



**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**



**Australian Government**

**Australian Centre for  
International Agricultural Research**

**Institute of Marine Resources: Technical Report  
05/2012**



**School of Marine Studies  
Institute of Marine Resources**

**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  
School of Marine Studies  
Faculty of Science, Technology and Environment  
University of the South Pacific

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

This publication should be cited as:

Morris, C. & Bala, S. 2012. *Value adding and supply chain development for fisheries and aquaculture products in Fiji, Samoa and Tonga: Supply chain for Sea grapes (Caulerpa racemosa) in Fiji*. Suva, Fiji: Institute of Marine Resources, School of Marine Studies, FSTE, USP. IMR Technical Report 05/2012. 19pp.

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Published by Institute of Marine Resources,  
School of Marine Studies, FSTE, USP,  
Private Mail Bag, Suva, Fiji.

ISBN: 978-982-9143-11-2

Cover photographs from left to right:

Lovell, E., 2008, *Porites cylindrical* coral off Suva waters, Fiji  
Morris, C., 2008, Prawn harvest at Navua Farm, Fiji.  
Morris, C., 2009, Tilapia harvest at Navua Farm, Fiji.  
Miller, C., 2010, Spinner dolphin off Moon Reef, Dawasamu, Fiji.  
Morris, C., 2011, *Caulerpa* at Tongan Market

Layout and Design: Dikoila A. Valemei

Printed by: University of the South Pacific

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## 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).

