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1st SPC Aquaculture Meeting

Building Capacity for Aquaculture in the Pacific

Suva, Fiji Islands

11-15 March 2002



Secretariat of the Pacific Community Noumea, New Caledonia



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Acknowledgement

The 1st SPC Aquaculture Meeting brought together aquaculture advisers from Pacific Community member countries and territories with representatives of research and development institutions in the region, and Pacific aquaculture enterprises. The University of the South Pacific and the WorldFish Center assisted the SPC in organising the meeting. The meeting facilitator, A.T.A. Healey, also prepared the report. Funding for meeting was provided by SPC and ACIAR.

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EXECUTIVE SUMMARY

The primary purpose of the 1st SPC Aquaculture Meeting was to develop a regional shortlist of aquaculture commodities with the greatest development potential, and to highlight needs for aquaculture assistance.

The specific objectives of the meeting were to:

- Develop an understanding of the status of and potential for aquaculture in the Pacific.
- Assess the need for regional assistance in establishing and promoting various aquaculture commodities.
- Develop a strategic action plan for the implementation of SPC's Aquaculture Programme.
- Provide a basis for development of a regional technical network for supporting national aquaculture programmes.
- Provide the basis for developing regional training in various aquaculture professions.

The meeting was conducted as an interactive workshop, using a small group visualisation technique to ensure the opportunity for full participation by delegates.

The meeting assessed the main features, advantages and potential of the region's aquaculture sector, and determined impediments and constraints to achieving national aspirations with respect to aquaculture development.

Meeting participants assessed 17 aquaculture commodities against two major criteria:

- Potential impact (comprising potential benefits and the suitability of commodities to the Pacific).
- Feasibility (comprising capacity to access and deliver information and technology, and capacity of countries to utilise the information and technology).

As part of the process, a list of key factors to be addressed in assessing each commodity against the various criteria was developed.

The meeting agreed that the priority commodities for the region were coral, giant clam, macrobrachium, milkfish, pearl oyster, sea cucumber, seaweed and tilapia.

Participants developed the components of a strategic action plan for implementing SPC's Aquaculture Programme. Participants worked in small groups that focused on one of the agreed priority commodities. These small teams addressed a number of issues, including: lessons from the past; major issues to be resolved; principles; objectives; deliverables; country focus; teams; communication strategy; what has to happen to establish the commodity in the Pacific; and actions for the next three years.

A number of important points were made during the workshop in the context of implementing the Aquaculture Programme. These included:

- A commitment needs to be made at the country, institution and/or enterprise level before sending people on training courses, if the training is to be put into practice on the trainees' return.
- There is a need for entrepreneurial skills and business training.
- Before actions are taken to establish the priority commodities it is critical that market and financial analysis be carried out to determine the potential scale of production, cost of production and product specifications of each priority commodity.
- The regional strategy needs to include actions to minimise the threat of disease introduction, and should include preparations for disease control and management in the event of disease incursion or outbreaks.
- There is an urgent need across the region to address policy and legislative imperatives for the successful introduction of priority commodities into the Pacific.
- Country strategies, consistent with the regional strategy, need to be developed in the areas of policy, legislation, and development. It would be useful if country responses use the regional workshop framework, but care should be taken to adapt the criteria and factors to each particular situation. Countries should assemble as much objective information as possible as they address their own priorities. Sharing experiences in the use of the framework and the information collected at the country level would enrich the inter-country learning process.
- The commodity profiles developed for the workshop represent an important resource for the region. These should be revised in the light of information presented at the workshop, and then updated at intervals as experience is gained.

INTRODUCTION

The Secretariat of the Pacific Community (SPC) hosted the 1st SPC Aquaculture Meeting as part of the process of developing a plan of action for implementing SPC's Aquaculture Programme (2001–2004). This programme, funded in part by the Australian development assistance programme though AusAID, arose as a consequence of requests from Pacific Community members. The WorldFish Center (formerly ICLARM) and the University of the South Pacific (USP) cooperated with SPC in the development of a "Strategy for the Continued Development of Aquaculture in the Pacific Region". The strategy, endorsed at the First SPC Heads of Fisheries Meeting in August 2000, is to be implemented by SPC, the WorldFish Center and USP.

A technical visit organised by AusAID in June 2001 to develop a project design document was linked to a joint consultation between SPC, AusAID, the WorldFish Center and the Australian Centre for International Agricultural Research (ACIAR) to explore opportunities for ACIAR and the WorldFish Center to augment the resources available for the applied research component of the project. The applied research component has three parts: a review of aquaculture development and technology for the key species/groups for farming, restocking and stock enhancement; a regional workshop to identify the best species for aquaculture and the research required to complete an assessment of their commercial potential; and implementation of agreed research projects.

The primary purpose of the 1st SPC Aquaculture Meeting was to develop a shortlist of aquaculture commodities with the most potential for the region, highlight needs for aquaculture assistance, and develop a plan of action for the SPC Aquaculture Programme. Funding for the meeting was provided by SPC and ACIAR.

This report outlines the process used for the meeting and provides a summary of the outputs.

MEETING OBJECTIVES

The agreed objectives for the meeting were:

- Develop an understanding of the status of aquaculture and its potential in the Pacific.
- Assess the regional potential of aquaculture commodities and identify priority commodities to receive regional assistance.
- Develop a strategic action plan for SPC's Aquaculture Programme.
- Provide a basis for developing a regional technical network for supporting aquaculture at the national level.
- Provide the basis for developing regional training for aquaculture professions.

MEETING STRUCTURE AND PROCESS

The meeting was structured as follows:

- 1. Opening and welcoming statements.
- 2. Participant introductions and statements of expectations.
- 3. Outline of priority-setting principles.

- 4. Development of a shared understanding of the status and main features of aquaculture in the region.
- 5. Agreement on priority criteria and factors to be considered.
- 6. Development of an understanding of the technical potential of aquaculture commodities.
- 7. Determination of the relative priority of aquaculture commodities for the Pacific.
- 8. Development of a strategic action plan for implementing SPC's Aquaculture Programme.
- 9. Identification and allocation of responsibilities for follow-up action.

More detail regarding the meeting structure and process is provided at the start of each section of the report.

Participants were allocated to small discussion groups to provide a mix of countries, institutions and professional expertise. Group composition was changed to a more specialised commodity grouping once the priority commodities were identified. Participants were provided with some basic rules to help them work effectively in groups:

- Recognise that each person's opinion is valid.
- Take responsibility for contributing and understanding.
- Criticise after providing positive feedback.
- Listen actively; use "and" instead of "but", and enlarge the area of agreement.
- Express yourself concisely.
- Keep to agreed time limits.
- Turn off mobile phones unless absolutely necessary.
- Discomfort zone: issues may arise during the workshop that either cannot be resolved quickly or are not appropriate for the workshop. These issues should be recorded in the "discomfort zone".

The core of the meeting was discussion in these small groups, with the main points arising during discussion being written on small cards. Participants presented a summary of their discussion and their cards were pasted onto paper sheets (in this case two or three sheets of flip chart paper glued together).

MEETING EXPECTATIONS AND ASSESSMENT

Each group was asked to discuss and record what they did and did not want to have happen at the meeting. The main expectations of participants and their assessment of the progress made at the meeting were:

Expectation	ASSESSMENT OF PROGRESS MADE
Understand status of aquaculture in the region	Some progress
Assess priorities for assistance	Some progress
Develop strategic action plan	A lot of progress
Provide basis for developing regional network	A lot of progress
Provide basis for developing regional training	Some progress
Build collaboration/cooperation opportunities	Some progress
Provide information exchange	A lot of progress
Develop workable plans	Some progress
Develop consensus on priorities	A lot of progress
Identify fundamental constraints to aquaculture	Some progress
Have full, constructive, open participation	A lot of progress
Good use of time	A lot of progress

The assessment of progress was made through a very rapid plenary session evaluation. Individual participants may have been more comfortable with an individual evaluation, and the opportunity to make suggestions for improvements to the process.

PRIORITY-SETTING PRINCIPLES AND FRAMEWORK

The following principles were taken into account in designing the priority-setting framework:

- Importance of commitment from the top, in terms of leadership and resources.
- Framework to be consistent with strategic goals.
- Linkage to implementation is important, and should include project development, resourcing, and evaluation (reporting, feedback).
- Principles and framework to be systematic and transparent.
- Process to be open, credible, critical and participative.
- Importance of sense of ownership by key staff.
- Stakeholder and peer involvement partners, collaborators, clients.
- Framework should be simple, easy and inexpensive to use, independent of structure and not threatening to staff.
- Should provide a rationale and quantitative back-up to decisions.
- Needs to reflect total investment.
- Has to be adapted as organisations develop.

Implementation is important; it is better to begin the process and learn from the experience rather than worrying about whether or not it is academically perfect.

More specific principles about priority setting include:

- Consider areas of aquaculture development easily related to the benefits of research (the purpose) not disciplines.
- Areas are: mutually exclusive, collectively exhaustive, consistently based, forward looking, manageable in number.
- Criteria are independent.
- Criteria used should consider:
 - The potential economic, environmental, social, institutional benefits linked to livelihoods, food security, the environment and research self-sufficiency
 - The context within which products and services will be used
 - The state and availability of research tools and techniques
 - The availability of skills and infrastructure
- Importantly, priorities are relative; projects which have lower priority areas have a greater range of selectivity, as illustrated below.



Selectivity of investment

Commodities to prioritse

The commodities chosen for priority consideration at the meeting were:

Abalone Carp Coral Freshwater shrimp Giant clam Grouper

Larval fish Milkfish Mud or mangrove crab Pearl oyster Penaeid prawn Rock lobster Sea cucumber Seaweed Sponge Tilapia Trochus

Participants suggested a number of other commodities that might be assessed at some future time. These were:

Green snail	Frog	Polyculture
Mangrove oyster	Snail	Freshwater ornamentals
Pacific oyster	Crayfish (Procambarus)	
Eel	Silk worm	

The relative priority of various commodities was determined to be a function of two factors: the potential of a commodity to make a positive impact in the region, and the feasibility of successfully developing the commodity. The following framework and criteria were agreed to.

