

Exploring the market potential for Fiji's Rewa River oysters

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Introduction

As reported on in the previous issue of the *SPC Fisheries Newsletter*³, the women of Muanaira Village in the Rewa River delta near Suva, Fiji are harvesting mangrove oysters for sale to relatives and others in Suva and farther afield (Kinch et al. 2019). The main oyster harvested is a species that was introduced into Laucala Bay in the 1970s.

The deployment of spat collectors is one activity conducted to date in an effort to shift the women's efforts from oyster harvesting to oyster farming. Juvenile oysters that had settled onto these collectors were collected in February this year and were counted and graded, and then transferred to plastic mesh baskets hanging on stakes for growing out at a pilot farm site in Laucala Bay. After three months of farming, these oysters were found to have grown rapidly. In May this year, Kinch et al. (2019) conducted a socioeconomic assessment of Muanaira Village and oyster

harvesting practices to gain a better understanding of current activities, especially given the opportunities to start farming mangrove oysters to supply Fiji's tourism sector. This has received support from Fiji's Ministry of Fisheries (MoF) and the Pacific Community (SPC) (Jimmy 2019). In August this year, oyster baskets were once again retrieved and again the oysters were graded. New bags of wider mesh size were made, and oysters were placed into the new baskets and returned to the pilot farm (Fig. 1). In December 2019, after 10 months of culture in the mesh baskets, the oysters had reached marketable size (Fig. 2). Their shells measured, on average, 11 cm in length and 7 cm in width, and were of a regular rounded shape with a nice deep cup. This compares with typical grow-out times of 18 months for oysters grown in farms in New South Wales, Australia. During this same activity in December 2019, the spat catching gear was re-deployed to take advantage of the current spawning season and set up a new batch of oysters in baskets during February 2020.



Figure 1. Muanaira Village Women's Group pilot oyster farm at Laucala Bay near Suva, Fiji. (image: Timothy Pickering, SPC)

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² Fiji Ministry of Fisheries

³ http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/159/FishNews159_45_Kinch.pdf



Figure 2. SPC staff Penina Ravunamoce and Losana Nakabea hold up one of the culture baskets of 10-month-old mangrove oysters, ready for harvesting. (image: Timothy Pickering, SPC)

With such promising results, the women of Muanaira Village are hopeful that these farmed oysters will be more plentiful, easier to harvest, and provide more income in the future (Jimmy 2019). Before more effort is provided for this pilot project, a simple value-chain analysis was conducted in August this year to determine the value of wild harvested oysters and the potential value of fresh farmed oysters sold to hotels or restaurants. The value-chain analysis also looked at other issues such as environmental factors, food safety, and up-scaling production constraints.

The Rewa River Delta

The Rewa is Fiji's largest river, with a total catchment area that is more than a quarter of the total land area of the island of Viti Levu, which equates to approximately 2980 km². It discharges an estimated 7900 million m³/yr of water and approximately 1200 t of sediments (Watling 1985). The Rewa River delta covers an area of 12,062 ha and hosts Fiji's largest and most diverse area of mangroves, the Bonatoa Swamp (Watling and Chape 1992; Gray 1993; Spalding et al. 2010). It also includes other wetland types such as lowland littoral forests, freshwater wetlands, intertidal mudflats, mangrove forests, coastal strand vegetation, estuarine areas, and seagrass beds (Mueller-Dombois and

Fosberg 1998). The ecological and environmental services that the Rewa River delta provides includes safe habitat for juvenile and adult marine fauna, the provisions of nutrients to marine food chains through the export of organic matter, the protection of inland areas and settlements from storm damage, salt spray, coastal erosion and inundation due to sea-level rise, and the interception of sediment and nutrient rich runoff from the land, thus maintaining the water quality of the surrounding inshore area (Ewel et al. 1998; Gilman et al. 2006; Polidoro et al. 2010; Marie et al. 2017). The Rewa River delta supports an artisanal fishery that supplies much of the needs of greater Suva (Gray 1993).

Climate change impacts

For Muanaira Villagers, the projected impacts of climate change include increased coastal erosion, contamination of groundwater by saltwater incursion, cyclones and storm surges, heat stress, and drought (Barnett 2011). Overall, climate change threats to the Rewa River watershed and delta include greater intensity of flood events, an increase in the magnitude of storm surges, and more frequent droughts (DBR Pty Ltd 2012). Previous flood events for the Rewa River have resulted in the damage of between 50 and 70% of all crops grown in the delta (Chaudhury 2015).