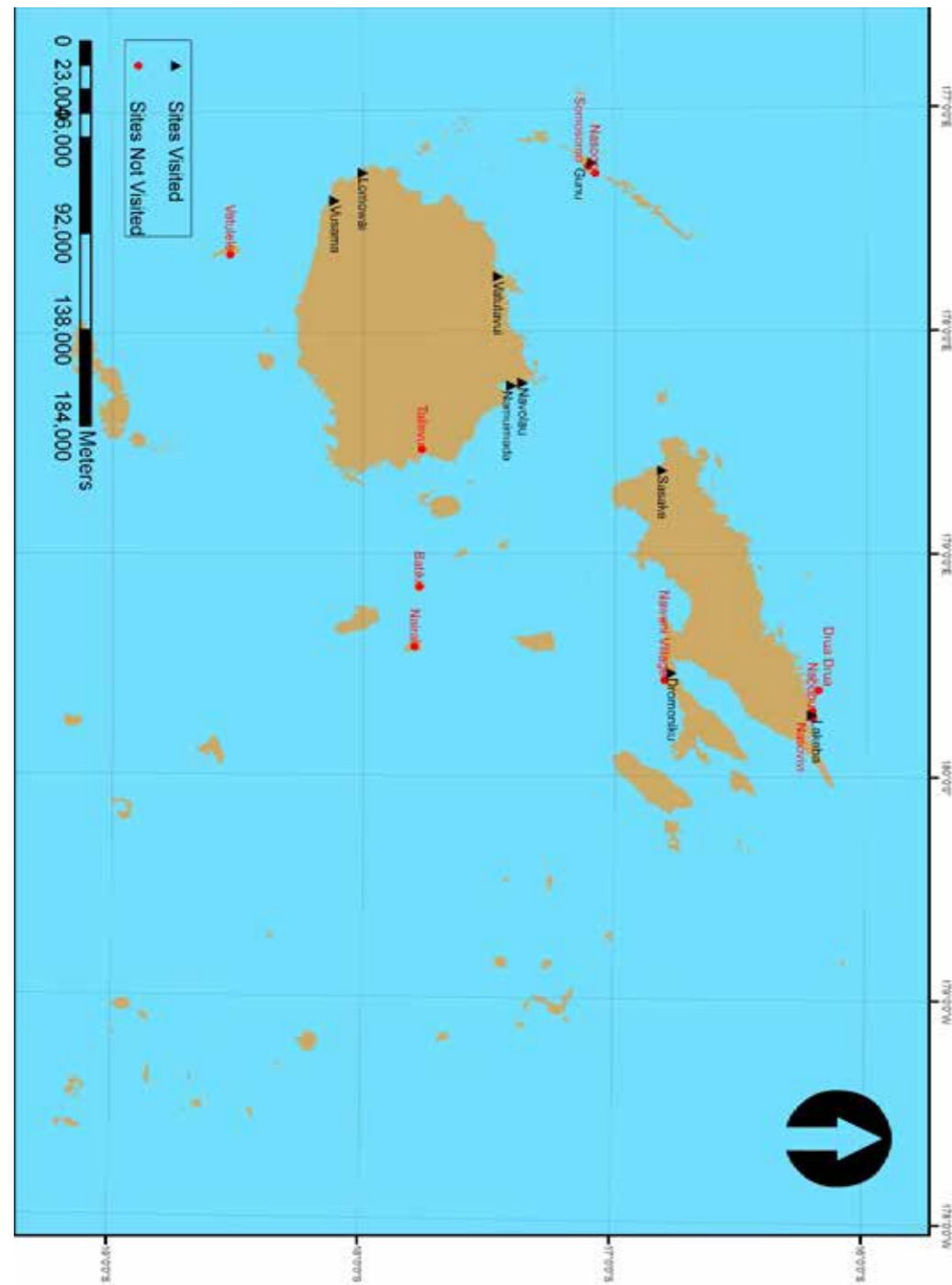


Figure 1: Fiji Islands: Nama Sites Visited

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 compiled 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 1: Details of *C. racemosa* production and costs of harvesters

Area/ Village	No. of harvester	Harvest method, frequency and average duration	Harvest site and varieties	Estimated production/ week;/ based on 36 fishing weeks/yr (kg)	Post-harvest handling	Market	Total costs/week for harvesters	Constraints
<b>Yasawa</b> Gunu	30	Only uprights harvested 3 days/week from Mondays to Wednesdays for 4 hours/day. Total fishing time is about 12 hours/week/person.	Reef flats close to and at a distance from village. Two varieties found.	2100/week; 75,600/yr	<i>Nama</i> stored in sugar bags in a cool place. Transferred to potato sacks inside coconut baskets for transport to market	Transported to Lautoka domestic wharf on Thursday. Middleman picks up and transports to market (Lautoka, Nadi and Suva) by bus Wholesale price ranged from \$40-\$100 depending on bag size & availability of <i>nama</i> . Average weight of bag is 35kg. Middleman sold at a retail price of \$2/plate with chilli & fermented coconut	\$300 \$30 return to harvest site twice/week, \$4/bag freight for 60 bags/week	Harvesting restricted by tide and weather Market demand not met when <i>nama</i> is less abundant. Losses from handling and storage. Only 1 boat available for transport to market
<b>Sigatoka</b> Lomawai	20	Runners harvested by 12-15 women every Friday for 2.5 hours. Total fishing time is 2.5hrs/week/person.	Mudflats close to village & fringing reef at a distance from village. Four varieties found.	75/ week; 2,700/yr	Uprights separated from runners, placed in a wet cloth and hung in a cool place inside house. This removes excess water.	Transported to Sigatoka market on Saturday by 4 harvesters.  Transported to Sigatoka market on Saturday by 3 harvesters. Wholesaled at \$30-\$50/bag (average weight of 17kg) depending on availability of <i>nama</i> . Retail price ranged from \$1-\$2/plate	\$138; \$90 return boat fare, \$45 return to market and \$4 market fee  \$21/week \$18 fare to market /person, \$3 market fee One customer bought 12-15 plates and supplies to hotels in Coral Coast	Harvesting restricted by tide and weather. Supply restricted by unsustainable practices.
Vusama	7	Runners harvested twice/week (Thurs & Fri) for 2 hrs. Total fishing time is 4 hrs/week/person	Reef flat close to village. Two varieties found.	122.5/week; 4,410/yr	Uprights separated from runners on site. <i>Nama</i> stored in potato sacks in a cool place.			

