VALUE ADDING AND SUPPLY CHAIN DEVELOPMENT FOR FISHERIES AND AQUACULTURE PRODUCTS IN FIJI, SAMOA AND TONGA

Supply chain of Sea grapes (*Caulerpa racemosa*) in Fiji

Institute of Marine Resources: Technical Report
05/2012
Value adding and supply chain development for fisheries and aquaculture products in Fiji, Samoa and Tonga: Supply chain of Sea grapes (Caulerpa racemosa) in Fiji

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November 2011

Pacific Agribusiness Research and Development Initiative (PARDI) Project 2010/002:
Value adding and supply chain development for fisheries and aquaculture products in Fiji, Samoa and Tonga
1.0 Summary

Women, men and children harvest *Caulerpa racemosa* or nama, its Fijian equivalent (South, *et al.* 2011) but only women manage this fishery. Information gathered from questionnaire interviews at 10 sites within six areas showed that women spent an average of two hours per harvesting day (with the exception of Yasawa and Savusavu), harvesting *nama* from reef flats during low tide. Uprights were harvested from 5 sites and runners were harvested from the remaining 5 sites. Runners were harvested in sites where time was a constraint and *nama* was not considered the main priority. Harvesting frequency varied according to site and indicated priority with harvests ranging from once a week, twice a week, three times a week and once a fortnight. Varieties of *nama* found within sites ranged from one to four. Harvest constraints included tide, weather and status of the *nama* stock. The number of harvesters and harvest frequency also determined production value of *nama* per week. Production ranged from 5kg to 2,100kg/week (with an average of about 321kg/week) and the main production areas were the Yasawa group followed by Labasa, Tavua and Rakiraki. Results from this study showed that *nama* production was around 115 tons per year, with a value of almost $FJD350,000.

Harvested *nama* kept in potato/ sugar sacks with or without leaves in a cool place was the most common method of storage. Post-harvest storage ranged from 1 to 3 days depending on distance and method of transport to the market. Up to 35 kg per batch was lost through post-harvest handling and storage.

The marketing system varied according to site with the women selling *nama* wholesale to middleman (Yasawa) or through retail sales (Sigatoka, Labasa and Savusavu) or through a combination of wholesale and retail sales (Suva, Rakiraki and Tavua). The majority of *nama* were sold in major municipal markets with *nama* being sold every week in Suva, Sigatoka, Lautoka, Nadi, Labasa and Savusavu markets. Occasional sales were reported at Nausori, Rakiraki, Tavua and Ba markets.

Expenses for harvesters varied depending on distance to harvest site and to market and ranged from $21 to $300/week (average of $97/week). Income ranged from $30 to $100/bag depending on quantity of *nama* (measured by bag size) and ranged from $2 to $4 per kilogram (average of $3/kilogram).

Some preliminary shelf-life trials have been conducted at the University of the South Pacific’s Post Harvest Facility. When bottled in weak (10%) brine, following treatment to reduce bacterial numbers, shoots have lasted for 3-4 months. In October 2011, a local seaweed export company sent a trial shipment of 5kg pickled (brined) *nama* to New Zealand.
2.0 Introduction

The aim of this survey was to gather information for the supply chain analysis of *Caulerpa racemosa* in Fiji. Sites were identified from preliminary market surveys conducted in 2010. Site visits were carried out during July, October and November, 2011. The areas visited included, Yasawa Islands (Gunu), Sigatoka (Lomawai, Vusama), Rakiraki (Namiumada, Navolau), Tavua (Vatutavui), Labasa (Vuniuto, Sasake, Lakeba) and Savusavu (Dromoniku).

Some villages that supplied *nama* were not visited due to time constraints and a village funeral. These included Somosomo and Nasoqo in Yasawa, Naweni in Savusavu, Vatulele Island in Serua, Nasosivi, Nabubu and Drua Drua in Labasa (Figure 1). Anecdotal information from shipping personnel, fisheries officers and market vendors suggested that Lomaiviti (Nairai and Batiki islands) and Tailevu also supplied *nama* occasionally, depending on availability of transport.

3.0 Methodology

A questionnaire survey was used to interview key informants (Appendix 1).

During the course of this survey, a few bags of *nama* were weighed and these results, along with a 36 fishing week duration, were used to estimate annual village production. Production and revenue per annum has been extrapolated from the weekly harvest and sales data.

