Conduct training needs assessment.	SPC, Chuuk DMR, COM Land Grant, COM-FSM, FSM R&D	Needs assessment is completed	1 year
Establish linkages with national, state, private sector and regional partners (COM Land Grant, MERIP, SPC, FSM R&D, JICA, etc.), who may be able to provide trainings on specific commodities.	Chuuk DMR, COM Land Grant, MERIP, SPC, FSM R&D, JICA	Network of technical training providers is established	1 year

Conduct training workshops and on-the-job training for famers, communities, CBOs and NGOs.	Chuuk DMR, COM Land Grant	Workshops are completed and farmers trained	2-3 years
Establish demonstration sites for trainings.	Chuuk DMR, COM Land Grant	Farmers are able to learn more effectively from hands-on training	2-3 years
Work with DOE, COM Land Grant, and COM-FSM to incorporate aquaculture into secondary science curriculum.	Chuuk DMR, Chuuk DOE, COM Land Grant, COM-FSM, PREL	Aquaculture is incorporated into secondary science curricula	3-5 years
Work with COM Land Grant to explore the possibility of hiring an aquaculture researcher to boost capacity within Chuuk State.	Chuuk DMR, COM Land Grant, FSM R&D	Capacity for aquaculture training and research is increased in Chuuk	3-5 years

3.4.2 Economic viability

Two areas were prioritized under this thematic area: the need for feasibility studies (11.5% of respondents) and access to funding (7.7% of respondents).

Table 6. Strategies to overcome economic challenges to aquaculture development in Chuuk State

Objective 2: Conduct feasibility studies for aquaculture projects prior to initiation on a case-by-case basis.			
Priority: High (11.5% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Identify local and outside agencies who can provide assistance in assessing feasibility studies.	Chuuk DMR, SBDC, SPC, MERIP	A list of people or agencies who can provide assistance in assessing feasibility studies is completed	1 year
Identify Chuuk State Government positions/personnel who would need to review any feasibility assessments and set up a review board or committee.	Chuuk DMR, EPA and SBDC	Committee or review board is appointed	1 year
Develop a framework for determining the complexity of a feasibility assessment that will be required depending on the size of the project (i.e. large commercial projects may require a more complex feasibility study than smaller, community-based projects).	Chuuk DMR, EPA, SBDC, C and I	Framework is completed	1 year

Conduct feasibility assessments on a case-by-case basis.	Chuuk DMR and assessment committee	Aquaculture projects are more economically and environmentally sustainable. Regulations and processes are fair and promote development while protecting the environment	2–5 years
Review the framework periodically.	Chuuk DMR and assessment committee	Regular beneficial adjustments are made to the framework	2–5 years
Objective 3: Well-trained stakeholders that have the ability to access and mobilize funds for aquaculture projects.			
Priority: Medium (7.7% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Identify sources of funding for aquaculture – banks, grants, loans, foreign investment.	Chuuk DMR, SBDC, SPC, FSMDB and other lenders	List of potential funders is completed	1 year
Conduct series of workshops with SBDC and Chuuk Chamber of Commerce (CCC) on starting an aquaculture business (business plans, technical aspects).	Chuuk DMR, SBDC, CCC	Stakeholders are trained on how to apply for funding	1 year
Develop a funding priority list so that incoming funds can be directed appropriately.	Chuuk DMR, FSM National Government	Chuuk DMR is able to prioritize funding based on need and priority	1 year
Produce a guideline on starting an aquaculture business and include list of sources of funding and precise list of what is needed to start a business.	Chuuk DMR with SBDC, CCC	Stakeholders are aware of where to go to obtain funding	2–3 years
Facilitate grant-writing workshop for state-level, communities and interested private sector partners.	Chuuk DMR, CCC, SBDC and stakeholders	Stakeholders are trained on how to best obtain funds	2–3 years
Provide information on aquaculture investment to lenders.	Chuuk DMR, CCC and SBDC	Lenders are better informed about aquaculture	2–3 years
Continue training with stakeholders on obtaining funding to start aquaculture.		Stakeholders are trained on how to best obtain funds	3–5 years

3.4.3 Governance and policy

Governance and policy was identified as a constraint by 27% of respondents during consultations, and concerns were spread out over many areas. One particular challenge was prioritized: sufficient laws and regulations to promote aquaculture development (13.5% of responses).

Table 7. Strategies to overcome governance and policy challenges in Chuuk State

Objective 4: Ensure laws and regulations are sufficient to promote sound and responsible aquaculture development.			
Priority: High (13.5% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Commission a report on laws and regulations that affect aquaculture, including EPA, historic preservation, foreign investment, water use, biosecurity/border control. The report should recommend who is responsible for enforcement of regulations.	Chuuk DMR, attorney general's office, consultant	Full understanding is attained of legislative bottlenecks to aquaculture development	1 year
Develop a policy framework for feasibility assessment of aquaculture projects, taking into account costs, climate change, environmental impact assessments, and source of funds. Coordinate activities with Objective 2 personnel.		Framework is developed	
Educate leadership and lawmakers, through workshops, on outcome of review and recommendations for changes to, and implementation of, laws and policies on aquaculture.		Leadership is educated on aquaculture legislation and policy	1 year
Use recommendations from the report to strengthen state fisheries laws and regulations.	Chuuk DMR with state attorney general's office, EPA, C and I, foreign investment office	Laws and regulations are strengthened and structured to support aquaculture development	2-3 years
Finalize laws and regulations for aquaculture in Chuuk State.	Chuuk DMR and attorney general's office	Aquaculture is well regulated, promoting business while protecting the environment	3-5 years
Conduct outreach to the communities on results and changes.	Chuuk DMR, CCS and CBOs		
Provide outreach and training with the agencies involved with aquaculture regulation.	Chuuk DMR and attorney general's office		
Publish a document on how to start an aquaculture venture in Chuuk (from community level to foreign investor).	Chuuk DMR with SBDC		
Undertake training with enforcement and compliance arm of government.	Chuuk DMR and attorney general's office		

3.4.4 Environment and climate change

Adapting aquaculture development to the impacts of climate change was identified as a thematic constraint by 11.5% of respondents.

Table 8. Strategies to overcome environmental and climate change–related constraints in Chuuk State

Objective 5: Climate change adaptation methods are incorporated into future aquaculture activities.			
Priority: High (11.5% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Obtain training on climate change and aquaculture.	Chuuk DMR, EPA, GIZ, SPC, FSM National Government climate change specialists	Chuuk DMR staff are trained in climate change adaptation for aquaculture activities	1 year
Identify priority adaptations based on priority commodities and priorities of the state objectives, to be reflected in state-level action plans (Add full term here; JNAP).			
Ensure climate change is mainstreamed with disaster risk reduction and conservation and biodiversity activities in Chuuk.			
Raise awareness of climate change with communities becoming involved with aquaculture.	Chuuk DMR, CRE, EPA and partners	Communities are more aware of climate change in aquaculture	1 year
Work with communities, EPA, COM Land Grant and C and I to help mainstream climate change adaptation into aquaculture construction.		Climate change is considered in all construction relating to aquaculture	2–3 years
Continue raising awareness of climate change, with communities becoming involved with aquaculture.	Chuuk DMR, CCS, other CBOs and NGOs	Communities are more aware of climate change–related events	2–3 years
Work to ensure climate-resilient species are used in aquaculture.	Chuuk DMR, SPC	A list of relevant species or strains is used in selecting aquaculture commodities	2–3 years
Continue to take planning for climate adaptation into account for aquaculture.	Chuuk DMR and partners	Aquaculture ventures are more climate resilient and are more likely to succeed	3–5 years

3.4.5 Infrastructure

Poor infrastructure, in particular the need to secure reliable sources of seed stock (7.7% of respondents), was identified as a major constraint to aquaculture development in Chuuk State.

Table 9. Strategies to overcome seed stock-related constraints in Chuuk State

Objective 6: Secure a reliable source of seed stock for aquaculture production.			
Priority: Medium (7.7% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Conduct a needs assessment for seed production of sea cucumbers, pearl oysters and trochus.	Chuuk DMR	Needs assessment is completed	1 year
Approach Korean partner in Chuuk to determine willingness to collaborate and provide seed.	Chuuk DMR, Korea International Cooperation Agency (KOICA)	Seed supply is potentially secured	
Approach COM Land Grant Pohnpei to determine willingness to collaborate and provide seed.	Chuuk DMR and COM Land Grant	Seed supply is potentially secured	
Work with COM Land Grant, JICA and KOICA to determine if an aquaculture researcher would be suitable for Chuuk.	Chuuk DMR and COM Land Grant	Aquaculture capacity for Chuuk and funding for research and seed supply is increased	
Place Chuuk DMR staff at selected sites for training in seed production.	Chuuk DMR, COM Land Grant, communities, SPC	Chuuk DMR staff are well trained in seed production	2-3 years
Assess progress on seed production with partners.		Seed sources are secured	
Encourage further private sector/public partnerships for seed production.			
Continue relationships with seed producers.	Chuuk DMR, COM Land Grant, communities	Farms are reliably provided with seed stock	3-5 years
Assess seed production progress and determine needs for Chuuk DMR hatchery.			