The annual mean tidal range for the Rewa River delta is 1.1 m, with a range of neap tides of 0.9 m and spring tides of 1.3 m. Sea level rise is projected to increase by 39 cm by 2090 (IUCN 2013). With this level of projected sea level rise, mangroves in the Rewa River delta will be able to keep up with sustainable rates of sediment replenishment if space is still available landward (Ellison and Stoddart 1991; Ellison and Strickland 2010). Lata and Nunn (2012) offer a different scenario, whereby sea level rise for the Rewa River delta will actually be 1.2 m by 2100. If this scenario was to eventuate, then most of the Rewa River delta's mangroves could be lost as early as 2060 (IUCN 2013). In addition, sea surface temperature is expected to increase 1.9°C by 2090 (IUCN 2013).

The most immediate impact of climate change for Muaniara Villagers will, therefore, be on their livelihoods.

Value of wild harvest and farmed oysters

To determine the current value of wild harvested oysters for Muaniara Village, an assessment was conducted on the number and weight of oysters required to fill certain units of sale that are used by the women of Muaniara Village.

To prepare wild harvested oysters for shucking, oysters are first simmered in hot water for 30 minutes. Each cooked and shelled oyster weighs approximately 90 g (n = 100), and a woman can shuck six oysters per minute (Fig. 3). As oysters are shucked, they are collected in a container (Fig. 4) and then counted as they filled various units of sales:

- 100 oysters = 500-g margarine container (weighing 0.42 kg);
- 200 oysters = 20 cm x 20 cm ziplock plastic bag (weighing 0.83 kg); and
- 300 oysters = 2-L ice cream container (weighing 1.32 kg).

From these measurements, it was determined that one cooked wild harvested oyster was worth FJD 0.16.

To determine the value of sale of the potential fresh farmed oyster, 14 hotels and restaurants in Suva were contacted, with 11 providing information. None of the hotels or restaurants that were contacted were currently selling oysters on their menus, although several had served local wild-harvested oysters in the past (the native oyster assumed to be *Saccrostea mordax*) or had imported them from New Zealand (Pacific oyster, *Crassostrea gigas*), but there was continued issues with consistency of supply and concerns over food safety. Only five hotels and restaurants knew that local oysters could be bought locally.

All of the hotels and restaurants that responded stated that they would buy fresh farmed oysters from Muaniara Village.



Figure 3. Shucking oysters at Muaniara Village. (image: Alessandro Romeo, SPC)



Figure 4. Shucked oysters at Muaniara Village ready for packaging. (image: Alessandro Romeo, SPC)

Seven said they would pay at a higher price if the oysters were certified safe to eat, two said they would not. Currently, only one hotel said that it serves freshwater mussels (*Batissa violacea*), mainly on Fijian-theme nights or buffets. Other hotels and restaurants serve imported green-lip mussels (*Perna canaliculus*) from New Zealand.

From discussions with various hotels and restaurants, it was determined that they would sell a half dozen fresh oysters for between FJD 20 and 30. Within the food industry, a ratio of one-third is usually used to determine the cost of a meal and the price that it will be advertised for on the menu. Using this ratio, it was determined that women from Muaniara Village could sell one fresh farmed oyster for around FJD 1.00–1.50, and possibly FJD 2.00 for one fresh farmed oyster. It was also



Figure 5. Introduced oyster species, *Crassostrea bilineata*. (image: Timothy Pickering, SPC)

estimated that there was a possibility of supplying at least 1800 fresh farmed oysters each week, just to the 11 hotels and restaurants alone that responded.

Genetic testing

Kinch et al. (2019) noted that there were two species of oysters harvested by the women of Muaniara Village: a local species (assumed to be *Saccostrea mordax*) and an introduced species (originally thought to be *Crassostrea iredalei*). To determine what species of oyster were actually being harvested, 40 oysters were sent to the James Cook University in Australia for genetic testing. Results of the this testing determined that there was, in fact, three species of oysters being harvested by women of Muaniara Village: two native *Saccostrea* species (non-*mordax* lineage), and an introduced species identified as *C. bilineata* (Strugnell 2019; Fig. 5). As noted in Kinch et al. (2019) the introduced species is easily identified as it has a distinct black muscle scar.

From further sampling at the Suva Market, it appears that the introduced oyster has spread widely and can be found in

multiple areas of Bau District (Avinash Singh, SPC Aquaculture Officer, pers. comm.).

Food safety testing

To determine if the wild-harvested oysters were safe to eat, 20 oysters were sent to the University of the South Pacific's Microbiology Laboratory for testing of *Salmonella* spp. and faecal coliform bacteria (*Escherichia coli*). The results showed that *E. coli* was present at 430 most probable number (MPN) per 100 g of oyster⁴, but *Salmonella* spp. was not⁵. Unfortunately, the levels of *E. coli* detected in the wild harvest oysters means that any fresh farmed oysters will need depuration before sale. *E. coli* is destroyed when wild-harvested oysters are soaked overnight in freshwater and then cooked before shucking.