4.0 Results and Discussion

Information gathered during the survey has been complied in Table 1. *Nama* was the main marine commodity harvested in Yasawa, Rakiraki and Tavua whereas in Sigatoka, Labasa and Savusavu other marine commodities were a higher priority. However, the women understood that harvesting of runners was unsustainable and affected the *nama* stock in their collection area. Varieties varied according to region as follows: Yasawa (2), Rakiraki (1), Tavua (1), Sigatoka (4), Savusavu (2) and Labasa (1) in Vuniuto (2) in Sasake (2) and in Lakeba (4). More research is needed to verify this information and to determine the species.

Results of the interviews suggested that harvesting was limited by the tide, weather and stock status. According to the harvesters, *nama* was more abundant during the months when temperatures were low.

Harvested *nama* kept in potato or sugar sacks, with or without leaves, in a cool place was the most common method of storage. Post-harvest storage ranged from 1 to 3 days depending on distance and method of transport to the market. Women in Dromoniku in Savusavu were the only ones who occasionally used the healing method which involved keeping the bag of *nama* soaking in the sea overnight. According to these women, this method kept the *nama* fresh for longer. In Labasa, uprights were separated from runners either at home or at the market and wrapped in banana/pawpaw leaves before sale. Losses varied between sites and ranged from ½ to 1 bag (approximately 18-35 kg) during each period of storage on site and at the market which equated to approximately 35-70kg per week.