Priority framework



• Criteria

Potential impact:

- Potential benefits to the Pacific Economic, environmental, social, and capacity enhancement benefits deriving from successful introduction
- Suitability for the Pacific Technical and cultural suitability of commodities for establishment in the Pacific

Feasibility:

- Capacity to access and deliver required information Availability of information, technology and resources to SPC, associated institutions and member countries
- Capacity of countries to utilise information The capacity of Pacific countries to utilise the information provided

Factors to be considered

The meeting reviewed a number of possible factors that might be used to assist determining the relative priority of each of the commodities. Participants developed the following list of factors, realising that experience gained in using them would lead to a more refined set for future use:

• Potential impact factors

Potential benefits

- Who shares the benefit
- Impact on community development and culture
- Environmental impact (catalyst for raising environmental awareness)
- Provides managers with tools to reduce pressure on wild stocks, rebuild fisheries and enhance stocks
- Opportunities for remote/rural development
- Opportunities for employment, especially for women

• Feasibility factors

Capacity to access and deliver

- Availability of skills
- Extent of concern among member countries about sharing information
- Extent to which SPC can provide the adaptation required
- Availability of relevant expertise from within or outside the region
- Levels of common interest for regional cooperation (market intelligence, technology transfer), extent of shared ownership of information
- Sufficiency of time frame(up to 10–15 years)
- Ability to promote strong networking among NGOs to broaden "intellectual" resource
- · Ability to obtain and channel funding

Suitability to the Pacific

- Existence of established markets for identical or similar products domestic and export, commercial aquaculture
- The product value/unit weight
- · Level of capital investment required
- Applicability of current technical knowledge regarding materials, labour, and seed stock
- Site availability
- Economic and social suitability
- Level of management and maintenance needed
- Cost of feeding inputs
- · Perishability of product
- Time to harvest

Capacity to utilise

- Cooperation between countries
- Country commitment and support
- Capacity to utilise information (manuals etc.) where available
- Extent of government support for donors
- Extent of in-country expertise
- Extent of in-country infrastructure
- Extent to which appropriate legislation and policies are in place
- Private sector demand for information (factor added during discussions)

UNDERSTANDING THE STATUS OF REGIONAL AQUACULTURE

This session sought to develop a shared understanding of the present status and main features of aquaculture in the Pacific. Country representatives had previously been requested to develop country profiles. Drawing on information in the country profiles, country representatives were asked to briefly outline:

- The main features of the aquaculture sector in their country
- National aspirations for the sector
- Overview of the value and trends of aquaculture production
- · Main uses of and markets for aquaculture products
- Major advantages of and potential for aquaculture
- Most important impediments and constraints to achieving national aspirations

Countries able to present were: American Samoa, Cook Islands, Fiji Islands, French Polynesia, Guam, Kiribati, Nauru, Palau, Papua New Guinea, Samoa, Tonga, Tuvalu and Vanuatu. The Federated States of Micronesia (FSM) and the Marshall Islands were unable to attend the workshop. A country presentation by FSM was later provided.

Brief group discussions followed each block of three presentations, to enable participants to note what had struck them as particularly significant about the aquaculture sector in each of the countries.

Following the presentations, participants discussed and consolidated their observations regarding the main features of the aquaculture sector, most important aspirations for the sector, major advantages of and potential for aquaculture, and the most important impediments and constraints to achievement of national aspirations.

Main features of the aquaculture sector in the region

- Production is relatively low compared to other regions. In terms of value of production it is dominated by pearls, with other commodities farmed only at a small scale. The number of people engaged in the sector is small. There is little stock enhancement activity.
- The Pacific region has long transport distances and high relative costs.
- The primary export commodities are pearls and seaweed. Primary contributions to food security are made by carp, tilapia and giant clams.
- Individual countries have tried many species (most of them introduced), but there have been a high proportion of failures and few success stories. It is likely that too many aquaculture development objectives are being pursued.
- Most development has occurred through government agencies, with massive assistance from aid donors.
- Most countries lack regulations, which results in a lack of secure access for the very few private companies involved in the sector.
- There are few alternative sources of income for individuals in many rural regions.
- Although the large high island nations have a greater range of aquaculture activities, many Pacific islands have a large area of clean, sheltered seawater, and high biodiversity. About 70% of land and reefs remain under customary ownership.

Most important aspirations for the sector in the region

- Provide opportunities in income and livelihoods, food security, rural development and employment, import substitution, and foreign exchange, as well as reducing pressure on and helping to restore capture fisheries.
- Provide education at all levels and practise environmentally friendly aquaculture.
- Meet the needs of industry and market; activities are legislated and aspire to quality improvement.
- Controls are in place on the introduction and movement of aquatic organisms.

Major advantages of and potential for aquaculture in the region

- Healthy fresh product that can provide food security.
- Aquaculture encourages conservation and resource management, and supplements natural resources.
- Reduces foreign exchange outflow and provides local employment.
- Ready markets exist (both local and export) with a high demand for seafood in northern nations.
- Pristine, disease-free environment and good water quality both fresh and salt water can be used to promote the sale of aquaculture products.
- Technical expertise is available through regional institutions (USP and SPC).
- Aquaculture industry is not overly large and unwieldy, and has reasonably low labour costs.
- Transfer of established technology and techniques is cheaper than new research.
- Aquaculture is attractive to indigenous stakeholders and communities. By involving resource users in aquaculture, conflicts between industry and resource users (especially those involved in artisanal fisheries) can be avoided.
- There is a judiciary system established for resolution of disputes land etc.

Most important impediments and constraints to achieving national aspirations

- Frequent failures and lack of success stories impact confidence.
- Governments do not form partnerships from the start (especially with pilot trials), and provide insufficient support for infrastructure development (market, hatcheries, feed mills, finance). There is a lack of continuity, resulting from political instability and ineffective, conflicting and incompatible policies and legislation affecting sites, movement, quarantine, and quality control, which are enforced by different government agencies.
- There is limited technical capacity, a lack of training and expertise (inappropriate training, the lack of hands-on experience, and a lack of extension efforts) and the loss of trained personnel into other areas of government.
- Lack of incentive because of: abundance of wild seafood, historical absence of aquaculture, and widespread access to fisheries.
- Land tenure may limit availability and access to land.
- The lack of a business plan (for commercial species), a lack of analytical capacity and the need to manage/accommodate commodity price cycles.
- Poor motivation of government staff.
- Poor exchange of information regarding research, feasibility, experience, and markets.
- Poor advice for aquaculture development.
- Inadequate donor support for capacity building.

UNDERSTANDING THE TECHNICAL POTENTIAL OF AQUACULTURE COMMODITIES

The purpose of this session was to develop a shared understanding of the technical constraints and the potential for the main aquaculture commodities in the region. A general background for the discussions was provided by an overview of the region's aquaculture potential, including a summary of regional attributes relevant to aquaculture and factors that are likely to inhibit development of the sector. Having agreed on the priority criteria and the factors to be considered when assessing each commodity, participants then reviewed the commodity profiles. This was followed by a presentation that summarised the commodities with particular attention to:

- Primary potential/use.
- Requirements for successful establishment of culture or restocking systems.
- · Current regional and global production status.
- Marketing aspects.
- Particular risks associated with production in the Pacific, including local capacity.



[Prepared by Mark Gervis]

Commodity Summary

Tropical Abalone

Culture requirements and costs

- *Hatchery*: Developed and simple technology. Aquaculture training required. Low invesment. Suits centralised, multi-species facility.
- *Nursery:* Developed technology. High investment. Aquaculture training required. Similar requirements to trochus and sea cucumber.
- *Grow-out*: Ranges from low-cost cage culture to high-cost land based culture. Food type crucial (weed or formulated).

Primary and secondary markets

• Live (premium) or processed (lower return).

Current production status

• Total worldwide production 8000 tonnes; 6500 tonnes of tropical abalone from China and Taiwan.

Main advantages for production in the Pacific

- Linkage with seaweed farms.
- Suitable for family units.

Main disadvantages for production in the Pacific

- Competition from Asian producers.
- Risks with live export.
- High cost of juvenile production.
- Need continuous volume.

Country requirements for successful establishment of culture or restocking system

- Centralised hatchery/nursery (possibly multi-species).
- Evaluation of seaweed as feed.
- Grow-out production development and training.
- Centralised live pack-out and marketing facility.
- Evaluation of air freight capacity and logistics.
- Availability of processing facilities.

Carp

Culture requirements and costs

- *Hatchery*: Developed and simple technology. Aquaculture training required. Low investment. Suits centralised or small-scale facilities.
- *Nursery*: Developed technology requiring some skill. Pond requirement with supplementary feeds.
- *Grow-out*: Developed technology that requires pond area. Integrated animal or crop culture an advantage. Cost dependent on whether farmed extensively or intensively and whether lakes or rivers are available for net culture (alternative is creation of ponds).

Primary and secondary markets

• Domestic consumption and income source. Main decision for farming in the Pacific is whether income or protein is required. Compare with barramundi, tilapia, freshwater prawn.

Current production status

• 44.7% of world aquaculture production or 14.9 million tonnes in 1999.

Main advantages for production in the Pacific

- Cheap source of protein; can be integrated with crops in relevant systems (e.g. rice culture).
- Suitable for family units.

Main disadvantages for production in the Pacific

• Threat to indigenous fish.

Country requirements for successful establishment of culture or restocking system

- Decision on product requirement, needed or not.
- Evaluation of potential areas for culture.
- Assessment of acceptance as a domestic food fish.
- Evaluation as a threat to indigenous species.
- Training requirements for farmers.

Coral

Culture requirements and costs

- Hatchery and nursery: No requirement due to use of coral fragments as seed stock.
- *Grow-out*: Low cost, simple technology that still requires some development to streamline the system; no scuba required is an advantage.

Primary and secondary markets

• Live export to aquarium trade (species choice essential) or dried for curio market.

Current production status

• Pilot scale in Fiji Islands, Philippines, Palau.

Main advantages for production in the Pacific

- Low technology.
- Suits family based production.
- Domestic and export demand.

Main disadvantages for production in the Pacific

• Risks associated with live export.

Country requirements for successful establishment of culture or restocking system

- Technology development and species choice.
- Training requirements for farmers.
- Assessment of airfreight potential.
- Live pack out and marketing facility.

Freshwater shrimp

Culture requirements and costs

- *Hatchery*: Developed and simple technology. Aquaculture training required. Low investment, suits centralised facility.
- *Grow-out*: Developed simple technology that requires pond area. Cost dependent on whether farming extensively or intensively. Integrated animal/shrimp culture feasible.

Primary and secondary markets

- Domestic live, fresh, chilled product for local niche markets.
- Compare with barramundi, tilapia, carp.

Current production status

• 130,000 tonnes in 1999 and growing.

Main advantages for production in the Pacific

- Established in some areas of the Pacific and found to be benign.
- Good income from pond areas.
- Short grow-out period, double cropping.
- Integration with other crops possible.
- Suits family units.
- Local market, especially where significant tourist numbers are present.

Main disadvantages for production in the Pacific

• Necessity to introduce to some areas.

Country requirements for successful establishment of culture or restocking system

- Assessment of potential grow-out areas.
- Training requirements for farmers.
- Evaluation of local market size and accessibility from grow-out sites.