Under European Union legislation, fresh farmed oysters based on the Food and Agriculture Organization and the World Health Organization's Codex Alimentarius⁶, which is the international standard-setting body for food safety. Based on the Codex Alimentarius, there are three zones

⁴ ISO Method 16649 – 3: 2015. See: <https://www.iso.org/standard/56824.html>

⁵ ISO Method 6579 – 1: 2017. See: <https://www.iso.org/standard/56712.html>

⁶ <http://www.fao.org/fao-who-codexalimentarius/about-codex/en/#c453333>

classified for the aquaculture of shellfish based on the presence and amount of *E. coli* in the aquaculture area (Table 1). Fiji's Food Safety Act 2003 (Government of Fiji 2003) and Food Safety Regulation 2009 (Government of Fiji 2009) are aligned with the levels detailed in the Codex Alimentarius.

As the results of the testing show levels of *E. coli* fall within Group B, any fresh farmed oysters from Laucala Bay must undergo a mandatory purification process before sale. Purification processes for shellfish are also defined in the Codex Alimentarius.

Kinch et al. (2019) noted that for the Laucala Bay area, previous research by Morrison et al. (1996, 2001, 2006) and Collen et al. (2011) had noted that contamination of trace metals and persistent organic pollutants were relatively low. In addition to regular testing for *Salmonella* spp. and *E. coli*, oysters grown at Laucala Bay should also be regularly tested for heavy metals, especially cadmium, mercury and lead.

Discussion

From the value-chain analysis, it is possible that farming oysters could be commercially viable with potential to supply domestic and possibly export markets. There are already some small-scale exports by Muaniara Villagers sending wild harvest shucked and cooked oysters to relatives living in Australia, New Zealand, the United States of America and the United Kingdom. This is also similar to the small-scale exports of freshwater mussel (*Batissa violacea*) meat exported by Fijians of Indian descent to relatives in Australia and New Zealand (Kuridrani-Tuqiri 2015).

For both local sales and commercial exports, however, there will be a need for a suitable quality assurance programme. To assist with this, it will be necessary to develop food safety protocols and a quality assurance programme that is specific to fresh farmed oysters. A depuration facility will also need to be established. Even though Muaniara Village have running water and power, the location and operation of a depuration facility will need some consideration. Training on hazard analysis and critical control points and food safety

would also need to be conducted. It is possible that there is an oligotrophic reef site offshore within the Muaniara fishing rights area that could be used to hold oyster baskets for a short period, so that oysters can depurate without the need for onshore infrastructure. This is a subject for follow-on research.

When women of Muaniara Village and other villages begin farming oysters to market their farmed oysters, there will be a need for support institutions to assist them with long-term planning or financial development. In general, there are difficulties in getting women involved in projects due to social and traditional obligations as women typically tend to the necessary chores of the household and village, and their knowledge and skills are often left out of decision-making processes. Results of the survey in May this year (Kinch et al. 2019), and again in August, show that women from Muaniara Village are essentially occupied with household chores, child care, gardening, church activities and the making of utilitarian items and handicrafts. Subsequently, selling, setting prices and ensuring a profit margin will be a challenge. Decisions will need to be made if they are to meet all traditional obligations and social expectations in their everyday village activities, as well as compete in the market economy.

Another important component will be transportation because, at present, Muaniara Villagers use fibreglass dinghies with outboard engines to access the Bailey Bridge Market or take buses or taxis to meet relatives to sell their oysters to them. Appropriate packing and transport will also need to be considered for delivering oysters that are ordered by restaurants and hotels.

Because the introduced oyster is found in other areas in Bau District, there is the potential to have other villages establish pilot farms in "cleaner" waters. These areas could be identified by physical surveys based on discussions with women selling *C. bilineata* and visiting their home villages in Bau District. It is also possible to identify potential areas by observing *chlorophyll a*. Areas of high concentrations of *chlorophyll a* are shown in red (Fig. 6). This area coincides with Laucala Bay and the wider Bau District.

Table 1. Codex Alimentarius classification for the three aquaculture of shellfish zones. Values for 100 g of flesh and interstitial fluid.

Group A	Group B	Group C
<ul style="list-style-type: none"> 80% of the results < 230 colonies No result is greater than 700 colonies. Oysters grown or extracted from these areas can be marketed without any purification treatment. 	<ul style="list-style-type: none"> 90% or more of the results < 4600 colonies. No result is greater than 46,000 colonies. Oysters grown or harvested in these areas must undergo a mandatory purification process before sale. 	<ul style="list-style-type: none"> Less than 90% of the results < 4600 colonies. No result is greater than 46,000 colonies. These oysters must undergo two months (minimum) of culture in an area classified as A or B before being commercialised.

