Freshwater Mussel (*Batissa violacea*) Fishery and its Value in Fiji

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Abstract

This paper examines the local freshwater mussel, or *kai* (*Batissa violacea*), fishery value chain, its values and contribution to the livelihood of people in Viti Levu, Fiji. The assessment was performed through face-to-face interviews, with the use of semi-structured questionnaires administered to 125 actors. A walk through the value-chain was also conducted that confirmed the sites' environmental conditions. Results revealed that even though the *kai* fishery is dominated by rural women, men were also employed as *kai* processors, transporting agents and exporters. This fishery generated at least 58 other employments through the 500 *kai* harvesters within the five major provinces understudy. These were drivers, boat builders, retailers, processors, exporters, and harvesters. Three sales pathways were identified that determined the revenues and profits: (i) harvesters sell own harvests directly to the consumer at the municipal markets, (ii) harvesters sell through intermediary traders to consumers, and (iii) harvesters sell through processors to supermarkets, hotels or exporters. When revenues and profits were calculated, harvesters earned much less, compared to intermediary traders, processors, and exporters. Major constraints include continuous reduction in catch size of *kai*, lack of transport, and marketing at the local municipal markets that require improvements.

Keywords: *Batissa violacea*; Fiji freshwater mussels; *kai* fishery; marketing; women harvesters

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Introduction

The fisheries sector is vital for the economic development of developing states. Both fisheries and aquaculture remain an important source of food, nutrition, income and livelihoods for hundreds of millions around the world (Kumar, 2017). In 2016, the developing countries accounted for more than half of the fish exports. In other words, the developing countries hold a greater share of the fisheries market as compared to the developed economies. As a result, fish is not just used for human consumption in developing and least developed countries, but also adds to the upstream and downstream values (Kumar, 2017).

In Fiji, freshwater mussels (*Batissa violacea*) or *kai* are one of the major sources of protein, and a revenue earner that contributes to the livelihood of communities that reside along and near the major rivers and their associated tributaries in the two major islands of Viti Levu and Vanua Levu. Some of the major rivers include the Rewa, Navua, Sigatoka, Nadi, and Ba rivers in Viti Levu, while Labasa, Wainikoro, and Dreketi rivers are in Vanua Levu. *Kai* in Fiji grows wild in restricted, lower freshwater reaches of rivers, between the upper limit of salt water penetration, and the upper reaches of the rivers.

There are three distinct shapes of *kai* in Fiji, which are mainly identified by their local names: "*kai buli*", "*kai bukivula*", and "*kai dina*". The *kai* shapes appear to be related to river conditions and ecological factors of the environment (Richards, 1994; Thangavelu et al., 2011). "*Kai buli"* is identified by its fat and mostly round shell shape; "*kai bukivula"* is thin and oval in shell shape with eroded umbo, while "*kai dina"* is the intermediate shell shape between "*kai buli"* and "*kai bukivula".*

Kai is the major inland fishery in Fiji that engages women throughout the supply chain, from harvest to the market (Vunisea, 2004). The local market price for live *kai* is between FJD$3 - $5 per heap depending on sizes. It is harvested from the river bed, depending on the depth of the river. Diving for *kai* is usually carried out in deeper stretches of rivers, while squatting and picking *kai* from river bed is done in shallow waters. Distribution and abundance of *kai* in the Rewa river is estimated at 79 individuals/m^2 with the standing crop estimated at 5.9 x 108 individuals in the 7.5 km^2, while the total fishery yield at approximately 130 tons/annum (Naqasima, 1996; Naqasima-Sobey & Roger, 1999). Ledua, Matoto, Sesewa, & Korovulavula (1996) estimated the density of *kai* in the Ba River at 270.38 individual/m^2 with the total population estimated at 787,608,829, and a total biomass of 1,993,374.5 kg. Studies have also indicated that the *kai* stock has undergone some changes, especially with

the high volume of harvesting due to pressure for income generation and employment opportunities (Smale, 2013; UNIDO, 2011).

This study examines the *kai* fishery value chain in Viti Levu, Fiji. This is the first ever research conducted that examined the local freshwater mussels, their value, and contribution to the livelihood of the people in Viti Levu, Fiji.

Methodology

The snowball sampling approach (Kuper, Linggard & Levinson, 2008) was adopted for this research, whereby the Fiji Ministry of Fisheries officers initially identified the major *kai* fishery stakeholders and the key actors from various villages along the major rivers and at the major municipal markets.

Through the use of semi-structured questionnaires, face-to-face interviews were conducted with a total of 125 *kai* fishery actors, of which there were 101 harvesters, 11 intermediary traders, two exporters, one processor, one representative for each of four restaurants and hotels, five transporting agents, and one boat builder. The questionnaires adopted Brown et al.'s (2010) approach that gathered information related to frequency and volume of harvest with estimated costs, consumer preference and specifications, processing and value-adding, supply and demand, transportation, marketing, and other related activities. Evidences of information gathered during the interview were checked and confirmed when the interviewers walked through the value chains.

