Journal of
Marine Science: Research & Development

Ram et al., J Marine Sci Res Dev 2014, 4:3
DOI: 10.4172/2155-9910.1000152

Research Article Open Access

Effects of Processing Methods on the Value of B ê che-de-mer from the Fiji Islands

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Abstract

Sea cucumber harvesting, processing into bêche-de-mer (BDM) and exporting had been an important marine commodity trade for over two centuries. Sea cucumber trading has also become an important export earner for the Fiji Islands and a source of income generation for coastal communities involved in this trade. This study showed that the processing techniques being utilized for BDM in Fiji have changed little since they were developed in the 1800's. Fijian BDM (18 commercial species) is generally categorized as 'grade B' in Asian markets because of relatively poor product quality. The quality and value of bêche-de-mer are significantly impacted by negligence during processing by sea cucumber fishers and marine products agents. The loss of value due to poor quality of the final dried product in Fiji ranges from 10% to 50%. Sea cucumber fishers in Fiji need to adopt improved processing techniques that support production of better quality product, improved yield and greater income.

Keywords: Sea cucumber; bêche-de-mer; Value and processing

Introduction

The sea cucumber fishery is an important source of income for coastal communities in the Pacific [1]. Holothurians or sea cucumber are consumed as a delicacy and for their perceived medicinal properties, and are particularly sought by south-east Asian markets [2,3]. The major consuming countries are China, Hong Kong SAR, Taiwan PC, Singapore and Malaysia [4]. The global trade in sea cucumbers is based on the dried form known as bêche-de-mer (*iriko* in Japanese, *hai – som* in Chinese or *trepang* in Indonesian) [5-7]. From a total of approximately 1,200 species of sea cucumbers known today, around 58 are commercially exploited in Asian markets [1,5,8]. The majority of commercially exploited species belong to the Genera *Actinopyga* Bronn 1860, *Bohadschia* Jaeger 1833, *Stichopus* Brandt 1835, *Thelenota* Brandt 1835 and *Holothuria* Linnaeus 1758, with Asian buyers particularly targeting species from the genus *Holothuria* [8]. *Holothuria scabra* (Jaeger 1833) (Sandfish), *H. (Microthele) fuscogilva* (Cherbonnier 1980) (White Teatfish) and *H. (Microthele) whitmaei* (Bell 1887) (Black Teatfish) are among the highest value species [9] in Asian markets where well-dried 'A' grade product commands a price of $US 70-190 per kg depending on size and quality [5]. Papua New Guinea, Solomon Islands, Australia and the Fiji Islands are the leading suppliers of bêche-de-mer to Asian markets from the Pacific [4]. Approximately 98% of sea cucumber products imported by consuming countries are in the dried form with the remainder being brined, frozen or fresh [4].

Bêche-de-mer processing entails an uncomplicated sequence of actions resulting in a product that is non – perishable if stored in dry, dark conditions. The processing techniques currently used for bêche-de-mer in the Fiji Islands were developed in the 1800's and have changed little since. Post-harvest steps include first boiling, slitting and gutting, second boiling, smoking and finally sun drying [1,5,8-13]. Although these steps are uncomplicated, it requires continuous attention to obtain a standard dry product. Failure to do so can result in reduced quality and value of the final product [11,13].

Factors affecting the quality of bêche-de-mer have been poorly studied and there is limited literature in this field. There is a particular lack of data on the influence of processing methods on the value of bêche-de-mer in Asian markets [1,8,14-16]. The aim of this study was to document the potential losses in value (income) at different stages of bêche-de-mer processing in the Fiji Islands. Our results will help pin-point critical points in the processing of bêche-de-mer, and provide a basis for improving current methods to maximise livelihood benefits from this important fishery.

Materials and Methods

A standard questionnaire was prepared to gather information on the perceptions of sea cucumber fishers (n=86 completed questionnaires), as well as marine product agents (n=5 completed questionnaire) and the middlemen (n=8 completed questionnaire) involved in the bêche-de-mer industry in the Fiji Islands (Figure 1). The marine product agents purchase sea cucumbers in a perishable state from fishers and process them for higher return from exporters. Comprehensive information on the issues and problems faced by marine product agents and fishers in Fiji was collected; it included information on problems related to sea cucumber harvesting and processing, socio–economic issues, species-specific issues, prices attained for sea cucumbers and the guidance provided to the fishers by the marine product agents relating to processing methods. Data were collected through formal and informal interviews held with the marine product agents and fishers. Data were also gathered on the socio–economic status of sea cucumber fishers, and for critical evaluation of the supply and value distribution chain of BDM in Fiji Islands. The information on supply and value chain was essential to understand the various channels within the bêche-de-mer trade in Fiji and the value received at each stage.