4. Kosrae State Aquaculture Development Plan



4.1 Introduction

Kosrae State is the eastern-most state in the FSM, about 5°N latitude and 163°E longitude. With an area of 110 km², it is the second-largest single island in the FSM after Pohnpei. Kosrae State is made up of four municipalities known as Lelu, Malem, Utwe and Tafunsak. The Capital of Kosrae is Lelu. Kosrae is a volcanic high island, roughly triangular in shape, associated with surrounding reefs. The reefs vary in distance from the shoreline from only a few meters at some points to several kilometers in other places, and mangrove swamps surround most of the island. Kosrae is the only state of the FSM that consists of a single island. Its narrow reef flat and lack of outer atolls make it less feasible than some of the other FSM states for the development of mariculture activities. However, with consistent rainfall throughout the year averaging around 500 cm p.a. and ample undeveloped land area, there is a high potential for freshwater aquaculture.

The population of Kosrae in 2010 was 6616 or 6% of the total population of the FSM. Approximately 22% of the population is involved in market-oriented fishing or farming and 26% are in pure subsistence. Real per capita GDP in 2010 was estimated at USD 2398, the third lowest in the FSM.

4.2 Key Kosrae State Government agencies involved in aquaculture development and regulation

- Kosrae Department of Administration and Finance, Overseas Development Assistance (ODA) Office
- Kosrae Department of Resources and Economic Affairs (DREA) – Fisheries Division
- Kosrae DREA – Economic Planning Division
- Kosrae DREA – Trade and Investment Division
- Kosrae Island Resource Management Authority (KIRMA)
- Kosrae Small Business Development Center (SBDC)

4.3 Priority commodities

A list of priority commodities was developed through consultations with Kosrae stakeholders and resource personnel. These were scored by participants on two main criteria: feasibility and impact. Feasibility was defined by how appropriate the technology was for Kosrae and how well the commodity might be grown and marketed. Impact was defined by how widespread the benefits would be and how the commodity would affect local culture, society and the environment.

Table 10. Commodity priorities for Kosrae State

		Impact		
		Low	Medium	High
Feasibility	High			
	Medium		Seaweed Ornamental fish	Corals Giant clams Trochus Sea cucumbers Marine Food Fish Freshwater fish and crustaceans
	Low	Pearls Tilapia	Mangrove crabs Green snail Milkfish Sponges	

4.3.1 Corals and Giant Clam Commodity Development Plan

Giant clams and corals for the marine ornamental trade were both ranked high for impact and medium for feasibility. This is most likely because both commodities are already being farmed on Kosrae, and there is a large private sector exporter (MMME) of both commodities already exporting these commodities.

Immediate actions (1–2 years)

- Develop legislation to support community-based farming.
- Train DREA staff and community members in farming techniques.
- Secure funding for developing the program.
- Design and implement a monitoring program.
- Develop a private sector/public sector partnership with MMME to export the products grown by the communities and provide giant clam seed stock.

In 3–6 years

- Farms will be operating and sustainably producing corals and clams.
- Extension services provided by DREA will be in place.
- DREA will act as a liaison between the community farmers and MMME.

In 7–10 years

- More farms will come on line as demand grows.
- Research and development into more coral species to grow.



4.3.2 Trochus Commodity Development Plan

Trochus was ranked high for impact and medium for feasibility. It is a valuable export product for Kosrae, and the DREA Fisheries Division manages periodic harvests.

Immediate actions (1–2 years)

- Collect data on previous harvests.
- Identify areas for restocking and develop restocking methods.
- Develop a private sector/public sector partnership with MMME to use tank space for spawning and grow out of trochus seedlings.
- Secure training for propagation and reseeding methods.
- Secure funding for rearing of trochus.

In 3–6 years

- Develop a management plan that includes aquaculture of trochus.
- Develop legislation and regulations for the activities.
- Monitor success of restocking activities and adjust sites and methodologies where necessary.

In 7–10 years

- Trochus harvests are larger and restocking continues annually.

4.3.3 Sea Cucumber Commodity Development Plan

Sea cucumbers were ranked high for impact and medium for feasibility. This commodity is also the focus of a valuable export fishery for Kosrae State.

Immediate actions (1–2 years)

- Conduct a survey to identify which species in Kosrae could be cultured.
- Collect data on previous harvests.
- Identify areas for restocking efforts.
- Conduct a restocking feasibility trial using sea cucumbers obtained from the land grant hatchery in Pohnpei.
- Obtain training in restocking and propagation methods.
- Secure funding for restocking efforts.

In 3–6 years

- Evaluate success of the program.
- If successful, consider construction of hatchery in Kosrae.
- If not successful, evaluate why and consider ending aquaculture efforts and focusing only on fishery management.
- Develop sea cucumber management plan incorporating aquaculture.

In 7–10 years

- Maintain sea cucumber restocking efforts.
- Conduct review of project and amend where necessary.

4.3.4 Marine Food Fish and Milkfish Commodity Development Plan

Marine food fish and milkfish (*Chanos chanos*), as a local food source, were ranked high for impact and medium for feasibility. The focus of culturing this commodity would be for food security and later on for local and/or interstate sale.

Immediate actions (1–2 years)

- Conduct feasibility study on what species might be sustainably collected and how many fry may be harvested annually.
- Provide training on collection techniques, farming techniques and small business management for communities and fisheries staff.
- Identify and secure funding.
- Understand and document permitting procedures.
- Conduct pilot collection and grow-out project.

In 3–6 years

- Initiate and replicate community farms.
- Seek marketing assistance for local sales and possibly export.
- Consider options to construct a hatchery on Kosrae.

In 7–10 years

- Farms are operating sustainably.
- Consideration is given to establishing larger, commercial-scale milkfish farming at this point.

4.3.5 Indigenous Freshwater Fish and Crustacean Commodity Development Plan

This commodity was introduced during the group consultations and was selected as a priority commodity with the same ranking as the marine food fish and milkfish commodity. This group would include, but not be limited to, the locally named flat fin, catfish and mudfish and also the indigenous freshwater prawn (*Macrobrachium* spp.).

Immediate actions (1–2 years)

- Conduct feasibility study on what species might be sustainably collected and how many fry may be harvested annually.
- Provide training on collection techniques, farming techniques and small business management for communities and fisheries staff.
- Identify and secure funding.
- Understand and document permitting procedures.
- Conduct pilot collection and grow-out projects.

In 3–6 years

- Initiate and replicate community farms.
- Seek marketing assistance for local sales and possibly export.
- Consider options to construct a hatchery on Kosrae.

In 7–10 years

- Farms are operating sustainably.

4.3.6 Mangrove Crab Commodity Development Plan

This commodity received only a medium impact and low feasibility ranking, but during the group consultation it was decided it should remain a priority commodity for Kosrae. This species was the subject of some years of research and development in Kosrae, and a mangrove crab hatchery was operational on the island for some time.

Immediate actions (1–2 years)

- Conduct a comprehensive review of successes of mangrove crab farming in the Pacific.
- Conduct a feasibility study for Kosrae, including a review of current regulations.

- Encourage private sector investment in the commodity for establishment of a hatchery if feasibility study looks promising.

In 3–6 years

- Support private sector investor by locating sources of feed through fish processing, identifying and training local community-based farmers, and sourcing more durable supplies.
- Seek outside assistance to support farming efforts.
- Ensure that there are regulations to prevent unnecessary environmental damage.

In 7–10 years

- Increase the number of community-based farmers.
- Continue extension and training efforts with farmers.



4.4 Challenges to the development of aquaculture in Kosrae State and strategies for success

During consultations, participants were asked to list broad challenges to the success of aquaculture in Kosrae. The results of these consultations are shown in Figure 9.