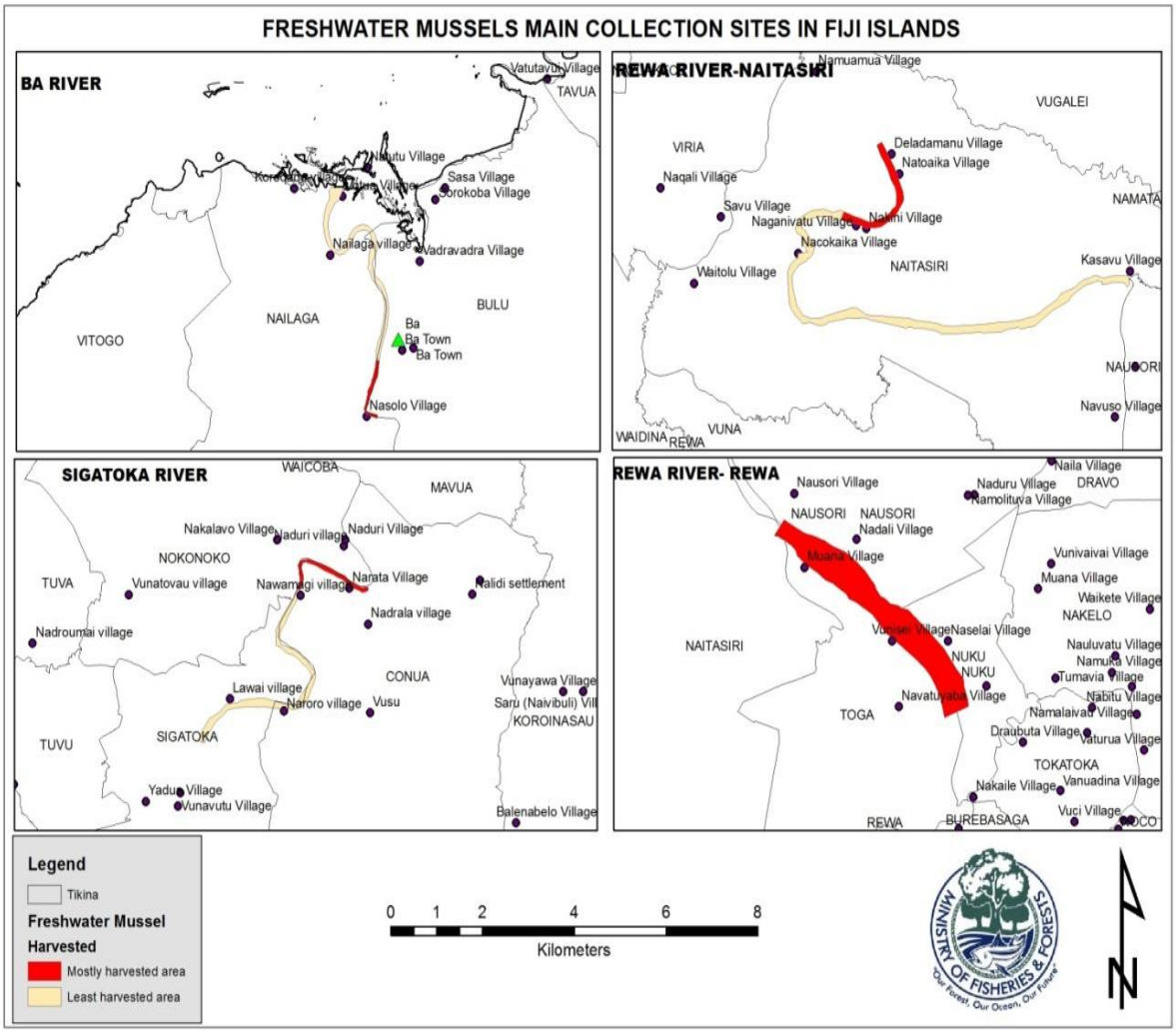
Interview Sites of Key Actors

The key actors identified in this study were the *kai* harvesters, intermediary traders, processors, exporters, retailers, and other supporting services. They were interviewed in their respective work places or selling sites.

Harvesters

A total of 101 *kai* harvesters were interviewed. These were individuals who took part in the harvesting of *kai* from various rivers in Viti Levu. The interview sites for these *kai* harvesters were categorized into three: villages and/or settlements, municipal markets, and harvest sites, as shown in Figure 1.

Figure 1. Maps of the *Kai* Harvesting Area.



Source: Authors' compilation

A total of twenty-seven villages and two settlements within the three provinces of Nadroga, Rewa, and Naitasiri were visited for the interview. Other harvesters were interviewed at their respective selling sites, mainly at the local municipal markets in Suva, Nausori, Lautoka, Ba, Nadi, Sigatoka, and Navua. Further interviews were conducted at the major harvest sites along the Rewa River, from Kasavu village to Wainasasi (Figure 1).

Intermediary traders

Intermediary traders were those that bought *kai* from harvesters and who then resold the mussels at the local municipal markets. A total of eleven intermediary traders

were identified and interviewed, of which 63% were females and 27% males. The female intermediary traders were selling *kai* at the Nadi market, while male intermediary traders were selling *kai* mainly in Lautoka, and Navua markets. The *kai* suppliers to these intermediary traders were harvesters from the villages of Naitasiri province, except the one male intermediary trader who usually buys *kai* from the Suva market and resells to Warwick, and Naviti resorts.

Processors

Kai processors were those who bought *kai* from the harvesters and processed it following the processing flow chart shown in Figure 5: cleaning, boiling, shucking, packaging, and freezing, prior to reselling to either local supermarkets or to exporters. About four *kai* processors were identified, but only one was interviewed.

Exporters

Only two exporters were identified and interviewed: one based in Bilavou, Navosa, and the other in Wailada, Lami. The Bilavou exporter exports sporadically, while the Wailada exporter exports *kai* weekly.

Retailers

Only four big retailers were identified, and representatives were interviewed. These retailers included two supermarkets in Suva that sell frozen *kai*, a restaurant in the Coral Coast, and a hotel in Denarau that value-add *kai* for use in the restaurant and hotel menus.

Other supporting actors

Other *kai* fishery actors identified were the service industry that supported and contributed to the smooth product flow of the *kai* supply chain. These include the transport industry in Nausori, boat builders in Baulevu, and the law enforcement agency of the Government of Fiji, situated both in Nausori, and Suva.

