Study on the Potential of Aquaculture in the Pacific

To the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA)

Prepared by
Moses Amos, Ruth Garcia, Tim Pickering & Robert Jimmy
Secretariat of the Pacific Community (SPC), Noumea
August, 2014
# Table of Contents

Acronyms ................................................................................................................................. 3  
1   Summary .................................................................................................................................. 4  
   1.1 Preparation of this document ................................................................................................. 4  
   1.2 General Conclusions .............................................................................................................. 4  
   1.3 Key aspirations and attributes for Pacific Aquaculture .............................................................. 5  
      1.3.1 Aspirations ....................................................................................................................... 5  
      1.3.2 Attributes ....................................................................................................................... 5  
   1.4 Contribution to food and nutrition security .............................................................................. 5  
   1.5 Contribution to improving livelihoods ..................................................................................... 5  
   1.6 Addressing long-term sustainability of the aquaculture sector .................................................. 6  
   1.7 Areas where support would be needed over the next five years ............................................. 6  
2   Background ................................................................................................................................ 8  
   2.1 Geography and the SPC Governance ..................................................................................... 8  
   2.2 Aquaculture in the Pacific ....................................................................................................... 9  
3   Current status of the aquaculture sector in the Pacific ................................................................. 10  
4   Significance of the aquaculture sector for the Pacific region ....................................................... 10  
   4.1 Main commodities farmed in the Pacific region ...................................................................... 13  
   4.2 Main producing countries in the Pacific region ...................................................................... 13  
   4.3 Main markets and international quality standards .................................................................... 14  
      4.3.1 Markets ........................................................................................................................... 14  
      4.3.2 Standards ......................................................................................................................... 15  
   4.4 Relevant stakeholders in the region .......................................................................................... 15  
   4.5 Main hatchery and aquaculture facilities within the region ...................................................... 16  
5   Contribution of aquaculture to food and nutrition security ......................................................... 18  
6   Contribution of aquaculture to income generation ..................................................................... 19  
7   Key areas for long-term sustainability ........................................................................................ 20  
   7.1 Aquatic biosecurity (including Risk analysis and aquatic animal health management) .......... 20  
   7.2 Policy issues/good governance ............................................................................................... 21  
   7.3 Private public partnership ..................................................................................................... 21  
   7.4 Input supply: feeds, seeds, broodstock ................................................................................... 22  
8   Main limitations and constraints faced by the region ................................................................... 22  
9   Main opportunities for the sector ................................................................................................ 23  
10   Areas where support is needed .................................................................................................. 24  
11   The way forward ....................................................................................................................... 25  
References ..................................................................................................................................... 26  
Annex I: Country case studies for Vanuatu, Samoa, Fiji and Kiribati ................................................. 27  
   Country Report: Vanuatu ............................................................................................................ 28  
   Country Report: Samoa ............................................................................................................. 33  
   Country Report: Fiji .................................................................................................................. 40  
   Country Report: Kiribati ............................................................................................................ 47  
Annex II: List of Tables and figures ............................................................................................... 52  
ANNEX III: Terms of reference ..................................................................................................... 53  
Annex IV: Geography and demographic scope of the SPC ................................................................ 55
Acronyms

ABW: Average body weight  
ACIAR: Australian Centre for International Agricultural Research  
BAF: Biosecurity Authority of Fiji  
CBA: Community based Assessment  
CBD: Convention on Biological Diversity  
COFI: Committee on Fisheries  
CRIOBE: The Insular Research Centre and Environment Observatory in French Polynesia  
DFAT: Department of Foreign Affairs & Trade  
FAO: Food and Agriculture Organisation  
FNU Fiji National University  
FSM: Federated States of Micronesia  
GADTC: Guam Aquaculture Development Training Centre  
GIZ: Deutsche Gesellschaft fuer Internationale Zusammenarbeit  
HAQDEC: Highlands Aquaculture Development Centre, Aiyura, PNG  
HOF: Heads of Fisheries  
IFREMER: French Research Institute for Exploitation of the Sea  
IRD: Institute of Research & Development  
JH: Justin Hunter Pearls  
JICA: Japan International Cooperation Agency  
MAF: Ministry of Agriculture & Fisheries  
MOFF: Ministry of Fisheries and Forests  
mT: Metric tonnes  
NACA: Network of Aquaculture Centres in Asia-Pacific  
OFCF: Overseas Fishery Cooperation Foundation of Japan  
OIE: World Animal Health Organisation  
PARDI: Pacific Agribusiness Research for Development Initiative  
PMDC: Palau Mariculture Demonstration Centre  
PNG: Papua New Guinea  
PPP: Public Private Partnerships  
RMI: Republic of Marshall Islands  
SAFA: Samoa Aquaculture Farmers Association  
SFG: Small Farmer Groups  
SPC: Secretariat of the Pacific Community  
SPS: Agreement on the Application of Sanitary and Phytosanitary Measures  
TRMHP: Taiwan ROC Milkfish Hatchery Project  
TTM: Taiwan Technical Mission  
USP: University of the South Pacific  
WAHIS: World Animal Health Information System  
WHO: World Health Organisation  
WTO: World Trade Organisation
1 Summary

1.1 Preparation of this document

This report provides an overview of the developments of aquaculture in the Pacific region by addressing key issues and challenges faced in the aquaculture sector in the region. The report is based on SPC’s work in the Pacific region drawing from recent assessments that have been undertaken on aquaculture. More specifically, the report draws from the analysis of 4 countries (Fiji, Kiribati, Samoa and Vanuatu) that were visited as part of the Mission to undertake this study.

During June and July 2010, the SPC was contracted by the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA) to undertake a Study on the Potential of Aquaculture in the Pacific countries which forms part of three regional studies in the ACP region commissioned by CTA to build evidences on global aquaculture sector.

The study involves field visits of 7-10 days to each of the four selected countries, in-depth discussion with national stakeholders including national fisheries staff, policy makers, aquaculture farmers and regulators. The analysis has been dependent on the support from national governments in arranging site visits, accompanying mission team to site visits, spending time in answering questions and providing information.

The structure of this report is guided by the TOR outlined in Annex III.

1.2 General Conclusions

As a way forward for Aquaculture in the Pacific:

i. Pacific aquaculture will always be small by global standards, yet there are aquaculture successes and challenges in the region where lessons can be drawn from.

ii. Aquaculture is successful if it is run as a business therefore providing support to governments to creating an enabling environment for private sector investment in aquaculture but recognizing that some Pacific Island Countries and Territories have very weak private sector.

iii. Community engagement in aquaculture works best when technology is simple and accessible, and aquaculture activity blends in with traditional rural lifestyles and other agricultural practices.

iv. Insular Pacific is still free of many known aquatic diseases. Maintenance of this status will be necessary if the aquaculture advantages of the region are to be capitalized upon.

v. The Pacific region has few indigenous species with the necessary traits for successful aquaculture. Four of the five commodities are Pacific success stories and are based upon introduced species. Provided it can be done responsibly, access to improved varieties of these species will be important to maintain competitiveness and adapt to climate change.

vi. Commonality of issues makes regional approaches a powerful tool for addressing constraints in Pacific aquaculture development.
vii. Research & Development (R&D) has been too much on fish and not enough on people. Emphasis on more extension work is needed.

viii. The expansion of aquaculture in the Pacific will depend on providing better production methods for species currently being farmed as well as improving the infrastructure for propagating the species being farmed.

1.3 Key aspirations and attributes for Pacific Aquaculture

1.3.1 Aspirations

The followings are key aspirations (SPC 2007) for the development of aquaculture in the Pacific region:

- Create a range of options for rural livelihoods to reduce urban drift
- Improve food security
- Improve trade balance-more exports and less dependence on imports
- Capitalize on the region’s comparative advantages-pristine environment, low incidence of fish disease and high biodiversity to produce premium products
- Restore severely depleted fisheries

1.3.2 Attributes

- A great diversity of coral reefs species which are high in demand
- Proximity to major aquaculture and seafood markets in Asia
- Availability of suitable grow-out sites in pristine habitats
- Geographic conditions which favors restocking and stock enhancement
- A tradition of working with marine resources

1.4 Contribution to food and nutrition security

- Culture of lower value fish for food security is gaining higher priority in the Pacific region. Both tilapia fish (*Oreochromis niloticus*) and milkfish (*Chanos chanos*) production are encouraged as a means to meet the projected supply gap for fish in some PICTs.
- Small pond aquaculture is encouraged as a key strategy to culture low value fish where fish can be delivered right to the door step in the communities where they are most needed.
- For low-tech inland aquaculture to meet PICT aspiration in addressing food security, nile tilapia is the most readily adopted option.

1.5 Contribution to improving livelihoods

a) **Pearl culture**: the developments in pearl culture have traditionally been from French Polynesia and Cook Islands. More recently pearl culture includes smaller and more specialized producers that target tourism and local industry for instance in Fiji and Federated States of Micronesia. New developments in pearl are happening in Tonga, Fiji and PNG.

b) **Seaweed culture**: it continues to be promoted as an important cash crop and is relatively simple to culture and require little investments. New improved strains are being sought from Indonesia for Kiribati, FSM and Fiji.
c) **Marine ornamentals**: opportunities for growth in marine ornamentals especially giant clams and coral culture production targeting aquarium trade industry appear good especially in locations accessible to international connections.

d) **Marine shrimps**: shrimp farming remains one of the most successful mariculture activities in the region with major focus on Northern Mariana Islands, Fiji, French Polynesia, New Caledonia, Vanuatu, Guam and Papua New Guinea. A major focus for the region is on improving aquatic biosecurity related to shrimp farming.

e) **Finfish culture**: A variety of finfish species are being pursued for culture in the region. For instance in Vanuatu, the introduction of barramundi (*Lates calcarifer*) into Vanuatu was carried out by the industry and is now an established industry. Rabbitfish (*Siganus spp*) culture in New Caledonia and batfish (*Platax orbicularis*) in French Polynesia equally gaining popularity.

### 1.6 Addressing long-term sustainability of the aquaculture sector

The following areas are needed to be addressed to ensure a sustainability of the aquaculture sector:

i. **Aquatic biosecurity**: Pacific States have very limited capacity to detect and manage aquatic diseases therefore there is a strong need for responsible practices to ensure that Pacific biodiversity is protected.

ii. **Policy and governance**: there is a need for clear policy direction to be developed at the national levels to ensure sustainability in the developments of aquaculture.

iii. **Public private partnership**: the roles for public and private sector stakeholders in aquaculture needs to be clearly defined in ensuring government to do less of doing aquaculture and more of supporting aquaculture by creating an enabling environment for private sector investment but recognizing that some PICTs have very weak private sector.

iv. **Input supply (feed, seed and brood stock)**: these remained key challenges facing aquaculture in the region particularly in remote coastal and inland communities.

### 1.7 Areas where support would be needed over the next five years

- Support aquaculture input supply: Seed is a key constraint in most hatcheries which are often government run and have often underperformed. Strategies for seed production in hatcheries need to be better defined and better equipped. On the other hand feed is also a major constraint and there is an absence of locally produced feed that is affordable in price. The need for locally produced versus imported feed need to be determined.

- Support good governance in terms of policies, legislations, development and management plans. Absence of good governance is said to slow development in aquaculture.

- Provide appropriate socioeconomic assessments.

- Strengthen aquaculture statistics and data bases.
• Strengthen aquatic biosecurity: Pacific does not have a tradition of aquaculture whereby local species have been domesticated. Suitable species for aquaculture have to be introduced from elsewhere. To protect the biodiversity of the region, there is a strong need for responsible practices and regional capacity in biosecurity is very limited.

• Provide responsible access to genetically improved fish varieties for aquaculture.

• Further research on indigenous species with aquaculture potential.

• Focus efforts upon promoting the high-priority species (do not develop too many species at once)

• Build capacity of aquaculture staff and practitioners, including training exchanges such as inter-ACP collaboration and EU-ACP collaboration, while accepting that high staff turn-over is a fact of life in Pacific administrations.

• Improve aquaculture infrastructure, especially to meet national responsibilities in brood stock management, to provide bio-secure facilities for quarantine, and to support fledgling private sector with aquaculture inputs (seed, feed).

• Strengthen capacity of aquaculture associations or organizations to support their sector: there is a need to provide critical mass of competent personnel.

• Private sector development and up-scaling of production from research phase to commercial phase.

• Provide opportunities to access to finance for aquaculture projects.

• Improve net-working and collaboration, technology and skills and research transfer, and technical advice, because the Pacific does not have a good network for aquaculture within the region, let alone with Africa or Caribbean.

• Strengthen markets for aquaculture products in the domestic market to meet demand for fish locally and for import substitution. Often, local or national market is relatively small meaning that the economies of scale is difficult to achieve on the back of domestic markets and breaking into international markets in most cases difficult to achieve.
2 Background

2.1 Geography and the SPC Governance

The Secretariat of the Pacific Community (SPC) or South Pacific Commission as it was formally called is a regional intergovernmental organisation formed in 1947 by the six participating governments that then administered territories in the Pacific: Australia, France, New Zealand, the Netherlands, the United Kingdom and the United States of America. The Organisation was established then to restore stability to a region which had experienced the turbulence of the Second World War with the objective to assist their dependent territories and to benefit the People of the Pacific.

Since 2010, SPC’s 26 membership includes 22 Pacific Island Countries and Territories and 4 metropolitan countries. The Conference of the Pacific Community is the SPC’s governing body which is held every two years. The Committee of Representatives of Governments and Administrations (CRGA) meet annually, and in the years that the Conference does not meet, is empowered to make decisions on the governance of SPC.

The Pacific covers some 30 million sq kilometres of ocean with more than 8 million people. The region is divided into 3 sub regions, Melanesia, Micronesia and Polynesia. The SPC’s role is to provide technical assistance to the Pacific Island Countries in the areas of land resources, public health, social sector, economic development and fisheries including aquaculture and marine ecosystems. The SPC’s vision for the region is a secure and prosperous Pacific Community whose people are educated and healthy and manage their resources in a sustainable way.