Giant clam

Culture requirements and costs

- *Hatchery:* Developed and simple technology. Aquaculture training required. Low investment, suits multi-species, centralised facility.
- *Nursery*: Developed technology requiring some skill. Capital intensive.
- *Grow-out:* Developed, low-cost technology; intensive farming increases capital requirement.

Primary and secondary markets

• Live for aquarium market, frozen meat market for larger animals (stock enhancement).

Current production status

• Commercial production from Micronesia and Hawaii, pilot scale production from various island nations and the Philippines.

Main advantages for production in the Pacific

- Low technology, family based production system.
- High income potential.

Main disadvantages for production in the Pacific

- High cost of juvenile production.
- Risks associated with live export.
- Common marketing required.

Country requirements for successful establishment of culture or restocking system

- Market evaluation required.
- Centralised hatchery and nursery (multi-species).
- Centralised live pack out and marketing facility.
- Evaluation of air freight capacity and logistics and costs.
- Identification of grow-out areas.
- Training requirements for farmers.

Grouper

Culture requirements and costs

- *Hatchery and nursery:* No requirement due to collection of wild juveniles; hatchery technology still to be fully developed.
- *Grow-out*: Developed, medium cost operation. Food purchase necessary. Reasonable aquaculture skills will enhance success.

Primary and secondary markets

• Live for fish market or local niche markets. Supply of juveniles only.

Current production status

• 6000-7000 tonnes p.a., mainly from Asia.

Main advantages for production in the Pacific

• Potential source of juveniles from some areas.

Main disadvantages for production in the Pacific

- Requirement for live pack out facility and fresh freight space.
- High risk in export.
- Highly competitive market environment.
- High volume requirement for live fish transport vessels.
- Food source for fish.

Country requirements for successful establishment of culture or restocking system

- Assessment of source of juveniles.
- Identification of food source and determination of food cost.
- Determination of live air or sea freight capacity.
- Aquaculture training needs.
- Centralise live pack out and marketing facility.

Larval reef fish and invertebrate collection

Culture requirements and costs

- *Hatchery and nursery*: No requirement due to collection of wild juveniles but capture equipment ranges from low to high cost.
- *Grow-out*: Variable dependent on species caught, increased technology and knowledge will increase variety of species able to be grown on. Food requirement variable.

Primary and secondary markets

• Live for aquarium and aquaculture market.

Current production status

• Low production. One company in French Polynesia and pilot project in Solomon Islands.

Main advantages for production in the Pacific

- Potential source of juveniles from some areas.
- Low cost, low technology requirement for some species.

Main disadvantages for production in the Pacific

- Requirement for live pack out facility and fresh freight space.
- High risk in export.
- Knowledge base currently insufficient.

Country requirements for successful establishment of culture or restocking system

- Assessment of source of juveniles.
- Targeting of species of choice and assessing demand.
- Determination of live air or sea freight capacity.
- Aquaculture training needs.
- · Centralised live pack out and marketing facility.

Milkfish

Culture requirements and costs

- Hatchery and nursery: No requirement due to collection of juveniles.
- *Grow-out*: Developed, low cost operation. Reasonable aquaculture skills will enhance success.

Primary and secondary markets

• Domestic consumption and bait.

Current production status

• Large tonnage from Asia. Fiji Islands has 80 ha under culture.

Main advantages for production in the Pacific

- Low cost.
- Suitable for family units.
- Easy to market, a known product.
- Supplies the large tuna industry with a desirable fresh bait.

Main disadvantages for production in the Pacific

- All areas may not have easy access to juveniles.
- Need for pond areas.

Country requirements for successful establishment of culture or restocking system

- Assessment of source of juveniles.
- Assessment of site suitability.
- Aquaculture training needs.
- Determine potential country food and bait demand.

Mud crab

Culture requirements and costs

- *Hatchery and nursery*: Option of either collection of wild juveniles or hatchery production. Larval production difficult.
- *Grow-out*: Technologies still developing for different modes of culture. Medium cost operation. Food use necessary.

Primary and secondary markets

• Live for international or local markets.

Current production status

• Southeast Asia has significant production but becoming constrained by inconsistent crablet catch. Australia has small production.

Main advantages for production in the Pacific

- Existing local markets.
- Low technical requirement for farming.
- No need for refrigeration of harvested stock.
- Suit family units.

Main disadvantages for production in the Pacific

- Requirement for live pack out facility and fresh freight space.
- Food source.

Country requirements for successful establishment of culture or restocking system

- · Assessment of source of juveniles and need for hatchery.
- Identification of food source and determination of food cost.
- Assess local demand.
- Determination of live air or sea freight capacity.
- Aquaculture training needs.
- Centralise live pack out and marketing facility.

Pearl oyster

Culture requirements and costs

• *Hatchery and nursery*: No requirement in most areas due to collection of wild juveniles. Hatchery production expensive, high technical requirement.

• *Grow-out*: Developed, low cost operation. Reasonable skill base required. Pearl production expensive due to operators, need for technical expertise at this stage.

Primary and secondary markets

• International and local for pearls.

Current production status

• Large worldwide production. Japan, Australia, India; black pearl production mainly from French Polynesia (\$165 million) and Cook Islands. Pilot production elsewhere in the Pacific.

Main advantages for production in the Pacific

- Low cost operations.
- Suitable for family groups.
- Non-perishable easily transported product.

Main disadvantages for production in the Pacific

- Need for high quality product, strict quality control imposition.
- High technician cost.

Country requirements for successful establishment of culture or restocking system

- Assessment of source of juveniles.
- Technician funding or training.
- Quality control mechanism.
- Aquaculture training needs.

Penaeid prawn

Culture requirements and costs

- *Hatchery*: Developed technology for low investment (outdoor) or high investment (indoor) hatcheries. *P. monodon* (PM) (only in Fiji Islands, Solomon Islands and PNG) more complex than *L. stylirostris* (LS).
- *Grow-out*: Moderate to high cost, reasonably skilled process with well-developed technology. PM requires brackish water and is more complex than LS.

Primary and secondary markets

• Local niche markets and international "green" frozen markets.

Current production status

• High worldwide production. Limited Pacific production from Fiji Islands and Solomon Islands of PM, LS produced in New Caledonia, French Polynesia and Guam.

Main advantages for production in the Pacific

- High income product.
- Suit varying scales of production.
- Short growth cycle.
- Frozen product.

Main disadvantages for production in the Pacific

- LS needs to be introduced.
- PM limited in range and more complicated.

Country requirements for successful establishment of culture or restocking system

- Introduction of species.
- Identification of suitable areas.
- Aquaculture training needs.

Rock lobster

Culture requirements and costs

- *Hatchery and nursery*: No requirement due to collection of juveniles. Hatchery technology still to be fully developed; will be expensive and technically demanding.
- *Grow-out*: Developed, medium cost operation. Food purchase necessary. Reasonable aquaculture skills will enhance success.

Primary and secondary markets

• Live export market or local niche markets.

Current production status

• >1000 tonne production in Vietnam and Philippines, considerable research effort in Australia.

Main advantages for production in the Pacific

- High income, low cost product.
- Suits small-scale culture.
- Existing high demand market.

Main disadvantages for production in the Pacific

- Requirement for live pack out facility and fresh freight space.
- High risk in export.

Country requirements for successful establishment of culture or restocking system

- Assess market demand.
- Assessment of source of juveniles.
- Identification of food source and determination of food cost.
- Determination of live air or sea freight capacity.
- Aquaculture training needs.
- Centralise live pack out and marketing facility.

Sea cucumber

Culture requirements and costs

• *Hatchery:* Developed and simple technology. Aquaculture training required. Low investment. Suits centralised, multi-species facility.

- *Nursery:* Developed technology requiring some skill. Capital intensive, very similar to methods used for abalone, trochus and green snail.
- *Grow-out*: Methodology tested to release size; limited information on grow-out to harvest size.

Primary and secondary markets

• Dried for export markets.

Current production status

• Experimental in variety of Asian and Pacific countries.

Main advantages for production in the Pacific

- · Ease of export into existing marketing channels.
- Potential polyculture use.
- Probable low cost grow-out mechanism.

Main disadvantages for production in the Pacific

- High cost of juvenile production.
- · Lack of established technology for full term grow-out.

Country requirements for successful establishment of culture or restocking system

- Centralised hatchery and nursery.
- Research into grow-out methodology.
- Training needs.

Seaweed

Culture requirements and costs

- Hatchery and nursery: No requirement due to collection of cuttings as seed stock.
- Grow-out: Developed for some species. Low cost operation.

Primary and secondary markets

• Dried for international marketing.

Current production status

• Largest worldwide aquaculture product, 1000 dry tonnes p.a. from Kiribati, sporadic production from other countries.

Main advantages for production in the Pacific

- Low technology, low cost operation.
- Suits village production.
- Non-perishable nature of product once dried.
- Large potential grow-out areas.
- Benign product.

Main disadvantages for production in the Pacific

- Highly competitive, sometimes volatile market.
- Potentially high freight costs and complicated routing.

Country requirements for successful establishment of culture or restocking system

- Identification of sites through pilot trials.
- Additional research into suitable species and optimum culture methods.
- Determination of sea freight capacity and routing.
- Aquaculture training needs.

Sponge

Culture requirements and costs

- Hatchery: None required. Sponges grown from cuttings.
- Grow-out: Developed, simple low cost grow-out methods.

Primary and secondary markets

• Local niche and international markets.

Current production status

• Low volume commercial production in FSM and research and development programmes in Australia and New Zealand.

Main advantages for production in the Pacific

- Simple grow-out technology.
- Ideal for remote farms.
- Ideal for family production.

Main disadvantages for production in the Pacific

- Marketing of new species.
- Difficulties with extension assistance.

Country requirements for successful establishment of culture or restocking system

- Introduction of species.
- Marketing of product, branding etc. to ensure entry into niche (not commodity) market.
- Central marketing.
- Extension and training needs.

Tilapia

Culture requirements and costs

- Hatchery: Low technology, low cost hatchery.
- Grow-out: Adaptable to a wide range of grow-out systems, extensive and intensive.

Primary and secondary markets

• Local (live, fresh or frozen) or frozen international markets.

Current production status

• High worldwide production. Limited Pacific production from Fiji Islands.

Main advantages for production in the Pacific

- Easy to culture.
- Low cost.
- Easy to market.
- Suitable for small scale systems.

Main disadvantages for production in the Pacific

- Tilapia needs to be introduced into many Pacific Island nations; not a benign fish.
- Stocks need tight management for optimum growth.
- Must be more than 20°C.

Country requirements for successful establishment of culture or restocking system

- Introduction of species.
- Identification of suitable areas for culture.
- Aquaculture training needs.
- Introduction to local market.