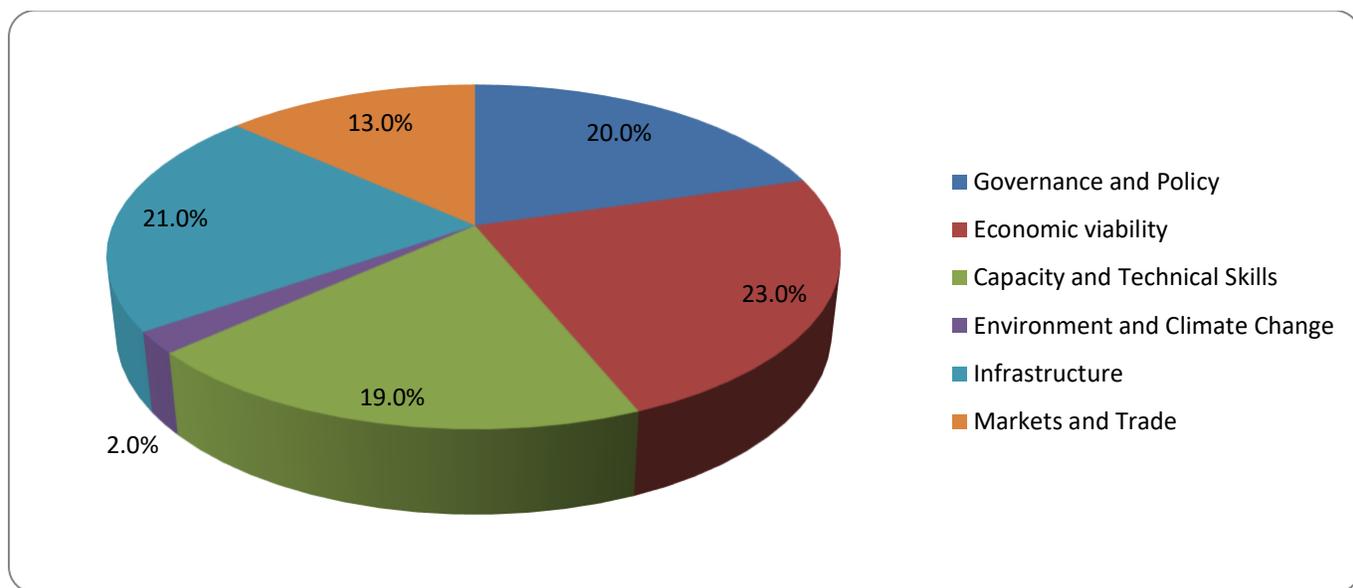


Figure 9. Challenges to successful aquaculture development for Kosrae State as prioritized by respondents during consultations (98 responses in total).

4.4.1 Economic viability

This thematic area garnered the most responses as a major challenge to successful aquaculture in Kosrae. In particular, 17% of respondents felt access to funding was a limiting factor.

Table 11. Strategies to overcome economic viability challenges in Kosrae State

Objective 1: Well-trained stakeholders that have the ability to access and mobilize funds for aquaculture projects.			
Priority: Very high (17% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Provide training in grant writing for community and relevant government personnel.	DREA, community members, KCSO, SPC, SBDC	More farmers are accessing funding	1-3 years
Identify and document all available sources of funding.		List is completed of available funding sources, including banks and granting agencies	1-3 years
Initiate pilot demonstration projects.		Pilot projects are initiated and are successful	1-3 years
Replicate projects within 4 communities.		Projects are initiated in the 4 communities	4-10 years
Improve sustainability of projects.		Farms are able to run successfully without further	4-10 years

		grants or loans and also comply with all environmental regulations	
Continue to provide business, grant writing and basic aquaculture assistance to farmers.		New farmers continue to access funding to start farms	4–10 years
Objective 2: Conduct feasibility studies for aquaculture projects prior to initiation on a case-by-case basis.			
Priority: Medium (5% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Identify local and outside agencies who can provide assistance in assessing feasibility studies.	DREA, SBDC, SPC, MERIP	A list of people or agencies who can provide assistance in assessing feasibility studies is completed	1–3 years
Identify Kosrae State Government positions/personnel who would need to review any feasibility assessments and set up a review board or committee.	DREA, KIRMA, Kosrae State Legislative Counsel	Committee or review board is appointed	1–3 years
Develop a framework for determining the complexity of feasibility assessment that will be required depending on the size of the project (i.e. large commercial projects may require a more complex feasibility study than smaller, community-based projects).	DREA, KIRMA, Kosrae State Legislative Counsel	Framework is completed	1–3 years
Conduct feasibility assessments on a case-by-case basis.	DREA, assessment committee	Aquaculture projects are more economically and environmentally sustainable. Regulations and processes are fair and promote development while protecting the environment	3–10 years

4.4.2 Capacity building and technical skills

Lack of human capacity and technical knowledge was ranked as the second-biggest challenge to successful aquaculture development in Kosrae, with 14% of respondents prioritizing this challenge.

Table 12. Strategies to overcome capacity and technical skills challenges in Kosrae State

Objective 3: Increase the capacity of stakeholders to access funding for aquaculture.			
Priority: High (14% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Enlist SBDC to work with farmers to put together funding packages for the banks.	DREA, community members, SBDC, lending agencies	Both farmers and lenders are better educated on aquaculture loaning practices	1–3 years
Conduct business planning training with potential farmers.	DREA, community members, SBDC	Farmers are better trained to access loans for aquaculture development. More farms are started	1–3 years

Provide information to banks on aquaculture project feasibility.	DREA, SBDC	Lenders are better informed regarding feasibility of different commodities	1–3 years
Assess capacity of grant writing assistance on Kosrae.	Overseas Development Agency (ODA) and DREA	Better understanding of who can assist with grant writing in Kosrae	1–3 years
Conduct grant-writing workshops for stakeholders.	ODA or outside assistance	Stakeholders are better able to apply for grants	1–3 years
Identify and document all available sources of funding.	DREA	List is completed of available funding sources, including banks and granting agencies	1–3 years
Undertake mid-term assessment of success in coordination with DREA strategic development plan review.	DREA	Understanding of where to improve the process	5 years
Repeat trainings and updated list of assistance/funding providers.	DREA	Increased uptake and success in finding funds for stakeholders	Annually (years 3–10)
Objective 4: Increase capacity of stakeholders to assess the feasibility of aquaculture projects.			
Priority: High (14% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Request SPC to organize workshops on assessing the environmental and economic feasibility of aquaculture projects.	DREA, SPC, communities, KIRMA	Government, private sector and communities are trained on assessing aquaculture projects	1–3 years
Assess specific training both locally and overseas that would increase DREA Fisheries Division staff capacity in assessing aquaculture feasibility.	DREA	Government fisheries employees are better trained in assessing aquaculture feasibility	1–10 years
Use information gained from training to train community members, NGOs and private sector on assessing feasibility of aquaculture.	DREA	Farmers and assistance providers are better able to assess aquaculture. More feasible projects are attempted and more farms succeed	1–10 years
Objective 5: Increase the technical capacity of stakeholders in aquaculture techniques.			
Priority: High (14% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Organize or seek training for DREA Fisheries Division staff on aquaculture techniques for specified priority commodities.	DREA, MERIP, MMME, SEAFDEC, JICA, OFCF, SPC, SBDC, ODA	Fisheries staff are fully trained in necessary aquaculture techniques	1–10 years
Use information gained from training to train community members, NGOs and private sector on aquaculture techniques.	DREA, SBDC	Farmers and assistance providers are better able to conduct aquaculture. More feasible projects are	1–10 years

		attempted and more farms succeed	
Work with Kosrae DOE and COM-FSM to incorporate aquaculture into curricula and training.	DREA, COM-FSM, DOE	Students learn about aquaculture early in their careers and understand the basics of operations	1–3 years

4.4.3 Markets and trade

Marketing in general, and in particular poor local and export marketing, was classified as a major obstacle by 13% of respondents.

Table 13. Strategies to overcome marketing challenges in Kosrae State

Objective 6: Improvement of trochus and sea cucumber export marketing.			
Priority: High (13% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Assess restructuring harvest regulations to make it more continuous while sustaining harvest yields.	DREA, KIRMA	Harvesters receive more regular income on a monthly and yearly basis	1–3 years
Revisit regulations relating to buyers of these commodities to try and ensure more income from the fishery remains in Kosrae.	DREA, KIRMA, Department of Justice	Farmers earn more per unit and export income is better retained in Kosrae and FSM	1–3 years
Train Kosraean private sector in markets and marketing of these commodities through exchange visits and trade shows.	DREA, private sector, SPC	Kosraean businesses are better able to compete for export licenses for these commodities	1–3 years
Objective 7: Improvement of local and export marketing of aquaculture products.			
Priority: High (13% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Conduct training for private sector in entrepreneurship, local marketing, overseas marketing and general aquaculture techniques.	DREA, SPC, ODA, SBDC	Private sector companies are better prepared to enter into aquaculture ventures and to successfully export their products	1–3 years
Seek outside training experiences for private sector individuals in export and local marketing.			
Commission an outside study to assess physical, legislative and regulatory bottlenecks to local sales and export of aquaculture products.	DREA	Hindrances to successful aquaculture export and local sales are identified	1–3 years
Work with necessary branches of the government to relax export and local marketing laws and regulations for Kosrae.	DREA, KIRMA, legislature	Businesses and farmers are more easily able to export or market products locally	3–10 years

4.4.4 Infrastructure

Poor infrastructure, in particular poor and expensive transportation and access to feed, equipment and supplies, was listed by respondents as a major obstacle to the

development of aquaculture in Kosrae. The need for an aquaculture facility was cited as important by only 3% of respondents.