The SPC’s Division of Fisheries, Aquaculture and Marine Ecosystems, FAME as it is normally called, is one of the SPC core programme areas, who’s main work is to provide the 22 SPC’s member countries and territories with the information they need to make informed decision on the management and development of their aquatic resources, and help to provide the tools and strengthen the capacity needed to implement these decisions. FAME is composed of two programmes, the Oceanic Fisheries Programme (OFP) and the Coastal Fisheries Programme (CFP). The OFP is the Pacific Community’s regional centre for tuna fisheries research, fishery monitoring, stock assessment and data management. The CFP’s role is in the area of coastal fisheries, near-shore fisheries and aquaculture ensuring a sustainable development and management in the coastal fisheries sector. Aquaculture is one of the 3 sections within CFP which provides the Community’s regional framework for sustainable aquaculture in the areas of planning, research, development and trade for Pacific Island governments, private enterprises and relevant stakeholders.

Aside from climate change, one of the key challenges occurring in the Pacific is the growth in population which is predicted to increase by almost 50% across the region by 2030. Therefore the need to secure a prosperous future for the Pacific Community is of paramount importance to the Pacific Leaders and the region. Ensuring food security for the Pacific people through provision of good quality food and rewarding livelihood is a vital part of the equation.

The Pacific People associate themselves with the ocean and are simply “fish eating people”. Traditionally, people have looked to the ocean for most of the fish they eat. While coastal communities continue to look to coastal fishery to supply this need, coastal fishery alone will not be able to meet future demand if the growth in the Pacific population continues at its current rate. There is likely to be a short fall in fish supply, therefore a different approach is needed,
“aquaculture”, is required and need to be integrated in the current and future planning process as part of the solution for the Pacific.

### 2.2 Aquaculture in the Pacific

The SPC considers aquaculture as a relatively “new” sector within the Pacific region, with its history going back to 30-40 years in most countries. There is an absence of traditional knowledge for culturing fish and/or shellfish in the region, it’s simply catching them, except in very specialized instances and areas such as the ancient fish ponds in Oahu, Hawaii.

Modern aquaculture was tried first in various Pacific countries during the 50’s and the 60’s through various sources of funding and projects. As an example, in PNG, fish pond culture was first introduced to supplement protein deficient diet of the highland communities during the late 40’s. Several experimental fish culture stations were established during the 50’s, such as the Aiyura Agricultural Experimental Station, Bomana Quarantine Station, Dobel Fisheries Experimental Station and Kanudi Station. Rainbow trout (*Oncorhynchus mykiss*) was introduced in 1952 from Australia and New Zealand for release into streams and rivers where they became established, and a rainbow trout farm was established at Mendi, Southern Highlands Province, for rearing and release of imported rainbow trout ova.

One of the first farmable fish species spread around most of the Pacific was the Mossambicus tilapia, which was introduced from Africa during the 50’s to most countries and territories for “improvement of natural waters” to create a new freshwater fishery resource, and for bio-control of mosquitoes. Following its introduction it became well established in most of the countries where it was introduced. With hindsight it became known that Mozambique tilapia was the wrong species for cultivation and it never served this purpose. Its widespread invasion in the wild was touted by environmentalists as a red flag for aquaculture (Ponia, 2010).

In the 60’s and the 70’s other species were considered for the development of the aquaculture sector in the region, such as milkfish, seaweeds (mostly *Gracilaria* spp. and *Kappaphycus* spp.) or Nile tilapia. Most countries initiated the design and implementation of national aquaculture management and development plans, in order to provide a clear and transparent framework to main stakeholders involved in the sector.

The two major producing SPC-members within the region are French Polynesia and New Caledonia. Pearl oyster experimental culture trials started in 1961 in French Polynesia and were relatively successful. Farming activities were confined to the Tuamotu and Gambier archipelagos. Small-scale production amongst local Tahitian and foreign interests, mainly French and Japanese, developed into commercial farming as a joint venture initiative. Pearl cooperatives were formed and several private companies were established. In New Caledonia, the Mexican blue shrimp (*Litopenaeus stylirostris*) was introduced between 1978 and 1981. It was identified as the best candidate for aquaculture after trials with local and imported prawns. Since then, the same strain was used for commercial production until 2004, when a pathogen free broodstock was introduced from Hawaii to renew the genetic variability of New Caledonian prawns. Nowadays, there are 19 prawn farms in New Caledonia (around 670 ha), two conditioning plants, and two feed mills. The prawn farming industry employs about 1000 persons (full or part time employment - mostly unqualified staff) and produces about 1.500-2500 tons per year.

Compared to fishing, aquaculture still has limited commercial significance in the Pacific. Apart from the blacklip pearl oyster, which is a feasible and sustainable business in several Pacific countries, other species of current relevance are shrimp species (*Penaeus* spp.), whose farming has been a
focus of commercial development in several islands over the past 30 years, with varying degrees of success; Nile tilapia (*Oreochromis niloticus*) and freshwater prawn (*M. rosenbergii*), species that have entered the subsistence economy in many countries and territories; and seaweed (*Kappaphycus* spp.), which is now an export commodity for some countries in the region. The culture of other marine and freshwater species like mangrove crabs, scallops, sponges, or spiny lobsters is mostly at experimental or pilot-commercial stages.

3  Current status of the aquaculture sector in the Pacific

Freshwater aquaculture is supplying fresh and highly nutritious food to the rapidly growing rural and urban populations of the region. The number of households farming freshwater fish is increasing really quickly in certain countries such as Fiji, Vanuatu and PNG – as an example, the latest aquaculture data indicate that there are more than 15,000 farms (with 50,000 ponds) in PNG. Coastal aquaculture commodities, particularly pearls, shrimp and seaweed, make substantial contributions to livelihoods in some countries and territories. More than 7,000 people are employed full-time or part-time in coastal aquaculture, including 5,000 jobs in French Polynesia and 200–600 jobs in each of Cook Islands, Fiji, New Caledonia and Solomon Islands.

Despite the comparatively limited penetration of aquaculture into Pacific Island economies, and despite the loss of interest by some of the international development community after many short-term project failures, most of the Pacific Island governments have accepted the challenge. They recognize that expansion in capture fisheries is limited, and that in many places the catches and fish sizes are now decreasing. Meanwhile human populations are increasing, and the projected effects of climate change are that the situation in coastal fisheries will get worse. SPC member governments and administrations rank aquaculture development as high priorities in national development frameworks. They have made and continue to make substantial investments in freshwater aquaculture and mariculture.

4  Significance of the aquaculture sector for the Pacific region

Current aquaculture production among SPC-member Pacific Island Countries and Territories (PICTs) is worth around USD 200 - 250 million per year in total (2012). Value has been relatively stable at around this level for the last decade. The aquaculture sector in the Pacific is dominated by blacklip pearl (*P. margaritifera*) and marine shrimp (*L. stylirostris*), together making up to 90% of the total value of the sector, and being mostly reared in French Polynesia and New Caledonia, respectively, which are both French territories.

*Kappaphycus* seaweed (*K. alvarezii*) aquaculture is regarded as the third priority commodity in the region, with a total production of 3.100 metric tonnes (dry weight) in 2013. Seaweed farming is well established in the outer-island provinces of Kiribati, Fiji, Papua New Guinea (PNG) and Solomon Islands. It is relatively low in value, but high in socio-economic impact in remote and isolated areas of small-island micro-economies.

On the other hand small scale aquaculture, particularly small-pond aquaculture of Nile tilapia (*O. niloticus*) in PNG, Fiji, Vanuatu, Solomon Islands, Samoa, American Samoa, Guam, and Commonwealth of Northern Marianas, is the type of aquaculture next in social and economic importance among SPC-member PICTs, particularly for those that are ACP States. Tilapia aquaculture has been developed mainly for remote-area food security purposes and has not yet provided the same basis for private-sector led economic growth and employment as has been the case in Africa or
the Caribbean, however this trend is now beginning to emerge in some Pacific ACP States and there is much scope for up scaling of tilapia production.

Other commodities are currently moving from pilot projects to real commercial activities, but do not yet comprise significant industries. These include Freshwater prawn (*M. rosenbergii*) in Fiji, Vanuatu and PNG, among others; marine penaeid shrimp (*P. monodon and P. vannamei*) in Fiji, Guam and Vanuatu; milkfish (*Chanos chanos*) in Palau, Kiribati, Solomon Islands and French Polynesia, mud crab (*Scylla* spp.) in Fiji; marine finfish (e.g. barramundi, batfish *Platax orbicularis* and various grouper species) in Palau, Guam, New Caledonia, Vanuatu, PNG and French Polynesia; giant clams (various species of the genus *Tridacna* and *Hippopus*) in Palau, RMI, FSM, French Polynesia; and marine ornamentals such as corals and live rock in Tonga and Fiji. Sea grapes *Caulerpa racemosa* is the subject of farming trials in Samoa and Fiji.

In addition other species of relevance to the region that are being cultured both for commercial and for restocking and stock enhancement purposes include giant clam, trochus, green snail and sea cucumber (*Holothuria scabra*). Sea cucumber aquaculture for re-stocking of capture fisheries is now technically feasible and this is generating much interest, but appropriate marine tenure arrangements, community partnerships, and fishery compliance regimes need to be formed before investment in re-stocking is justifiable.  Trochus (*T. niloticus*) have been cultured for restocking purposes with promising results in many Pacific countries (e.g., Vanuatu, Samoa, Fiji among others). Green snail has had similar results to trochus; and giant clams (various species of *Tridacna* and *Hippopus*) is currently being farmed for restocking purposes in many countries of the region (e.g., Palau, Fiji, Vanuatu, Solomon Islands, Cook Islands, French Polynesia, FSM, RMI, among others).

Overall, in comparison to the situation of the aquaculture sector two decades ago, the sector in the Pacific has made progress to the extent that:

- At least 5 commodities are a proven basis for viable aquaculture businesses (pearl oysters, marine shrimp, Nile tilapia, *Kappaphycus* seaweed and freshwater prawn).
- Aquaculture facilities and infrastructure are now established in almost all countries of the region, though facilities are basic and often not well equipped.
- Local expertise and knowledge is currently available within the region.
- Improvements in terms of policy and legislation are being made at the national level with few countries having a stand-alone aquaculture legislation while others incorporating aquaculture as a component of their national fisheries legislations.
- National governments are starting to invest into aquaculture through national budgets into aquaculture development programmes such as improving infrastructure and human resources capacities.
- There is a track record of successes and failures from which lessons can be learned.
- Peoples’ liking for freshwater fish, like tilapia, is increasing.
- There are regional technical programmes in aquaculture, and regional training opportunities (e.g., SPC, FAO, private sector and University of the South Pacific, among others).
Table 1: Production (in metric tonnes: mT) of main producing countries within the Pacific Region (source Fishstatplus, FAO)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiji, Republic of</td>
<td>561.5</td>
<td>1618</td>
<td>830</td>
<td>888</td>
<td>670.03</td>
<td>767.5</td>
<td>646</td>
<td>700</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>2961.83</td>
<td>2483.1</td>
<td>2255.19</td>
<td>1945.68</td>
<td>1905.36</td>
<td>2184.44</td>
<td>2918.92</td>
<td>2654.56</td>
</tr>
<tr>
<td>Guam</td>
<td>160</td>
<td>162</td>
<td>162</td>
<td>162</td>
<td>140.5</td>
<td>129</td>
<td>111</td>
<td>111</td>
</tr>
<tr>
<td>Kiribati</td>
<td>5012</td>
<td>8849</td>
<td>1117</td>
<td>1094.14</td>
<td>1798.16</td>
<td>475</td>
<td>429</td>
<td>829</td>
</tr>
<tr>
<td>New Caledonia</td>
<td>2533</td>
<td>2365</td>
<td>1923</td>
<td>2103</td>
<td>1920</td>
<td>1220</td>
<td>1561</td>
<td>1663</td>
</tr>
<tr>
<td>Palau</td>
<td>5</td>
<td>5</td>
<td>18</td>
<td>20</td>
<td>41.88</td>
<td>25.11</td>
<td>23.58</td>
<td>35.91</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>491</td>
<td>691</td>
<td>841</td>
<td>1123</td>
<td>1372</td>
<td>1588</td>
<td>1621</td>
<td>1825</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>326</td>
<td>169</td>
<td>108</td>
<td>144</td>
<td>510</td>
<td>801</td>
<td>801</td>
<td>1300</td>
</tr>
<tr>
<td>Tonga</td>
<td>81</td>
<td>5</td>
<td>4</td>
<td>301</td>
<td>300</td>
<td>300</td>
<td>300</td>
<td>300</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>1</td>
<td>114</td>
<td>31</td>
<td>40</td>
<td>36.75</td>
<td>104.5</td>
<td>57</td>
<td>60.35</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>12132.33</strong></td>
<td><strong>16461.1</strong></td>
<td><strong>7289.19</strong></td>
<td><strong>7820.82</strong></td>
<td><strong>8694.68</strong></td>
<td><strong>7594.55</strong></td>
<td><strong>8468.5</strong></td>
<td><strong>9478.82</strong></td>
</tr>
</tbody>
</table>

Table 2: Aquaculture value (in USD) of main producing countries within the Pacific Region (Source Fishstatplus, FAO)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiji, Republic of</td>
<td>617.76</td>
<td>1619.61</td>
<td>985.99</td>
<td>1254.56</td>
<td>953.85</td>
<td>924.55</td>
<td>1048.73</td>
<td>1015.57</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>139597.1</td>
<td>131487.3</td>
<td>143902.3</td>
<td>123461.5</td>
<td>94949.51</td>
<td>86599.3</td>
<td>90166.04</td>
<td>80514.55</td>
</tr>
<tr>
<td>Guam</td>
<td>1333.5</td>
<td>1230.8</td>
<td>1391</td>
<td>1391</td>
<td>1188.5</td>
<td>1127.5</td>
<td>906.5</td>
<td>906.5</td>
</tr>
<tr>
<td>Kiribati</td>
<td>219.56</td>
<td>373.04</td>
<td>52.63</td>
<td>109.7</td>
<td>159.13</td>
<td>452.86</td>
<td>441.7</td>
<td>628.83</td>
</tr>
<tr>
<td>New Caledonia</td>
<td>21207.63</td>
<td>19958.27</td>
<td>16429.02</td>
<td>23600.78</td>
<td>19767.17</td>
<td>12084.08</td>
<td>17123.93</td>
<td>16915</td>
</tr>
<tr>
<td>Palau</td>
<td>21</td>
<td>21</td>
<td>79.84</td>
<td>73.14</td>
<td>152.89</td>
<td>130.56</td>
<td>136.42</td>
<td>218.22</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>1533</td>
<td>2193.93</td>
<td>2722.96</td>
<td>4064.52</td>
<td>4784.53</td>
<td>6158.82</td>
<td>7962.76</td>
<td>10033.53</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>86.59</td>
<td>33.33</td>
<td>35.17</td>
<td>71.63</td>
<td>191.95</td>
<td>299.6</td>
<td>316.53</td>
<td>534.24</td>
</tr>
<tr>
<td>Tonga</td>
<td>21</td>
<td>25</td>
<td>20</td>
<td>65</td>
<td>60</td>
<td>60</td>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>4.12</td>
<td>765.95</td>
<td>389.36</td>
<td>427.05</td>
<td>182.16</td>
<td>906.8</td>
<td>581.32</td>
<td>648.87</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>692158.6</strong></td>
<td><strong>784528.2</strong></td>
<td><strong>1098836</strong></td>
<td><strong>1093996</strong></td>
<td><strong>790221.6</strong></td>
<td><strong>1105051</strong></td>
<td><strong>1167987</strong></td>
<td><strong>1243501</strong></td>
</tr>
</tbody>
</table>

Figure 1: Aquaculture productions (in metric tonnes: mT) of main producing countries within the Pacific region for 2012.
4.1 Main commodities farmed in the Pacific region

Pearls are the region’s most valuable commodity through the farming of black lipped pearl oyster (*Pinctada margaritifera*), silver-lip oyster (*Pinctada maxima*) and winged oyster (*Pteria penguin*), although black pearls makes up the bulk of production. This followed by crustaceans, mainly the blue shrimp (*Litopenaeus stylirostris*).