Trochus

Culture requirements and costs

- *Hatchery*: Developed and simple technology. Aquaculture training required. Low investment, suits centralised, multi-species facility.
- *Nursery*: Developed technology. High investment. Aquaculture training required. Similar requirements to abalone and sea cucumber, but needs more research to intensify production.
- Grow-out: Juveniles released for stock enhancement (not grown to full size).

Primary and secondary markets

• Established international shell market, potentially lucrative processed meat market. Potential juvenile market in aquarium trade.

Current production status

• Enhancement taking place in various Pacific Islands.

Main advantages for production in the Pacific

- Established fishery and market.
- Simple hatchery and nursery technology.

Main disadvantages for production in the Pacific

- Some need for translocation.
- Tariff mechanism necessary to ensure longevity of hatchery and nursery.

Country requirements for successful establishment of restocking system

- Introduction of species.
- Funding mechanism established.
- Aquaculture training needs.
- Testing of aquarium market.
- Upgrading of nursery and enhancement technology.

ASSESSING THE PRIORITY OF AQUACULTURE COMMODITIES FOR THE PACIFIC

Assessment procedure

The purpose of the session was to agree on those commodities that would receive priority assistance from SPC's Aquaculture Programme (see priority framework criteria, page 5). All groups first discussed <u>potential benefits</u> of all commodities, noting the most important aspects on cards.

Each group was asked to select the five commodities with the highest potential benefits, and the six with the lowest (leaving six as having medium benefit). Ratings were recorded.

All individuals were then asked to score the commodities from 1 to 10, (10 being a high rating), using the group-derived ratings of high, medium and low potential as a guide. Although it was suggested that the commodities rated high should be scored 8-10, the medium commodities 4-7, and the low commodities 1-3, individuals were under no obligation to follow this procedure. Individual scores and table scores were collected before commencing discussion of the next criterion, <u>suitability for the Pacific</u>.

This procedure was followed for each of the remaining criteria, <u>capacity to access and</u> <u>deliver</u> and <u>capacity to utilise</u>.

The Appendix includes figures and tables detailing how the commodities were scored by various combinations of participants.

Discussion of priority results

The following discussion of the priority results is based on the combined individual ratings, with some reference to significant variances, and a brief synthesis of the comments and notes arising from the table discussions. The table notes indicate that many participants were not fully able to differentiate between the four criteria. This is to be expected given that the factors to be considered were generated at the workshop and the group of participants had not been exposed to this priority-setting framework before. The comments reported here are thus confined to potential impact and feasibility.

Abalone

This commodity was rated low for both potential impact and feasibility.

Potential impact. Although the technology is available, a high level of both capital investment and working capital is needed from the private sector for hatcheries and nurseries. Abalone requires intensive production systems and is unsuited to small-scale/community level hatchery based production, thus limiting the scope of beneficiaries. There is a very competitive market and the tropical species are not competitive with Asian production. There is no local market and there is no experience in the region. There is a need for full assessment of the potential in the region. Abalone has an advantage of being able to be cultured with other products such as seaweed.

Feasibility. Information and expertise is readily available, mainly in Southeast Asia. However, there is minimal awareness within the region, and significant research and development and training would be needed. There is no in-country expertise or cooperation between countries; the product lacks government and community support; and there is no legislation or policy in place.

Carp

Overall, carp was rated low for potential impact, but medium for feasibility. The Fiji Islands observers gave a medium rating for both impact potential and feasibility, while the institutions rated it as having medium feasibility.

Potential impact. Carp would mainly benefit rural communities in high island populations who need cheap protein. The species requires simple, low cost technology, has low feed costs and can be integrated with other fish species. It has a short grow-out period of 6-12 months. However, it is largely unacceptable as a food source, and there are potential negative environmental impacts associated with carp introduction.

Feasibility. The regional capacity to deliver is based on the availability of skills in the region, especially in Fiji Islands and PNG, and the capacity for networking and sharing of information (although there is currently little cooperation between countries). SPC can easily deliver, as information is readily available in Asia, requiring only training for the transfer of known techniques. Country commitment is limited to PNG and Fiji Islands, and legislation for fish farming is required. Policies for exotic species management are not in place.

Coral

Although coral was given an overall rating of medium potential impact and feasibility, it was given a high rating for impact potential by the high countries, institutions and the post-graduate students.

Potential impact. Coral is a low technology commodity with a short growth period of 3–12 months that is adaptable to small and remote villages and benefits small-scale growers. High involvement of communities, especially women, provides good opportunities for rural employment. Coral has positive environmental effects, is a catalyst for environmental awareness and resource stewardship, and provides managers with a method for habitat restoration. It is a high value product with available markets and strong demand, but requires market research. Low investment and minimum skills are required and a large number of sites are available. It is difficult to transport domestically, however, and air links are needed. Although very suitable for community scale production coral requires centralised dispatch for aquarium products; involvement of a dispatch or marketing company is essential, which may limit it to localities having a private local aquarium export facility.

Feasibility. Information and expertise is available and there is a common interest among member countries. SPC's role would be limited to low-level training and eco-labelling. Promotion of the need to culture (and not deplete wild stocks) would be required. There is great support from NGOs. Government support exists, but there is a lack of country cooperation, and countries need to implement policies and laws to enable export. Existing legislation may not be appropriate for farming.

Freshwater shrimp

Macrobrachium was rated medium for potential impact and feasibility by all except the countries with low lying landmass (for example atolls) who rated both as low.

Potential impact. High-price product and advanced technology with high potential, but limited to fresh water polyculture. Provides employment, assists rural development and provides opportunities for involvement of women, but benefits mainly accrue to private enterprise. Limited by feed and seed supply. Potential negative environmental impacts on local species, and through competition for fresh water. Useful byproducts (waste). There is strong local and regional demand and commensurate pricing. Established technology, but hatchery is needed. Suitable for high islands; has proven record.

Feasibility. Information and expertise is available in the region and there is strong regional capacity for sharing expertise, although currently there is a lack of information sharing. Training needed but there are low research and development needs. Expertise present in Fiji Islands, New Caledonia and Asia (NACA). SPC has a role in gathering and disseminating information from outside the region, especially Asian research and development results. The technology could be easily transferred between countries; there is a need to educate the government sector in requirements, etc.

Giant clam

This commodity was given a medium rating overall for potential impact and feasibility. The high countries rated it high for both potential impact and feasibility while the private sector rated it low on both criteria.

Potential impact. This is a high value commodity for the aquarium trade and is widely harvested as a subsistence food. It is an established low technology commodity with no negative environmental impact. High community involvement will provide community-level benefits. Although technically feasible, giant clams take a long time to grow, require significant husbandry, have expensive seed production, are vulnerable to poaching, and require restocking. The logistical problems with air freight pose significant market risks. Clams also require central hatcheries which need funding. Giant clams are the most utilised species in the region, but success had been limited, and sustainable management unsuccessful. There are some problems with community level management because of the slow growth, causing long delays before large clams can be harvested for meat.

Feasibility. Information and expertise is available in the region and there is common interest among countries. There are low research and development needs, and SPC's role is limited to facilitation of the training and marketing required. There is limited government support, and countries need policies and laws to facilitate an export trade. Country cooperation exists for sharing of information.

Grouper

This commodity was rated low for potential impact and feasibility by all groups.

Potential impact. Grouper is a commodity in high demand, but although commanding a high price the markets are risky and highly competitive (especially the Asian market). The business requires village collectors for commercial growers, which could jeopardise

replenishment. There is some benefit to small-scale collectors, but most benefit accrues to a handful of entrepreneurs. The species requires high technical and capital inputs, feed supply is not established and there is a long time frame for development. There is a shortage in the supply of young fish, while seed production is difficult or unknown, and culture methods not well established. Successful establishment would reduce pressure on the wild catch.

Feasibility. Information is available from the SPC Special Interest Group bulletin and expertise is available outside the region, especially in Asia. Although there is strong interest among member countries there is an absence of regional skills and capacity for networking. There are high research and development needs but the technology is protected. There is no in-country expertise in finfish hatchery techniques, and government support, legislation and policy is lacking.

Larval fish

Larval fish were rated low for potential impact and feasibility, although institutions and postgraduate students rated the potential impact as medium.

Potential impact. Larval fish have similar benefits to clams and corals. The commodity has high value for the established aquarium trade and is used for stock enhancement. The market for ornamental is controlled. Environmental impact is low; larval fish are a benign way of collecting ornamentals and can help raise awareness of the fish life cycle. There are shared benefits at village level with short but seasonal income cycle and low technology needs, although commercial validation is required. Hatchery technology is available from the US, Southeast Asia, Australia, etc. There is some difficulty in identifying sites for collection, with supply varying between islands. An important advantage is the greater biodiversity of fish in the Pacific.

Feasibility. Information and expertise is available (from the Australian Institute of Marine Science) and there is strong interest among member countries. There is regional capacity to implement with possible assistance from the WorldFish Center. There is limited experience inside the region and at SPC; networking, information transfer and training roles are potentially important. Community acceptability will depend on information regarding suitability. Countries need to implement policies and laws to enable export; more environmental impact assessment regarding harvesting is needed. Availability of private sector expertise is limited.

Milkfish

Milkfish were rated medium for both potential impact and feasibility overall. The private sector, institutions and postgraduate students rated potential impact as low.

Potential impact. Good potential for baitfish for the tuna fishing industry; some demand as food. Broad-based benefits for collectors and growers and good opportunities for remote and rural development and employment. Although technology needs are low it is labour intensive. There are potential negative impacts in converting mangroves to ponds. There is limited space for ponds on small islands. Compatible with existing traditional culture systems. Low technology, but medium capital investment is required; development restricted to areas where wild fry are available.

Feasibility. Information is available in Fiji Islands, Kiribati, etc; hatchery technology is available from SEAFDEC, Philippines, Hawaii and Indonesia. There is strong common interest but information sharing could improve. In-country expertise is available, but there is a need to strengthen government support to assure project continuity.

Mud or mangrove crab

The commodity was rated low for potential impact and feasibility by all except the Fiji Islands observers who rated it medium for both.

Potential impact. This is a high value commodity and successful establishment would reduce pressure on wild stocks. There are direct benefits to growers and coastal collectors of crabs. On-growing of juveniles is beneficial to communities, especially women, in a limited number of countries with high domestic demand. Large operations could affect mangroves. Restocking is possible once hatchery technology is developed. Ease of shipping allows remote communities to participate. There is a good domestic market on high islands. Mud crabs have complicated hatchery techniques. Suitable to the areas in the Pacific with large mangrove areas. More research and development is required to resolve technical problems, particularly for the larval stages. Community acceptance is high.