<b>Rakiraki</b> Namuimada	16	Uprights harvested twice/week (Tuesday & Thursday) for 2.5 hours/day Total fishing time is 5 hrs/week/person  1 hour spent harvesting uprights every fortnight	Reefs flat a distance from village. Only one variety found.  Same harvesting site as Namuimada.	144/week; 5,184/yr	<i>Nama</i> stored in potato sacks and taken to Suva market by 3 harvesters on Wednesday. Another batch of <i>nama</i> harvested on Thursday is sent to Suva by bus.  <i>Nama</i> stored in bush taro leaves (via leaves)	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 (@\$2/plate)  10kg sold at wholesale for \$50 to middleman who sold to Mana Isl. Resort in Mamanuca.	\$209.5/week; \$25 return bus fare to harvest site (5 pax) \$52.50 bus fare & cartage to Suva, \$34.50 return bus fare to Rakiraki, \$6 cartage fee at Suva market, \$60 meals and \$31.50 market fee \$5/fortnight (Return bus fare to harvest site)	Harvesting restricted by tide and weather.
Navolau	1			10 kg/fortnight 180/yr				
<b>Tavua</b> Vatutavui	25	Uprights harvested once/week either on Wednesday or Thursday for 1.5 hours. Total fishing time is 1.5 hours/week/person	Reef flat at a distance from village close to Vatia Lailai island  One variety found.	250/week; 9,000/yr	<i>Nama</i> stored in potato sacks with leaves in a cool place. Put into large striped plastic bags when transported to market	<i>Nama</i> regularly taken to Lautoka & Nadi markets, occasionally to Tavua and Ba market by 5 harvesters at a time. 8 middleman sell regularly at Suva market. Market days are Friday and Saturday.  Sold wholesale for \$30-\$50/bag (average weight of 26kg) depending on bag size and quantity at market. Retail sales fetch up to \$100/bag (average weight of 26kg)	Varies depending on distance from market \$31/week for Tavua market; \$33.50/week for Ba market; \$52/week for Lautoka market; \$62/week for Nadi market	Harvesting restricted by tide and weather

<b>Labasa</b> Vuniuto	1	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.	70/week; 2,520/yr	<i>Nama</i> stored in potato sacks or sugar bags.	<i>Nama</i> taken to Labasa market on Friday. Market days are Friday and Saturday. \$30-\$40 income received for 1 bag (average weight of 14kg) sold at retail price of \$2/heap.	\$87/week (\$30 fare to Sasake, \$27 boat fare, \$13 fare to market, \$15 meal, \$2 market fee)	Harvesting restricted by tide and weather. Supply restricted by unsustainable practices.
Sasake	2	Total fishing time is 3-5 hours/week/person	Reef flats close to village. Four varieties found.	210/week; 7,560/yr		\$30-\$60 income received per bag (average weight of 14kg) depending on bag size sold at retail price of \$2/heap; <i>Nama</i> taken to Labasa market on Saturday and sold at retail price of \$4/heap. \$50 income received per bag (18kg)	\$57/week (\$27 boat fare, \$13 fare to market, \$15 meal, \$2 market fee)	
Lakeba	26	Group of 5-6 women harvest runners at any one time for 1 hour once/fortnight on Friday		108/fortnight 1,944/yr	Uprights separated from runners at village, wrapped in banana/ pawpaw leaves and stored in a coconut leaf basket		\$30/week (\$14 fare to harvest site, \$15 fare to market, \$1 market fee)	
<b>Savusavu</b> Dromoniku	20	Group of 10 harvest uprights at any one time for 4.5 hours once/week on Friday	Reef flats close to village. Two varieties found.	180/week; 6,480/yr	3 storage methods: In coconut leaf basket & covered with leaves; In sack/basket & hung in house; In sack and kept overnight in sea	<i>Nama</i> transported to Savusavu market on Saturday by 6 women. Retailled 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.