There are however other significant aquaculture commodities apart from black pearls and blue shrimp which have been proven on the basis of their viability and are very well sustained such as Pacific oyster in New Caledonia, seaweed in Kiribati and Solomon Islands and finfish mainly nile tilapia (*Oreochromis niloticus*) in Fiji, Vanuatu and PNG (Fig 2).

![Other significant aquaculture activities in the PICTs (Source: Hambrey Consulting 2011).](image)

### 4.2. Main producing countries in the Pacific region

The main producing countries are categorized in terms of the commodity produced and its contribution in terms of value to the overall aquaculture production in the region. The leading producers are the French Territories of New Caledonia and French Polynesia on pearls and blue shrimp, Fiji on pearl production, Papua New Guinea on nile tilapia, and Solomon Islands and Kiribati on seaweed. There has been a dramatic decline on pearl production from Cook Islands since 2009 due to disease and environmentally related problems. Table 3 provides a list of countries and species produced.

<table>
<thead>
<tr>
<th>Countries</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Caledonia</td>
<td>Blue shrimp, sandfish, lobster and scallops</td>
</tr>
<tr>
<td>French Polynesia</td>
<td>Blacklip pearl oyster, blue shrimp, platax, milkfish and giant clams</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>Nile tilapia, common carp, rainbow trout, barramundi, giant tiger shrimp, freshwater prawn and cottonii seaweeds</td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>Cottonii seaweeds, giant clams and corals</td>
</tr>
<tr>
<td>Kiribati</td>
<td>Cottonii seaweed, giant clams and sandfish</td>
</tr>
<tr>
<td>Vanuatu</td>
<td>Nile tilapia, freshwater prawn, <em>M. lar</em>, barramundi, red tilapia, white shrimp, giant tiger prawn, trochus, giant clams</td>
</tr>
<tr>
<td>Fiji</td>
<td>Nile tilapia, freshwater prawn, common carp, blacklip pearl oyster, giant clams, sandfish, white shrimp, giant tiger prawn, cottonii seaweed and sea grapes</td>
</tr>
<tr>
<td>RMI</td>
<td>Corals, giant clams and various species of groupers</td>
</tr>
<tr>
<td>FSM</td>
<td>Corals, sponges, giant clams, sandfish and blacklip pearl oyster</td>
</tr>
</tbody>
</table>
4.3 Main markets and international quality standards

4.3.1 Markets

Market varies hugely between and within PICTs but presents a number of fundamental opportunities as well as constraints that worth highlighting. In discussing market, it is also worth presenting relevant examples from countries. The continuing growth in urbanization through influx of movement of people from rural to urban centres in search for employment and better life contributes to the increasing demand for fish supply. This adds to the growth in the tourism sector faced in some PICTs. Though the challenge remains that cheap import particularly from countries which have a long history of aquaculture such as Asia makes it difficult for local producers to even compete domestically.

Some examples of products produced targeting domestic and international markets in some PICTs are highlighted below:

- Kiribati, **giant clam** production and export for the aquarium trade market in Europe: the Company cultured clams in collaboration with small scale community farmers and harvest clams are sold to aquarium companies in Germany and the USA. The key issue is maintaining compliance with CITES.
- Fiji, **black pearls** is cultured and produced by JH Pearls and targets the flourishing local tourism market.
- Cook Islands, **black pearls** production: Pearl production in the Cook Is has suffered a serious set-back in 2007 with disease and environmental related issues and poor infrastructure and equipment facilities being some of the key factor. The industry is reviving partly due to a vibrant tourism industry experienced in the country.
- Palau, **milkfish** production: Production for milkfish in pond culture supports the domestic market for food and baitfish. Potential for export may be hard to compete against the high production of the Philippines.
- New Caledonia, **blue shrimp** production: there is an established export to Japan, New Zealand and France as well as a strong domestic market. Key challenge remains to continue to strengthen industry capacity on aquatic biosecurity.
- Federated States of Micronesia, **giant clam** production: cultured clams produced from hatchery and cultured in the ocean is harvested and supplied to the aquarium operators in Europe. Private Sector in collaboration with the government is taking the lead on giant clam farming. Maintaining compliance with CITES is important.
- Samoa, community type **tilapia** production: both GIFT and Chitralada strains of tilapia are cultured by over 20 subsistence farmers targeting local domestic market.
- Vanuatu, **tilapia** and **barramundi** pond and cage culture: Over 50 small scale community type farms culturing GIFT tilapia for village base market. Similarly, a locally-based entrepreneur is producing red tilapia and barramundi for the domestic market on a commercial basis with expansion recently for export products to a niche market in Fiji.
- Fiji, **tilapia** farming: there is a strong presence of small scale community and individual type farming of tilapia which is easily absorbed in the domestic market.
- Federated States of Micronesia, **sponge** farming is well established in collaboration with a number of community farmers producing sponges for the overseas market.
- Papua New Guinea, trout, carp and tilapia production: Commercial aquaculture activity is new in PNG but there is a high interest in subsistence aquaculture with approximately 6,000 trout and carp farmers supplying for the domestic market. Tilapia is also gaining footing in Port Moresby. Given the expansion in the development of the mining industry in the country, demand for fish to meet domestic market is very high.
4.3.2 Standards

In terms of meeting market requirements and standards two organizations stand out for the PICTs, WTO and Codex Alimentarius.

World trade organization

Some Pacific countries and territories are members of the World Trade Organization (WTO), which is the international forum to negotiate trade agreements and that set up basic international standards for trade.

One of the major commitments as members of the WTO is the obligation to report on animal health status, including aquatic animal health, to the World Animal Health Organization (OIE), which is recognised as a reference organisation by the World Trade Organization (WTO).

Most countries within the Pacific region are not members of the OIE, although they report periodically to this organization through an agreement SPC-OIE, in order to maintain and strengthen their trade agreements with Europe regarding the aquatic species for the ornamental market.

Pacific Island country and territories have an obligation to maintain biosecurity through their commitments to international agreements such as the World Trade Organization, Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) and the United Nation’s Convention on Biological Diversity (CBD).

Codex Alimentarius

Aquaculture products for human consumption, countries are required to adopt the international standards set by the Codex Alimentarius Commission, which was established by FAO and the World Health Organization (WHO) in 1963, which develops harmonised international food standards, guidelines and codes of practice to protect the health of the consumers and ensure fair practices in the food trade. The Commission also promotes coordination of all food standards work undertaken by international governmental and non-governmental organizations.

4.4 Relevant stakeholders in the region

The SPC aquaculture program was established in the early 2000s as the lead agency to provide technical services, coordinate capacity building and a clearing house for information. The efforts by national fisheries administrations, SPC and FAO have been augmented by those of other technical agencies including ACIAR, WFC, JICA, FAO and so to name a few. For the most part, these activities lacked formal coordination mechanisms at a regional level. Table 4 provides a list of relevant agencies involved in aquaculture in the region.
Table 4 Institutions providing support to aquaculture in the Pacific region

<table>
<thead>
<tr>
<th>Donors</th>
<th>Training centres</th>
<th>Research institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACIAR</td>
<td>University of the South Pacific</td>
<td>IRD</td>
</tr>
<tr>
<td>DFAT (formerly AusAID)</td>
<td>University of Guam</td>
<td>IFREMER</td>
</tr>
<tr>
<td>French Pacific Fund</td>
<td>James Cook University</td>
<td>CRIOBE</td>
</tr>
<tr>
<td>Agence Francaise de Developpement</td>
<td>University of New Caledonia</td>
<td>Institute of Marine Science (USP)</td>
</tr>
<tr>
<td>European Union</td>
<td>Queensland University</td>
<td>University of the South Pacific</td>
</tr>
<tr>
<td>New Zealand Aid Programme</td>
<td>Micronesia College</td>
<td>James Cook University</td>
</tr>
<tr>
<td>Japanese Government (Japan Grassroot Funds/JICA/OFCF)</td>
<td>University of French Polynesia</td>
<td>Tongareva Marine Research Centre</td>
</tr>
<tr>
<td>Food and Agriculture Organization (FAO)</td>
<td>Fiji National University (FNU)</td>
<td>Aquaculture Technical Centre of New Caledonia</td>
</tr>
<tr>
<td>GIZ</td>
<td>Guam Aquaculture Development and Training Centre</td>
<td>Mariculture Technical Centre of New Caledonia</td>
</tr>
<tr>
<td>Taiwanese Cooperation Programme</td>
<td>National Fisheries College (PNG)</td>
<td>NIRFM (PNG)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WorldFish Centre (WFC)</td>
</tr>
</tbody>
</table>

4.5 Main hatchery and aquaculture facilities within the region

Most countries in the region as in the case of the 4 countries used in the case study have hatcheries in place. Most hatcheries in the region are established pretty much around similar period during the late 1980s under aid funded programmes and these are government run. In some countries the hatcheries are basic and primitive and as a result they appear to be under performing and cannot meet the current demand. As a result this leads to high mortality and decline in productivity, high operational cost due to less efficiency in utility consumption, lack of funding to maintain hatchery facilities and the difficulty to make an impact on the development in aquaculture through poor infrastructure.

Some member countries such as the French Territories (French Polynesia & New Caledonia) have better hatchery facilities due to a high level of government policy support in research and development which is evident in the growth in aquaculture in these Territories. Some of the most common hatcheries in the region include: Palau Mariculture Demonstration Centre in Palau, National Aquaculture Centre in Kosrae, Federated States of Micronesia, Tanaea Mariculture Hatchery in Tanaea, Kiribati, Nadururolo Aquaculture Research Centre, Fiji, Sopu Aquaculture Research Centre in Tonga, IFREMER in New Caledonia, WorldFish Centre in Nusa Tupe, Solomon Islands, and Mariculture hatchery in Port Vila, Vanuatu. Table 5 provides a complete list of hatcheries in the region.

However, some countries are starting to make investments into hatchery establishments and renovations through their national governments national budget contributions. This has become apparent partly due to some traditional donor partners not funding the usual “brick and mortar” anymore forcing small island economies to prioritise national budget contributions to sectors such as aquaculture which has previously not been the case. Recent examples include:

- Fiji Government investing into a new multi-species hatchery in the Western Division of Fiji Islands in 2013
- Samoa Government investing on a new mariculture hatchery in 2013
Table 5 List of List of aquaculture facilities by countries in the Pacific region

<table>
<thead>
<tr>
<th>Institution/facility</th>
<th>Country</th>
<th>Main species produced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Araura Marine Research Station (AMRS)</td>
<td>Cook Islands</td>
<td>Giant clam hatchery</td>
</tr>
<tr>
<td>Tongareva Marine Research Centre (TMRC)</td>
<td>Cook Islands</td>
<td>Blacklip pearl oyster hatchery</td>
</tr>
<tr>
<td>College of Micronesia (COM-FSM)</td>
<td>FSM, Pohnpei</td>
<td>Blacklip pearl oyster and sandfish hatchery</td>
</tr>
<tr>
<td>National Aquaculture Centre (NAC)</td>
<td>FSM, Kosrae</td>
<td>Giant clam, hatchery</td>
</tr>
<tr>
<td>Naduruloulou Freshwater Research Station</td>
<td>Fiji</td>
<td>Nile tilapia, common carp and freshwater prawn hatchery</td>
</tr>
<tr>
<td>Galoa mariculture hatchery</td>
<td>Fiji</td>
<td>White shrimp and sandfish hatchery</td>
</tr>
<tr>
<td>Caboni hatchery</td>
<td>Fiji</td>
<td>Nile tilapia hatchery</td>
</tr>
<tr>
<td>Aquaculture Technical Centre</td>
<td>French Polynesia</td>
<td>Platax orbicularis and blue shrimp hatchery</td>
</tr>
<tr>
<td>Blacklip pearl oyster research centre</td>
<td>French Polynesia</td>
<td>Black lip pearl oyster hatchery</td>
</tr>
<tr>
<td>The Guam Aquaculture Development and Training Centre (GADTC)</td>
<td>Guam</td>
<td>Nile tilapia, white shrimp and coral trout hatchery</td>
</tr>
<tr>
<td>Tanaea hatchery</td>
<td>Kiribati</td>
<td>Sandfish, giant clam trochus and seaweed centre</td>
</tr>
<tr>
<td>TTM hatchery</td>
<td>Kiribati</td>
<td>Milkfish hatchery</td>
</tr>
<tr>
<td>Atoll beauties hatchery</td>
<td>Kiribati</td>
<td>Giant clam hatchery</td>
</tr>
<tr>
<td>College of Marshall Islands, Science Station (MISS) aquaculture facility</td>
<td>RMI</td>
<td>Giant clam and blacklip pearl oyster hatchery</td>
</tr>
<tr>
<td>Aquaculture technical centre</td>
<td>New Caledonia</td>
<td>Blue shrimp hatchery</td>
</tr>
<tr>
<td>Mariculture technical centre</td>
<td>New Caledonia</td>
<td>Grouper (various species) hatchery</td>
</tr>
<tr>
<td>Ome aquaculture society</td>
<td>New Caledonia</td>
<td>Sandfish hatchery</td>
</tr>
<tr>
<td>Palau Mariculture Demonstration Centre hatchery (PMDC)</td>
<td>Palau</td>
<td>Giant clam and trochus hatchery</td>
</tr>
<tr>
<td>Marine finfish hatchery</td>
<td>Palau</td>
<td>Grouper (various species) hatchery</td>
</tr>
<tr>
<td>Micronesia college</td>
<td>Palau</td>
<td>Rabbitfish hatchery</td>
</tr>
<tr>
<td>Highlands Aquaculture Development Centre (HAQDEC), Aiyura</td>
<td>PNG</td>
<td>Rainbow trout, common carp and Nile tilapia hatchery</td>
</tr>
<tr>
<td>University of PNG</td>
<td>PNG</td>
<td>Freshwater prawn hatchery</td>
</tr>
<tr>
<td>NIMRF</td>
<td>PNG</td>
<td>Ornamental species hatchery</td>
</tr>
<tr>
<td>Milne bay Ltd</td>
<td>PNG</td>
<td>Seaweed distribution centre</td>
</tr>
<tr>
<td>Bismarck Barramundi Ltd</td>
<td>PNG</td>
<td>Barramundi hatchery</td>
</tr>
<tr>
<td>Fisheries Division hatchery</td>
<td>Samoa</td>
<td>Nile tilapia hatchery</td>
</tr>
<tr>
<td>Toloa Multispecies hatchery</td>
<td>Samoa</td>
<td>Giant clam hatchery and caulerpa distribution centre</td>
</tr>
<tr>
<td>WorldFish Center Nuse Tupe station</td>
<td>Solomon Islands</td>
<td>Giant clam hatchery</td>
</tr>
<tr>
<td>Sopu Mariculture Centre, Ministry of Fisheries</td>
<td>Tonga</td>
<td>Giant clam hatchery</td>
</tr>
<tr>
<td>Vanuatu Fisheries Department Multi-species Hatchery</td>
<td>Vanuatu</td>
<td>Giant clam, trochus, and green snail hatchery</td>
</tr>
<tr>
<td>Tagabe Freshwater hatchery</td>
<td>Vanuatu</td>
<td>Nile tilapia and freshwater prawn hatchery</td>
</tr>
<tr>
<td>Teouma Prawns</td>
<td>Vanuatu</td>
<td>Giant tiger prawn hatchery and white shrimp farm</td>
</tr>
</tbody>
</table>
5. Contribution of aquaculture to food and nutrition security