Table 14. Strategies to overcome infrastructure challenges in Kosrae State

Objective 8: Improve standard and cost of transportation.			
Priority: High (10% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Assess areas where transportation is a bottleneck to aquaculture development.	DREA	A clear idea is obtained of where to focus efforts to improve transportation	1-3 years
Research alternative means of transportation such as sea freight.	DREA	Farmers are better able to export products from Kosrae	1-3 years
Negotiate for reduction in air freight charges and increase in space available for aquaculture export products.	DREA, legislature, governor's office	Farmers are better able to export products from Kosrae	3-7 years
Objective 9: Improve access to feed, equipment and supplies for aquaculture.			
Priority: Medium (7% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Carry out a needs assessment on supplies most needed for Kosrae aquaculture.	DREA, stakeholders	Full list of most-needed items is identified	1-3 years
Request some items be placed on Japanese goods and services roster.	DREA	Some necessary items are sourced at no cost	1-3 years
Construct a facility to house incoming aquaculture supplies and equipment.	DREA, overseas donors	Aquaculture feeds, supplies and equipment are properly stored	3-7 years

4.4.5 Governance and policy

While governance and policy was a concern for 20% of respondents during consultations, concerns were spread out over many areas. Two particular challenges were prioritized: improved planning and plan implementation (6% of responses), and lack of awareness of aquaculture (6% of responses).

Table 15. Strategies to overcome governance and policy challenges in Kosrae State

Objective 10: Improve awareness of aquaculture within Kosrae State.			
Priority: Medium (6% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Develop a website for aquaculture information for Kosrae State. Link the website to regional and international organizations.	DREA, KIRMA	Knowledge of aquaculture is increased in the public and private sectors	1-3 years
Increase awareness of aquaculture through the media, such as newspaper and radio.	DREA, KVB	More people are aware of aquaculture on Kosrae	1-3 years

Establish collaborations with COM-FSM for raising awareness of aquaculture with students through field visits, classes and guest lectures.	DREA, COM-FSM, DOE, private sector	Youth are engaged in aquaculture and are more aware of its benefits	3-7 years
Objective 11: Improve strategic plan implementation for aquaculture in Kosrae State.			
Priority: Medium (6% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Review existing policies on aquaculture development.	DREA, legislature, KIRMA, SBDC	Full understanding is attained of hindrances to aquaculture development	1-3 years
Develop capacity in implementing aquaculture projects (see Capacity section).	See Capacity section	See Capacity section	1-3 years
Develop framework for feasibility assessments (see Economic Viability section).	See Economic Viability section	See Economic Viability section	1-3 years
Develop appropriate legislation.	DREA	Investment climate is relaxed and projects are less hindered	3-7 years
Undertake a mid-term review of program.	DREA, SPC	Necessary changes to the program are implemented	3-7 years

4.5 Facilities

Only 3% of respondents felt it was necessary to have a dedicated aquaculture facility for Kosrae. Instead, the following strategies are to be employed:

- Request a full-time aquaculture researcher at the Kosrae campus of COM-FSM CRE. This individual could bring in funds to build research and development facilities.
- Collaborate with Pohnpei COM Land Grant hatchery as a source of sea cucumber seedlings for restocking efforts.
- Collaborate with MERIP in Pohnpei.
- Approach OFCF/JICA as a possible source for refurbishing existing but disused facilities.
- Encourage development of private sector-funded facilities, especially for mangrove crabs.
- Collaborate with MMME/NAC for access to giant clam and trochus seed.

5. Pohnpei State Aquaculture Development Plan



5.1 Introduction

Pohnpei State is the capital of the FSM and lies centrally within the country. The state is located approximately between 155°E to 161°E longitude and 1°N to 8°N latitude. The main mountainous island of Pohnpei is the largest in the FSM and houses the capital, Palikir. Pohnpei has eight outer atolls, two of which, Ahnt and Pakin atolls, are very close to the main island. Residents of Nukuoro and Kapingamarangi atolls to the far south of Pohnpei Island have Polynesian, rather than Micronesian, ancestry. Pohnpei Island and the outer atolls all have large sheltered lagoons, which are ideal for mariculture. Storm activity in Pohnpei State is significantly lower than its neighbors to the west. Rainfall is approximately 5 m p.a., and there is ample land on the main island for freshwater aquaculture.

Pohnpei State had an estimated population of 34,685 in 2010 and total land mass is 345 km², the highest in the FSM. Real per capita GDP in 2010 was estimated at USD 3163. All submerged lands are owned by the state, and there are also large amounts of state-owned land on Pohnpei Island, giving the government significant control over aquaculture development in the state.

5.2 Key Pohnpei State Government agencies involved in aquaculture development and regulation

- Pohnpei Small Business Development Center (SBDC)
- Pohnpei State Environmental Protection Agency (EPA)
- Pohnpei State Foreign Investment Board
- Pohnpei State Office of Fisheries and Aquaculture (OFA)

5.3 Priority commodities

A list of priority commodities was developed through consultations with Pohnpei stakeholders and resource personnel. These were scored by participants on two main criteria: feasibility and impact. Feasibility was defined by how appropriate the technology was for Pohnpei and how well the commodity might be grown and

marketed. Impact was defined by how widespread the benefits would be and how the commodity would affect local culture, society and the environment.

Table 16. Commodity priorities for Pohnpei State

		Impact		
		Low	Medium	High
Feasibility	High			Sponges Pearls Marine food fish Sea cucumbers Trochus Giant clams Seaweed
	Medium		Corals Mangrove crabs Milkfish	
	Low	Tilapia Post-larval collection and capture		

5.3.1 Sponge Commodity Development Plan

Sponges received the highest ranking and were ranked high for impact and high for feasibility. Two species of sponge occur in Pohnpei State with proven potential for aquaculture. *Cosinoderma matthewsi*, the Micronesian wool sponge, occurs only around Pohnpei Island Lagoon and channels.

Immediate actions (1 year)

- Provide community training for sponge farming focusing mainly on communities not currently involved in sponge farming.
- Explore farm certification with USDA to improve ease of export.
- Identify farmers from Kitti and Sokehs municipalities in Pohnpei and also outer islands of Pohnpei.

In 2–3 years

- Establish new farms in Kitti, Sokehs and outer islands.
- Train farmers.
- Initiate first harvests.
- Expand markets for sponges.

In 3–5 years

- Expand farms to new communities.
- Test outer island farming.
- Increase marketing efforts.
- Link activities to conservation, coastal fisheries and climate change programs.



5.3.2 Black Pearl Commodity Development Plan

Black pearls received the second-highest ranking and were ranked high for impact and high for feasibility. Despite the technical difficulty of pearl farming, there is a long history of this form of aquaculture in Pohnpei.

Immediate actions (1 year)

- Provide additional training to communities already involved in pearl farming.
- Conduct pearl farming workshop in Pohnpei for interested individuals and communities, including the outer islands.
- Select sites and develop management plan for new farms.
- Provide start-up materials for new farms.
- Provide technical assistance in spat collection and hatchery spat production.

In 2–3 years

- Assess progress and provide additional training, especially in seeding and best management practices (BMPs).
- Provide technical assistance in half and round pearl seeding.
- Develop strategies and provide training in value adding and pearl marketing.
- Continue spat production.
- Identify sustainable funding for farming projects.

In 3–5 years

- Train and guide communities toward self-sufficiency in pearl farming.
- Conduct an assessment workshop of pearl farming activities.
- Continue technical assistance.
- Encourage private sector engagement and partnerships in pearl farming.

5.3.3 Marine Food Fish Commodity Development Plan

Marine food fish was ranked high for impact and high for feasibility. There has been some interest in farming marine species such as rabbitfish (*Siganus* spp.) for some time in Pohnpei.

Immediate actions (1 year)

- Select species of rabbitfish for culture through expert consultations and bibliographic research.
- Determine infrastructure necessary to start farming.