Results and Discussion

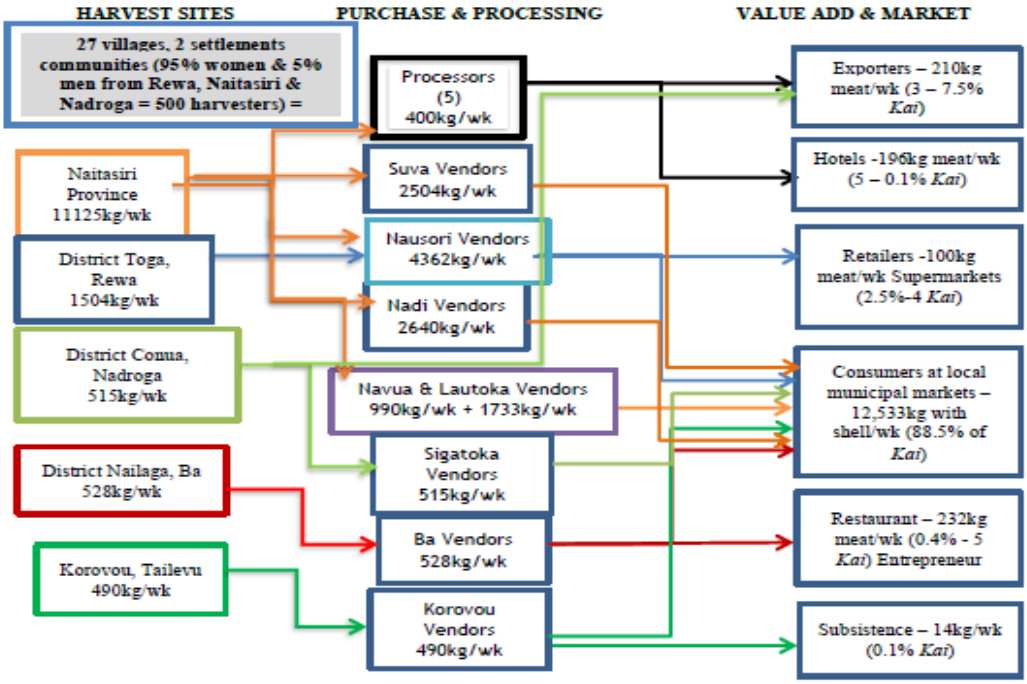
Local freshwater mussel, *kai* (*Batissa violacea*), is Fiji's largest freshwater fishery that is mainly dominated by women. Although the *kai* fishery is one of the top three freshwater fisheries in the Pacific, with catches estimated at 4000-7000 tons per annum, this fishery is poorly studied. Hence, the importance of this research.

A total of 500 harvesters were identified from the interview. These *kai* harvesters appeared to have created self-employment as a source of livelihood for their respective communities. The *kai* and its related products are sold to the public, retailers, and processors.

Value Chain Map for Kai Industry

Figure 2 shows the value chain map of the *kai* fishery in Viti Levu, and demonstrates the involvement of multiple stakeholders and actors. Apart from the 101 *kai* harvesters interviewed from Nadroga, Rewa, and Naitasiri provinces, a further 399 *kai* harvesters were identified through the interview, providing a total of 500 *kai* harvesters altogether. They harvest approximately 14,162kg *kai*/wk from the five provinces of Naitasiri, Rewa, Nadroga, Ba, and Tailevu. Out of the five provinces, Naitasiri appears to have the highest number of *kai* harvesters, who harvest approximately 78.6% of the national total, or 11,125kg/wk. These are usually sold in the five urban centres in Suva, Nausori, Nadi, Navua, and Lautoka. Sometimes, *kai* are also sold to processors for export, and to local supermarkets and hotels.

Figure 2. Value Chain Map for the *Kai* Fishery in Viti Levu.



Source: Authors

Key Actors in the Kai Industry and Related Activities

The key actors identified for the *kai* fishery in Viti Levu include harvesters, intermediate or middlemen traders, processors, supermarkets, hotels, restaurants, and consumers from the local markets, as shown in Figure 2 above. A number of other formal and informal employments have been spawned along the supply chain, as shown in Table 6.

Harvesters and Associated Activities

Out of the 500 *kai* harvesters identified through face-to-face interview, 95% were women, while only 5% were men. The majority of these women were aged 50-55 years, with the ages ranged from 20-70 years. Many of these women have been harvesting *kai* for over 20 years. These women harvesters are involved in both subsistence and commercial sales of *kai*, while male harvesters are only involved in the subsistence use of *kai*, mainly as companionship to the wife, who goes out to harvest. Results further revealed that women have high tolerance to cold water, as evident in the 68% of women spending about three-four hours per day for three-four days per week harvesting *kai*.

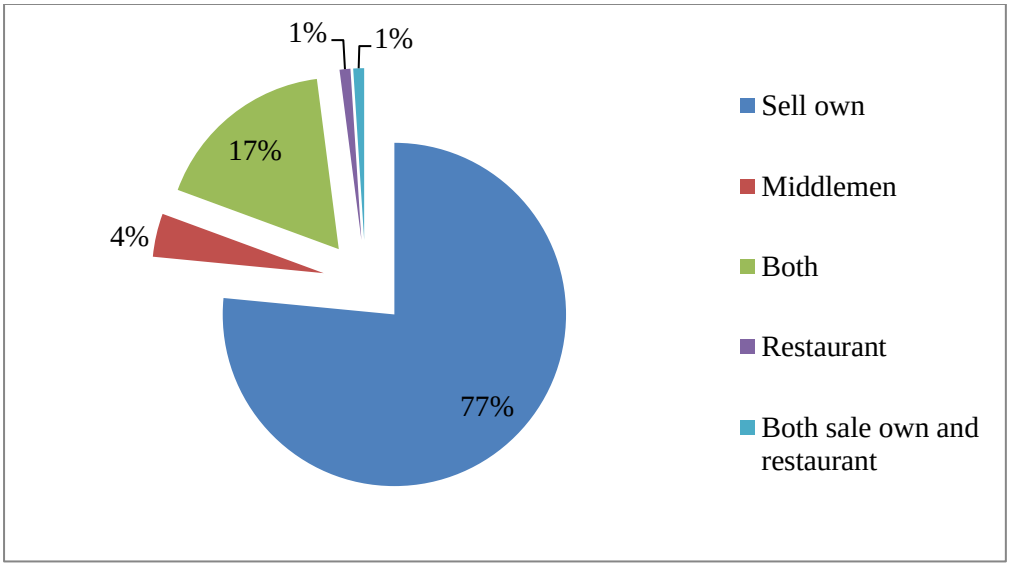
Harvesters travel to harvest sites through various means, either walking on foot, or travelling in public transport or private vehicles, except in Sigatoka where harvesters sometimes travel on horseback. In the province of Naitasiri, a common practice is for males (husbands or sons) to accompany female harvesters for the purpose of carrying harvested *kai* in sacks. This is because lifting and loading the 80kg heavy sacks full of *kai* from the river to the transport vehicle, such as van, carrier, or bus, is a laborious activity that females cannot perform.