Production of *C. racemosa* by region

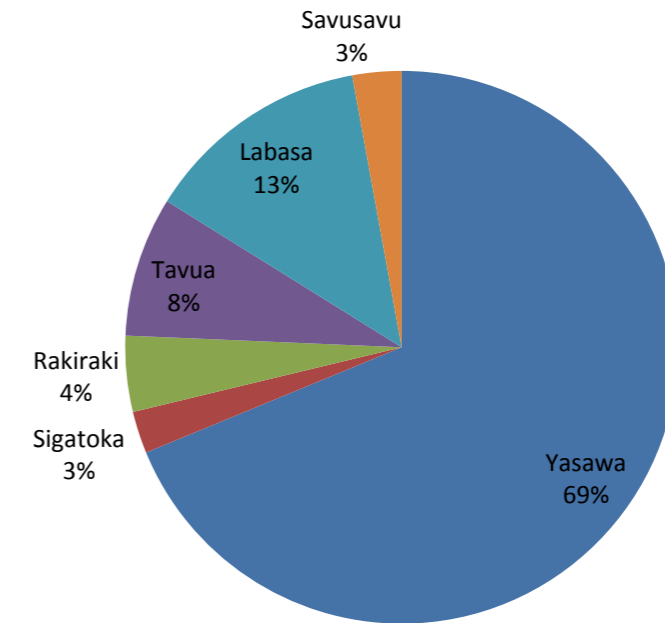


Figure 2: Production (%) of *C. racemosa* per region [production figures from Vusama village in Sigatoka have been excluded since they are not currently harvesting]

Overall, the price of *nama* ranged from \$2-\$4/kg. Wholesale prices ranged from \$30-\$100 per bag depending on availability of *nama* and the quantity in the bag. Retail prices ranged from \$2-\$4 per heap/plate depending on the quantity.

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). Average income per week for one woman worked out to be about \$70 from wholesales and \$115 from retail sales. This equates to an average annual income per person of \$2,520 from wholesales and \$4,140 from retail sales of *nama* alone based on the assumption that 70% of their time is spent harvesting *nama*. While most *nama* was sold plain, the vendors in Suva and Nausori markets sold *nama* with chilli and fermented coconut.

Majority of the customers were locals (Fijians, Indians, Chinese and others). Some resorts and restaurants used *nama* in their seafood menu. Hideway Resort’s Purchasing Manager confirmed that he purchased *nama* 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 *nama* in their menu, but only when there was a special request from customers. He believed that in order to introduce *nama* to resorts and restaurants, there was a need for awareness and a consistent fresh supply. Gunu village occasionally sold *nama* to tourist boat operators (Captain Cook Cruises) who serve *nama* as a salad to the tourists. Nadi’s Bounty Restaurant is also known for serving *nama* with their cold seafood salad.