Small and medium scale aquaculture of lower-value freshwater finfish (e.g., Nile tilapia, common carp, and milkfish among others) for food and nutrition security, which historically was the initial reason to promote aquaculture in the Pacific, is now gaining even higher priority. This is particularly so in places where there are significant urban or inland-rural populations. Main reasons for this increased significance of small scale freshwater aquaculture are:

(i) the growing urban and peri-urban population in many Pacific countries;
(ii) the increase in the acceptance of freshwater fish in Pacific communities, and
(iii) the decline in coastal fisheries, driven by overfishing to feed increasing populations, and loss of fish habitat due to impacts on coral reefs of climate change.

Pacific people are traditional consumers of seafood which plays an important part in their diets and overall wellness. Domestic market opportunities for aquaculture remain strong, and the economic contribution that can be made by import substitution is extremely significant, more specifically in countries with a strong tourism or mining industry such as Fiji, Vanuatu and PNG, where high quality aquaculture products are imported in big quantities every week from Asian markets. Aquaculture industry development should not be geared only toward exports, particularly because price-competitiveness and regulatory compliance can be problematic, but should also aim at meeting strong domestic-market demand and help reduce fiscal leakage from tourism and mining sectors.

Some examples from member countries provided by Bell et. al (2011) on contribution to food security, highlighting the countries that were used in the present case study. The following countries were among PICTs highlighted where estimated production from their coastal fisheries will be unable to supply national population with 35kg of fish per person per year recommended for good nutrition:

- **Fiji**: average national fish consumption is estimated to be 21kg per person per year, well below the recommended level for good nutrition. The country will require an additional 34,200 tonnes by year 2035 to meet its food security requirement due to its predicted growth in population. In filling the gap pond aquaculture is identified as a strategy to contribute to meeting the short fall.

- **Kiribati**: average national fish consumption is estimated to be 67kg per person per year, well above the recommended level for good nutrition. The country will require an additional 9,000 tonnes needed by year 2035 to meet its food security requirement due to its predicted growth in population. In filling the gap, coastal aquaculture activity such as milkfish farming is identified as a strategy to contribute to meeting the gap in fish supply.

- **Samoa**: average national fish consumption is estimated to be 87kg per person per year, well above the recommended level for good nutrition. The country will require an additional 17,600 tonnes by 2035 to meet its food security requirement due to its predicted growth in population. Developing pond aquaculture to diversify the supply of fish is identified as a strategy to contribute to meeting the gap in fish supply.

- **Vanuatu**: average national fish consumption is estimated to be 20kg per person per year, well below the recommended level for good nutrition. The country will require an additional 14,800 tonnes by year 2035 to meet its food security requirement due to its predicted growth in population. In filling the gap developing pond aquaculture is identified as a strategy to contribute to meeting the short fall.
6. Contribution of aquaculture to income generation

Aquaculture in the Pacific Region comprises diverse systems of farming plants and animals in inland and coastal areas and often complements other food production systems. In the context of the rural poor or isolated communities of our region, aquaculture complements catches from traditional capture fisheries. The capture or culture of aquatic species forms the basis of food security in PICTs, enabling the use of livestock or cultured fish as a source of income generation. It should be mentioned that aquaculture is an attractive and important component of rural livelihoods in situations where increasing population pressures, environmental degradation or loss of access limit catches from wild fisheries.

Statistics is often poor in terms of the number of farm units, contribution to employment and gender. More difficult is to be able to determine the level of employment aquaculture provides on community type aquaculture systems in terms of full-time or part time employment as spending time on aquaculture in a village environment is just one part of a daily routine while there are other aspects such as subsistence farming or artisanal fishing which an individual or community member is engaged in on a daily basis. However some statistical figures from 2007 taken from Ponia (2010) are highlighted below for some countries engaging in pearl, shrimp and tilapia aquaculture:

- Cook Islands: number of farm units is estimated at 80, with 450 persons employed.
- Fiji: 50 farm units with 280 persons employed
- French Polynesia:530 farm units with 5,000 persons employed
- New Caledonia: 40 farm units with 560 persons employed
- PNG: 2500 farm units with 3,000 persons employed

In 2010, it was estimated that the region had 14,439 farm units with 20,323 persons employed in the aquaculture sector.

In terms of gender, Pacific women play a very important role in coastal fisheries and in aquaculture, particularly community based aquaculture, it is a family involvement where women and children in involved. Formal assessments to quantify the involvement of women and children in aquaculture are lacking and it is important that these are undertaken. A recent study funded by the Australian Centre for International Agriculture Research (ACIAR) is underway in Fiji, Kiribati Samoa and Vanuatu to determine the role of women and children in aquaculture production and marketing with the intention that the findings for this assessment will be easily transferred to other Pacific countries.
7. Key areas for long-term sustainability

7.1. Aquatic biosecurity (including Risk analysis and aquatic animal health management)

As mentioned above, the aquaculture sector contributes greatly to improving food and nutrition security and increasing livelihoods within the Pacific region; but it should be noted that the majority of the aquatic animals being successfully cultured in the region are introduced species (e.g., Nile tilapia, freshwater prawn, common carp, Mexican blue shrimp, Kappaphycus seaweed), and new species introductions are being pursued for further aquaculture development. On the other hand, aquatic animal diseases are a significant threat to the sustainability and productivity of aquaculture in the region. Potential threats for trans-boundary diseases spreading cannot be overlooked.

Furthermore, the geographical isolation of countries, the limited availability of specialist expertise and resources, and narrow prospects for development of specialist capability across multiple disciplines are some of the significant challenges that PICTs face in implementing sustainable aquaculture development and effective biosecurity governance programmes.

Both the relevance of aquatic biosecurity for Pacific Island Nations and Territories and feasible approaches to develop a regional pathway to deal with it has been addressed at a number of regional fora: the 2007 Regional Workshop on Implementing Ecosystem Approach to Coastal Fisheries and Aquaculture, organized by SPC and supported by FAO; the 6th Heads of Fisheries (HOF) in 2008; 5th FAO COFI Sub-Committee on Aquaculture; and at the 2011 joint SPC/FAO Regional Aquaculture Scoping Workshop, among others.

Pacific States have very limited capacity to detect and manage diseases of aquatic organisms. There are currently no formal aquatic biosecurity networks in place to enable timely detection of disease, or do deal with outbreaks should they occur. Similarly, there is no long tradition of aquaculture whereby local aquatic species have been domesticated: this creates demand to introduce species from elsewhere. To develop, yet also protect biodiversity, in the island Pacific, there is a strong need for responsible practices.

Main actions to be considered:

• Develop a regional biosecurity framework based upon an assessment of national/regional capacities and performance survey, and identification of priority issues.
• Conduct research and collate case studies to address knowledge gaps in decision-making and management of aquatic animal diseases and aquatic species introductions.
• Develop minimum standards for biosecurity in the region based upon compliance with international norms.
• Improve national capacity to collect, compile and analyse data on aquatic animal health.
• Promote the exchange of information on aquatic animal health within the region (e.g. through the establishment of “regional disease information systems” and through WAHIS – world’s animal health information system - OIE).
• Utilise available data collection and disease information systems.
• Establish commodity-specific inter-regional networks of practitioners to exchange aquatic animal health scientific information and farm management experiences, for example in blacklip pearl oyster.
7.2. Policy issues/good governance

There is a notable absence of specific aquaculture policies at both regional and national levels in the Pacific region. Much of aquaculture policy-making is embedded in wider fisheries sectorial planning and is often production-focused, rather than providing a platform for sustainable aquaculture development (Huntington & Shelley 2013). In most cases, countries and territories have complex marine tenure systems, no specific aquaculture legislation, and no formal processes to allocate space, consider other coastal users, or protect aquaculture rights once allocated.

The SPC has been assisting member countries in developing their aquaculture potentials through providing technical advice and trainings. Member countries are being provided with assistance on the development of national aquaculture development plans which focus on prioritizing potential commodities available or of interest to the countries on the basis of their feasibility and potential impacts to the country. Such plans mirror the SPC’s Action Plan (2007). In recent years, national aquaculture plans have been developed for Samoa, Solomon Islands, Cook Islands, CNMI, Vanuatu, Nauru and FSM.

SPC is providing assistance to member countries on the development of legal frameworks that are needs to support aquaculture development. Recent assistance has been provided to Fiji, Cook Islands, Tonga, Papua New Guinea and Vanuatu.

However, aquaculture development in the Pacific Island region has largely occurred in a policy vacuum; and that this has undoubtedly contributed to the sector’s slow and uncertain growth since its inception. Indicators of this lack of policy direction include: (i) a dearth of strategic analysis and resultant plans, resulting in both government and donor-led aquaculture development activities often having limited commercial viability or long-term economic sustainability; and (ii) a marked reluctance for private sector investment in aquaculture in the Pacific compared to other similar biogeographic regions.

Main actions to be considered:
- Establish and adapt generic principles, give assistance with drafting, and provide model-law templates to policy makers on aquaculture legislation development.
- Review of interface between marine tenure arrangements and rights allocation mechanisms for aquaculture.
- Improve aquaculture statistics/data collection systems for collection and analysis of aquaculture data to monitor progress of development and underpin aquaculture policy and decision-making.

7.3. Private public partnership

Small-scale aquaculture for subsistence purposes is only viable with on-going government support and subsidy of farm inputs (e.g., seeds, feeds, brooders, equipment, etc). Even so, household-level aquaculture for food security is seen as important and political support for it remains high. There is a need to boost “aquaculture as a private initiative/business” as much as possible, in order to avoid unnecessary drain on the public purse. From the present layer of small-scale and subsistence fish farmers, the next challenge is to add a layer of viable small-medium scale commercially-oriented aquaculture for peri-urban markets.

Main actions to be considered:
• Increase capacities and skills of countries and territories to assess the economic and social viability of aquaculture projects and investments.
• Support small-scale aquaculture enterprises and increase economies of scale by adopting from other regions of the world (e.g., Africa and Asia) the concepts of “farm clusters” built around “lead farmers” and competent extension agents.
• Encourage private-sector mechanisms for provision of aquaculture services.
• Directly support selected Pacific aquaculture enterprises to increase production, competitiveness and sustainability, through targeted assistance to address production constraints and increase business literacy.
• Foster exchange of ideas and experiences between the three ACP regions through creation of formal channels for “south-south” cooperation in aquaculture promotion and development.
• Improve national policies/legal frameworks to promote private sector led growth in aquaculture but recognizing that some PICTs have very weak private sector.
• Improve access to market/production information.

7.4. Input supply: feeds, seeds, broodstock

Regional collaborative approaches towards aquaculture inputs (e.g., seeds, feeds, broodstock, etc) have been mooted to achieve economies of scale through centralization of broodstock maintenance, fry or post-larvae production, as well as fish feed manufacture. Nationally, this centralization process requires designation and upgrade of certain key infrastructure to undertake these roles, including improvement of their ability to support biosecurity roles (e.g. quarantine of aquatic organisms).

Main actions to be considered:
• Establish a central distribution centre (“regional hub”) for broodstock, seed, and/or feed among Pacific ACP countries to achieve economies of scale.
• Construct/upgrade aquaculture infrastructures to support regional or sub-regional roles, and to increase capacity in biosecurity.
• Increase capacity in broodstock selection and maintenance of genetic quality and fry production.
• Develop a trade directory for farm inputs (seed, feed, technology) and examine options for a one-stop shop approach.
• Strengthen applied research to solve nationally relevant constraints (e.g., feed, seed and production systems).

8. Main limitations and constraints faced by the region

There are a number of limitations and constraints faced by the aquaculture sector in the region and the key ones are identified:
• Transport limitations. Extremely high shipment costs in the Pacific add considerably to the cost of producing and exporting aquaculture products. Limited internal transport services restrict opportunities to grow perishable products in remote locations, and limited international air connections inhibit continuity of supply to export markets. Transport arrangements dictate that species cultured for export need to be of high value and low weight. Alternatively, the products must be non-perishable (processed products such as seaweeds) or frozen (blue shrimp) so that they can be shipped easily.
• The Pacific has been relatively slow to turn “potential” into “production”. The socioeconomic aspects of the sector have been given less importance that the technical ones, this leading to
many unfeasible and unviable aquaculture projects and actions being implemented, which have created a bad public image of the sector within the region and among donors.