The transportation of *kai* within the five provinces, from the harvest sites to the market, is organized based on the level of tides and distance to the market. For example, the Naitasiri province is far from the market, and *kai* is thus usually harvested and sold a day after harvest, while for those provinces nearer the market, *kai* is harvested and sold on the same day. Similarly, *kai* that are harvested at low tides and in the morning are transported to the market on the same afternoon. However, if the harvest was done at low tides and in the afternoon, transportation to the market is done the following day.

Further analysis revealed that most harvesters play dual roles, i.e. both as harvester and vendor, as evident in Figure 3, where 77% of harvesters were also vendors. Approximately 17% of harvesters sold half of their *kai* to middlemen traders and sold

the other half themselves, 4% sold all their *kai* to middlemen traders, while the rest sold only to the public. The distribution of *kai* being harvested appears to indicate that most harvesters prefer to sell their own harvest at the municipal markets, due to higher returns. Most of these vendors sell *kai* from 8am-4pm until the market closes. Any unsold *kai* inside the markets are further sold outside the markets or returned home and consumed by the family. However, at the Nausori market, unsold *kai* on Saturdays are usually bartered for coconuts or fish with vendors from the coastal areas. The barter system is a traditional practice that usually occurs between the coastal and the inland people where they exchange protein foods with fruits and vegetables.

Figure 3. Percentage Harvesters and Sales of *Kai*.



Source: Author

Intermediary/Middlemen Traders

Intermediary traders were those that sold live, unprocessed *kai* with shells to the market vendors and to other outlets. Results show that 46% of intermediary traders were females, 36% males, and 18% represented the activities of the husband and wife combined. These traders were mainly from the Naitasiri province, while no intermediary traders were found in Sigatoka or Ba. The age group of intermediary traders range 30-70 years, of which the majority of young traders below age 45 sold *kai* at the Nadi, Lautoka, and Navua markets. Older traders, aged 65-70 years, were all females, and sold *kai* at the Nausori market. In the Naitasiri province, males were

mainly involved in the marketing of the *kai* as intermediary traders, which may be due to the heavy weight involved in carrying the 80kg sack full of *kai*, that requires male strength. This male activity was mainly prevalent in Navua, Nadi and Lautoka markets.

Processors

Processors were those that processed or cooked *kai* and then resold to exporters, supermarkets, and hotels that were based in Nausori. A total of five processors were identified, but only one was interviewed. The four processors were reluctant to be interviewed. It may be assumed that fear of being identified for non-compliance to the Food Safety Act (Anon, 2003) and Food Safety Regulation (Fiji Islands Government Gazette Supplement, 2009) may be one of the reasons for their reluctance. Based on information received from supermarkets to which these processors supply processed *kai*, about 20kg of processed *kai* meat per week had been received from these four processors. Hence, it may be assumed that these four processors were perhaps processing *kai* from their respective residential properties or elsewhere without proper license. Similarly, an exporter confirmed receiving 100kg of processed *kai* meat per week. Likewise, a Sigatoka female harvester also processed *kai* meat and sold to three restaurants in the Sigatoka town at $12 per kg of 2kg weekly.

Local Customers

Local customers were those that purchased *kai* for sale to supermarkets, hotels, and restaurants, or any other local consumers for home consumption. Interestingly, 95% of the fresh *kai* consumers that purchased *kai* from the municipal markets were Fijians of Indian origin. Apparently, *kai* vendors experience low sales during Hindu prayers, when these customers become vegetarian, as revealed by municipal markets sales section.

While the municipal markets sell fresh *kai* with shells, some supermarkets sell frozen *kai* meat. It was revealed by a supermarket sales department in Suva that, generally, the demand for frozen *kai* at the local market is low. However, increased purchase of *kai* by local Fiji-Indians were observed for relatives abroad. It was also noted that local Fiji-Indians usually consume *kai* as snacks during drinking sessions or parties, so only small portions of *kai* had been purchased for this.

Moreover, only 0.1% of *kai* had been purchased for hotel restaurants use. This was evident in only about 10-14kg/week of processed *kai* meat purchased by all the four

hotels, which may indicate minimal purchase and low demand by the hotels. *Kai* meats that were purchased by the hotels were used in various dishes, such as in *lovo*[1], boiled, and *kokoda*[2], marinated and cooked in coconut milk, and usually sold at FJ$15-FJ$70 per dish. Furthermore, *kai* dishes sold in local restaurants appear to be more popular compared to those served in the hotels. This may be due to high cost and unfamiliarity with the taste of local *kai* for tourists used to imported mussels. *Kai* dishes in local restaurants include *kai* cooked in *lolo*, baked, or cooked with pasta, and sold at FJ$7-FJ$25 per dish.