In 2–3 years

- Identify funding for a pilot project.
- Identify technical support and assistance for the project.
- Initiate farming activities.
- Conduct capacity building.
- Identify method of seed supply.

In 3–5 years

- Determine marketing strategies – local or overseas markets.
- Undertake project evaluation and improvement.
- Evaluate other species as potential candidates for farming.

5.3.4 Sea Cucumber Commodity Development Plan

Sea cucumbers were ranked high for impact and high for feasibility. This commodity has recently been the focus of research and development, by COM Land Grant, in hatchery and ranching technologies with a view to stock enhancement and export.

Immediate actions (1 year)

- Conduct survey of sea cucumber resources in Pohnpei State.
- Complete and adopt a sea cucumber management plan.

- Develop hatchery and nursery techniques for new species of sea cucumbers.
- Provide workshop on sea cucumber aquaculture.
- Continue research and development efforts for sea cucumbers.

In 2–3 years

- Involve communities in sea cucumber aquaculture, farming and restocking.
- Provide start-up materials and technical assistance to communities for farming.
- Conduct research and development and monitoring of grow-out farms.

In 3–5 years

- Conduct community training on harvesting and post-harvest treatment.
- Provide assessment workshop at end of year 5.
- Assess and adjust OFA sea cucumber management plan.
- Continue technical assistance as necessary.

5.3.5 Seaweed Commodity Development Plan

Seaweed, specifically the commonly cultured *Kappaphycus alvarezii*, was ranked high for impact and high for feasibility. This species has had significant economic impact in other Pacific Island nations such as Solomon Islands, Fiji and Kiribati.

Immediate actions (1 year)

- Conduct bibliographic research on *K. alvarezii*.
- Introduce the species to Pohnpei using a biosecure protocol in a land-based facility.
- Conduct site assessments and determine infrastructure needed to begin farming.
- Install a nursery farm for the seaweed.

2–3 years

- Identify funding for a pilot project.
- Identify and gain support of technical assistance providers.
- Research marketing and processing technologies.
- Begin community-based farming.
- Identify an ethical buyer for seaweed products.

3–5 years

- Continue farm expansion.
- Undertake project evaluation and monitoring.



5.3.6 Giant Clam Commodity Development Plan

Giant clams were ranked high for impact and high for feasibility, probably due to the fact that this commodity has been farmed on Pohnpei in the past.

Immediate actions (1 year)

- Negotiate agreements with MERIP and COM Land Grant to produce *Tridacna maxima* and *Hippopus hippopus* seed.
- Partner with COM Land Grant and MERIP for community engagement for restocking and grow out of clams for export to the aquarium trade.
- Develop a management plan for giant clam restocking.

In 2–3 years

- Continue twice-annual spawning and seed production of clams.
- Initiate permitting process for giant clam farming, collection and export.
- Conduct first restocking and farming trials.
- Monitor growth and survival of clams.
- Continue training farmers and community engagement.

In 3–5 years

- Continue monitoring growth and survival of restocking programs.
- Continue spawning and stock enhancement activities.
- Re-evaluate the management plan.
- Community farming becomes sustainable.

5.3.7 Trochus Commodity Development Plan

Trochus was ranked high for impact and high for feasibility. It is a valuable export product for Pohnpei, and OFA manages periodic harvests.

Immediate actions (1 year)

- Negotiate an agreement with COM Land Grant to produce trochus seed.
- Develop a management plan for trochus reseedling and harvest.

In 2–3 years

- Continue twice-annual spawning and seed production of trochus.
- Conduct first restocking.
- Monitor growth and survival of clams.
- Conduct resource survey in preparation for harvest.
- Engage communities in resource management.
- Continue restocking twice annually.

In 3–5 years

- Continue monitoring growth and survival of restocked trochus.
- Continue spawning and stock enhancement activities.
- Re-evaluate the management plan.
- Conduct periodic harvests based on resource surveys.

5.4 Challenges to the development of aquaculture in Pohnpei State and strategies for success

During consultations, participants were asked to list broad challenges to the success of aquaculture in Pohnpei. The results of these consultations are shown in Figure 12.

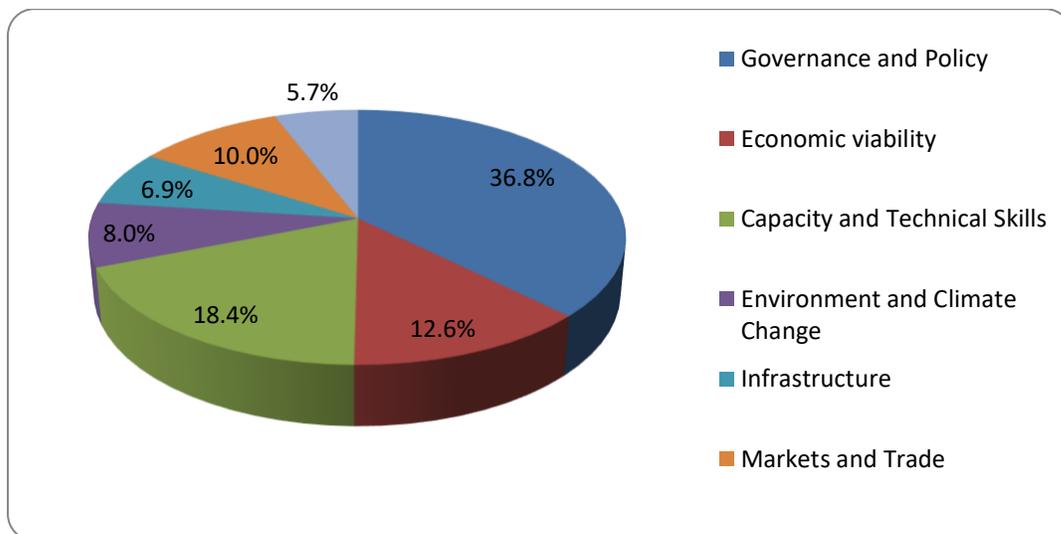


Figure 12. Challenges to successful aquaculture development for Pohnpei State as prioritized by respondents during consultations (87 responses in total).

5.4.1 Capacity building and technical skills

This thematic area was identified as a major challenge to successful aquaculture in Pohnpei. In particular, 16% of respondents felt that the lack of technical capacity was a limiting factor.

Table 17. Strategies to overcome capacity and technical challenges in Pohnpei State

Objective 1: Raise the technical capacity of major stakeholders in aquaculture development in Pohnpei State.			
Priority: High (16% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Identify stakeholders/clients and conduct workshops in Pohnpei and outer islands.	OFA, COM Land Grant, MERIP, CSP, SPC, municipal governments, private sector	Increased interest in aquaculture in Pohnpei	1 year
Undertake economic and technical feasibility studies for shortlisted species.	OFA, COM Land Grant, MERIP, CSP, SPC	Feasibility studies are published	2–3 years
Conduct on-site training in hatchery and farming techniques of identified high-priority species.	OFA, COM Land Grant, MERIP, CSP, SPC	Demonstration sites are established for target species. Farmers and technicians are trained	2–3 years
Develop BMPs for high priority commodities.	OFA, COM Land Grant, MERIP, CSP, SPC	Guidelines for BMPs are published and disseminated	2–3 years
Conduct technical audit of trainees and farmers and adjust aquaculture development plan accordingly.	OFA, COM Land Grant, MERIP, CSP, SPC, municipal governments, private sector	Aquaculture plan is adjusted to meet capacity-building needs of stakeholders	3–5 years

5.4.2 Governance and policy

Governance and policy was considered a challenge by 37% of respondents during consultations, and concerns were spread out over many areas. Three particular challenges were prioritized: poor planning and management (15%), legislation and regulations (13.8%), and awareness and support for aquaculture development (5.7%).