- Limited domestic markets. Local markets for the fresh products of aquaculture in the Pacific are relatively small, except from a few exemptions (e.g., PNG, Fiji, Vanuatu, New Caledonia, and French Polynesia). For this reason, most of the large-scale aquaculture development in the Pacific catering to the trade in seafood might depend heavily on export markets.

- Poor control on importation of aquaculture products into the country and thus affecting locally produced aquaculture products ability to compete.

- Not enough emphasis on private sector uptake of aquaculture. Government agencies need to better clarify their roles to lessen interference with, and create enabling environments for, private investment (while noting that, in some Pacific ACPs, the private sector is very small).

- Limited policies and regulatory frameworks to govern aquaculture in a sustainable, secure and attractive way to private investors and individual fish farmers.

- Availability of farm inputs with the region is a major constraint (e.g., feed, seed, capital, equipment).

- Regarding indigenous species, most freshwater finfish have marine ancestries; therefore have complex life histories and tricky larval phases. Furthermore, although Pacific states have unique species, domestic and export markets are quite unfamiliar with most of these.

- Absence of science-based information on potential aquaculture commodities that may be attractive to potential business investors when needed.

- Limited capacity in undertaking potential aquatic disease surveillance which is presently not done but it should be undertaken.

9. Main opportunities for the sector

The Pacific region with its physical, natural, environmental, cultural and demographic endowments is perceived as a source of comparative advantage and provides an opportunity for developments in aquaculture. The followings are a number of opportunities for the development of aquaculture in the region:

- Availability of sites for all types of aquaculture systems.

- There is high biodiversity and many unique species.

- Largely free of relevant aquatic animal diseases.

- Small-scale livelihoods opportunities for communities are contained within larger aquaculture businesses (e.g. pearl spat catching, pearl handicrafts, custodianship of re-stocked sea cucumbers, etc)

- Small niche-market opportunities for exports of unique species (e.g., corals, giant clams, certain ornamental marine finfish).
• There are major opportunities for import substitution in various countries (e.g., PNG, Vanuatu, Fiji, and New Caledonia among others). Domestic demand for seafood is the Pacific aquaculture sector’s greatest strength.

• Freshwater aquaculture for food security and livelihoods can be an adaptation to the effects of climate change on coastal fisheries.

10. Areas where support is needed

• Support aquaculture input supply (seeds, feeds, equipment, materials, etc).

• Support good governance in terms of policies, legislations, development and management plans.

• Provide appropriate socioeconomic assessments.

• Strengthen aquaculture statistics and data bases.

• Strengthen aquatic biosecurity.

• Provide responsible access to genetically improved fish varieties for aquaculture.

• Further research on indigenous species with aquaculture potential.

• Focus efforts upon promoting the high-priority species (do not develop too many species at once).

• Build capacity of aquaculture staff and practitioners, including training exchanges such as inter-ACP collaboration and EU-ACP collaboration, while accepting that high staff turn-over is a fact of life in Pacific administrations.

• Improve aquaculture infrastructure, especially to meet national responsibilities in brood stock management, to provide bio-secure facilities for quarantine, and to support fledgling private sector with aquaculture inputs (seed, feed).

• Strengthen capacity of aquaculture associations or organizations to support their sector.

• Private sector development and up-scaling of production from research phase to commercial phase.

• Provide opportunities to access to finance for aquaculture projects.

• Improve net-working and collaboration, technology and skills and research transfer, and technical advice, because the Pacific does not have a good network for aquaculture within the region, let alone with Africa or Caribbean.

• Strengthen markets for aquaculture products in the domestic market to meet demand for fish locally and for import substitution.
11. The way forward

Public-private partnerships: Pacific islands aquaculture will always be small by global standards, yet within “micro-economies” a small amount of aquaculture can have a large impact in peoples’ lives. There are clear aquaculture successes in our region, from which lessons can be learned. The main one is that best success occurs if aquaculture is run as a business. At the very least, aquaculture projects need to be placed on a business-like footing whereby revenue is sufficient to at least cover the cost of production inputs.

Access to inputs and good governance: moreover, business-like aquaculture requires investment and security. It can be seen that such investment flows to places where secure property rights can over farmed fish can be obtained, and where statutory decision-making processes over the establishment of aquaculture businesses are clear and timely.

Community engagement in aquaculture works best when technology is simple and accessible, and the aquaculture activity blends in with traditional rural lifestyles and other agricultural practices. In addition, the expansion of aquaculture in the Pacific will depend on providing better production methods for species currently being farmed as well as improving the infrastructure for propagating the species being farmed.

Experiences in other regions demonstrate that aquatic animal diseases and invasive species can devastate aquaculture industries, causing heavy economic losses. The insular Pacific is still free of relevant aquatic animal diseases and problematic invasive aquatic species. Maintenance of this status will be necessary if the aquaculture advantages of the region are to be capitalized upon. On the other hand, the Pacific region has few indigenous species with the necessary combination of both agronomic and market traits for successful aquaculture. Four of the top five Pacific success stories are based upon introduced species. Provided it can be done responsibly, access to improved varieties of these species will be important to maintain competitiveness and adapt to climate change.
References


Hambrey, 2011. *Opportunities for the development of the Pacific Island mariculture Sector.* (Secretariat of the Pacific Community, Noumea, New Caledonia, 123p).


Annex I: Country case studies for Vanuatu, Samoa, Fiji and Kiribati
Country Report: Vanuatu

Study on the Potential of Aquaculture in the Pacific

(Photo: Red tilapia cage culture at Vate Ocean Gardens, Vanuatu)
Background

Vanuatu consists of over 80 islands and has a land area of 11,880 km$^2$ and a coastline of 2,528km. Main aquaculture commodity involves shrimp, barramundi, tilapia and freshwater prawn (Macrobachium rosenbergii) which has recently being introduced.

This brief report was prepared in support of a wider study on the “Potential of Aquaculture in the Pacific” for the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA) and forms one of a set of four country case studies undertaken between June and August 2014. Reports were prepared for the following countries: Fiji, Kiribati, Samoa and Vanuatu. Roughly one week was spent in each country including site visits and discussion with stakeholders.

1. SIGNIFICANCE OF THE NATIONAL AQUACULTURE SECTOR

Priority aquaculture commodities cultured in Vanuatu at present

a. Freshwater fish tilapia (Oreochromis niloticus)
b. Freshwater fish Pangasius (Pangasius hypophthalmus)
c. Finfish Barramundi (Lates calcarifer)
d. Freshwater prawn Macrobachium rosenbergii & M. lar
e. Marine shrimp (Litopenaeus vanamei, Penaeus monodon)
f. Marine ornamentals (giant clam, corals)
g. Trochus (Trochus niloticus) & Green snail (Turbo marmoratus)

Relevant stakeholders engaged in Vanuatu aquaculture

a. JICA/ Japan Embassy: Under the Japan Grassroot Funds assistance was provided to Vanuatu Fisheries to establish the Tagabe Aquaculture Station
b. QUT: providing technical assistance on freshwater prawn M. rosenbergii aquaculture
c. SPC: providing technical assistance in the area of mariculture and freshwater aquaculture
d. ACIAR: Community based Aquaculture Project
e. VAC: has a facility for producing and selling tilapia fingerlings for farmers; provide a technical training module on tilapia and M. lar aquaculture
f. DFAT/TVEF: funding technical training on small scale aquaculture in collaboration with Fisheries Department with emphasis mainly on SANMA, and TORBA Provinces
g. Vate Oceans Gardens Limited: private commercial operator engaged in red tilapia, Pangasius and barramundi aquaculture
h. Teouma Prawns LTD: private commercial operator engaged in shrimp culture with emphasis on L. vanamei
i. GIZ: initiated a pilot program looking into back-yard aquaculture with the main focus on SHEFA Province. GIZ has funded establishment of small hatchery holding facility for the Fisheries Department sub-office in Santo.
j. EU-EDF10: provided assistance with equipment supplies for hatchery and demonstration farms
k. Integrated Water Resources Management (IWRM) through Department of Geology & Mines: funded a small scale demonstration community farm in Santo

2. KEY AREAS FOR LONG TERM SUSTAINABILITY OF THE SECTOR
Aquatic biosecurity & Environmental aspects:

- There is a Biosecurity Act in place which is under the Vanuatu Biosecurity Authority.
- Any importation of fry, feed and seed outside Vanuatu requires the authorization of the Vanuatu Biosecurity Authority, and imported specimens are maintained in quarantine under strict surveillance from the Vanuatu Biosecurity competent authorities.
- Currently the GIFT strain that is being cultured in the country may not be performing well and there is a need for the existing strain to be reassessed and if need be for a better strains to be reintroduced.
- Barramundi fry are being imported from Australia and Thailand into the country for culture and this is not being reared in the hatchery locally. In the long-term consideration be given to producing own frys in the hatchery.
- White marine Shrimp (L. vanamei) post-larvae are currently being imported from Thailand’s hatchery as the cost of utility supply such as electricity is way too high.
- Need for development of capacity in terms of infrastructure and human resources through provision of appropriate trainings to address areas related to aquatic biosecurity.

Policy and regulatory framework to support aquaculture

- Aquaculture Development Plan 2008-2013. The existing plan has been revised and is yet to be finalized.
- Revised new Fisheries Act in place with a chapter covering regulating aquaculture mainly the commercial scale operation.
- Suggestion from Vanuatu for a need to develop an aquaculture management plan, now that the new Fisheries Act has been developed.
- National Government Policy direction “Priority & Action Agenda” recognizes aquaculture as an important component of the Fisheries development sector and the role of private sector in the development of the sector.
- Encourage to invest and to retain private sector development in the country.

Input supply: feed, seeds, broodstock:

- Feed: highlighted as a major constraint. Two core ingredients being in use copra and meat meal used mostly. Chicken starter is also purchased locally and used in Macrobrachium rosenbergii and Nile tilapia culture in Port Vila and Santo, respectively. It needs to be assessed what is feasible and accessible for farmers to use. Clear guidelines on feed formulation as well as feed supplement (e.g. agro livestock and kitchen wastes) need to be developed.
- Seeds: the level of production at the present is insufficient. In Santo, the current facilities at the Fisheries Department and at the Vanuatu Agriculture College are not able to meet the demand. Quality of seeds produced is also poor though VAC is already selling seeds to farmers. There is a need to build capacity in terms of training and improve existing infrastructure. Proper strategies for seed production need to be developed.
- Broodstock: For tilapia number of broodstock available is Santo is few so only a few brooders are being used. Farmers are already experiencing smaller sized fish harvested in the end (e.g. 8-10 fish/kg) so new strains may be needed to be re-introduced. There is a need to establish a broodstock management strategy.
- Aquaculture equipment: availability of basic aquaculture equipment and materials for hatchery and grow-out is one of the main limitations of the country. Most materials should be imported from Asian or European countries, with high shipping costs and long periods for delivery.
3. MAIN OPPORTUNITIES FOR THE SECTOR

- GIFT tilapia (in the village, it is selling at VT500/kg for approximately 200g fish). Demand remained very high in the rural areas and the fish is readily accepted by consumers.
- Red tilapia is produced commercially in Port Vila for VT650/kg and there is a market for it locally.
- Freshwater prawns (*Macrobrachium lar*) produced and there is a local market for the product with price fetching VT1,000/kg.
- Freshwater prawns *Macrobrachium rosenbergii* produced and sold in Port Vila market for VT1,500/kg. Small scale trials have produced >60kg so far.
- White marine shrimp *L. vanamei*, is produced locally and there is already an established market available locally. In 2012, 12 tonnes (t) were harvested and sold in the local market. There is a small export market to New Zealand with 1.5t produced in 2012.
- Presence of a strong tourism industry which enable locally produced aquaculture products to be easily absorbed by the local market.
- Presence of a strong national demand for aquaculture products produced at an affordable price and easily absorbed by low and middle income earners.

4. AREAS WHERE SUPPORT IS NEEDED

- Strengthen extension support for aquaculture through regular visit of Aquaculture Staff to farmers in the areas of farm husbandry and management (stocking densities, feeding regimes and rates, water quality control, site selection, etc), basic business management training which include farm record keeping and business planning. Extension support is only strengthened when there is an improved infrastructure in place such as access to vehicle as a mean for transportation in remote locations particularly Santo and Port Vila.
- Improve capacity of Aquaculture Officers who are able to provide up to date training for farmers.
- Improve national aquaculture infrastructure and knowledge/skills to meet aquaculture inputs needs, such as feed and seed supply, broodstock management etc.
- Investigate the feasibility of feed production within the country (using available raw materials) to ensure its quality and ease of access to farmers.
- Strengthen recordings and maintaining of aquaculture statistics.
- Economies of scale: strengthen capacity of lead farmers to support small scale farmers.
- Strengthen capacity in aquatic biosecurity in terms of infrastructure and human resources at the national level.
- Limit/control the importation of seafood products from abroad in order to promote locally produced commodities. Importation of cheap aquaculture products from Asia into the local retail market is said to affect production and sale of aquaculture products from the country, making it difficult for locally produced products difficult to compete against cheaply imported products. E.g. frozen barramundi imported from Asia cheaply makes it difficult for locally produced barramundi to compete in the retail market.
- Absence of a trade and marketing strategy relating to aquaculture.

5. THE WAY FORWARD: Key drivers for successes and lessons for scaling up

Tilapia:
• Well accepted in the in-land communities and small scale aquaculture farms as a food fish where the demand is high in rural communities and villages pay VT500/kg.
• Recognized nationally as the fish to be promoted to improve food and nutrition security.
• Active national program in place for tilapia aquaculture and a number of organisations involved such as (GIZ, TVET, IWRM and SPC) supporting the national program.
• There is capacity in place nationally for tilapia aquaculture (skills, technical know-how, infrastructures, brooders, seeds, etc)
• In south Santo, farmers have already organized themselves into association to ensure they are better supported through extension services. There is potential to expand such initiatives to other areas in Vanuatu.
• Strong private sector involvement.