Exporters

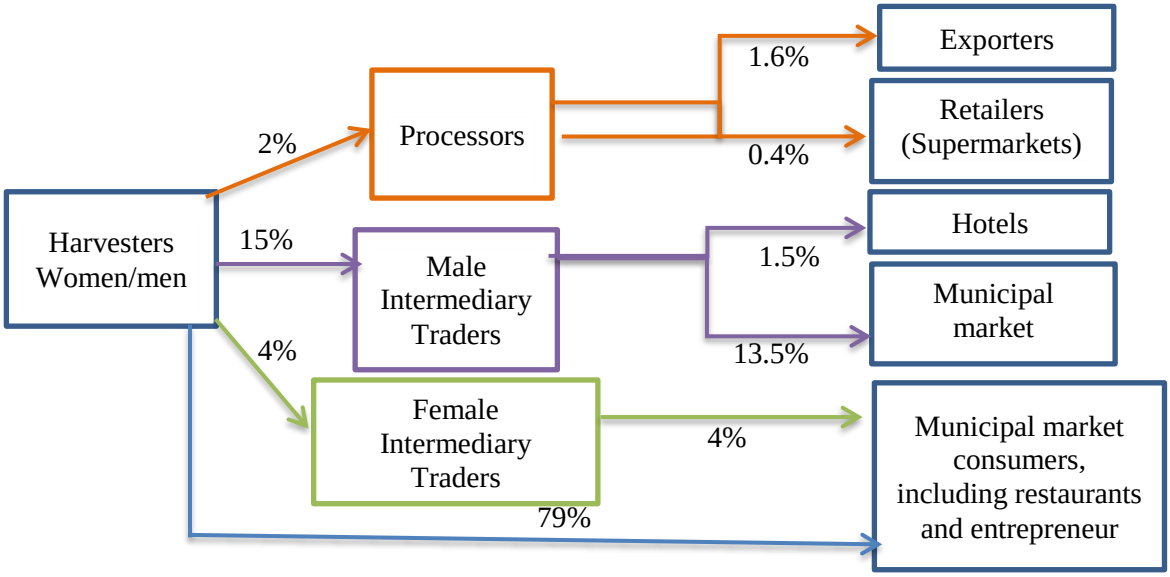
Kai does not seem to be a popular commodity for export. This was evident by the two exporters that were interviewed, which revealed that they only export frozen *kai* meat as a minor commodity. Low importer demands may have contributed to low exporter supplies. It appears that the export of frozen *kai* meat has not exceeded 100kg per week per exporter. The most regular exporter exports a maximum of 100kg of frozen *kai* meat per week. Therefore, it is estimated that about 7-8% of *kai* that are harvested per week is exported by all the three exporters. Exporters usually purchase at FJ$12-$14/kg and sell overseas at 55%-70% markup, approximately at FJ$21/kg. *Kai* is mainly exported to Australia and New Zealand, where majority of Fijian expatriates reside.

Volume of Kai

Figure 4 shows the total percentage volume of *kai* harvested, and its distribution along the value chain. It reveals that about 79% of the total volume of *kai* harvested were sold by the harvesters themselves at the municipal market, while the remaining 21% were sold to intermediary traders, restaurants, hotels, supermarkets, entrepreneurs, and processors. Of the 15% *kai* supplied to the male intermediary traders, about 13.5% were sold directly to consumers at the municipal market, especially in Navua, Nadi, and Lautoka, while the remaining 1.5% was sold to the hotels. The female intermediary traders appear to sell all their products to consumers at the municipal markets only. It appears that only 2% of *kai* harvested are processed, of which 1.6% are exported, while 0.4% are sold locally in supermarkets.

[1] *Lovo* is a traditional Fijian method of cooking where food is cooked on hot stone buried underground.
[2] *Kokoda* is raw fish or shellfish salad.

Figure 4. The Volume of *Kai* Harvested and Distributed to Various Outlets and Buyers.

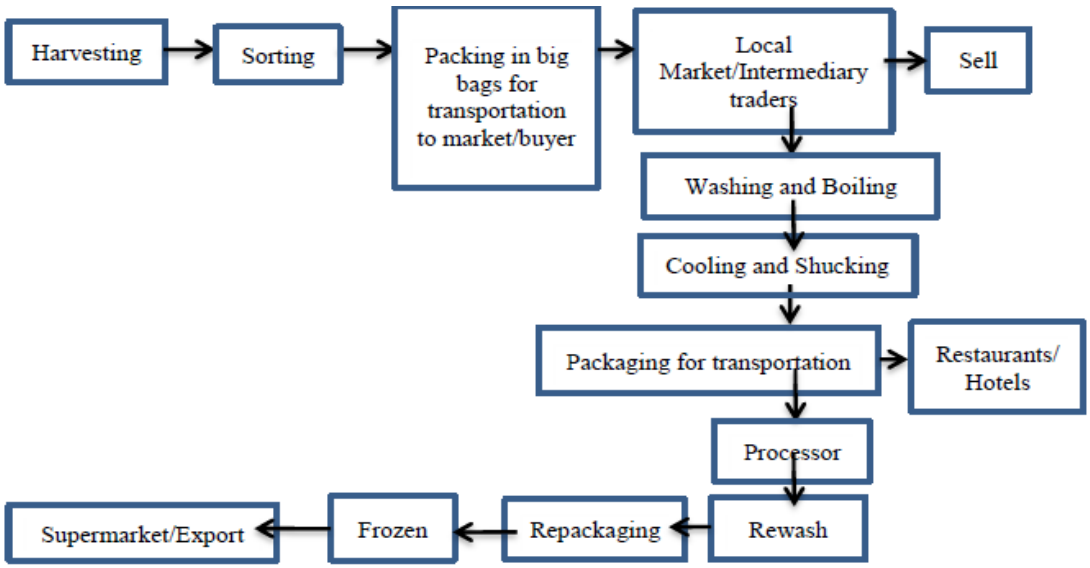


Source: Authors

Processing of Kai

The major processing methods of *kai* along the value chain are shown in Figure 5. These include sorting of the harvesting, cleaning, shucking, packaging, etc., depending on the market and customer requirements.