Table 18. Strategies to overcome governance and policy challenges in Pohnpei State

Objective 2. A planning process that results in profitable, environmentally sound aquaculture that benefits all stakeholders.			
Priority: High (15% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Form a committee that includes legislators, communities, NGOs and the private sector who can	OFA, MERIP, CSP, communities, government	Prospective aquaculture projects undergo sufficient	1 year

help to develop a planning process.	representatives, traditional leadership, private sector	due diligence to have a better chance of succeeding	
Compile a list of activities that prospective project applicants must complete in order to ensure economic and environmental suitability (technical, environmental and financial).			
Develop aquaculture projects with the assistance of OFA staff	OFA	Stakeholders better understand the chances of success of their project	2-3 years
Re-evaluate the aquaculture strategic development plan.	OFA, MERIP, CSP, SPC, communities, government representatives, traditional leadership, private sector	Aquaculture projects are more likely to make it past the pilot phase and be profitable and environmentally sustainable	3-5 years
Objective 3: Ensure laws and regulations are sufficient to promote sound and responsible aquaculture development.			
Priority: High (13.6% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Revisit and review existing laws and regulations pertaining to aquaculture development.	OFA, attorney general's office, municipal governments, EPA, foreign investment board	Full understanding is attained of legislative bottlenecks to aquaculture development	1 year
Update existing laws and regulations to incorporate sound aquaculture development and management.		Laws and regulations are updated to promote sound aquaculture development	2-3 years
Have draft laws and regulations reviewed by the legislature.	OFA, attorney general's office, municipal governments, EPA, foreign investment board	Aquaculture is well regulated, promoting business while protecting the environment	3-5 years
Draft bills for approval.			
Implement laws.			
Conduct awareness raising of new laws and regulations.			
Objective 4. Raise awareness of aquaculture among communities, private sector and leadership of Pohnpei.			
Priority: Medium (5.7% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Raise public awareness of aquaculture through radio and TV spots, community meetings, church groups and social media (Facebook or website).	OFA, SPC, CSP, MERIP, COM Land Grant, Chamber of Commerce	General public and private sector are more aware of aquaculture	1 year
Continue awareness raising through radio/TV, community meetings, social media, legislature and traditional conferences.	OFA	General public, legislature and traditional leadership are more aware of aquaculture	2-3 years

Incorporate aquaculture into secondary education science curriculum.	Pohnpei Department of Education, CSP, COM-FSM	Secondary school students are more aware of aquaculture	2-3 years
Work with COM-FSM to train students who take the aquaculture course.	OFA and COM-FSM marine science instructors	Students in tertiary education are more aware of aquaculture	2-3 years
Evaluate the awareness program and make improvements where necessary.	OFA, SPC, FSM R&D	The awareness program is continually improved	3-5 years
Continue with awareness and outreach programs as above.		Pohnpei's public are more aware of aquaculture	3-5 years

5.4.3 Economic viability

Lack of funding for aquaculture development was listed as a major challenge by 12.6% of respondents.

Table 19. Strategies to overcome economic viability challenges in Pohnpei State

Objective 5: Raise the capacity of stakeholders to access funding for aquaculture development.			
Priority: High (12.6% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Identify sources of funding for aquaculture – banks, grants, loans, foreign investment.	OFA, SBDC, FSMDB, other banks, FSM R&D	Stakeholders are aware of where to go to obtain funding	1 year
Conduct a series of workshops with SBDC on starting an aquaculture business (business plans, technical aspects).	OFA, SBDC	Stakeholders are trained on how to apply for funding	1 year
Produce a guideline on starting an aquaculture business and include list of sources of funding and precise list of what is needed to start a business.	OFA, SBDC, FSMDB, other lenders	Stakeholders are aware of where to go to obtain funding	2-3 years
Provide a grant-writing workshop for OFA staff, community members and interested private sector partners.	OFA, SBDC, FSMDB, other lenders	Stakeholders are trained on how to best obtain funds	2-3 years
Provide information on aquaculture investment to lenders.	OFA, SBDC, FSMDB, other lenders	Lenders are better informed about aquaculture	2-3 years
Continue training with stakeholders on obtaining funding to start aquaculture.	OFA, SBDC, FSMDB, other lenders	Stakeholders are trained on how to best obtain funds	3-5 years

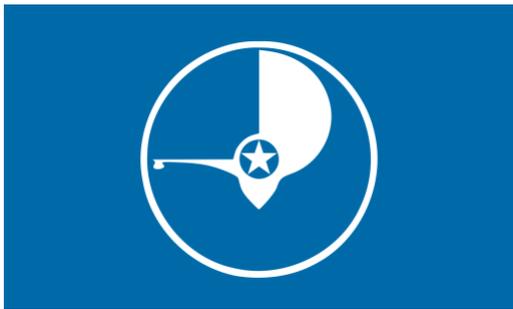
5.4.4 Markets and trade

Markets and trade challenges were identified as a constraint by 10.3% of respondents.

Table 20. Strategies to overcome markets and trade challenges in Pohnpei State

Objective 6: To improve markets and trade of aquaculture products.			
Priority: Medium/High (10.3% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Review existing state and national trade policies.	OFA, FSM R&D, regional partners	Existing trade policies are understood	1 year
Develop a marketing strategic plan for aquaculture products.	OFA, FSM R&D, regional partners	Clear strategies for improving trade and markets are understood	2-3 years
Identify specific markets for aquaculture products.	OFA, private sector growers, Pacific Trade and Invest	Strategic focus on key markets that can help Pohnpei commodities	2-3 years
Produce and disseminate marketing awareness materials for select aquaculture commodities.	OFA, FSM R&D, Pacific trade organizations	Growers and buyers are more aware of trade and market possibilities	3-5 years

6. Yap State Aquaculture Development Plan



6.1 Introduction

Yap State is the western-most state in the FSM. Yap proper comprises four main islands of Yap, Gagil, Tamil and Rumung and is located midway between Guam and Palau. The island of Yap has 10 municipalities that oversee less than 120 km² of shallow-water reef and lagoon and 100 km² of land. There are also about another 134 outer islands, most of which are low-lying atolls. The outer islands stretch eastward for approximately 1200 km between 136°E and 148°E longitude and 6°N and 10°N latitude. The 14 most important outer islands are Eauripik, Elato, Fais, Faraulep, Gaferut, Ifalik, Lamotrek, Ngulu, Olimarao, Piagailoe (West Fayu), Pikelot, Sorol, Ulithi and Woleai atolls. Further outlying municipalities are Satawal and Faraulap. These outer islands have enormous sheltered lagoons with great potential for aquaculture. Due to its proximity to the west, Yap tends to be hit by typhoons more regularly than the states to the east, a detractor for aquaculture. Rainfall is approximately 300 cm p.a., although there is distinct dry season. Yap generally has an excellent environment for conducting aquaculture both on land and in the ocean.

Yap State had an estimated population of 11,376 in 2010, with 66% residing on the main island of Yap proper and 34% on the outer islands. The real per capita GDP in 2010 for Yap was USD 3653, the highest in the FSM. Yap is unique in that it has a fourth branch of government, the customary Council of Chiefs. Yap's customary branch is paramount, as it has a very strong say over custom, behavior and development. The chiefs are considered the upholders of Yap custom and advise the government on matters affecting customs, and resolve problems and disputes in customary ways whenever possible. All submerged lands are also owned by the communities and managed by the chiefs, giving a high degree of discretion to communities regarding activities such as aquaculture.

6.2 Key Yap State Government agencies involved in aquaculture development and regulation

- Council of Chiefs
- Office of the Governor
- Yap Community Action Program (YapCAP)

- Yap Department of Resources and Development – Agriculture
- Yap Department of Resources and Development – Foreign Investment
- Yap Department of Resources and Development – Marine Resource Management Division (MRMD)
- Yap Department of Resources and Development – Transport and Communications
- Yap Environmental Protection Agency (EPA)

6.3 Priority commodities

A list of priority commodities was developed through consultations with Pohnpei stakeholders and resource personnel. These were scored by participants on two main criteria: feasibility and impact. Feasibility was defined by how appropriate the technology was for Yap and how well the commodity might be grown and marketed. Impact was defined by how widespread the benefits would be and how the commodity would affect local culture, society and the environment.

Table 21. Commodity priorities for Yap State

		Impact		
		Low	Medium	High
Feasibility	High		Milkfish	Giant clams Trochus Sponges Marine food fish Sea cucumbers Corals
	Medium		Seaweed Tilapia Post-larval collection and capture	Indigenous species Pearls Mangrove crabs
	Low			

6.3.1 Giant Clam Commodity Development Plan

Giant clams received the highest priority ranking. This is most likely due to the fact that this commodity has been farmed on Yap in the past.

Immediate actions (1 year)

- Conduct a resource survey to determine availability of giant clam broodstock.
- Develop a proposal and plan for restocking and village grow-out efforts and search for funding.

In 2–3 years

- Construct a small multi-species hatchery to include giant clams.
- Begin growing clams at multi-species hatchery at MRMD.
- Conduct restocking/grow-out trials with selected communities.
- Monitor growth and survival.
- Conduct community training and awareness raising program.

In 3–5 years

- Conduct an outer island awareness program to prevent over harvesting.
- Continue clam production and extension program with farmers.
- Initiate ornamental clam farming with communities in conjunction with coral farming.

6.3.2 Trochus Commodity Development Plan

Trochus was ranked high for impact and high for feasibility. It is a valuable export product for Yap, and the MRMD manages continuous harvests.