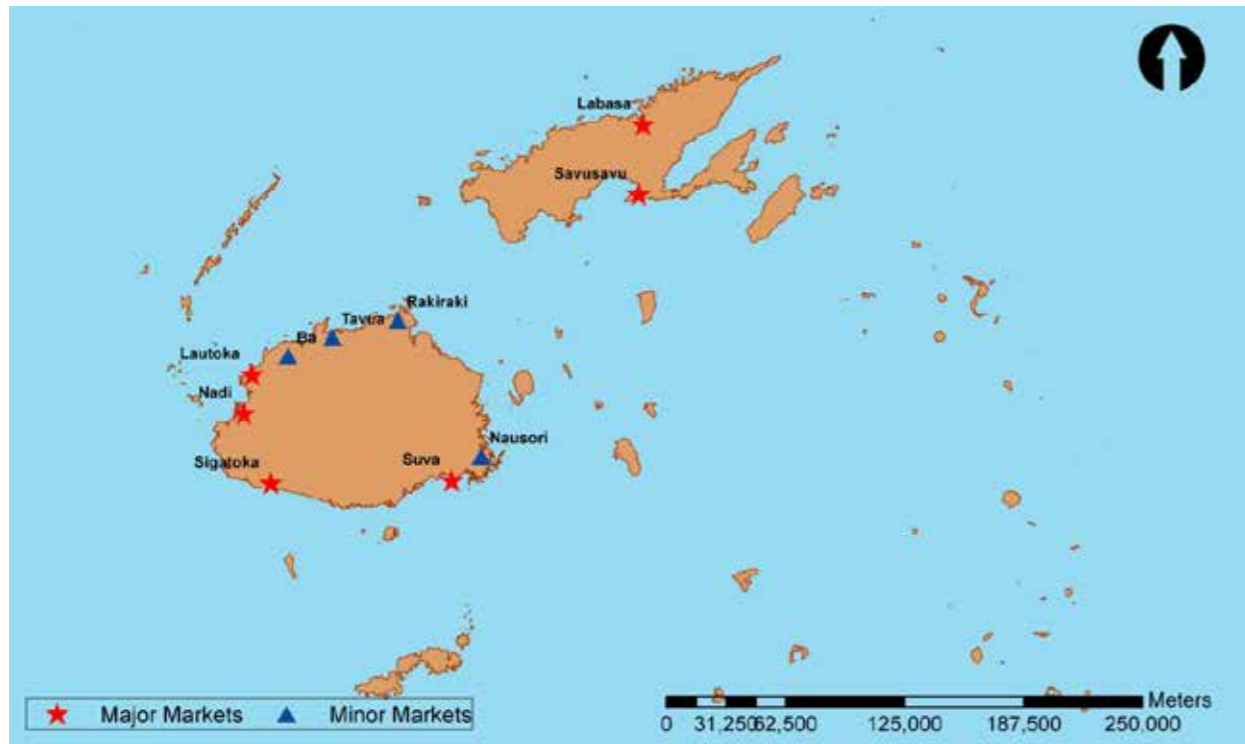


Figure 3: Major and minor markets of *C. racemosa* in Fiji

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).