The marketing system varied according to site whereby the women either sold *nama* wholesale to middleman (Yasawa) or through retail sales (Sigatoka, Labasa and Savusavu) or through a combination of wholesale and retail sales (Suva, Rakiraki and Tavua). The middleman who bought *nama* from Yasawa then sold at both wholesale and retail prices to other middleman, consumers at municipal markets, restaurants and hotels/resorts. In some cases, harvesters took turns at retail sales in the market.
<table>
<thead>
<tr>
<th>Area/ Village</th>
<th>No. of harvesters</th>
<th>Harvest method, frequency and average duration</th>
<th>Harvest site and varieties</th>
<th>Estimated production/ week/production/yr based on 36 fishing weeks/yr(kg)</th>
<th>Post-harvest handling</th>
<th>Market</th>
<th>Total costs/week for harvesters</th>
<th>Constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yasawa</td>
<td>30</td>
<td>Only uprights harvested 3 days/week from Monday to Wednesday for 4 hours/day. Total fishing time is about 12 hours/week/person.</td>
<td>Reef flats close to and a distance from village. Two varieties found.</td>
<td>2000/week; 75,600/yr</td>
<td>No bags stored in sugarcane bags in a cool place. Transferred to potato sacks inside coconut baskets for transport to market.</td>
<td>Transported to Lautoka domestic wharf on Thursday. Middlemens pick up and transports to market (Lautoka, Nadi and Suva) by bus. Wholesale price ranged from $40-$100 depending on bag size &amp; availability of names. Average weight of bag is 35kg. Middlemens sold at a retail price of $2/bag plate with chilli &amp; fermented coconut.</td>
<td>$300; $300 return to harvest site twice/week, $4/bag freight for 60 bags/week.</td>
<td>Harvesting restricted by tide and weather. Market demand not met when names is less abundant. Losses from handling and storage. Only one boat available for transport to market.</td>
</tr>
<tr>
<td>Sigatoka</td>
<td>20</td>
<td>Runners harvested by 15-15 women every Friday for 2.5 hours. Total fishing time is 5 hours/week/person.</td>
<td>Mudflats close to village &amp; fishing in a distance from village. Four varieties found.</td>
<td>75/week; 2,700/yr</td>
<td>Uprights separated from runners, placed in a wet cloth and hung in a cool place inside house. This removes excess water.</td>
<td>Transported to Sigatoka market on Saturday by 4 harvesters.</td>
<td>$138; $90 return to market fare, $45 return to market and $4 market fee.</td>
<td>Harvesting restricted by tide and weather. Supply restricted by unsustainable practices.</td>
</tr>
<tr>
<td>Lomawai</td>
<td>7</td>
<td>Runners harvested twice/week (Thurs &amp; Fri) for 2 hrs. Total fishing time is 4 hrs/week/person.</td>
<td>Reef flat close to village. Two varieties found.</td>
<td>125/week; 4,410/yr</td>
<td>Uprightseparated from runners on site. No bags stored in potato sacks.</td>
<td>Transported to Sigatoka market on Saturday by 3 harvesters. Wholesale at $30-$50/bag (average weight of 17kg) depending on availability of name. Retail price ranged from $1-$2/plate.</td>
<td>$21/week; $18 fare to market/person; $3 market fee. One customer bought 12-15 plates and supplies to hotels in Coral Coast.</td>
<td></td>
</tr>
<tr>
<td>Vusuma</td>
<td></td>
<td>Runners harvested twice/week (Thurs &amp; Fri) for 2 hrs. Total fishing time is 4 hrs/week/person.</td>
<td>Reef flat close to village. Two varieties found.</td>
<td>125/week; 4,410/yr</td>
<td>Uprightseparated from runners on site. No bags stored in potato sacks.</td>
<td>Transported to Sigatoka market on Saturday by 3 harvesters. Wholesale at $30-$50/bag (average weight of 17kg) depending on availability of name. Retail price ranged from $1-$2/plate.</td>
<td>$21/week; $18 fare to market/person; $3 market fee. One customer bought 12-15 plates and supplies to hotels in Coral Coast.</td>
<td></td>
</tr>
<tr>
<td>Rakiraki</td>
<td>16</td>
<td>Uprights harvested twice/week (Tuesday &amp; Thursday) for 2.5 hours/day. Total fishing time is 5 hours/week/person.</td>
<td>Reefs flat a distance from village. Only one variety found.</td>
<td>144/week; 5,184/yr</td>
<td>No bags stored in sugarcane bags in a cool place. Transferred to potato sacks inside coconut baskets for transport to market.</td>
<td>Sales at Suva market are from Thursday - Saturday. Income from wholesale ranged from $50-$70/bag (average weight of 15kg) and income from retail is around $90/bag ($5/plate). 10kg sold at wholesale for $50 to middleman who sold to Mana Isl. Resort in Mamanuca.</td>
<td>$209.5/week; $25 return bus fare to harvest site; $5.50 bus fare &amp; cartage to Suva, $34.50 return bus fare to Rakiraki, $6 cartage fee at Suva market, $31.50 market fee $5/fortnight (Return bus fare to harvest site).</td>
<td>Harvesting restricted by tide and weather.</td>
</tr>
<tr>
<td>Navolau</td>
<td>1</td>
<td>Same harvesting site as Namuimada.</td>
<td>10kg/fortnight 180/yr</td>
<td>Same harvesting site as Namuimada.</td>
<td>10kg/fortnight 180/yr</td>
<td>Same harvesting site as Namuimada.</td>
<td>Same harvesting site as Namuimada.</td>
<td>Same harvesting site as Namuimada.</td>
</tr>
<tr>
<td>Tavua</td>
<td>25</td>
<td>Uprights harvested once/every two days on Wednesday or Thursday for 1.5 hours. Total fishing time is 1.5 hours/person.</td>
<td>Reef flat at a distance from village close to Vatu Lailai Island. One variety found.</td>
<td>250/week; 9,000/yr</td>
<td>No bags stored in potato sacks with leaves in a cool place. Put into large striped plastic bags when transported to market.</td>
<td>No bags stored in potato sacks with leaves in a cool place. Put into large striped plastic bags when transported to market.</td>
<td>Varies depending on distance from market. $31/week for Tavua market; $33.50/week for Ba market.</td>
<td>Harvesting restricted by tide and weather.</td>
</tr>
</tbody>
</table>

Table 1: Details of *C. racemosa* production and costs of harvesters
Runners are harvested once/week (Thursday) for 3.5 hours. Reef flat site far from village within the Burenitu fishing grounds. Two varieties found. Harvester from Vuniuto travels to Sasake & harvests with women there.