Immediate actions (1 year)

- Conduct a resource assessment to identify sites for broodstock collection and restocking.
- Develop a proposal and plan for restocking trochus and search for funding.
- Review existing legislation and regulations relating to trochus harvest and export.

In 2–3 years

- Construct a small multi-species hatchery to include trochus.
- Begin growing trochus at multi-species hatchery at MRMD.
- Conduct restocking/grow-out trials with selected communities.
- Involve communities through training in monitoring growth and survival.
- Develop and implement an enforcement program.

In 3–5 years

- Hatchery is continuously operational.
- Enforcement program is continuously operational.
- Trochus harvests are larger and restocking continues annually bringing sustainable income to the communities.
- A management plan for trochus is developed.

6.3.3 Sponge Commodity Development Plan

Sponges were ranked high for impact and high for feasibility. Two species of sponge occur in Yap State with proven potential for aquaculture – *Cosinoderma matthewsi*, in the outer atoll of Ulithi, and the ubiquitous *Spongia matamata*.

Immediate actions (1 year)

- Conduct resource surveys to determine best sites for farming and also for broodstock collection.
- Develop a plan to initiate farming that includes costs, personnel and key communities.
- Research regulations and policies relating to sponge farming.

In 2–3 years

- Apply for and secure funding to begin farming.
- Conduct community training and awareness raising program.
- Initiate pilot-scale farms in selected communities.
- Monitor growth and survival.
- Harvest and test marketing.

In 3–5 years

- Expand farms to new communities.
- Test outer island farming.
- Include farm tours in ecotours.
- Increase marketing efforts.
- Link activities to conservation, coastal fisheries and climate change program.

6.3.4 Marine Food Fish Commodity Development Plan

Marine food fish as a local food source was ranked high for impact and high for feasibility. The focus of culturing this commodity would be for food security and later on for local and/or interstate sale.

Immediate actions (1 year)

- Research available techniques for this kind of aquaculture including materials needed.
- Develop a plan to initiate farming that includes costs, personnel and key communities.
- Research existing policies and regulations relating to fish farming.
- Develop a proposal and secure funding to begin operations.

In 2–3 years

- Conduct community consultations and identify pilot sites.
- Establish one pond and one cage grow-out pilot site.
- Collect wild rabbitfishes to stock the farms.
- Monitor growth and survival.

In 3–5 years

- Develop a management plan for fish farming to include restrictions on wild collection.
- Test local markets.
- Expand farms depending on interest.
- Consider beginning fry-rearing trials using multi-species hatchery.



6.3.5 Sea Cucumber Commodity Development Plan

Sea cucumbers were ranked high for impact and medium for feasibility. This commodity has recently been the focus of some foreign investment in hatcheries with a view to restocking and ranching.

Immediate actions (1 year)

- Conduct a resource survey for sea cucumbers.
- Review the existing management plan for sea cucumbers for Yap.
- Set new quotas for sustainable harvest of sea cucumbers.
- Conduct a community awareness program on sea cucumber harvest and farming.
- Monitor current hatchery operations and plans.
- Establish mechanisms for enforcement of the sea cucumber fishery.

In 2–3 years

- Develop a multi-species hatchery to include sea cucumber farming.
- Implement management plan at the community level, with buyers and exporters and also at exit points.
- Implement enforcement program for sea cucumber fishery.

In 3–5 years

- Restocking program continues.
- Monitoring and enforcement continues.
- Sea cucumber fishery is well managed and providing sustainable income for communities.

6.3.6 Coral Commodity Development Plan

Corals were ranked high for impact and high for feasibility. They would be grown for export to the marine ornamental trade.

Immediate actions (1 year)

- Conduct a feasibility study for coral farming on Yap including markets, freight costs, freight capacity, species present, existing policies and regulations.
- Secure seed funding and grants to begin farming.

In 2–3 years

- Demonstrate farming techniques in selected communities.
- Ensure fair but sound regulations for coral farming and export.
- Establish farms with selected communities.
- Begin buy-back program.
- Develop export station and begin export.
- Implement enforcement program for sea cucumber fishery.

In 3–5 years

- Export becomes stable and sustainable.
- Communities are making income from coral farming activities.
- Coral farming activities are linked to conservation, inshore fisheries and climate change activities.



6.3.7. Mangrove Crab Commodity Development Plan

Mangrove crabs were ranked high for impact but only medium for feasibility due to the complex nature of hatchery rearing and the need for pond or mangrove pen systems for grow out.

Immediate actions (1 year)

- Assess the status of the stocks and the fishery – who the operators are and where the operators are based.
- Propose a study tour to another country (e.g. New Caledonia or Palau) to better understand mangrove crab fisheries and also where aquaculture may play a role.
- Develop further strategies based on these results, putting a priority on sound fishery management rather than aquaculture as a means for optimal production.

6.4 Challenges to the development of aquaculture in Yap State and strategies for success

During consultations, participants were asked to list broad challenges to the success of aquaculture in Yap. The results of these consultations are shown in Figure 15.

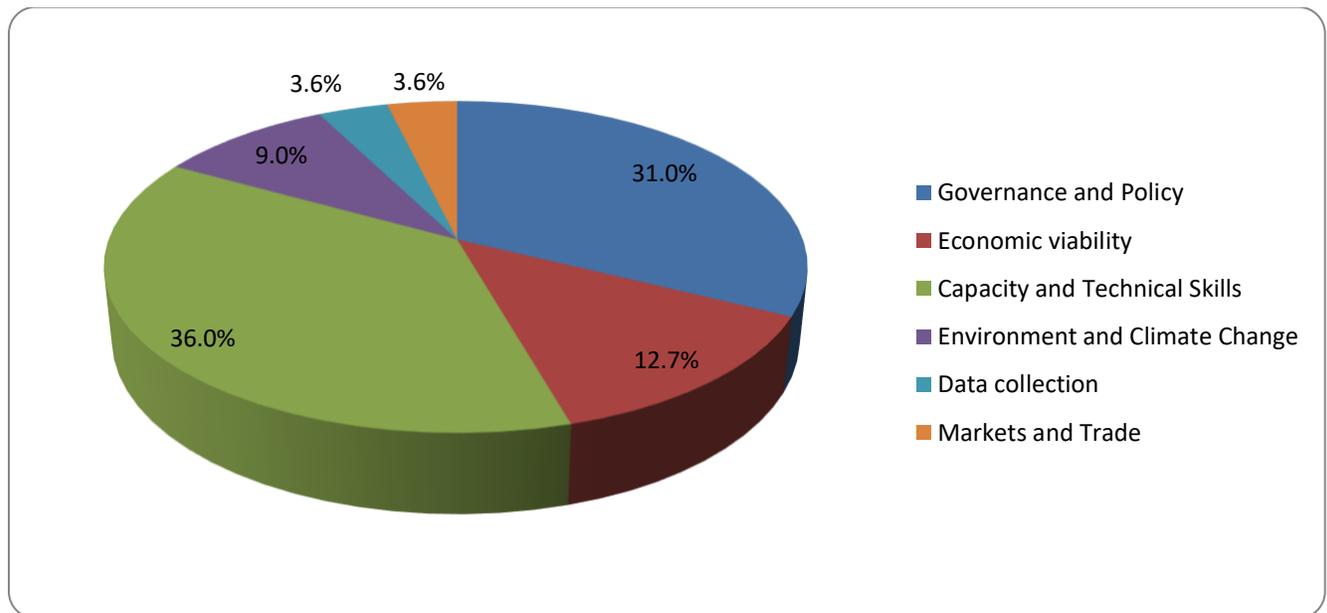


Figure 15. Challenges to successful aquaculture development for Yap State as prioritized by respondents during consultations (55 responses in total).

6.4.1 Capacity and technical skills

This thematic area garnered the most responses as a major challenge to successful aquaculture in Yap. In particular, 22% of respondents felt access to facilities and

hatcheries was a limiting factor and 13% of respondents felt technical assistance and technical skills were limiting.