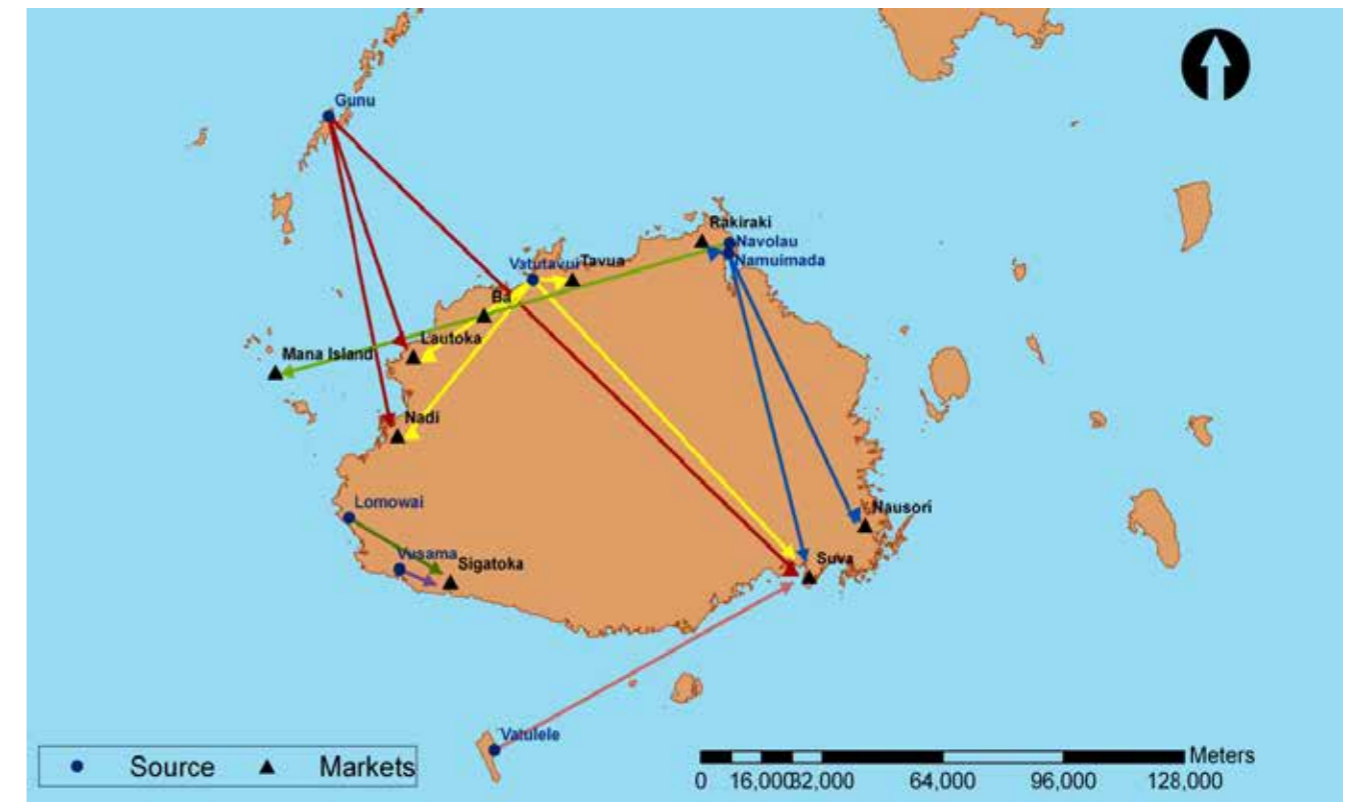
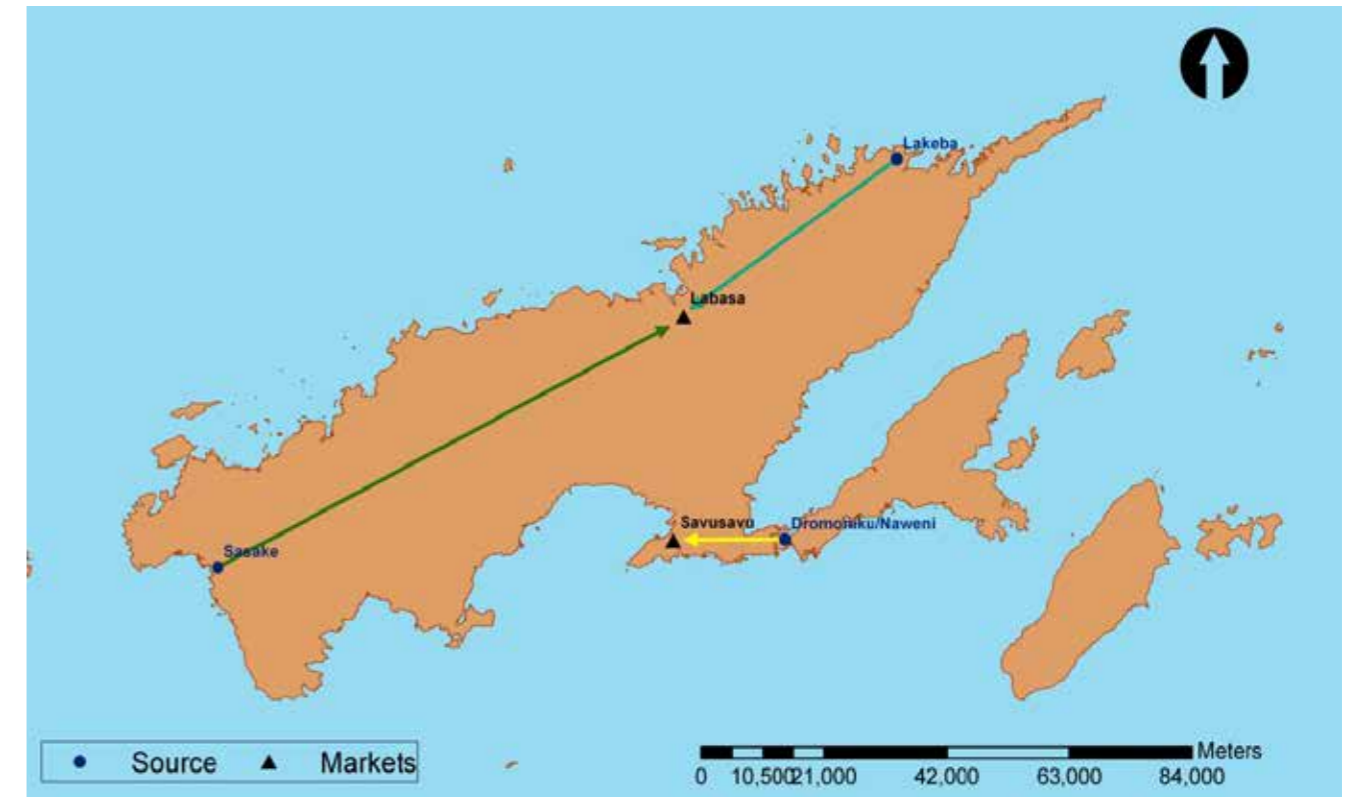


Figure 4: Maps showing sources and markets of *C. racemosa* on Vanua Levu (top) and Viti Levu (bottom)



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

South, G.R., Morris, C., Bala, S. & Lober, M. 2011. *Scoping study for tilapia in Fiji, Samoa and Tonga*. PARDI project 2010/002 report. 39pp.

## 6.0 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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