<table>
<thead>
<tr>
<th>Village</th>
<th>Total fishing time</th>
<th>Reef flat location</th>
<th>Number of women</th>
<th>Storage methods</th>
<th>Uprights separated from runners at village, wrapped in banana/papaya leaves and stored in a coconut leaf basket</th>
<th>Nama transported to Labasa market on Friday and sold at retail price of $2/heap.</th>
<th>$57/week (27 boat fare, $13 fare to market, $15 meal, $2 market fee)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vuniuto</td>
<td>3.5 hours/week/person</td>
<td>Reef flats close to village. Four varieties found.</td>
<td>2</td>
<td>210/week; 7,560/yr</td>
<td>Nama stored in potato sacks or sugar bags.</td>
<td>$30-$50 income received for 1 bag (average weight of 14kg) sold at retail price of $2/heap.</td>
<td></td>
</tr>
<tr>
<td>Sasake</td>
<td>3.5 hours/week/person</td>
<td>Reef flats close to village. Four varieties found.</td>
<td>2</td>
<td>210/week; 7,560/yr</td>
<td>Nama stored in potato sacks or sugar bags.</td>
<td>$30-$50 income received for 1 bag (average weight of 14kg) sold at retail price of $2/heap.</td>
<td></td>
</tr>
<tr>
<td>Lakeba</td>
<td>1 hour/fortnight on Friday</td>
<td>Reef flats close to village. Four varieties found.</td>
<td>5-6</td>
<td>108/fortnight; 1,944/yr</td>
<td>Nama stored in potato sacks or sugar bags.</td>
<td>$30-$60 income received per bag (average weight of 14kg) depending on bag size sold at retail price of $2/heap. Nama taken to Labasa market on Saturday and sold at retail price of $4/heap. $50 income received per bag (18kg)</td>
<td></td>
</tr>
</tbody>
</table>

Nama taken to Savusavu market on Saturday by 6 women. Retailed at $4/heap for a total income of $50/bag (18 kg).

$44/week (32 bus fare to market, $12 market fee)

Harvesting restricted by tide, weather & bus schedule restricts sale time.

Overall, the price of noma ranged from $2-$4/kg. Wholesale prices ranged from $20-$100 per bag depending on availability of noma and the quantity in the bag. Retail prices ranged from $2-$34 per plate depending on the quality.

Expenses for harvesters varied depending on distance to harvest site and to market and ranged from $11 to $300/week (average of $97/week). Income ranged from $50 from wholesale and $15 from retail sales. This equates to an average income per person of $250 from wholesales and $4140 from retail sales of noma alone based on the assumption that 70% of their time is spent harvesting noma. While most noma was sold plain, the vendors in Suva and Nausori markets sold noma with chilli and fermented coconut.

Majority of the customers were locals (Fijians, Indians, Chinese and others). Some resorts and restaurants used noma in their seafood menu. Hideway Resort’s Purchasing Manager confirmed that he purchased noma every Wednesday and served it to tourists on Thursday with their traditional Fijian dish cooked in an earthen oven (lovo). The owner of Casablanca Restaurant on the Coral Coast also used noma in their menu, but only when there was a special request from customers. He believed that in order to introduce noma to tourists, and restaurants from customers, there was a need for awareness and a consistent fresh supply. Noma Bounty Restaurant is also known for serving noma with their cold seafood salad.

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**Figure 2:** Production (%) of *C. racemosa* per region (production figures from Vusama village in Sigatoka have been excluded since they are not currently harvesting). Production by region:

- **Labasa**: 5% - 69%
- **Savusavu**: 3% - 13%
- **Sigaota**: 3% - 8%
- **Rakiraki**: 4% - 7%
- **Tavua**: 8% - 6%
The majority of the nama currently produced for market comes from Yasawa followed by Labasa, Tavua, Rakiraki, Savusavu and Sigatoka (Figure 2). Results from this study showed that nama production was around 115.578 tons per year valued at FJD346,734. (Note that the actual production figure would be higher as production from the sites not visited is excluded). This figure may fluctuate depending on price of nama and amount of nama collected.

The main suppliers of nama on Viti Levu are concentrated in the Western Division. Major markets (Figure 3) are being supplied by two or more sources. On Viti Levu, a regular supply of nama from Yasawa goes to Suva, Nadi and Lautoka markets. Rakiraki nama was also regularly supplied to the Suva market and to Mana island and occasionally to the Nausori market. A regular supply of nama from Tavua went to the Lautoka, Nadi and Suva markets and occasionally to Ba and Tavua markets. Suva market also received an occasional supply from Vatulele. Sigatoka market received a regular supply of nama from two sites and an occasional supply from one site in Sigatoka. On Vanua Levu, regular supplies of nama from six sites were sent to the Labasa market and Savusavu market had regular supplies from two sites plus occasional supply from one site (Figure 4).

Figure 3: Major and minor markets of C. racemosa in Fiji

Figure 4: Maps showing sources and markets of C. racemosa on Vanua Levu (top) and Viti Levu (bottom)
Shelf life of *C. racemosa* can be improved by preservation in brine, and some preliminary trials have been conducted at the University of the South Pacific’s Post Harvest Facility. When bottled in weak (10%) brine, following treatment to reduce bacterial numbers, shoots have lasted for 3-4 months. Preserved shoots that have undergone heat treatment have higher fibrosity than fresh brined ones and this could reduce their value to consumers. More research will be carried out in 2012 on the most appropriate method of preservation (J. Lako, 2011, pers. com).