Table 22. Strategies to overcome capacity and technical challenges in Yap State

Objective 1: Develop, construct and operate a multi-species hatchery at the MRMD.			
Priority: Very high (22% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Source technical assistance on hatchery design.	MRMD, COM Land Grant, communities, SPC	Hatchery design is completed	1 year
Identify partners for technical and funding assistance.			
Develop long-term funding plan.		Funding plan is completed	
Select adequate site.	MRMD, COM Land Grant, communities, SPC	Site is secured	2-3 years
Develop proposal for construction and secure funding.		Funding is secured	
Procure hatchery materials and begin construction.		Construction is initiated	
Hire and begin training hatchery staff.		Staff are hired and trained	
Complete hatchery construction.	MRMD, COM Land Grant, communities	Hatchery is fully operational	3-5 years
Develop operations manual.			
Begin hatchery operations on trochus, giant clams and sea cucumbers.		Juveniles are produced and disseminated to farmers and stock enhancement programs	
Objective 2: Provide aquaculture technical skills training and facilitate access to aquaculture technical assistance for stakeholders in Yap.			
Priority: High (13% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Seek funding for training and technical assistance.	MRMD, JICA, COM Land Grant, MCT, ADB, PIDB, FSMDB	Funding is secured	1 year
Conduct training needs assessment.	SPC, MRMD, COM Land Grant	Needs assessment is completed	1 year
Conduct training workshops and on-the-job training for farmers.	MRMD, COM Land Grant, JICA, UOG	Workshops are completed and farmers trained	1 year
Explore integrating aquaculture into secondary high school curricula.	MRMD, DOE	Aquaculture is integrated into secondary curricula	2-3 years
Provide college-level training in aquaculture.	COM-FSM, UOG, MRMD	College-level graduates are trained in aquaculture	2-3 years
Develop scholarships for aquaculture.	COM-FSM, MRMD	Scholarships are made available to eligible students	2-3 years

Develop a public-private sector partnership for on-the-job training.	MRMD and private sector	Interns are trained in practical aquaculture	2-3 years
Continue short-term aquaculture workshops.	MRMD, COM Land Grant	Workshops are completed and farmers trained	2-3 years
Continue with COM-FSM training, internships and workshops.	MRMD, COM Land Grant	Workshops are completed and farmers trained	3-5 years

6.4.2 Governance and policy

Governance and policy was ranked as the second-biggest challenge to successful aquaculture development in Yap, with 31% of respondents prioritizing this challenge.

Table 23. Strategies to overcome governance and policy challenges in Yap State

Objective 3: Improve planning and administration of aquaculture development.			
Priority: Very high (16.4% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible Parties</i>	<i>Measures</i>	<i>Time Frame</i>
Conduct an aquaculture workshop for leaders and decision-makers.	MRMD, SPC	Decision-makers and leaders are better educated on aquaculture topics	1 year
Conduct aquaculture training for communities.	MRMD	Communities have higher awareness of aquaculture	1 year
Conduct outreach using radio/TV and/or website.	Department of Education	General public better understands aquaculture	1 year
Complete strategic aquaculture development plan.	MRMD, SPC and FSM National Government	Plan is complete and disseminated	1 year
Conduct annual review of aquaculture plan.	MRMD and partners	Plan is better adhered to	2-5 years
Research relevant BMPs for key commodities for Yap and adapt them to Yap's cultural and environmental conditions.	MRMD in partnership with SPC and consultant	BMPs are adapted for Yap	2-3 years
Develop an aquaculture demonstration site.	MRMD, COM Land Grant	Hands-on aquaculture trainings	2-3 years
Repeat workshops for leadership.	MRMD	Leaders acquire better understanding of aquaculture	3-5 years
Continue outreach and training for communities.	MRMD, COM Land Grant		
Make an annual report to leadership on aquaculture activities.	MRMD		
Objective 4: Ensure laws and regulations are sufficient to promote sound and responsible aquaculture development.			
Priority: High/Medium (10% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Commission a report on laws and regulations that affect aquaculture, including EPA, historic preservation,	MRMD, YFA with SPC/SPREP	Full understanding of areas that need attention	1 year

foreign investment, water use, biosecurity/border control. The report should recommend who is responsible for the enforcement of regulations.			
Develop a policy framework for feasibility assessment of aquaculture projects, taking into account costs, climate change, environmental impact assessment, source of funds.		Framework developed	
Use recommendations from the report to strengthen state fisheries laws and regulations.	MRMD with state attorney general's office, EPA, Communications and Infrastructure, Foreign Investment office	Laws and regulations are strengthened and structured to support aquaculture development	2-3 years
Conduct outreach to the communities on results and changes.	MRMD	Aquaculture is well regulated, promoting business while protecting the environment	3-5 years
Provide outreach and training with the agencies involved with aquaculture regulation.	MRMD and attorney general's office		
Publish a document on how to start an aquaculture venture in Yap (from community level to foreign investor).	MRMD with SBDC		
Conduct training with enforcement and compliance arm of government.	MRMD and attorney general's office		

6.4.3 Economic viability

Access to funding for aquaculture was specified as a constraint by 9% of respondents.

Table 24. Strategies to overcome economic viability challenges in Yap State

Objective 5: Well-trained stakeholders that have the ability to access and mobilize funds for aquaculture projects.			
Priority: Medium/High (9% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Identify sources of funding for aquaculture – banks, grants, loans, foreign investment.	MRMD, SBDC, YapCAP, SPC, Yap Investment Trust	Stakeholders are aware of where to go to obtain funding	1 year
Conduct series of workshops with SBDC on starting an aquaculture business (business plans, technical aspects).	MRMD, SBDC	Stakeholders are trained on how to apply for funding	1 year
Develop a funding priority list so that incoming funds can be directed appropriately.	MRMD, FSM National Government	MRMD is able to prioritize funding based on need and priority	1 year
Produce a guideline on starting an aquaculture business and include list of sources of funding and precise list of what is needed to start a business.	MRMD with SBDC	Stakeholders are aware of where to go to obtain funding	2-3 years

Provide grant-writing workshop for state-level, communities and interested private sector partners.	MRMD, SBDC and stakeholders	Stakeholders are trained on how to best obtain funds	2-3 years
Provide information on aquaculture investment to lenders.	MRMD and SBDC	Lenders are better informed about aquaculture	2-3 years
Continue training with stakeholders on obtaining funding to start aquaculture.		Stakeholders are trained on how to best obtain funds	3-5 years
Update funding priority and source lists.			

6.4.4 Environment and climate change

Table 25. Strategies to overcome environment and climate change challenges in Yap State

Objective 6: Climate change adaptation methods are incorporated into future aquaculture activities.			
Priority: Medium/High (9% of respondents prioritized this challenge)			
<i>Activities</i>	<i>Responsible parties</i>	<i>Measures</i>	<i>Time frame</i>
Obtain training on climate change and aquaculture	MRMD, GIZ/SPC, FSM National Government climate change specialists	MRMD staff are trained in climate change adaptation for aquaculture activities	1 year
Identify priority adaptations based on priority commodities and priorities of the state objectives, to be reflected in state-level action plans (JNAP).			
Raise awareness of climate change with communities becoming involved with aquaculture.		Communities are more aware of climate change in aquaculture	1 year
Work with councils, communities, EPA and C and I to help mainstream climate change adaptation into aquaculture construction.	MRMD and partners	Climate change is considered in all actions relating to aquaculture	2-3 years
Ensure climate proofing of hatchery planning and construction.	Hatchery designers with MRMD, GIZ/SPC, FSM National Government climate change specialists	Hatchery will be resilient to climate change-related events	2-3 years
Continue raising awareness of climate change with communities becoming involved with aquaculture.	MRMD	Communities are more aware of climate change-related events	2-3 years
Try to ensure climate-resilient species are used in aquaculture.	MRMD, SPC	A list of relevant species or strains is used in selecting aquaculture commodities	2-3 years
Improve planning for climate adaptation in aquaculture.	MRMD	Aquaculture ventures are more climate resilient and are more likely to succeed	3-5 years

6.5 Facilities and staffing

As part of the challenge identification process, facilities and the need for a hatchery were identified as high priorities for the state of Yap. The strategy to fulfill this need is outlined in Objective 1 (Section 6.4.1). Additional information relating to the hatchery is as follows:

- Two full-time hatchery staff will need to be employed and trained.
- The hatchery will be designed and constructed for the rearing of trochus, giant clams, sea cucumbers and, subsequently, marine food fish.
- Operational cost for the hatchery will be approximately USD 35,000 p.a.

In addition to having its own hatchery as a source of seed stock, MRMD may collaborate in the following ways to meet seed stock needs:

- Request a full-time aquaculture researcher at the Yap campus of COM-FSM CRE. This individual could bring in funds to build research and development facilities.
- Collaborate with Pohnpei COM Land Grant hatchery as a source of sea cucumber seedlings for restocking efforts.
- Collaborate with MERIP in Pohnpei as a source of seed stock.
- Encourage development of private sector-funded facilities, especially for sea cucumbers and giant clams.
- Collaborate with Palau Mariculture Demonstration Center as a source of trochus and giant clam seed.

7. Appendix. Key agency contacts

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