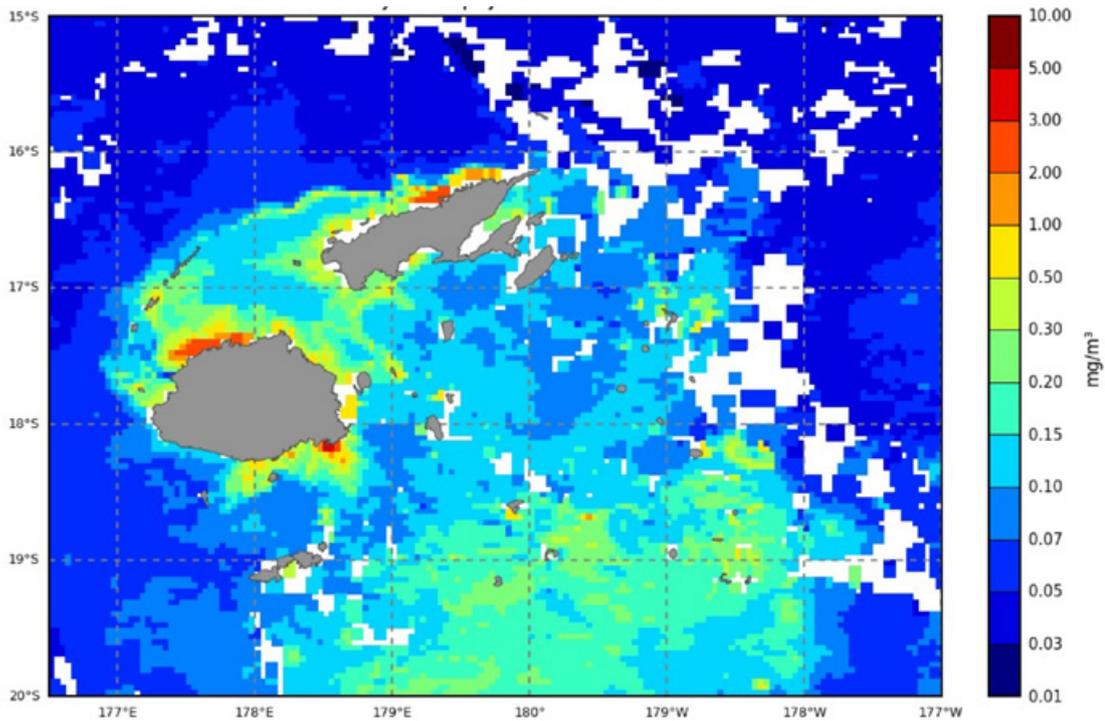


Figure 6. October 2019 chlorophyll a levels for Fiji. Source: Pacific Community 2019 (<http://oceanportal.spc.int/portal/app.html#climate>)

If there were economies of scale with several villages farming oysters, it would be easier to have a private sector partner support the villages that are farming oysters. This private sector partner could assist with overseeing production through a small-holder cropping model and be responsible for establishing a shore-based depuration system based in Suva that could be used to depurate oysters irrespective of harvesting area. They would also be responsible for packaging, marketing and transport. Monitoring water quality in grow-out areas and conducting regular testing would also be the responsibility of the private sector partner. Another option would be to investigate the potential for a cooperative style community-based depuration system, whereby oyster farmers incur extra costs that would hopefully be recouped by consumers willing to pay a higher price for a “safe” product. The Nature’s Way Cooperative⁷ in Fiji is an example of a company that seeks to ensure equitable disbursement of rewards to contributors. This process would, however, still require substantial coordination by an external partner. In either case, appropriate benefit-sharing would need to be worked out.

As noted above, climate change impacts will become an increasing emerging issue for people of the Rewa River delta. One of the recommendations stemming from the International Union for the Conservation of Nature’s ‘Mangrove Ecosystems for Climate Change Adaptation and

Livelihoods’ (MESCAL) project, which ran from 2009 to 2013, was to enhance livelihood options so that less pressure is exerted on the mangrove system and associated resources (Tuiwawa and Tuiwawa 2013). Farming oysters could assist with this livelihood diversification, and improve economic benefits and living standards for women and their families of Muauaira Village (and for other villages around Fiji) if economies of scale were achieved and a suitable private sector partner was in place.

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⁷ See: <http://www.fao.org/3/a-an427e.pdf>

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