Health benefits of *nama* include low calorie content, Vitamin A for healthy eyes, beta-carotene an antioxidant and iodine which keeps the thyroid gland healthy, thus reducing the chances of goiter (Lako, 2011, pers. com).

Due to the difficulty in preserving *nama* for long periods, its export has not yet been fully exploited. Export trials done in late 1990s were unsuccessful. “Chamberlain and Pickering in 1999, conducted a HACCP-type study of the post-harvest treatment of sea grapes for the artisanal and export fisheries in Fiji. Holding the sacks in sea water for two days allows for healing of the wounds created by harvesting. Attempts were made to ship the plants in vented, polystyrene boxes. The boxes were drained and prepared for air shipment – during this process approximately 50% of the plants were rejected. After a 9.5 hour flight to Japan, followed by a 15 hour road journey from Osaka to Nagoya, 100% of the shipment was rejected. Apart from the quality and storage issue, it was calculated that the shipment costs were prohibitive. While this study was unsuccessful, it led to a number of recommendations for future ways of shipment and loss of plants (South et al. 2011).”

In 2011, a local seaweed export company sent a trial shipment of 5kg pickled (brined) *nama* to New Zealand. It was reported that this shipment reached the customer in good condition (even after being in quarantine for at least two days). The preservation process was fairly simple, whereby *nama* bought from the Lautoka market was sorted (almost 50% was rejected), washed in freshwater and packed in plastic bags containing brine. This demonstrates that export of *nama* to nearby countries is possible.

5.0 References

Appendix 1

Questionnaire for the *Nama* Survey:

_________________________Village

1. How is *nama* harvested and how many people from the village is involved. How is it stored after harvest? Is there any cost involved in harvesting: - boat etc
2. Have they noticed any difference in *nama* coverage over the years. How many weeks does it take for the same area to recover for the next harvest; crop rotation??
3. Is there any history behind *nama* collection. How was it started in the village?? Has *nama* been there since time?
4. Any medicinal benefits of *nama*??
5. How many bags can one woman collect per day? Specify bag size and time consumed to fill the bag (CPUE)
6. How is the sales money distributed?
7. In total, how many women are involved in *nama* and what percentage are these to the number of house hold in the whole village.
8. How may bags picked per week per village. Estimate total harvest for the month and year
9. Is there seasonality on *nama* harvesting (collect more/less in different months)
10. Is there different types of *nama* found:
11. If Yes, then describe
12. Which type of *nama* is better and why:- what qualities do they have, any taste difference, customer preference (demand), get different names (local names)
13. Is there different price for different *nama*
14. Which variety keeps longer?
15. Can harvesters negotiate a better price for the *nama*?
16. How is *nama* sold.? If middleman involved: - get details of middle man:- where are they from, how many are there, how much they pay; how they transport; any idea where they retail; etc
17. Price for 1 bag (size of bag; weight of bag)
18. If harvesters do not selling *nama* in market, what options are there for them to sell. Would they prefer to sell themselves and get more money, or would they rather sell to middleman. Why?
19. Do the villages sell other products in the markets and to the middleman. Like fish, vasua, coconuts, dalo etc. what scale is *nama* :- in terms of revenue generation
20. If harvesters sell themselves, then how is *nama* transported to the market, what are the cost involved, how is it stored during transportation
21. What is the harvesters view on the demand of *nama*. Do they think, they can sell more, if proper transport is available, or they think that what they are selling is sufficient?
22. If sold on early week days:- would people buy??
23. Who all are the consumers; Chinese, Indo-Fijians, Fijians: - who buys more?
24. Is *nama* from other areas sold in the respective markets. If yes, then where from?
25. Is there any information of the Hotels usage of *Nama*, if YES then who sells to them?
   If possible get contact details.
26. How is *nama* prepared, any new recipes??
27. Is there any scope of expanding the *nama* industry
28. Contact details on Harvesters and middle man
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Much of IMR’s work is externally-funded research and consultancies on the region’s marine environment and its resources. Current activities centre on coral reef monitoring, marine biodiversity assessment, aquaculture management and cetacean research. The Institute also coordinates the South-West Pacific node of the Global Coral Reef Monitoring Network (www.GCRMN.org).

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