Freshwater prawn (*Macrobrachium rosenbergii*):
• Recent national research has been completed which was able to demonstrate propagation of *M. rosenbergii* aquaculture from hatchery production to grow-out and sale of *M. rosenbergii* in the local market in Port Vila.
• Small scale culture using 10 x5 m ponds on 3 farms in Efate using post-larvae produced by Tagabe Aquaculture Facility demonstrated potential for upscaling.
• About 40kg harvested recently sold at an average of VT 1,600/kg and it appeared to be a high demand for the prawns in Port Vila.
• Local capacity in place in terms of cultivation of this species needed.
• Potential to expand this project to Santo based on Port Vila experiences.

Giant clam farming:
• There is a vibrant aquarium trade operator which is involved in giant clam farming as well as purchasing giant clam from farmers for the aquarium export market. There are farmers established for giant clam farming with seeds provided by Fisheries Department.
• Require improvement in terms of genetic studies to putting together a broodstock management system in place to ensure selected bright-coloured clams are produced to ensure an attractive market.

Marine Shrimp *L. vanamei*:
• There is an established market and the farm gate including retail price (Vt2,250/kg) is less than imported prawn price of Vt3,350/kg.
• Able to produce prawns using locally made feeds (based on locally available ingredients only: meat meal and copra meal).
• Strong private sector involvement.
Country Report: Samoa

Study on the Potential of Aquaculture in the Pacific

(Sea grape harvest)
**Background**

Samoa consists of two larger islands of Upolu and Savai'i and 8 smaller islands and has a land area of 2,944 km\(^2\) and a coastline of 403km. Main aquaculture commodity involves tilapia, trochus, giant clams & sea grapes.

This brief report was prepared in support of a wider study on the “Potential of Aquaculture in the Pacific” for the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA) and forms one of a set of four country case studies undertaken between June and August 2014. Reports were prepared for the following countries: Fiji, Kiribati, Samoa and Vanuatu. Roughly one week was spent in each country including site visits and discussion with stakeholders.

1. **SIGNIFICANCE OF AQUACULTURE SECTOR IN SAMOA**

Table 1: Aquaculture production, value, and livelihoods (2013):

<table>
<thead>
<tr>
<th>Species</th>
<th>Production</th>
<th>Value</th>
<th>Livelihoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilapia</td>
<td>2.9 tonnes (estimated)</td>
<td>T$55,000 at T$5.00 per kg</td>
<td>41 households + 2 community youth groups</td>
</tr>
<tr>
<td>Giant clam</td>
<td>620kg from fishery augmented by re-stocking</td>
<td>T$2,600</td>
<td>113 regular sellers in markets and at roadside</td>
</tr>
<tr>
<td>Trochus</td>
<td>1,301kg from fishery established by translocations</td>
<td>T$31,500 T$10 per piece</td>
<td>113 regular sellers in markets and at roadside</td>
</tr>
<tr>
<td><em>Caulerpa racemosa</em></td>
<td>130 kg from one pilot farm (Savaia)</td>
<td>T$800 in 2012-13 T$17 per kg (T$10 for a bundle of approx. 600g)</td>
<td>6 pilot-scale farms established jointly with community groups in 2014</td>
</tr>
<tr>
<td><em>M. lar</em></td>
<td>1kg</td>
<td>T$40 per kg</td>
<td>2 pilot-scale farms</td>
</tr>
</tbody>
</table>

Relevant stakeholders with funded projects operating:

- SPC ACIAR Community-based Aquaculture Project.
- JCU ACIAR Pacific Seaweeds Diversification project.
- Aquaponics (channelled to FAO via MAF Agriculture Division).

2. **AREAS WHERE SUPPORT IS NEEDED**

The aquaculture needs listed below are based upon those already stated in the Samoa Aquaculture Plan. This document presents a clear vision of Samoa’s current aquaculture priorities. The list of needs highlights those items from the Plan either not covered by other initiatives, or likely to be of interest to the EU EDF11 mandate. The list is augmented by new ideas contributed by Samoa
Fisheries officials during this consultation. MAF officials’ views about the priority of the various items put forward for possible support under EU EDF11 are also indicated.

Policy and legislation needs:

- Promulgation of aquaculture regulations; permits and licensing system; monitoring, compliance and enforcement. Though model-law and legal drafting assistance would be appreciated, officials state that the Ministry already has the resources to undertake these tasks.
- Aquaculture Commodity Management Plans for each high-priority species, as a one-stop summary of technical and economic prospects, management policies, and regulatory requirements.
  - Increased capacity to assess and manage biosecurity risks in aquaculture, in accordance with international norms.
  - Assess and manage risks to aquaculture from activities of other sectors.
  - Assess and manage risks of aquatic species introductions.
  - Increase capacity to identify and respond to any outbreaks of aquatic animal diseases in Samoa (training, and identification of responsibilities, for the introduction custody chain).

MAF officials noted that biosecurity issues were specifically highlighted among the three top-priority aquaculture areas identified for action at a regional level in the joint SPC-FAO Pacific regional aquaculture strategy processes held in 2011 and 2012. Samoa MAF is of the view that these are still the top priorities. They look forward to allocation of resources and commencement of specific actions within these regional frameworks.

- Increased capacity to collect, store, manage and analyse aquaculture statistics, and databases development. This is viewed by Samoa as a priority for action at a regional level, jointly coordinated by SPC and FAO.

a. Markets for aquaculture products

- Market access requirements, e.g. for Caulerpa seaweed exports to New Zealand
- Market research for diversification in domestic market channels Samoa Aquaculture Farmers Association (SAFA) talks about having export ambitions, but they cannot meet the requirements for volume or quality standards. Tilapia is still not well known at domestic market levels, so needs further market promotion within Samoa but it has good prospects nationally.
- Value Chain Analysis under the ACIAR PARDI project gave good insights for Caulerpa, and for tilapia, however the PARDI product development work on tilapia is perceived as only benefitting restaurant chefs, not average people. Samoa MAF’s current strategy of tilapia market promotion via Cookery Competitions highlights what average Samoan households can do with tilapia fish, not just chefs with sophisticated ingredients. Value-adding objectives do not necessarily benefit the fish farmer – they benefit mainly processors and middlemen. Work to diversify tilapia market channels, while keeping the product forms fairly simple and low-tech, is more likely to benefit the farmers.

b. Technical/scientific and infrastructure needs:

- Research on capture-based aquaculture of indigenous species (M. lar prawn, mullet, Freshwater eels, milkfish). Anguillid eels are a high-status delicacy for Samoan communities,
at the same level as pork. It is mainly lack of scientific knowledge that results in eels being currently ranked as a low priority commodity for capture-based aquaculture in Samoa.

- Hatchery infrastructure and staff capacity needs further strengthening to support diversification of culture-based aquatic species in Samoa (giant clams, trochus, green snail, M. rosenbergii prawn, mullet spawning. The basic structure of a multi-species mariculture facility at Toloa was completed this year 2014, and now needs commissioning with equipment, staff training, and some added infrastructure, such as:
  - Additional on-shore water storage tanks, e.g. for rainwater from the roof, cement raceways, and a broodstock pond for fish or prawn species.

- Feasibility assessment of aquaponics in Samoa. Samoa MAF intends to watch and wait for outcomes of aquaponics trials in Cook Islands, RMI and Fiji over the next 12 months, before making decision about whether to adopt aquaponics technology for Samoa.

- Feeds development work to make fish feeds more available and more affordable to fish farmers. Fish feeds availability is ranked by Samoa MAF as Priority No.1 within this “technical and infrastructure” heading.
  - Feed storage facility
  - Optimum feed formulations developed
  - Staff trained on fish feeds formulation and production
  - National capacity and infrastructure to produce feeds for research and brood stock management purposes, for fingerling nursery phase (national responsibility), and in times of shortage by private sector
  - Strengthening of private-sector capacity to meet the fish feed requirements of the emerging Samoan fish farming industry.

- Capacity-building
  - Training Needs Analysis of aquaculture sector staff
  - Donor funding to support staff training to fill identified gaps in capacity
  - Mariculture hatchery skills already stand out as an urgent training need for MAF in Samoa.

Note: all items under this heading were accorded 2nd highest priority out of the various headings overall. Within this heading of scientific/technical needs, work on fish feeds development was accorded the highest priority.

c. **Availability of fish varieties for aquaculture**

- Ensure access by farmers to the varieties of fish most suitable for aquaculture
  - Infrastructure development to safeguard national broodstock (e.g. convert tilapia broodstock facility to a rain-fed re-circ system, construct broodstock pond at Toloa hatchery).
  - Broodstock management protocols developed and codified for the available infrastructure, to maintain genetic quality and to extend the life of brood stock before replacement with new brood stock becomes necessary.
  - Access to improved genetic varieties of domesticated fish, as and when they become available from genetic improvement programs elsewhere in the world (e.g. Worldfish GIFT tilapia), due to general absence in Samoa of fish species domesticated for aquaculture and lack of capacity to run genetic improvement programs at a national level.
  - Information requirements, and decision-making processes that meet international norms, for introduction of improved genetic varieties (e.g. GIFT tilapia).
Note: access to improved fish varieties suitable for aquaculture in accordance with international norms was given 4th highest priority for assistance and capacity-building under EDF11.

d. Private-sector development of aquaculture in Samoa

- National strategy to develop a commercial aquaculture sector for improved nutrition and livelihoods.
- Pilot-scale commercial farms established as public-private partnerships (PPP) to demonstrate feasibility to potential investors.
- Training in business literacy and aquaculture project feasibility assessment for public- and private-sector project participants.
- Tailor-made assistance to specific private-sector enterprises that targets identified constraints within an enterprise, makes interventions in the technical, human-capacity, production-issues or marketing areas (assessed by CBA tools), and takes each enterprise forward to the next level (This type of intervention, for which there is precedent by EU in Samoa at a community level, is given top priority under this heading by Samoa MAF).
- Enterprises need assistance to help improve their access to finance for development.

Note: private sector engagement in commercial aquaculture is viewed as Priority No. 1 for aquaculture in Samoa.

e. Aquaculture networks and communities of practice

- At national level: apply the “farm cluster” concept centred upon established “lead farmers” to foster information exchange and collaborative approaches to marketing and obtaining farm inputs by small-scale farmers:
  - Engage with Samoa Aquaculture Farmers Association and assist them to acquire the attributes of a “farm cluster” concept.
  - There is a Community Based Fisheries Management Program in Samoa MAF, within which aquaculture techniques (e.g. reef re-stocking, and fishery products diversification via aquaculture production) can be integrated and provide support to CBFM.
- At regional level: establish mechanisms to promote and maintain regional and international networks for advice, training opportunities and information exchange in aquaculture:
  - Improve the existing links between countries with SPC and NACA.
  - Establish formal links, training opportunities and collaborations between selected aquaculture centers of the three ACP regions

Note: networks are ranked as 3rd highest priority for consideration under EDF11.

Summary of aquaculture assistance priorities for Samoa

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Priority</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for private sector development</td>
<td>1\textsuperscript{st}</td>
<td>National</td>
</tr>
<tr>
<td>Technical/scientific and infrastructure</td>
<td>2\textsuperscript{nd}</td>
<td>National</td>
</tr>
<tr>
<td>Aquatic biosecurity and aquaculture statistics</td>
<td>3\textsuperscript{rd}</td>
<td>Regional, national</td>
</tr>
<tr>
<td>Networks and communities of practice</td>
<td>4\textsuperscript{th}</td>
<td>International, national</td>
</tr>
</tbody>
</table>
3. MAIN OPPORTUNITIES FOR THE AQUACULTURE SECTOR

- *Caulerpa* seaweed (high-value commercial – T$10 per bundle of approx. 600g).
- *Macrobrachium lar* (home consumption, and cash sales).
- Tilapia (best opportunity, but needs further market development and feed development).
- Mullet (high market demand in Samoa, but production methods untested so far).
- Trochus (domestic meat market, plus shell for export later on).
- Green snail (success of trochus translocation, demonstrated by 2014 Samoa trochus survey, indicates that green snail could also thrive in Samoa, because they utilize similar habitat as trochus).
- Mud crab (high value – T$ 30 per kg – but limited natural resource).

Opportunities in Samoa are provided by plentiful freshwater supplies, pollution-free reef habitat, presence of some indigenous species suitable for aquaculture, and strong domestic demand for aquaculture products.

4. THE WAY FORWARD-KEY FACTORS EXPLAINING SUCCESS OF SAMOAN AQUACULTURE

*Caulerpa* seaweed

- Effective collaboration between Fisheries and the communities.
- Staff capacity to conduct research and to modify overseas methodologies to suit the local circumstances.
- Availability of wild resources of seaweed for farm stocking.
- Availability in Samoa of facilities/equipment and technical know-how to domesticate this species.
- This seaweed is a local delicacy that is in high demand.

Tilapia

- Farmers have organized together under a national association with their own constitution, from which benefits of membership include obtaining information from fellow members, and making joint funding applications by groups of farmers to funding agencies for finance and support.
- The farmers enjoy technical support by Fisheries aquaculture staff, are provided with training by Fisheries staff, and can be provided with some aquaculture services and farm inputs by government (e.g. fingerlings).
- Establishment of demonstration farms has enabled prospective new farmers to see for themselves what can be done and how to do it.
- Appreciation for eating tilapia among Samoans is steadily increasing.

*M. lar* prawn
• High demand locally for freshwater prawn (1kg at average body weight (ABW) 35g+ can be as high as T$40, in supermarkets at smaller sizes it is T$24 per kg).
• An indigenous species with no importation risks.
• It has low %CP feed requirements.
• The culture method is low-tech (no hatchery phase).
• There is technical support from Fisheries and from other SPC members e.g. Vanuatu (“South-south” cooperation).

Trochus
• Low-tech propagation method by translocation which is primarily aimed at food security, however commercial benefits (meat, shell) are a bonus benefit.
• Recent survey work shows that trochus breeds and disperses well in Samoa waters.

5. LESSONS FOR SCALE-UP (best approaches/worst approaches based on past experience)

Best approach – Samoa MAF has a Community-Based Fisheries Management programme which provides an entry point for aquaculture to be introduced at a community level (giant clam, Caulerpa). Community leaders assign responsibilities and mobilize labour. Income flows back to community. After projects have been demonstrated in this way, there is further uptake e.g. some households decide to establish their own activities on family plots, or church projects adopt it for fund-raising purposes.