Feasibility. Information and expertise is available outside region, particularly in Asia. There is limited hatchery expertise. There is a need to collate, interpret and transfer research results from academia to industry. Donor support may be low due to unresolved technical problems, and infrastructure for hatchery production is limited.

Pearl oyster

This commodity was given a medium rating for potential impact and feasibility by all except institutions, who rated the potential impact as high.

Potential impact. This is a high value commodity that is a good export earner. It generates employment and can involve entire communities, generating broad-based economic benefits. There are potential negative disease-related impacts for related organisms near areas of intensive cultivation. Technology for community level grow-out is simple, but technical and marketing issues are critical. Capital and operational costs (seeding, marketing, etc.) are high, and although value/weight ratio is high there is also high price uncertainty. The commodity is non-perishable and easily transported; quality control is imposed to meet the needs of a well-established market.

Feasibility. Information and expertise are available in the region, particularly in French Polynesia and Cook Islands, although much information is not publicly available. There is strong interest among member countries. There is a need for training of local seeding technicians and for cooperation on marketing. There is also a need for an advocacy role with Pacific Island leaders to instill discipline with regards to pearl marketing, properly inform new entrants regarding the industry, and establish Pacific-wide coordination to stabilise prices. Pearl oysters are a high-cost investment, and require development of a business plan.

Penaeid prawn

Although this commodity was rated medium for potential impact and feasibility overall, there was significant variation in scoring between different groups. The countries with low-

lying landmass and institutions rated it low for both potential impact and feasibility while the private sector and postgraduate students rated it medium for potential impact and low for feasibility.

Potential impact. Demand for and value of this commodity are high; it is economically suitable for high islands. Benefits accrue mainly to private commercial owners and labourers (including women), although there may be multiplier effects in countries with good infrastructure. There are potential negative disease-related impacts due to introduction of species, and potential problems due to management practices (soil souring), but it is environmentally benign in mangrove areas. There are excellent high value domestic and export markets but there are also high risks due to high feed costs, the high cost of investment, the moderately complex hatchery techniques and the complex hatchery and disease prevention infrastructure required. It is not suitable for clear water, coral lagoon habitats.

Feasibility. SPC can provide assistance, as much information is available in the region (from New Caledonia, Asia, Australia, etc.); there is strong interest among member countries. Minimal time is needed for information transfer but there are high training needs and it is important that thorough investigation into markets, feeds and disease are undertaken. Country expertise and infrastructure support is high in large island countries where there is tried and tested technology. Legislation for import and for environmental impact assessment for farms is needed.

Rock lobster

Potential impact. There are widespread community benefits (to collectors, growers and middlemen), but there may be high environmental impacts unless there is a post-larvae capture program or hatchery facility. Foraging for feed may affect fisheries. It is a good potential fisheries management tool and would raise environmental awareness. It is a high value product in high demand in most Pacific Islands, but lacks significant export potential. It is a technically difficult commodity to establish: culture methods are not well established; it requires high-cost feed; the seed supply is unreliable; and there are transport problems for live product. The scale of production may be limited by the supply of juveniles.

Feasibility. There is limited information available and available expertise is outside the region. Assistance is difficult to deliver as there is limited information available and more resources and development are required. Regional interest is low as it is in an early stage of development research, and development needs are high. There is no policy for sustainable management of resources and there is insufficient knowledge in the region to assess culture potential and market demand.

Sea cucumber

Sea cucumbers were assessed as having medium potential impact but low feasibility on average, but there was considerable variation between groups. The high countries and institutions gave it a medium feasibility rating, the private sector rated it low for impact potential and medium for feasibility while the Fiji Islands observers and postgraduate students rated it low for both criteria.

Potential impact. This is a traditional high value commodity with extremely good benefits to all sectors of remote communities, and is suitable for community management as it maintains traditional lifestyle. It is useful for stock enhancement in depleted areas; fishermen benefit from increased harvests; impacts on other species are low; and there is a positive impact on spawning biomass. It is a non-perishable high-value product, for which there is high demand; it is easy to process and store. It requires hatchery production and there are problems with mass production; a post-seeding survival bottleneck needs to be solved (requires research and development). Few countries have hatchery facilities for mass production for a restocking program; sea ranching and restocking are yet to be validated.

Feasibility. Good information is becoming available through SPC and the WorldFish Center. Country and donor support is unlikely, however, until reseeding problems are overcome. There is a need for legislation and management advice.

Seaweed

This commodity was assessed to have the highest potential impact for the Pacific and the highest feasibility, although the low-lying countries and the private sector rated the potential impact as medium.

Potential impact. This is a low technology, polyculture commodity that generates employment; remote communities share in the benefits. It has a low cost of production, has a short culture period (6 weeks), is environmentally friendly and improves water quality by absorbing nutrients from human wastes. It is a food source for herbivorous fish (e.g. rabbitfish), and could be suitable for value-adding, if a semi-refined factory was built in the region. Although there are abundant sites, large quantities and regular shipments are needed to maintain product quality and that necessitates supporting infrastructure (specifically transport).

Feasibility. There is strong interest from member countries but there is a need for market coordination and intra-regional exchange of knowledge and information. Assistance is available from the private sector. As a highly feasible, low-cost commodity it is likely to get government support.

Sponge

Sponges were assessed as having low potential impact and feasibility by all except the institutions, who rated it has having medium potential impact.

Potential impact. This is a low technology, non-perishable product that is environmentally benign and has high potential for biochemical production. It is a polyculture, nonlabour-intensive commodity that could be grown with seaweed. It is easy to process and store, has a short culture period but needs massive marketing. There is an opportunity to expand (only one island is currently culturing sponge at present). It is easy to handle and ship, requires low start-up capital and a low level of management. There is no feed requirement, no need for a hatchery, and there is a potential for value-adding. However, there is a need to research markets.

Feasibility. There is strong interest from member countries and case studies exist in region. Surveys are needed to determine species, and common frameworks are required

for movement and transfer (could be facilitated by SPC). In-country expertise is limited and more information on commercial species and their availability is needed. Legislation and national policies have to be in place for bio-prospecting to occur.

Tilapia

This commodity was assessed as having medium potential impact and feasibility overall, although the low countries rated it low for potential impact and the Fiji Islands observers rated it high for feasibility.

Potential impact. This a low technology commodity suitable for polyculture by smallscale subsistence and local commercial producers. There is good impact on rural community development but there is potential negative impact on indigenous species. It is a low cost fish for the local market that has a negative perception in the Pacific. It should be restricted to mono-sex stock. Although feeding is easy there can be a problem with provision of feed. It can be integrated with agriculture and is a productive, low maintenance commodity.

Feasibility. Although abundant information, technology and expertise exist in the region there is limited interest from member countries. There is a need for market research and to update information to be competitive. There is high capacity in the Pacific region to utilise available information and technology (Fiji Islands and PNG), and support is likely in high countries where it now exists. Legislation for introduction of species and management of introduced species must be in place.

Trochus

Trochus was assessed to have low potential impact and low feasibility by all except the countries and institutions, which assessed the feasibility as medium.

Potential impact. There are high cultural and social benefits from this popular target species as there is high community involvement and it helps maintain traditional lifestyles. It is fairly benign environmentally and is used primarily for restocking. Although there is limited commercial application there is potential management of wild stocks. There is a low probability that hatchery produced trochus will assist fisheries management. It is a low market, low value commodity.

Feasibility. There is a long history of development in the region and there is much information available within the Pacific region and Australia. Government support exists but is limited; some country cooperation exists. Hatchery production capacity is high but technical capacity is limited (i.e. in growing juveniles to size (40 mm) for survival in the wild). Regulation and management are needed for aquaculture to be successful. Sea ranching and restocking have yet to be validated; resource management is critical.

Priority result

The scoring process and discussion of the results led to agreement that the priority commodities are: coral, freshwater shrimp, giant clam, milkfish, pearl oyster, sea cucumber, seaweed and tilapia.

STRATEGIC ACTION PLAN

The purpose of this session was to develop a strategic action plan for implementing the SPC Aquaculture Programme. Participants worked in small groups that focused on one of the agreed priority commodities.

For each priority commodity, each group identified:

- Lessons from past experience
- Major assistance needs in the areas of:
 - Information and technology delivery
 - Research and development
 - Training

For each priority commodity and major issue groups were then asked to identify:

- Principle objectives (what will be achieved)
- Main deliverables
- Country focus (main country where activity will take place)
- Teams (who needs to be involved)
- Communication (strategies for creating awareness and facilitating use)

Finally, groups identified:

- What has to happen to establish commodity in the Pacific
- Work plan for next three years (given human, financial and infrastructure resource present within SPC, other institutions, countries and the private sector)

Coral

Lessons learned

- Wild harvest of corals (seed) can damage corals.
- Coral farming needs landowner understanding and participation.
- Damage by farmer fish (Stegastes spp.) and bleaching can be unexpectedly high.
- Coral farms should be situated in areas where fish are present (otherwise algal overgrowth may occur).
- All corals grown can not be sold (extra corals can be used for site restoration).

Major assistance needs

- Funding for facilitating agency.
- More research and development for present coral farmers (funding required).
- Community awareness and conservation required.
- Establish rights of suppliers to coral biodiversity (e.g. to prevent farming in US of Pacific genetic strains).
- Funding assistance required to understand or develop coral marketing.
- Eco-labelling required; need for regional standards.

Objectives

- Identify market preferences and farming methods to meet them.
- Create a site to meet demonstration, local and regional training and research needs.
- All aspects of coral trade addressed: aquarium; curio; restoration (resorts etc. in Guam); medical; betel nut lime (Solomon Islands, PNG, Palau).

Deliverables: site

- Improve farming and export methods.
- Establish best management practices for farmers.
- Enhance product marketability to existing trade.
- Use coral culture to stimulate community management practices.
- Improve stock selection and culture of mother colonies.

Country focus

- Main country of focus: Fiji Islands.
- Seven commercial stakeholders already established.
- Government, NGOs and community already involved.
- Good geographical setting.
- Can be used for a regional training centre.
- Inexpensive air transport available.
- Infrastructure exists (on Makogai Island).
- FSP already starting coral extension projects on Fiji.

Teams

- Fiji Islands organisations FLMMA (Fiji Locally Managed Marine Areas), WWF, IMA, FSP, USP, Fisheries, WIF (Women in Fisheries network), SPACHEE.
- Regional organisations SPC, FAO, FSPI, USP, IMA, WWF, CI.

Communication

- Develop handbook addressing best management practices and methods.
- Community awareness (increase through primary and secondary school curriculum).

- Adult level awareness (increase through seminars, community workshops) (some sites are ready for training/awareness purposes).
- Establish training program for Pacific region trainers.
- Convene forum (including Marine Aquarium Council and all aquarium traders) to gauge market demand and establish mechanism to interact with growers.