Figure 5. Flow Charts of Processing Related Activities of *Kai* along the Supply Chain.



Source: Authors

Sales Pathways and Profits

Three sales pathways that appear to determine the revenues and profits received along the supply chain were: (i) harvesters sell own harvests directly to the consumer at the municipal market, (ii) harvesters sell through intermediary traders to consumers, and (iii) harvesters sell through processors to supermarkets/hotels/exporters. The income received by the harvesters, processors, and exporters appears to be different based on market requirements, further processing, and value adding, as shown in Figure 5. It appears that processors obtained the most profit compared to other actors in the chain.

Worth noting is that harvesters usually sell the 83kg bag *kai* with shells at a wholesale price of FJ$50-60 per bag to the processor, while the same 83kg *kai* with shells, when sold at the municipal market in heaps (equivalent to 40-50 heaps), fetches about FJ$120 when all the 40-50 heaps are sold. Furthermore, when the same 83kg *kai* with shells are shucked, it provides an estimated weight of 46kg, which are usually sold to the exporter at FJ$14.00 per kg. This fetches a total revenue of FJ$644 of 46kg meat. The high revenues with good profit margins obtained from shucked *kai* compared to *kai* with shells demonstrates the various processes used and value addition of *kai* products developed. These differences in revenues occur at different

sales pathways of the value chain. The three major sales pathways of *kai* are discussed below.

Direct Sale by Harvesters to the Municipal Markets

The major markets for the *kai* harvesters appear to be the municipal markets in the city and towns of Suva, Nausori, Korovou, Sigatoka, Nadi, Lautoka, and Ba. This study reveals that about 96.5 % of the *kai* that were harvested were sold at the municipal markets, of which 79% were sold directly by harvesters themselves to consumers at the municipal markets, as shown in Figure 4.

The cost incurred in the harvest of *kai* per day varies, depending on distance travelled to and from harvest sites, and the number of times harvesters travel to the municipal markets to sell. For example, harvesters in the Naitasiri province spent approximately FJ$12.40/day, while the harvesters of Ba and Sigatoka spent about FJ$16-FJ$17/day as shown in Table 1. The Naitasiri harvesters spent a bit less money due to their one-day marketing per week, either on a Friday or Saturday, while the Sigatoka and Ba harvesters go to municipal markets more than once per week, and usually after every harvest.

Table 1 also shows the daily revenue of the sale of fresh *kai* by harvesters as market vendors, which reveals that more revenues were obtained by the Naitasiri harvesters compared to the harvesters of other provinces. A total of 11,125kg of *kai*/wk were sold in five urban centers of Viti Levu, as shown in Figure 2. This may mean that Naitasiri harvesters save cost by gathering and storing *kai* throughout the week, and only travel to the market to sell once per week.

Table 1. Estimated Daily Revenue and Profit Received by Harvesters in the Sale of Fresh *Kai.*

Harvesting Site by Province	**Total Expenses (FJ$)**	**Revenue (FJ$)**	**Profit (FJ$)**
Naitasiri	22.50	120	84
Ba	16.00	40	24
Sigatoka	17.00	40	23
Rewa	17.00	57	40
Tailevu	21.00	42	21

Source: Authors' compilation

Based on the revenue earned from the normal sale volume brought to the market per

week: 83 kg kai with shell sold in heaps; 1 heap is equivalent to 2.0 kg sold at $4 per heap.

At the municipal markets, the cost of *kai* is determined by their sizes; small size *kai* are sold at FJD$3/heap, while big sizes are sold at FJD$5/heap. Hence, when all the 83kg *kai* are sold in heaps, the 40-50 heaps could earn around FJ$120- $250. This may be one of the reasons why the majority of harvesters prefer to sell their own harvested *kai* at the municipal markets. Some harvesters could fetch profits up to FJ$99- $229/83kg *kai* with shells.

Sale of Kai by Harvesters to Intermediary Traders

Male and female intermediary traders were identified to have collectively resold approximately 19% of the *kai* they bought from harvesters. It appears that there were more male intermediary traders (15%), and fewer female intermediary traders (4%). These male intermediary traders not only resold *kai* at the municipal markets in various towns and in the city, but also to hotels. On the other hand, female intermediary traders resold *kai* only at the municipal markets. It was observed that *kai* vendors were fetching the wholesale price of FJ$84.00/83kg to a high profit, ranging FJ$36-$166 depending on seasonality, especially on high demand seasons.

Sale of Kai by Harvesters to Processors for Export and Supermarket Retailers

As stated above, only 2% of *kai* that were harvested were sold to processors, of which 1.6% were processed for export mainly to Australia and New Zealand, while only 0.4% were processed and sold to local supermarket retailers, as shown in Figure 4.

On average, processors' total operation cost was estimated at FJ$235.69/week, without processing license fee (FJ$800.00/year), as shown in Table 2. Processing license fee of $800/year was excluded from the expenses because most *kai* processors were not licensed and did not pay the license fee. The data exhibited in Table 2 reveals that small scale processors earned only minimal revenue from selling processed *kai*, hence not sufficient to pay for the renewal of their licenses annually. This perhaps did not provide enough revenue to sustain the building and maintenance of a separate processing facility that is expected to be food safety compliant.

Table 2. *Kai* Processors Estimated Expenditure (Weekly) and Profits when Purchased Directly from Harvesters.

Activities	**Amount in FJ$**
Revenue received when bought from villages ($60/83kg *kai* with shell) and sold to exporter at FJ$14 per kg of meat for 100kg *kai* meat (equivalent to 83kg x 2.2 bags)	1,400
Expenses 1: Cost of intermediate inputs and products of 83kg x 2.2bags and other intermediate inputs such as packaging	150.31
Expenses 2: Less cost of services and other permits including transportation. Permits and other fees, less FJD800.00 processing fee/annum	85.38
Total Expenses	235.69
Profit (Gross revenue received less total expenses)	**1,164.31**

Note: 83kg *kai* with shell x 2.2 bags = 50% meat gives 46 kg of meat sold at $14/kg = approximately FJ$644.00. Therefore, 83kg x 2.2 = 200kg *kai* with shells is equivalent to 100kg *kai* meat.