Worst approach – newly-established aquaculture enterprises that try to access export markets straight away, without firstly developing domestic markets as a platform for establishing their initial production base.
Country Report: Fiji

Study on the Potential of Aquaculture in the Pacific

(Photo: Milkfish ponds in Vitawa village, Fiji)
Background:

Fiji consists of over 300 islands and has a land area of 18,272 km² and a coastline of 1129km. Aquaculture in Fiji has been developed in both freshwater and marine. Main aquaculture commodity includes black pearls, nile tilapia, seaweed, shrimp and freshwater prawn (Macrobrachium rosenbergii).

This brief report was prepared in support of a wider study on the “Potential of Aquaculture in the Pacific” for the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA) and forms one of a set of four country case studies undertaken between June and August 2014. Reports were prepared for the following countries: Fiji, Kiribati, Samoa and Vanuatu. Roughly one week was spent in each country including site visits and discussion with stakeholders.

1. SIGNIFICANCE OF AQUACULTURE SECTOR IN FIJI

Table 1: Statistics for aquaculture production, value, livelihoods (2013)

<table>
<thead>
<tr>
<th>Species</th>
<th>Production targets</th>
<th>Target met in 2014 so far</th>
<th>Livelihoods</th>
<th>Production</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilapia</td>
<td>750,000 fingerlings</td>
<td>70%</td>
<td>180 households</td>
<td>150 – 200 tonnes, estimated from 80% survival and ABW 180g</td>
<td>USD 3.50 per kg on average, depending upon size. Has recently reached USD 5.00 per kg in Nadi Market</td>
</tr>
<tr>
<td>Marine shrimp Litopenaeus vannamei</td>
<td>300,000 PL</td>
<td>50%</td>
<td>6 small-scale farms</td>
<td></td>
<td>USD 15.00 – 20.00 per kg depending upon size</td>
</tr>
<tr>
<td>FW prawn Macrobrachium rosenbergii</td>
<td>500,000</td>
<td>118% 600,000</td>
<td>39 farms stocked by MoFF in 2014. Mostly household scale.</td>
<td>12 T, 60% survival, 25g ABW \ Not counting FNU Farm</td>
<td>Farm gate price is USD11-13. Some as much as USD 18.00 Av. retail price is USD 16.00 – 20.00</td>
</tr>
<tr>
<td>Aquaculture Species</td>
<td>Number or Details</td>
<td>Target/Achievements</td>
<td>Notes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------</td>
<td>---------------------</td>
<td>-------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sea cucumber</td>
<td>10,000 pieces</td>
<td>Target achieved</td>
<td>For conservation purposes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giant clam</td>
<td>20 sites with 200 pieces per site of 2” size</td>
<td>Target achieved</td>
<td>For conservation purposes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grass carp</td>
<td>No target, spawn once per year, could be 2 million</td>
<td>100,000 per year stocked at 10g</td>
<td>Not known – home consumption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver carp</td>
<td>Not done annually – every 2 years. Not in high demand – slow growth c.f. tilapia, 1.5 years</td>
<td>2013 100,000</td>
<td>60 farmers, mixed with tilapia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Puntius</td>
<td>Breeds by itself</td>
<td>28 farmers</td>
<td>Not known</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milkfish (Caboni)</td>
<td>Capture-based culture</td>
<td>20,000 approx.</td>
<td>Crab Co, Vitawa, Caboni</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blacklip pearl</td>
<td>Secret</td>
<td>JHunter Pearls employs 60 direct employees, several hundred on contract or piece-work basis. 8 farms altogether in Fiji, one big one, most are small.</td>
<td>Secret</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JH exports about USD 800,000 worth of round pearls each year, and a similar amount is sold within Fiji</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Relevant stakeholders supporting aquaculture at the national level:**

List of requests to bilateral overseas development assistance or other multi-lateral development partners

- Brazil is hosting a group from Fiji for tilapia pond management and post-harvest handling training in September 2014

List of current donor-funded projects in aquaculture

- SPC ACIAR Community-based Aquaculture Project
- James Cook University ACIAR Pacific Seaweeds Diversification project
- Brazil aquaculture training
2. AREAS WHERE SUPPORT IS NEEDED NATIONALLY

Policy and legislation needs:
- New Aquaculture legislation will soon be coming into force in Fiji, however the Ministry of Fisheries and Forests (MOFF) is under-resourced for implementation requirements such as drafting of regulations and statutory plans, assessment of the policy and drafting requirements, creation of licensing/permits and administrative processes for issue, and the monitoring and enforcement of licences and conditions. They seek assistance with model law, legal drafting, development of policy and rules based upon generic principles, and up skilling of staff to apply and use the new law relating to aquaculture.
- National budget and planning processes require quality information about aquaculture, including a full economic evaluation of the aquaculture economic sector in Fiji as the basis for charting future strategies in the sector. MoFF needs a way to better prioritise and consolidate the aquaculture commodities that are to be worked on, and better tools to evaluate not only the “efficiency” but also the “effectiveness” of the department’s own capital projects in aquaculture.
- The relationship and roles of Biosecurity Authority of Fiji (BAF) and MoFF need clarification and strengthening, given that BAF is the newly-established competent authority for biosecurity while MoFF holds expertise about live aquatic species.

Markets for aquaculture products:
- Domestic markets, to meet demand for fish locally and by tourists, and for import substitution (mainly of marine shrimp) which is costing the country millions every year.
- Strongest demand in food products is seen for tilapia, and for marine shrimp, followed by FW prawn.
- In non-food products blacklip pearl has the strongest market pull, followed by Kappaphycus seaweed.

Technical/scientific and infrastructure needs:
- Training is needed because of imminent retirement of long-standing experts and replacement by new, young graduates. Priorities are Extension Officer training in aquaculture pond management, pond design and site selection skills, and for farmers in general farming skills, good aquaculture practice, and business literacy.
- Aquaculture infrastructure in Fiji is generally 30 – 40 years old and it is run-down and poorly equipped. Space is insufficient at the MoFF Galoa mariculture centre for the suite of species that the centre is charged with breeding and rearing (vannamei shrimp, monodon shrimp, sea cucumber, Macrobrachium prawn). For example, recent poor results in breeding of sea cucumber are apparently linked to inadequate water filtration and cross-contamination between that project and other projects in the same building. Improved infrastructure is also needed for quarantine and for holding and managing aquaculture broodstock without threat of losses by cyclones or theft.
- Environmental monitoring of sea space around pearl farms in Fiji is a priority to find correlations with pearl oyster health as a basis for improved farm site-selection and management practices.
Availability of fish varieties for aquaculture:

- Fiji has a strategic location in the Pacific, and is a hub of regional air and sea transportation links. Neighbouring countries look to Fiji as a source of replacement broodstock or improved genetic varieties of fish for aquaculture. Fiji’s own access to improved varieties, and national capacity to responsibly introduce such varieties, needs to be strengthened for the sake of the entire south Pacific region.

Private-sector development of aquaculture in Fiji:

- There is a high level of interest by investors in Fiji, who include aquaculture among the sectors they want to invest in. Fiji allows dual citizenship for former Fiji citizens who have migrated abroad and now want to return with their life savings. Such people seek timely and science based decisions by regulatory authorities regarding approvals for their business proposals.

- Cost of constructing ponds is the biggest barrier to entry in land-based aquaculture in Fiji. Commercial lenders lack awareness about aquaculture so credits are not easily obtained. Fish and prawn farmers consistently report that inland aquaculture is a more lucrative land use than vegetable or root crop farming and it enables more time to be devoted toward other pursuits, but only once their ponds have been constructed.

- Access to marine space on equitable and secure terms is the biggest barrier facing mariculture investors. There are some instances where high-value intensive users of marine space (pearl farmers) have successfully negotiated with traditional fishing rights owners to obtain farm sites, however the procedure is not clear-cut and lies mainly in the realm of customary law rather than in statute.

- Obtaining essential infrastructure is the next biggest hurdle for establishing aquaculture enterprises to overcome. The EU Increasing Agriculture Commodity Trade (IACT) project under EDF10 has already had a measureable positive impact on aquaculture enterprises through interventions addressing targeted constraints like infrastructure.

Aquaculture networks and communities of practice:

- “Farm clusters” (SFG or Small farmer groups) centred around a “lead farmer” is a new approach being tried in Fiji, which shows potential for up-scaling. This approach has been successful in Asia and in Africa in improving the competitiveness and sustainability of small-holder aquaculture farms. In the initial stages there is a high level of facilitation and support required over an extended period, which will require that specific projects be set up and aquaculture-specialist staff be recruited.

- Inter-regional networks and collaborations are needed for exchange of scientific information and experiences in pearl oyster health.

3. MAIN OPPORTUNITIES FOR THE SECTOR

- Tilapia – MoFF are inundated with requests to help establish farms. There is a lot of awareness and positive perception by the public about tilapia in Fiji nowadays. 100 new-farm applications received in June 2014 alone. Reason for popularity of tilapia:
  - Tilapia’s suitability for both food security and income generation.
  - Ease of culture.
  - Access to technology.
  - Matches government’s objectives for livelihood development.
- Import substitution by farming shrimp is a major driver to develop aquaculture, because it is costing the country millions to import shrimp for tourism industries.

- Blacklip pearl continues to be the mainstay of Fiji aquaculture, with almost USD 1 million in export sales by one company alone and a similar amount sold within Fiji to visiting tourists and local people. Fiji offers unique opportunities by producing some of the best quality, most vibrantly coloured blacklip pearls in the world. Spat catching operations provide opportunities for engagement at household or community level by people who lack the capital or expertise to participate further along the pearl aquaculture industry value chain.

- Green Growth Initiative has identified food security priorities for Fiji, which aquaculture could help address. There would be a National Food Security Policy for the nation, which identifies how each sector can contribute. It would establish a comprehensive database for collection and storage of food security statistics including fish production (from whatever source). R&D for food security (including aquaculture) and product development for fisheries, and fish feeds, was also spoken about. This Food Security Chapter Food (Thematic Area 3) of the Green Growth Strategy is available as a public document.

4. Areas where support would be needed:

Infrastructure and logistics:

- Extend and upgrade Galoa Mariculture Centre to make multiple species projects easier.
- Flood-proof and fence the Naduruloulou Research Station (freshwater aquaculture centre) to safe-guard brood stock genetic lines.
- Upgrade the NRS feed room (new machinery) and improve the feed storage.
- Upgrade laboratory equipment and materials (e.g., microscopes, etc).
- Training facility and dormitory accommodation at NRS Micro-hatcheries or fingerling distribution centres placed in remote areas, e.g. Sigatoka, Ba, Dreketi, Savusavu, Vunidawa or similar, owing to logistical difficulties in supplying remote fish farms from a central national hatchery.
- Transportation to enable for Extension Officers to visit farms.

Training and capacity building:

- Staff – Extension Officer training, pond design and site election training.
- Farmers – general farming skills and good aquaculture practice, business literacy.

Governance:

Assistance is needed to implement new legislation on aquaculture. There will need to be training on the new law, at all levels. A full economic evaluation of the aquaculture economic sector in Fiji is needed to assist in allocation of funding under national budgets, via external development assistance, or for charting future strategies in the sector.

Fiji needs assistance to meet the aquatic components of its obligations for membership of OIE, beginning with the regular reporting requirements, but also encompassing national capacity for monitoring of and responses toward aquatic animal disease situations.

5. THE WAY FORWARD-Key drivers of successes
• Overall demand for fish within Fiji is increasing. Local substitutes are needed for expensive imported commodities like marine shrimp and edible oysters.

• Tilapia – the number of farmers is still increasing and enquiries to establish new farms are coming in all the time.

• More farmers are now acquiring the necessary skills to manage farms properly.

• MoFF facilitates farmer awareness and training.

• Government is placing a renewed emphasis on aquaculture in national planning.

• Fiji has abundant resources of land, fresh water, and sheltered lagoon for aquaculture

6. Lessons for scale-up

Subsidies and hand-outs – combines the best and the worst of approaches. Many inappropriate projects got funded, because owners were bearing little risk. It got things started that otherwise would not have been started. People from the wrong backgrounds got involved in ventures they knew little about. There was too little capacity for monitoring of the use of the handouts.

Fees and charges for government services in aquaculture would be appropriate, to create a level playing field that would encourage private-sector mechanisms to provide these services.
Country Report: Kiribati

Study on the Potential of Aquaculture in the Pacific
Background
Kiribati consists of 32 atolls. It includes Kiritimati (Christmas Atoll in the Line Islands) which is the largest coral atoll in the world and Banaba or Ocean Island and the Phoenix Islands.
Kiribati has a land area of 811 km\(^2\) and a coastline of 1,143km. Main aquaculture commodities are seaweed and milkfish.

This brief report was prepared in support of a wider study on the “Potential of Aquaculture in the Pacific” for the ACP-EU Technical Centre for Agricultural and Rural Co-operation (CTA) and forms one of a set of four country case studies undertaken between June and August 2014. Reports were prepared for the following countries: Fiji, Kiribati, Samoa and Vanuatu. Roughly one week was spent in each country including site visits and discussion with stakeholders.

<table>
<thead>
<tr>
<th>Species</th>
<th>Main producing Institution</th>
<th>Farming systems</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milkfish</td>
<td>Taiwan ROC Milkfish Hatchery Project (TRMHP), Eco-Farm Milkfish</td>
<td>Hatchery &amp; Earthen ponds</td>
<td>For food fish and baitfish</td>
</tr>
<tr>
<td></td>
<td>Capture-Culture Project (Eco-Farm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Giant clams</td>
<td>Atoll Beauties, Fisheries Dept Tanaea hatchery, TRMHP, Communities</td>
<td>Land based hatchery, community grow-out cages</td>
<td>For community food security and marine ornamental export</td>
</tr>
<tr>
<td>Seaweed (Kappaphycus)</td>
<td>Fisheries Dept.</td>
<td>Ocean culture</td>
<td>For export</td>
</tr>
<tr>
<td>Sea cucumber</td>
<td>Fisheries Dept.</td>
<td></td>
<td>Introduction for sea ranching</td>
</tr>
<tr>
<td>(sandfish)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

KEY AREAS FOR LONG TERM SUSTAINABILITY OF THE AQUACULTURE SECTOR

Aquatic biosecurity
- Recently a new seaweed strain has been introduced into Kiribati from Indonesia, and it is hoped the new strain would be more heat tolerant and perform better under the natural conditions. Similarly, there are plans to re-introduce sea cucumber sandfish into the country for culture under a Community based Aquaculture Project.
- Import risk analysis have been undertaken in the past prior to previous introductions taking place. Similarly, capacity building in terms of training on quarantine protocols on introductions of species such as seaweed and sea cucumber were undertaken in the past.
- Need for development of capacity in terms of infrastructure and human resources through provision of appropriate trainings to address areas related to aquatic biosecurity

Policy and regulatory framework to support aquaculture
- No aquaculture strategic plan in place at the moment, but this has been highlighted as an area worth addressing.
- Import risk assessment protocols and health certificates are required when importing live species or strains into the country.