What has to happen to establish the commodity

- Local and regional policies on coral farming need to be developed.
- Eco-labelling standards need to be developed.
- Need regional body to coordinate policy and standards (e.g. SPC).
- Need capacity building at community level for conservation awareness and management.
- Need to identify available funding sources.

Action over the next three years

- Organise local and regional partners (NGOs, research institutions, and private industry).
- Identify roles of partners.



- Establish one demonstration/research site.
- Expand to other Pacific Islands (in addition to Fiji Islands) after two years.

Freshwater shrimp

Lessons learned

- Critical importance of private sector in training attachments, etc.
- Good regional expertise exists in Fiji Islands, French Polynesia; also significant expertise in Asia.
- Suitable for community project if well organised and free of internal politics.

Major issues for assistance

- Regular supply of post-larvae preferably from private sector.
- Cost-effective feed needed.
- Information and training:
 - Hatchery technology.
 - Analyse lessons and experiences.
 - Feed formulations.
 - Training attachments.
 - Infrastructure (technical) farm design.
 - Training should be linked to follow-up action in country (e.g. scholarships).
- Research and development:
 - Reduction in growth variability.
 - Effective formulated feeds based on local ingredients.
 - Culture potential of *M. lar* species to be investigated (widely distributed).

Objectives

• To support and facilitate the development of viable local macrobrachium industries in interested countries in the Pacific.

Activities

• Find out about what is known about macrobrachium, establish contacts with experts (identify key problems and assess if we can overcome these problems; identify research areas).

Outputs:

- USP CSPOD to develop manuals (year one):
- Develop list of experts and consultants.
- Establish a network of macrobrachium specialists.
- Draw up list of key problems and research needs.
- Training for private sector hatchery operators or new entrants and government technicians.

Outputs:

- Provide follow-up support to trainees upon their return home so that the training results are properly disseminated.
- Test manual's effectiveness.
- Make available SPC "master aquaculturist" for short-term in-country trouble-shooting.

Country focus

• Fiji Islands, Vanuatu, Solomon Islands, PNG, Samoa.

Action over the next three years

- Estimate size and nature of the market.
- Establish a suitable hatchery facility.

- Identify the level of country commitment to utilise training and follow up with macrobrachium projects.
- Develop post-training follow-up, to assist in utilisation of training.
 Initiate a post-harvest training component (focus on food safety, maintaining quality).

Giant clam

Lessons learned

- Clam was pushed as a product without firstly fully appraising the demands of the private sector.
- In the early stages of development there was a lack of community involvement (and few established successes).
- The technology for culture has been developed only needs some fine tuning.

Major issues for assistance

- Management advice.
- Enforcement of legislation.
- The development of an aquarium trade needs the support of a hatchery.
- Hatchery production to be part of multi-species hatchery due to small numbers needed.
- Find ways to use private aquarium clam producers to assist restocking programme.
- Assistance in selecting fast growing clams for local consumption.
- Study of market size (is the market being flooded?).
- Economics of giant clam farming.

Objectives

• Job creation.

• Food production.

Deliverables

- Stock enhancement for enhancement of resource and aquaculture.
- Guidelines for co-management.
- Guidelines for legislation.
- Development of multi-purpose hatchery, or rehabilitation of existing facility.
- Feasibility study for multi-purpose hatchery (ie. giant clams, corals, trochus).
- Assessment of markets and enhancement needs (i.e. demand).
- Compilation of lessons learnt (regarding restocking and co-management).

Country focus

- Samoa has experience in co-management with communities and government.
- Solomon Islands, Tonga expertise in hatchery and stock enhancement.
- Fiji Islands useful market study for export aquarium trade.

Teams

- Communities.
- Donors, NGOs, academics (expertise in social sciences and economics).
- Policy makers.
- Private sector.

Communication

- Website.
- Networking.
- Extension services.

What has to happen to establish the commodity

- Stock enhancement:
 - Upgrade hatchery facilities and staff capacity.
 - Assess status of existing stocks in order to guide stocking programme.
 - Develop regional stock enhancement programme.
- Guidelines for co-management:
 - Analyse lessons and experiences from Samoa and report on their applicability to other countries.
 - Establish pilot co-management activities in other countries.
- Guidelines for legislation:
 - Initiate consultations with all legitimate stakeholders.
 - Draft policy guidelines.
- Multi-purpose hatchery:
 - Conduct feasibility study.
- Assess the market, particularly for the aquarium trade (size, demand, long-term viability).

Action over the next three years

- Collate and analyse available information from the region (and other countries) for comanagement.
- Organise a regional meeting in an appropriate country (e.g. Samoa) to develop a regional co-management programme.
- Stock enhancement:
 - Collate, analyse and distribute available information.
 - Organise regional meeting to develop a stock enhancement programme.
- Establish a giant clam information network (similar to the Asian Marine Fish Research and Development Network).

Milkfish

Lessons learned

• Milkfish and tilapia can be competitive products on the market.

Major issues for assistance

- Lack of knowledge about fry collection areas and seasons.
- Local inexperience in fry collection, pond stocking and management.
- Lack of knowledge regarding hatchery techniques.
- Unknown feasibility for longline bait at different Pacific sites.
- Need market research into household consumption, both regionally and in Pacific Rim countries.
- Lack of information on all aspects of milkfish farming, harvesting and processing.

Objectives

- Economic evaluation: growing milkfish for longline fisheries as a basis for business plan development (SPC, FAO, consultant).
- Market research: identify demand in large Pacific Rim countries (who, price, quantity) (WHO, SPC).
- Research project: identify fry collection areas and seasons in selected countries (2–3 year duration) (FAO, SPC).
- Training workshop: sub-regional workshop on milkfish farming practices (SPC, FAO, consultant, SEADEC / NACA).
- Provide milkfish hatchery training and follow-up (at two regional sites); follow-up by email consulting.
- Information project: compile bibliography on milkfish and publish important pertinent documents on the Internet (SPC).

Country focus

• Hold workshops in Kiribati and Fiji Islands.

Teams

• SPC, FAO, consultants, SEADEC / NACA.

Action over the next three years

• Survey — SPC to poll member countries (fisheries departments and private sector) about impediments and needs in milkfish aquaculture.

Pearl oyster

Lessons learned

- Early private sector investment required.
- Government's role: provide a mechanism and criteria for investment, but don't set up farm.
- A simple how-to-invest list can be an important tool to facilitate investment.
- Don't reinvent the wheel technology transfer from existing operators.
- Marketing of pearls is important: quality control; use of brand names (generic and local).
- Avoid competitive stupidity for example deliberate misinformation given to competitors; ultimately this only drives market prices down.

Major issues for assistance

- Need a reality check on how to promote commodity at a rural level.
- Need a realistic appraisal on the initial investment level required (country dependent). Estimated that the minimum requirements in eastern Polynesia are 30,000 seeded shell or quarter million USD.
- Need for high-level government meeting (with heads of industry) to agree on quality and legislation.
- Grafters play a crucial role in success of farm operations.
- Establish a central register for competent grafters.
- Payment of grafters to be based on their harvest success rate.

Research and development

- Determine best practices (environmental and quality related).
- Develop a mechanism to allow regional institutes (e.g. USP postgraduates) to conduct research. Research must be on industry priorities and done with industry. For example, environmental best farming practices, etc.
- Develop common research goals.
- Develop market intelligence network.

Objectives

- Stabilise and improve price of commodity.
- Cooperation in a regional marketing strategy, i.e. product branding French Polynesia to lead.

Deliverables

- Have a regional focus particularly on quality control criteria.
- Adopt a value-added strategy for the pearl industry (i.e. encourage local jewellery industry).
- Develop and disseminate information on environment best practices for pearl farming linked to quality criteria.
- Develop mechanism for reducing cost of grafters.
- Consolidate list of pearl grafters.
- Involve producing countries in region, interested regional institutes and industry associations in development of strategic action plan.

What has to happen to establish the commodity

Producing countries should meet to address problems in:
 Quality control.

- Branding.
- Production.
- Meeting to be high level (i.e. ministerial), coordinated by SPC.

Action over the next three yearsNeed to agree at high level on drive for quality.Develop new markets.

- - Institute discipline among producers when selling commodity on market.
 - Undertake research and development activities.

Sea cucumber

Lessons learned

- Past management has not worked, and has led to boom and bust cycles.
- Basic production techniques are known.

Major issues for assistance

- Information:
 - SPC SIG bulletin on beche-de-mer (700 subscribers) is ranked second out of eight SIGs.
 - Need to increased awareness that aquaculture should not be treated separated from restocking/enhancement programmes.
- Research and development:
 - Methods for mass production need to be developed.
 - Need to learn how to release juveniles in the wild so they survive in high proportions.
- Training:
 - Hatchery production techniques.
 - How to release the juveniles in the wild.
- Other issues:
 - Management techniques to maximise gains from restocking efforts (e.g. moratoriums).
 - Protected areas.
 - Size limits.
 - New forms of processing (wet exports).
 - Can sea cucumbers be raised as a by-crop of shrimp farming.
 - Who will pay for the cost of producing juveniles and who will benefit in the case of bycropping.

Objectives

- Increase the awareness for the need of better management of sea cucumber stocks, particularly the stock of spawning biomass.
- Identifying where restocking is required to rebuild biomass.
- Where stocking is needed, scale up mass production of juveniles and develop optimum release strategies.

Deliverables

- Management plans for sea cucumber stocks.
- Prioritising options, including restocking.
- Development of an economically viable method for mass production and release.

Country focus

- New Caledonia:
 - Active beche-de-mer fishery.
 - Strong interest by government.
 - Access to adequate hatchery and nursery facilities (well-established shrimp industry).
 - Strong collaboration with SPC and IFREMER.

Teams

• IFREMER, provinces, WorldFish Center, fishermen and coastal communities, development agencies partners.

Communication

- Articles in SPC SIG bulletin on problems faced by the sea cucumber fishery and options for management, including restocking.
- Regional workshops for hatchery methods and release strategies.
- Presentation to community groups on the rationale of the progress of the project.

Action over the next three years

- Increase the awareness for the need for better management of sea cucumber stocks, particularly the stock of spawning biomass.
- Identify where restocking is required to rebuild biomass.
- Longer than three years:
 - Countries should seek training in hatchery production techniques and release strategies for sandfish and seek donor agency support for hatchery facilities.
 - Condition for training/extension is after the WorldFish Center research is demonstrated to be effective.