Source: Authors Compilation

It appears that there is less demand of *kai* meat from importers. This is evident in the export of only about 100kg *kai* meat/shipment, and as the minor export commodity by the exporter. Low importer demand coupled with low profits appear to make *kai* an unattractive commodity business for exporters. The exporter buys at FJ$14/kg locally, and sells abroad at only FJ$21/kg, from which a revenue of FJ$2,100 obtained from 100kg, less expenses of FJ$1,998 as cost of freight, labour, services, permit fees, overhead, etc., with the profit of only around FJ$102/shipment, as shown in Table 3.

Table 3. Weekly Expenditure and Profits by the *Kai* Exporter when Purchase from Processor.

Steps	**Amount in FJ$**
Gross value received on sales of 100 kg *kai* (FJ$21/kg)	2,100.00
Cost of Intermediate Inputs Cost of product (FJ$14/kg for 100kg from processor) Other intermediate inputs e.g. packaging materials, label, etc.	1,400.06
Less cost of services and other permits including transport and freight to destination Permits and other fees such as registration fee, exporting fee and processing fee	597.05
Total Expenses	1,997.11
Profit (Gross value received less total expenses)	102.89

Note: Figure is based on the normal weekly sale.

Source: Authors' compilation

Employment Generated Along the Kai Value Chain

The *kai* fishery has generated at least 58 other employments in the form of informal businesses, as well as medium-small microenterprises, through the 500 *kai* harvesters within the five provinces of Naitasiri, Rewa, Nadroga, Ba, and Tailevu.The employment generated includes drivers, boat builders, retailers, processors, exporters, and harvesters, as shown in Table 6.

Transportation for harvesters, retailers, and processors to the harvesting sites and to the markets appears to open and develop the *kai* transport business in the area, with some villagers operating mini-bus services to and from Nausori town to their respective villages. This transportation system also created opportunities for boat builders along the value chain. For example, in the Rewa River, there were three boat builders, two wooden boats and one canoe, and two carriers that directly transport vendors to the market on Fridays and Saturdays. These two carriers were usually hired to deliver the produce from the harvest sites to Nadi and Lautoka municipal markets. A total of seven vans were transporting harvesters to the harvesting sites every day, and to the municipal markets on Fridays and Saturdays.

Table 6. Estimated Employment Generated and Actors in the *Kai* Value Chain.

Employment Generated	**Number**	**Comments**
Boat builder	3	Self employed
Harvester	500	In 27 villages and 2 settlements
Transporter	3 dedicated truck drivers(3 ton) and 7 drivers of public buses, minibuses	Transports harvesters from Naitasiri to selected markets
Retailer/Vendor	10 - market vendors in Viti Levu 13 – *kai* middlemen 4 – supermarkets workers 10 – small restaurants workers 5 – hotel restaurants workers 1 - fulltime processor and exporter 2 – processors and part-time exporters	A number of people employed as retailer or vendor in these industries

Source: Authors' compilation

This research identified a total of 500 harvesters as the core of this *kai* fishery that generated self-employment that contributes to the livelihood improvement, and poverty eradication within families and communities in Viti Levu.

Constraints of the Kai Industry in Viti Levu

As listed in Table 4, one of the major challenges of the *kai* fishery is the abundance of small catch sizes, while limited big catch sizes of *kai,* observed especially at the Ba and Sigatoka rivers. Based on harvesters of the Rewa River, bigger catch sizes with mean of 71.30 ± 1.25 mm were only abundant in the deeper parts of the river, while the small catch sizes with mean of 32.22 ± 1.45 mm were readily available, mainly in shallow places, and were sold mainly at the Ba municipal market. Harvesters claimed that dredging of rivers appears to be destroying the breeding grounds of *kai,* which impacted the health and productivity of the river ecosystem. In the past, only big-catch-sized *kai* were harvested from what is now the gravel extraction site. Instead, harvesters had moved down the river to the non-dredging site, where there is apparently an abundance of *kai*. This appears to be the case in the Ba River. Bigger catch sizes of *kai* above 50.00mm fetched from clean rivers with low microbial counts are preferred.

Table 4. Constraints and Potential Solution for the *Kai* Industry.

Activity	**Standard**	**Actor**	**Constraints**	**Potential Solution**
Harvest	High quality and safe *kai*; big size with acceptable microbiological count. Acceptable water quality, packaging and storage	Harvesters	Frequent flooding, abundance of small sizes and limited big sizes	Agricultural farming to be conducted 100m away from river banks and plant terracing at river banks to reduce washing away of soil for reduction of dredging, avoid pollution, minimal use of pesticides, determination of size limit.
Transportation	Clean and spacious, provides shade, and readily available	Trucks, carriers and boat builder, owners and drivers	Limited vehicle and boats to transport harvested *kai* bags to the market	Government to assist
Marketing	Clean, shaded, spacious with water at the vicinity, heaps to be elevated away from the ground with good drainage system. Licence to sell	Harvesters, intermediate traders and consumers	Unhygienic market condition, inadequate market space, *kai* exposed to sunlight while selling, limited sales due to excessive supply resulting in tight competition	Liaise with town councils to improve market condition, development of more and new markets, provide business trainings to market vendors
Processing	Appropriate processing, packaging and storage facilities with trained workers. Proper certificate and licence to process. Food safety compliant	Intermediate traders and consumers	Unhygienic processing space, high cost of food business fee, limited sales due to less demand and excessive supply, lack of food safety knowledge	Conduct training on food hygiene, provision of funding assistance, provide business training, product promotion to create demand, more value adding of current and new demanding products
Retailing	Proper certification	Intermediate traders and consumers	Lack of promotion, lack of certification from Health authority, lack of food safety awareness	Promotion of product to create demand, liaise with Health Authority on proper requirement and certification
Export	Proper certificate and licence to export. Food Safety compliant.	Exporters, processors, wholesaler and retailers	Lack of export certification, lack of food safety awareness, limited markets abroad	Provide proper certification, create more market opportunities, promotion of product to create demand

Source: Authors

Nonetheless, it is interesting to note that controlling the catch size of *kai* may not be possible because there is no regulation available for the *kai* catch size limit in the Fisheries Act, (Fiji Fisheries Department, Unpublished). Hence, Fisheries Officers could not confiscate the small-catch-size *kai*. It is therefore recommended that local authority review the current Fisheries policy to include catch size limits.