Input supply: feed, seeds, broodstock
Feed:

- Research into feed ingredients and feed formulations for milkfish has already been undertaken locally by Taiwan Milkfish Project. What may be missing is a proper feed machine for Eco-Farm to produce sufficient feed for their culture. Capacity in live algal production for sandfish culture during hatchery phase will be required and sourcing of types of algae need may not be available locally which may require attention.

Seeds:

- Milkfish: The infrastructure and capacity on milkfish seed production is available locally. Taiwan Milkfish Hatchery project is the only established facility in the country if not the entire Pacific region that has successfully produced milkfish fry at a commercial scale. It has a target of producing 300,000 fry per annum and has produced 200,000 fry so far this year.
- Giant clams: capacity in terms of infrastructure and human resources is available nationally to produce sufficient seed to be supplied to community farmers. It is an on-going activity and production remains consistent.
- Seaweed: a hardier and more heat resistant strain of seaweed has recently been introduced from Indonesia to Kiribati. Trial is currently underway in two sites (Tanaea & Abaiang) in the country and it is hoped that this would be replicated to other sites once the culture stock has increased.
- Sea cucumber: sea cucumber (sandfish) does not exist naturally in Kiribati therefore there is no seeds available. Stocks will have to be introduced into the country to establish broodstock and subsequently produce seeds for sandfish culture in the country.

Broodstock

- There is broodstock available for giant clams in the existing facilities in the country, broodstock of milkfish available at Taiwan Milkfish Hatchery Facility and a new strain of seaweed *Kappaphycus* has recently been introduced.

PROVEN SUCCESS IN FISH FARMING AND OPPORTUNITIES FOR DEVELOPMENT

Main opportunities

- Milkfish: There is a huge demand for milkfish as a food fish locally as well as a potential market for baitfish in the national tuna industry or to small scale artisanal fishermen. For baitfish, it takes 3 months to reach the harvestable size required (150-300g sized fish). There are communities with backyard ponds culturing milkfish so people are familiar with the activity, a dedicated hatchery and technical know-how available in the country. There is a dedicated project on milkfish through the Taiwanese government which has undertaken long terms research on the feasibility of milkfish culture which proved favorable.
- Seaweed: There is a history for seaweed culture in Kiribati dated back to late 90s in places like Abaiang, Abemama, Abutaritari and Fanning Island which still remains as the main producing islands for seaweed in Kiribati. Seaweed culture is a familiar activity in most communities in Kiribati. A new hardier strain of seaweed has recently been introduced which the stock once replicated can be transferred to main seaweed producing islands for culture.
• Sea cucumber (sandfish): There is a history of sea cucumber culture in Kiribati using the white teatfish from a previous JICA funded project. The capacity and know-how exists in the country and is easily transferrable to sandfish culture. Sea cucumber stock in Kiribati is also known to be severely depleted. The application of an integrated sea cucumber aquaculture through utilising sandfish as the species of focus has the potential to strengthen community based fisheries management systems in Kiribati.

• Giant clams: despite the decline in the European market for cultured clams from Kiribati options are opening up for the US market where Kiribati through Atoll Beauties will be exporting to the US market through a supplier in the Marshall Islands. Focus for giant clam work will be on genetic work and proper selection and maintenance of broodstock for breeding to ensure that good coloured clams are produced for the aquarium market. In addition to production for the aquarium market, less colourful clams such as of the species *Hippopus hippopus* will be produced and restocked in depleted reef areas for food.

Areas where support is needed

• Milkfish aquaculture in terms of its research and feasibility assessment has already been demonstrated at the national facility. Production targets of >200,000 fry's per annum has been achieved. Farmers despite difficulties with logistics and transportation of fry's continues to receive fry from the Taiwan Milkfish Hatchery Facility. The challenge is for the National Government to commit to show interest in taking over the facility once the Taiwan Project comes to an end in 2016.

• A proper feed machine for milkfish feed production would be necessary.

• Strengthen capacity of Fisheries Extension Officers on extension work including regular assistance to farmers sourcing of fry, pond construction and assessments etc would be required.

• Giant clam production out of Kiribati for the aquarium market is currently being affected by the international market, beyond Kiribati’s control. The high volume of capture based culture of clams from French Polynesia and export into the European market meant that countries such as Kiribati were only able to now sell 35% of their cultured clams to the European market.

• Transportation and access to market for seaweed continues to be an issue and has been highlighted as a need. In addition, current seaweed strain is being affected by ice-ice therefore assessment of the newly introduced strain that will be resistant to ice-ice outbreaks is necessary.

• No aquaculture strategic plan developed at the moment and this has been highlighted as an area needing attention.

• Transfer of technology and capacity building in all areas continued to be highlighted as a need.

THE WAY FORWARD: Key drivers for successes and lessons for scaling up

• Private sector engagement in Kiribati is limiting. But there is a strong presence and interest from existing private sector in the country i.e. Atoll Beauty LTD producing giant clams and Taiwan Project on milkfish culture which should be further strengthened to further develop aquaculture activities in Kiribati.

• Strong community engagement. The application of strong community involvement and partnership in commodities such as giant clam farming demonstrated that this approach could be replicated to other aquaculture commodities such as sea cucumber.
• Feasibility of milkfish culture under the Taiwan ROC hatchery Project demonstrates to be a success and the facility is probably one of the very few ones that is producing milkfish fingerlings on a commercial scale (target 300,000 fry per annum). Important for national government to formulate a transition plan to build national capacity in taking over the Taiwan experts once the project ends in 2016 so that fry could continue to be supplied to existing facility such as Eco-Farm as well as maintain distribution of fingerlings to community farms in the islands.

• Giant clams: there is a vibrant aquarium trade operator which is involved in production of giant clams and engagement with community farmers in supplying the aquarium export market. There is a need for up-scaling in terms of genetic studies to putting together a broodstock management system in place to ensure selected coloured clams are produced for the targeted market.

• Seaweed: there is a strong interest in continuing seaweed farming. The new seaweed strain recently introduced from Indonesia to Kiribati needs to be properly assessed. Should the introduction be successful, culture of the new strain need to be replicated to other seaweed producing sites where community involvement in seaweed farming remains active.
### Annex II: List of Tables and figures

#### Table 3 List of aquaculture commodities farmed in the Pacific region.

<table>
<thead>
<tr>
<th>Species</th>
<th>Main producing countries</th>
<th>Farming systems</th>
<th>Contribution to Livelihood/Food security development</th>
<th>Markets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blacklip pearl oyster</td>
<td>French Polynesia, Cook Islands, Fiji and FSM</td>
<td>Floating long-lines</td>
<td>Livelihood</td>
<td>Domestic, Export</td>
</tr>
<tr>
<td>Blue shrimp</td>
<td>New Caledonia and French Polynesia</td>
<td>Earthen ponds</td>
<td>Livelihood</td>
<td>Domestic, Export</td>
</tr>
<tr>
<td>White shrimp</td>
<td>Vanuatu, Guam and Fiji</td>
<td>Earthen ponds</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Giant tiger prawn</td>
<td>Vanuatu, PNG and Fiji</td>
<td>Earthen ponds</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Nile tilapia</td>
<td>Fiji, PNG, Vanuatu, Samoa, American Samoa, CNMI</td>
<td>Earthen/concrete ponds and floating cages</td>
<td>Food security</td>
<td>Domestic</td>
</tr>
<tr>
<td>Red tilapia</td>
<td>Vanuatu and American Samoa</td>
<td>Ponds</td>
<td>Food security</td>
<td>Domestic</td>
</tr>
<tr>
<td>Milkfish</td>
<td>Solomon Islands, French Polynesia, PNG and Nauru</td>
<td>Earthen ponds</td>
<td>Food security</td>
<td>Domestic</td>
</tr>
<tr>
<td>Barramundi</td>
<td>Vanuatu, PNG</td>
<td>Floating cages</td>
<td>Livelihood</td>
<td>Domestic, Export</td>
</tr>
<tr>
<td>Bat fish (<em>Platax orbicularis</em>)</td>
<td>French Polynesia</td>
<td>Floating cages</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Groupers</td>
<td>Palau, Guam, RMI and New Caledonia</td>
<td>Floating cages</td>
<td>Livelihood</td>
<td>Export</td>
</tr>
<tr>
<td>Kapapaphycus seaweed</td>
<td>PNG, Kiribati, Solomon Islands and Fiji</td>
<td>Off-bottom and floating long-line</td>
<td>Livelihood</td>
<td>Export</td>
</tr>
<tr>
<td>Seagrapes</td>
<td>Samoa, Fiji and French Polynesia</td>
<td>Floating and submerged cages</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Freshwater prawn</td>
<td>Fiji, Vanuatu, PNG,</td>
<td>Earthen ponds</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Macrobrachium lar</td>
<td>Vanuatu and Fiji</td>
<td>Earthen ponds</td>
<td>Livelihood/food security</td>
<td>Domestic</td>
</tr>
<tr>
<td>Rainbow trout</td>
<td>PNG</td>
<td>Ponds</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Common carp</td>
<td>PNG and Fiji</td>
<td>Earthen ponds</td>
<td>Food security</td>
<td>Domestic</td>
</tr>
<tr>
<td>Giant clams</td>
<td>FSM, RMI, Palau, Fiji, Solomon Islands, Cook Islands, French Polynesia, Vanuatu, Kiribati and Tonga</td>
<td>Floating and submerged cages</td>
<td>Livelihood/food security</td>
<td>Domestic, Export</td>
</tr>
<tr>
<td>Trochus</td>
<td>Vanuatu, Fiji, PNG, Kiribati</td>
<td>Raceways, restocking</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Sandfish</td>
<td>New Caledonia, PNG, Fiji, Kiribati and FSM</td>
<td>Earthen ponds and sea ranching</td>
<td>Livelihood</td>
<td>Export</td>
</tr>
<tr>
<td>Corals</td>
<td>RMI, FSM, Palau, Fiji, Tonga</td>
<td>Submerged cages</td>
<td>Livelihood</td>
<td>Export</td>
</tr>
<tr>
<td>Lobster</td>
<td>New Caledonia</td>
<td>Floating cages</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Sponges</td>
<td>FSM</td>
<td>Floating long-lines</td>
<td>Livelihood</td>
<td>Export</td>
</tr>
<tr>
<td>Scallops</td>
<td>New Caledonia</td>
<td>Floating cages</td>
<td>Livelihood</td>
<td>Domestic</td>
</tr>
<tr>
<td>Live rock</td>
<td>Tonga</td>
<td>Floating cages</td>
<td>Livelihood</td>
<td>Exports</td>
</tr>
<tr>
<td>Pacific oyster</td>
<td>New Caledonia</td>
<td>Floating long-line</td>
<td>Livelihood</td>
<td>Domestic, market</td>
</tr>
</tbody>
</table>
ANNEX III: Terms of reference

Study on the Potential of Aquaculture in the Pacific

1. Context

The Brussels Briefing n. 32 on Fish-farming: the new driver of the blue economy? co-organised by the CTA, DG DEVCO from the European Commission, the ACP Secretariat and Concord as part of the bimonthly briefings on key issues and challenges for rural development in the context of ACP-EU cooperation, generated a lot of interest from the audience.

Following the presentations by the experts from the regional organisations in the ACP (NEPAD, CRFM and SPC) the ACP Group of ambassadors recommended a follow-up on defining specific needs for support for the ACP group to be presented at the 11th EDF.

CTA is supporting the regions to build evidence on the aquaculture sector by commissioning a global study and three regional studies to each of the ACP regions. While each region has its priorities, many issues are similar and there is scope for sharing experiences and expertise across the ACP. An action plan will be designed for each region, including specific targeted activities, timescale, resources and budget required.

The results will be presented in regions as well as in Brussels to the WG on Fisheries and the sub-committee on sustainable development.

2. Objectives of the Pacific study

The study to be carried out by SPC will focus on the opportunities for aquaculture development for the Pacific region and the drivers for success. It will highlight needed interventions to succeed.

Therefore specific interventions could be defined in a 5 year time frame to develop the sector, addressing challenges, strengthen current positive experiences and upscale successes.

The main findings of the study will be presented at the ACP and EU groups in Brussels.

3. Assignment

See below the content to be developed for the Pacific regional study. To deliver the study, various consultation processes, including a regional workshop, will be conducted to validate the findings of the study prior to be presented to CTA.

4. Deliverables

- Presentation of the results of the study in Brussels – end August (tbc)
Study on the Potential of Aquaculture in the Pacific

Executive Summary

1. Background

2. A brief literature review and available reports on the fish farming sector. A summary of background findings would form the basis to identify selected countries that may be used as case study in this assessment.

2.1. Trends in production and trade

a. Main farmed species
b. Main producing countries
c. Main markets and quality and food safety standards
d. Main actors in the chain

2.2. New opportunities in market development. This should take into account local and regional market opportunities as well as providing an evaluation of the global market trends in fish farming.

3. Considerations on review of constraints in fish farming in the Pacific.

4. Significance of fish farming sector in the Pacific

5. Contribution of sustainable fish farming to food and nutrition security
   a. Integrated agriculture and fish farming systems
   b. Contribution to employment
   c. Recognition of the role and opportunities for women and youth in aquaculture
   d. Benefits for small-scale producers

6. Addressing the long-term sustainability of the sector
   a. Policy processes and regulatory frameworks in support of aquaculture
   b. Aquaculture nutrition in regards to food security
   c. Risk and health management
   d. Environmental sustainability
   e. Availability of good-quality genetic varieties of fish suitable for aquaculture

7. Proven successes in fish farming and opportunities for aquaculture development
   a. Opportunities for aquaculture development across the Pacific
   b. Areas where support would be needed over the next five years

8. The way forward: Key drivers of successes and lessons for scaling up
Annex IV: Geography and demographic scope of the SPC

The Pacific Islands Region