Seaweed

Lessons learned

- Initial government intervention in marketing (between producer and buyer) helps to boost the industry and production; subsequently can be privatised.
- Needs regulation of seed stock transfer to minimise impacts.
- Areas with less opportunities for commercial activities are more suitable for seaweed farming.
- There is a minimum quantity of production required for start-up.
- Aspects of seaweed farmer livelihoods need to be understood (role, benefit, constraint, etc.).

Major issues for assistance

- Information and technology: increase awareness of government, private sector and farmers through video, manuals and leaflets.
- Coordinate efforts among agencies in the region.
- Involve farmers in development of awareness materials/manuals, videos, etc.
- Research and development: no research required on technical aspects of production (only monitoring); socio-economic studies needed on viability (e.g. social acceptability, livelihood analysis) at country and community level.
- Training: application involves direct training of farmers (initially through extension officers; subsequently responsibility should be transferred to private sector).
- Domestic transport can be a constraint (e.g. Fiji Islands).
- Gaining government commitment.
- Financial feasibility analyses.
- Processing.
- Study of value of byproduct as fertiliser.

Principal objectives and deliverables

- Commercially sustainable industry:
 - Identify suitable countries and sites for sustainable production.
 - Raise awareness among all stakeholders to increase level of understanding. What will be achieved:
 - Identify specific communities and know potential for production.

- Increase participation, commitment in supporting industry and resolving issues. **Deliverables/output:**

- Creation of employment opportunities improves livelihood; foreign exchange.
- Manuals, leaflets, video, gualified trainees/experts.
- Improvement of logistics and infrastructure support:
 Improve government regulations, industry services and infrastructure. What will be achieved:
 - Improved domestic shipping routes.
 - Increased investment from private sectors.
 - **Deliverables:**
 - Ensure constant supplies to buyers; most importantly creates a source of regular income for farmers.

• Establishment of regional process:

- Build production to minimum level needed to establish a processing plant.

What will be achieved:

- Establish a semi-processing plant.

Deliverables:

- Generates employment (local, national).
- Increase income at farmer and national level.

Country focus

• Potentially Kiribati*, Fiji Islands*, PNG, Solomon Islands, Marshall Islands, Palau, Samoa, Tuvalu, Vanuatu, Tonga [*current producers].

Teams

- Government: infrastructure/regulations; initial extension/training; increasing awareness.
- Island/village councils: community development; production.
- Private sector: privatisation of marketing and development should be the goal for the long-term basis (e.g. the buyer provides technical assistance and market assurance).
- Regional/international institutions through donor funding: site surveys, socio-economic studies, development of resource materials, coordination.
- Donors: to support infrastructure development in country initially (e.g. farm to market roads').

Communication strategies

Country level:

• Use of provincial council meetings to disseminate information.

Regional level:

- Workshops/meeting/conferences.
- Correspondence among focal points in countries.
- Technical cooperation among countries developing seaweed industries should be encouraged.
- Establishment of a code of conduct to ensure quality control, ethical management practices, and for handling of quarantine protocols.

What has to happen to establish the commodity

• Stronger commitment from government, private sector and other agencies working together toward the development of a seaweed industry.

Action over the next three years

- Identification of the important socio-economic criteria which may be predictors of success in developing seaweed farms (USP, FAO, SPC/ACIAR).
- Identify buyers' criteria (FMC).
- Resolve collection issues between fisheries and local buyer/exporter.
- Increasing awareness of infrastructure needs of the seaweed industry at the ministerial level (between ministries of fisheries, public works and transport).

Tilapia

Lessons learned

- · Poor management practices lead to low productivity.
- Poor site selection leads to low productivity.
- Introductions can have negative impact on the environment.
- There is a lack of appropriate skills to establish farms.
- Lack of commitment by authorities.
- Tilapia introduced for reasons other than farming.
- Subsistence farming achieved variable success.

Major issues for assistance

- Information:
 - Publications.
 - Dissemination of knowledge at all levels.
- Research and development:
 - Culture techniques.
 - Nutrition.
 - Marketing.
 - Product enhancement.
 - Market acceptance study.
 - Strain improvement.
- Training:
 - Establishment of training facilities.
 - Identify and meet training needs.
 - Data collection.

Objectives

- Awareness of and support for sustainable tilapia industry in the region:
 - Hatchery development.
 - Transportation accessories.
 - Marketing local/export.
- Research and development:
 - Maintain quality.
 - Selective breeding of species (Fiji Islands to take the lead).
 - Nutrition formulation (PNG to lead).
 - Improving farming systems.
- Training:
 - Extension training facilities.
 - Effective extension service.

Country focus

• Fiji Islands, PNG, Solomon Islands, Samoa, Vanuatu, Kiribati.

Teams

- Government stations, farmers.
- The WorldFish Center, NACA, USP, SPC, students, stakeholders.

Communication

- Meetings.
- Workshops/training.
- At sites.
- Farmers workshops.
- Networking, Internet, USP satellite.

Actions over the next three years

- Establish a report of the status among tilapia producing countries.
- Countries with potential for tilapia farming should report back their level of interest to SPC after they return.
- Investigate government policies and strategies on food and employment relevant to tilapia farming:
 - Ánalysis conducted with assistance from SPC and other institutions three-month study.
- Develop tilapia farming business proposals for investors.
- Develop a model legislation with regulations for tilapia farming done by SPC, government, private sector, farmers, Lands people, environmental and water supply people and other relevant agencies eg. NGOs SPREP, FSP, IMA 1–3 months.
- Set up a government/NGO/SPC demonstration pilot farm:
 - Location: Fiji Islands.
 - Facilities include: holding tank, nursery ponds, grow-out ponds, feed house.
 - Lessons over a 6–9 months.
 - Evaluation.
 - Analyse stakeholder factors (social/economic/education/consumer).
 - More training where necessary (lessons from Asia).
- Support infrastructure development:
 - Research facilities.
 - Development facilities.
- Support training:
 - Evaluate the benefits.
 - Provide reports to Government, SPC.
- Tilapia regional workshop in Fiji Islands:
 - Evaluate all aspects of the industry (collaborating institutions include SPC, the WorldFish Center, NACA, USP, private sector).
 - Develop regional policy/strategy.

NEXT STEPS

The purpose of this session was to identify and allocate responsibilities for follow-up action. Participants were aware that follow up is often absent when people return home. The following actions were identified:

Follow-up actions	Wно	By when
Prepare workshop notes and circulate to participants	Tim Healy Ben Ponia	ASAP
E-mail country presentations to Ben Ponia and Tim Healy	French Polynesia Nauru Vanuatu	ASAP
Prepare workshop report for ACIAR and SPC include high/low lying island analysis	Tim Healy	End March
Develop workshop proceedings	Ben Ponia	May
Circulate digital information on CD to participants	Ben Ponia	May
Explore possibility of aquaculture activity targeting species consumed in local communities	SPC	
Comments on commodity profiles to Warwick Nash	Participants	ASAP
Complete revised version of commodity report	Warwick Nash	June
Develop strategy to cope with introduction of species	SPC	Ongoing
Present report of meeting to NACA meeting	SPC	Next week
SPC aquaculture project to use workshop output to guide project activities	SPC	Ongoing
Report on workshop to home organisations and provide feedback to SPC	Participants	ASAP
Develop networking among participants	SPC	ASAP
Approach donors to fund priority research projects in line with workshop results	WorldFish Center	Next 3-4 months
Strengthen NGO linkages	Austin Bowden-Kirby	Ongoing
Develop regional aquaculture strategy	SPC	Ongoing
Develop country strategies consistent with regional strategy, focusing on policy, legislation, strategies	Country representatives	Ongoing

Participants also committed to a number of personal actions to assist with implementation of the strategic action plan.

PERSONAL ACTIONS TO ASSIST WITH IMPLEMENTATION OF STRATEGIC ACTION PLAN	CO-OPERATOR
Pedro Bueno Consult with the NACA constituents and assess what specific actions can be taken to: broadly cooperate; conduct activities of mutual interest; provide specific assistance	USP
SPC Training Section Seek funding for national/regional workshops as required under commodity strategic action plans; collaborate with SPC Aquaculture Section in organising individual training attachments	USP Satya Nandlal
SPC Training Section Produce resource material for seaweed as required; awareness video (under way); technical manuals for farmers (likely)	
Terii Seaman Report back to French Polynesian government with regards to pearl oysters; help organise regional Heads of Government meeting	
Mere (USP) Devise a rapid survey technique that will allow project managers to prioritise communities for seaweed farming development	Bong E. Ledua FAO (SAPA) Natalie
Sompert Gereva (Vanuatu) Help with seaweed and giant clam farming	FMC/Bong
Nikolasi Apinelu (Tuvalu) Carry out seaweed farming trial in Tuvalu; rehabilitation of existing milkfish demonstration pond	USP training E. Ledua
Litiana Seruvatu Transfer information and technologies to other communities	USP training and manuals and videos
Augustine Mobiha (PNG) Assist in facilitating tilapia feed development in PNG (with Fiji Islands assistance)	Sompert Gereva USP (feed trials by PNG students) Fiji Islands Fisheries E. Ledua D. Crisostomo Satya Nandlal
Barney Smith (ACIAR) Support research	Ken Mackay (C-SPOD) USP Fiji Islands Fisheries
Kalo Pakoa (Vanuatu) Find out the commitment the country has at this stage to venture into M. rosenbengii farming	Augustine Mobiha Sompert Gereva
Lynette Kumar (USP/Institute of Marine Resources) Assist with the information gathering scientific research capabilities of USP (especially for its member countries)	

PERSONAL ACTIONS TO ASSIST WITH IMPLEMENTATION OF STRATEGIC ACTION PLAN	CO-OPERATOR
Satya Nandlal Participants to discuss the plan with respective governments or heads and confirm the outcome to SPC; SPC to engage experts to analyse requirements by countries and finalise action plan	USP
Jim Tilbury Investigate feasibility of Makogai Island as site for multi-purpose facility	USP (IMR)
Flinn Curren Provide estimate of long-line baitfish needs in Pago Pago and Guam and willingness to buy live milkfish for bait	
Peter Jacob Milkfish stocking into ponds and management	
Warwick Nash As ACIAR (Pacific Office) head, and with the assistance of Johann Bell (WorldFish Center) and Barney Smith (ACIAR), develop a clear plan and timetable for the process to be followed for the strategic action plans to be prepared well and on time	USP
Russell Cole Help source local food supply	USP (trials)
Jean-Paul Gaudechoux (SPC Fisheries Information) Any commodity — provide in-country training through attachment of a technician or master fisherman	E. Ledua Satya Nandlal
Aisake Batibasaga Develop HRD and infrastructure per desired commodity — financial support	
Natalie Macawaris-Ele (SAPA Office) Proposal for regional (4+ country) project — FAO plus partners	
Temu Okotai Help train other new entrants into the pearl industry	USP jointly with others
Alec Forbes Promote and assist penaeid aquaculture and research	USP
Natalie Macawaris-Ele (SAPA Office) Support countries' efforts to improve legislation FAO sub-regional office and partners	USP (resource person)
Johann Bell Arrange for WorldFish Center to write an article for SPC beche-de-mer bulletin on the situations where restocking should be used	
Tim Pickering (USP) Education and training	IMR (USP) Ken Mackay (C-SPOD)
Tevita Taumaipeau Assist with the implementation of the pearl oyster programme of action	USP (applied research by PhD students on 1.5 to 3 year time frame) Temu Okotai

Personal actions to assist with implementation of strategic action plan	CO-OPERATOR
Ian Bertram Inform pearl industry in Cook Islands of meeting progress. Then take it from the	ere
Semisi Naivalu (Fiji Islands) Action plan — deliver the technology and experience of aquaculture to the communities/stakeholders within the Pacific region	USP aquaculture Training project Satya Nandlal

Austin Bowden-Kirby Assist with coral farming information/training

APPENDIX

COMMODITY SCORING

The following diagrams present the overall result for each of the potential impact and feasibility assessments by the participants, by various groupings. The table presents more detail of the scoring for four criteria. Participants made a number of general observations during the discussion and scoring process. These included:

Generic constraints

- Lack of entrepreneurial skills and business training.
- Limited skills in business planning.