Furthermore, limited and lack of transport to markets was also one of the biggest constraint faced by the harvesters, especially in the Naitasiri province. It appears that the available public transport and the two carriers that transported all the harvesters still could not accommodate the high numbers and demands of harvesters in the area. Therefore, opportunities for more transport could be organized by the transport industry to assist in the transportation of *kai* to and from harvest sites to the various markets.

Other constraints faced by the harvesters during the marketing of the product at the major municipal markets include:

- Lack of space to accommodate all the *kai* vendors
- Unhygienic selling areas that do not comply with the Food Safety Act 2003 and Food Safety Regulation 2009
- No proper shades in some selling area, vendors provided their own shade even though they were paying the market fee
- No proper tables for selling *kai*, hence vendors sat on the ground and provided their own tarpaulin for the display of *kai* for sale
- Limited water supplies at some selling areas while some areas are without proper drainage for water that are sprinkled on the *kai*. These appear to contribute to the slipperiness of the surface areas, resulting in high accident occurrence at the selling areas. *Kai* needs frequent water to stay alive, and taps are located a distance away from the selling area.
- Low ground space allocated for the selling area for *kai* frequently collects dust, contributing to high microbial count (Hatha. Christi, Reema and Kumar, 2005)
- Food business licenses were too costly for small processors to have a sustainable business. The cost of the license is about FJ$800.00 per year, and requires compliance with Food Safety Act 2003 and Food Safety Regulation 2009, which are audited by the Health Authority annually. Hence, most of the small-scale processors could not afford to pay, resulting in the processing *kai* for sale from home kitchens that are not HACCP or Food Safety compliant.
- Limited promotion and development of attractive value-added product from *kai*, especially to the hotel industry

- In the supermarket where frozen *kai* is sold, no proper labelling, including nutrition information and preparation instruction, are provided.
- Lack of knowledge and capacity of *kai* harvesters to integrate *kai* into formal value chains

The Way Forward

It is clear that the *kai* fishery in Fiji could be strengthened through various intervention projects, programmes, and potential solutions listed in Table 6. These may include technical training of harvesters to include resource management and conservation of *kai,* development of a *kai* association, and formal registration with the Fiji Crop and Livestock Council, size catch limit, price control, and food safety and quality handling of *kai*.

Achieving premium quality of *kai* is expected to fetch higher prices. Premium quality *kai* in this case refers to low microbial count and big catch sizes, which may warrant the increase in the price of the raw product close to the market value for wholesalers. In such a case, food safety and proper post-harvest handling practices must be monitored and assessed with the issuing of health certificates to wholesalers as evidence of acceptable quality. This may help improve the quality and safety of *kai* and justify the increase in the price (Russell & Hanoomanjee, 2012).

Likewise, a review of the Fisheries Act by the relevant authority to include *kai* catch size limit to enable Fisheries officers to confiscate the small catch size *kai* is recommended. The management of resources and conservation of *kai* may help harvesters, who are also resource custodians, to take care of their environment and to address the undersized harvest common in the Ba and Sigatoka markets (McLeod, 2013; M4P, 2008). Harvesting of undersized *kai* may also suggest over-harvesting, which may be addressed by the introduction of a quota system or restrictions for no take (*tabu*) in certain harvest sites (Pickering, Garcia-Gomez & Sobey, 2013). Perhaps a quota per harvester, especially for the low seasons, could be introduced; this may require thorough consultations with all the stakeholders. Restrictions for *tabu* of *kai* to be in place during low seasons could also be an option. These quota systems and restrictions for *tabu* in certain harvest sites may contribute to the sustainable growth and development of the *kai* industry, and may allow growth of *kai* to reasonable catch sizes before harvesters proceed with their usual harvest activity.

Furthermore, we recommend linking harvesters directly to exporters through the Fiji Crop and Livestock Council (FCLC), to encourage harvesters to form the *kai*

association, and to formally register the association with FCLC. This is because FCLC is mandated by the Ministry of Agriculture to provide assistance and training to farmers and fishers in various areas, including value chain analyses and addressing of bottlenecks and challenges, such as efficiency and quality of the various commodities they deal with, depending on the members' needs and requirements. This would be an advantage for the *kai* association, where FCLC will help them achieve premium quality that may attract premium price of *kai* for the harvesters (De Silva, 2011). It appears that the marketing constraints indicated in Table 6 may have also restricted vendors from earning the full revenue. Some vendors lose around FJ$48.00 revenues per week, equivalent to twelve heaps of *kai* with shells, or 13.4 kg deshelled *kai,* especially from unsold *kai.* If this unsold *kai* is sold to the exporter at the current price of FJ$14.00 per kg, approximately FJ$185.00 of revenue could be earned in return. Registration with FCLC may be a step in the right direction because FCLC also has the network for providing better access to markets, including international markets, which may resolve their current marketing issues.

Conclusion

This research reveals that the *kai* fishery is dominated by women. Despite earning much less, they are contributing to more employment generation for the rural people, self-employment, household income, livelihood improvement, and economic benefits of grassroots people. This industry is important to Fiji because it is addressing the sustainable development goals related to the reduction of poverty, hence should be supported by government.

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