Potential benefits

- Pearl oyster regional heads of government meeting required to discuss common legislation policies with regards to quality production and marketing.
- Critical need for financial analysis for each chosen commodity to determine scale of production and cost of production.

Suitability to the Pacific

- SPC could assist with regional/national frameworks for environmental impact assessment.
- SPC could advocate on behalf of responsible aquaculture operations.
- No clear legislative means to allocate aquaculture sites (generic issue).
- Limited capacity to undertake EIA leads to lack of frameworks for site assessment, licensing, etc.
- Market analysis per commodity vital prior to establishment.
- Disease, genetics, exotic organisms and quarantine: be prepared for disease. Viral and bacterial afflictions will come. Institutions and governments must be prepared in areas of pathology, diagnosis, treatment, prophylaxis, etc.

Capacity to access and deliver

- Cuts across all commodities.
- Some commodities will need training (SPC could assist).
- Others will need research and development assistance (WorldFish Center and others).
- Capacity of SPC to deliver depends on its commitment to create aquaculture training positions.
- Most of participants were not in a position to assess SPC's capacity to deliver.

Capacity to utilise

- Private sector demand not listed for consideration.
- SPC could facilitate the development of common or harmonised policies/strategies for the movement of species.

Private sector



Institutions



Fiji observers



Postgraduate students



Combined individual assessment of return to the Pacific from investment in aquaculture commodities



Potential benefits

Commodity/ Respondents	Table groups	All countries	High countries	Low countries	Private sector	Institutions	Fiji Islands observers	Postgraduate students	Combined individual
Number of respondents	∞	15	10	7	∞	Ħ	10	3	47
abalone	1.5	3.1	2.5	3.3	3.3	2.3	3.2	2.3	2.9
carp	2.5	3.7	3.8	3.4	3.4	2.9	5.7	4.0	3.9
coral	10.0	8.1	8.3	8.1	7.5	8.3	7.3	9.7	8.0
freshwater shrimp	6.9	6.4	7.1	5.9	7.3	6.2	7.7	7.7	6.9
giant clam	6.9	7.9	8.4	7.6	5.6	5.6	5.2	8.3	6.4
grouper	2.0	2.8	2.3	3.0	2.9	2.5	2.9	4.3	2.9
larval fish	4.5	4.3	4.2	4.1	4.8	6.0	4.1	4.7	4.8
milkfish	6.5	5.6	3.9	6.9	5.1	5.3	5.9	6.3	5.6
mud crab	3.0	5.2	6.0	4.0	5.3	3.2	4.4	4.0	4.5
pearl oyster	9.4	6.6	6.1	6.7	7.3	8.4	7.4	7.7	7.4
penaeid prawn	5.8	5.9	6.1	6.0	7.8	5.8	6.9	6.7	6.4
rock lobster	2.0	3.5	4.3	2.4	3.9	2.1	1.8	3.7	2.9
sea cucumber	7.0	6.1	6.9	5.6	4.8	7.6	5.6	5.3	6.1
seaweed	8.8	7.9	8.3	7.4	7.8	7.9	8.9	6.7	8.0
sponge	4.3	4.5	3.8	4.6	5.1	5.8	5.1	2.3	4.9
tilapia	5.8	6.6	7.1	5.7	6.1	5.8	7.6	7.7	6.6
trochus	2.5	4.8	5.0	5.4	2.9	3.9	3.6	5.0	4.0

Commodity/ Respondents	Table groups	All countries	High countries	Low countries	Private sector	Institutions	Fiji Islands observers	Postgraduate students	Combined individual
Number of respondents	∞	14	6	7	Π	13	Π	3	52
abalone	1.5	3.0	3.8	2.7	2.6	2.1	2.8	1.0	2.6
carp	3.0	4.1	4.1	3.1	3.8	3.4	5.9	5.7	4.3
coral	8.8	8.0	8.3	8.0	7.7	8.9	7.4	8.7	8.1
freshwater shrimp	6.4	6.1	6.7	5.1	6.7	5.4	7.1	7.3	6.3
giant clam	7.5	8.2	8.7	8.3	5.9	6.4	6.5	7.7	6.9
grouper	2.0	3.3	3.4	3.6	2.8	2.4	3.4	2.3	2.9
larval fish	3.5	4.5	5.0	4.4	3.5	5.5	4.2	8.3	4.7
milkfish	7.0	7.1	6.2	8.4	6.1	6.0	6.5	5.0	6.4
mud crab	3.1	5.1	5.0	4.0	5.9	3.5	5.1	4.0	4.7
pearl oyster	9.4	8.0	8.3	8.3	6.9	9.0	7.8	7.3	8.0
penaeid prawn	5.1	5.7	5.9	4.9	6.5	4.9	6.7	6.3	5.8
rock lobster	1.0	2.3	2.7	1.7	4.0	1.8	2.2	1.7	2.5
sea cucumber	5.3	5.8	6.1	6.6	5.9	7.2	5.6	3.7	6.1
seaweed	9.4	8.4	8.7	7.6	8.3	9.2	8.7	8.7	8.6
sponge	6.3	5.1	5.6	5.3	6.0	7.5	4.6	7.0	6.0
tilapia	5.9	6.2	5.9	5.3	7.3	5.8	7.8	5.7	6.6
trochus	2.1	5.0	4.6	5.7	2.5	4.1	3.6	3.7	3.9

Suitability to Pacific

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Capacity

Commodity/ Respondents	Table groups	All countries	High countries	Low countries	Private sector	Institutions	Fiji Islands observers	Postgraduate students	Combined individual	
Number of respondents	∞	Ħ	∞	Ŋ	∞	6	14	က	45	
abalone	2.0	1.7	1.8	1.6	2.6	2.7	2.4	3.0	2.4	
carp	7.0	5.6	6.4	5.0	5.1	6.1	7.1	6.3	6.2	
coral	7.0	7.5	7.5	8.0	5.6	7.0	7.4	6.3	6.9	
freshwater shrimp	7.5	6.1	7.0	5.4	6.6	6.2	8.1	6.7	6.9	
giant clam	7.0	8.0	8.4	7.2	5.5	6.0	7.4	6.3	6.8	
grouper	1.0	1.8	1.9	1.6	2.4	1.8	3.1	4.0	2.5	
larval fish	5.1	4.6	4.1	4.6	5.3	5.4	5.3	6.7	5.2	
milkfish	6.4	6.4	5.8	7.8	5.9	5.2	6.9	6.3	6.2	
mud crab	2.0	3.4	3.8	2.8	4.9	2.9	7.3	2.7	4.7	
pearl oyster	7.6	7.6	7.5	8.4	6.9	7.8	7.3	7.7	7.4	
penaeid prawn	6.5	5.5	6.4	4.6	6.5	6.0	6.7	5.7	6.2	
rock lobster	2.1	2.0	2.0	2.2	2.8	2.1	1.8	4.0	2.2	
sea cucumber	5.1	5.7	5.6	5.8	5.6	7.0	4.5	3.7	5.4	
seaweed	10.0	9.1	9.5	8.8	8.9	9.3	8.3	8.7	8.8	
sponge	5.3	5.0	4.4	6.6	4.5	5.8	4.3	5.3	4.9	
tilapia	7.5	7.7	7.9	7.8	7.1	7.1	8.6	6.3	7.7	
trochus	3.6	6.0	6.1	6.4	5.1	5.1	4.6	3.3	5.1	

Commodity/ Respondents	Table groups	AII countries	High countries	Low countries	Private sector	Institutions	Fiji Islands observers	Postgraduate students	Combined individual
Number of respondents	∞	14	10	9	•••	12	12	2	48
abalone	1.0	1.9	1.8	1.8	1.8	1.8	1.9	1.0	1.7
carp	5.0	5.3	5.8	4.7	5.6	6.2	6.7	4.5	5.6
coral	8.8	6.8	7.3	5.8	8.0	7.9	6.7	8.0	7.0
freshwater shrimp	6.4	5.7	6.6	4.3	6.6	5.8	7.5	8.5	6.2
giant clam	8.8	8.2	8.5	8.0	5.9	7.3	6.8	6.5	6.9
grouper	1.0	2.4	2.2	2.5	1.9	2.6	3.3	2.0	2.5
larval fish	3.5	3.7	3.7	3.2	4.0	4.8	4.0	6.0	4.0
milkfish	6.5	7.1	6.0	8.5	4.6	7.3	6.7	4.5	6.3
mud crab	2.0	3.4	3.4	2.3	5.5	3.2	4.2	3.5	3.7
pearl oyster	7.5	7.2	6.7	8.2	5.6	7.5	6.7	6.5	6.6
penaeid prawn	5.1	5.7	5.9	5.3	5.1	4.2	6.9	5.0	5.3
rock lobster	1.5	2.1	2.0	2.2	3.6	2.2	2.2	3.0	2.3
sea cucumber	5.1	5.7	6.1	4.7	6.5	6.8	4.3	5.5	5.5
seaweed	10.0	8.4	8.3	7.8	8.4	9.2	9.0	9.0	8.4
sponge	3.1	3.2	3.4	2.3	5.3	5.3	3.8	3.5	4.0
tilapia	8.1	7.8	7.7	7.3	7.6	7.4	8.3	6.5	7.4
trochus	5.3	6.5	6.2	7.5	4.5	6.7	4.0	5.5	5.3

Capacity to utilise