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Received September 10, 2014; **Accepted** October 27, 2014; **Published** October 29, 2014

Citation: Ram R, Chand RV, Southgate PC (2014) Effects of Processing Methods on the Value of Bêche-de-mer from the Fiji Islands. J Marine Sci Res Dev 4: 152. doi:10.4172/2155-9910.1000152

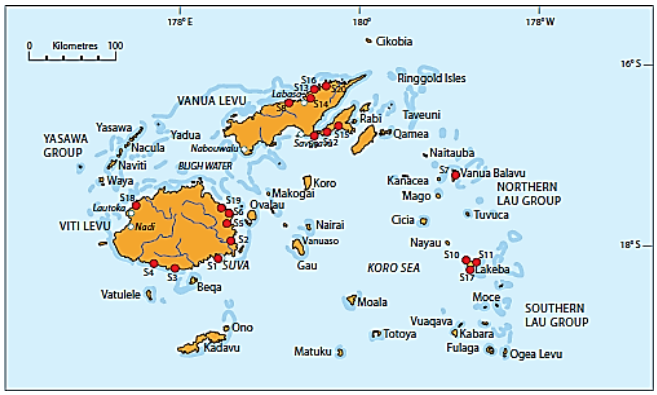

Figure 1: Sites visited in Fiji for collection of data (source: Ram, 2008)

Results and Discussion

Fiji Islands has exported a large quantity of bêche-de-mer to Asian markets for over two centuries. The major markets for Fijian bêche-de-mer products are now Taiwan, Hong Kong, China and Korea, as well as Australia, New Zealand, Canada and the USA [15]. Figure 2 shows official BDM export quantities from Fiji during the period from 1984 to 2012. Particularly large volumes of bêche-de-mer were exported in 1987 (>600 mt), 1988 (>700 mt) and 1996 (>600 mt). Declines in export volumes are notable following these peaks and these could be due to over fishing of sea cucumbers [17,18]. Subsequent peaks in export volumes of around 400 mt in 2005 and 2011 are considerably lower than those in the 1980s and 1990s. After 2005, the export trend levelled-off to average around 243 tonnes per year [19]. Sea cucumber harvests over recent years have generally declined for the high value species and fishing yield has now shifted from high value species to either medium or low value species [20]. Bêche-de-mer exporters now rely on the medium value species to make up a consignment for export. For example, data from Fiji's recent Annual Fishery Report [19] shows that the proportion of the sea cucumber fishery contributed by Hairy Blackfish (*Actinopyga miliaris,* Quoy and Gaimard 1833) has now declined to 6% of the harvest from around 90% of the harvest in 1988 [18,19]. This report further states that a decline in annual production of Black Teatfish (*H. whitmaei)*, Hairy Blackfish, Curryfish (*Stichopus hermanni,* Semper 1868), Deepwater Redfish (*Actinopyga echinities,* Jaeger 1833), Greenfish (*Stichopus chloronotus,* Brandt 1835), Chalkfish (*Bohadschia marmorata,* Jaeger, 1833), Prickly Redfish (*Thelenota ananas,* Jaeger 1833), Lollyfish (*Holothuria atra,* Jaeger, 1833) and White Teatfish (*H. fuscogilva*) was observed between 2003-2012 whereas, a very low production of Dragonfish (*Stichopus horrens,* Selenka 1868), Flowerfish (*Pearsonothuria graeffei,* Semper 1868), Stonefish (*Actinopyga lecanora,* Jaeger 1835) and Pinkfish (*Holothuria edulis,* Lesson 1830) was noted, indicating that their populations may have collapsed [19].

Chinese agents still dominate the bêche-de-mer market in Fiji. China accepts the full range of product quality that is produced in Fiji and is primarily concerned about the size of products (the larger the size the better the price) [21]. The Hong Kong market, on the other hand, values product quality since bêche-de-mer bought from the Pacific islands is reprocessed and value-added for shipment to other markets such as Taiwan and Singapore [4,22]. White Teatfish is a high value product for Fiji exporters. It can earn as much as US$90 per kg in summer and up to US$140 per kg in winter. However, the current average rate paid to Fijian marine agents is only US$5–55 per kg because of the suboptimal quality of the product. A large quantity of lower grade BDM (grades "C" and "D") is generally exported from Fiji with a relatively small proportion of higher grade (grades "A" and "B") product (Table 1).

Table 1 summarizes the prices offered to marine product agents in Fiji by Asian markets. The results show that for high value species such as White Teatfish, the number of individuals required to make up one kg in the lower grades (e.g. grades C and D) is considerably higher than the number of individuals required to make up the same quantity in the superior grades (e.g. grades A and B) because of their smaller size. Lower grade BDM are also of lower value to Fijian bêche-de-mer agents (Table 1). Thus in order to receive greater income for bêche-de-mer from Asian markets, improving product quality will be a key issue for the Fijian BDM industry. The relatively low quality of Fijian BDM and fluctuations in product quality results in variations of 5–20% in the prices paid by international agents to Fijian agents. We identified the following issues that drove variations in market price for Fijian BDM in Asia:

Undersized bêche-de-mer (all species);

Products not cut and gutted properly resulting in the presence of gut contents that were still visible in the dried product;

Products did not have ideal cylindrical shape and appearance is a major grade determinant [11,13];

Burnt products; and

Products contaminated with sand and dust (poor hygiene).

From the survey, about 90% of responding fishers indicted that they do some processing before selling their products to the main agents. As a result some processing steps are usually missed or done too rapidly (e.g. smoking the BDM products over a fire for rapid drying compared to smoking only results in a burnt, poor quality product). Improving product quality begins with awareness of the factors that influence product quality from the time of harvest to storage and processing [11]. For example, inappropriate handling of sea cucumbers during and after harvest may causes skin lesions and damage to the 'teats' of high value species such as White Teatfish, which directly affects the value of the final product [11,13]. Furthermore, because local fishers generally lack the basic processing tools required to produce a good quality product, marine products agents in Fiji prefer to buy higher value species of sea cucumbers from fishers in a raw state so that they themselves can process to market quality grades that achieve a higher price.

The data collected during this study were used to generate estimates of the value lost at each stage of sea cucumber processing in Fiji by both

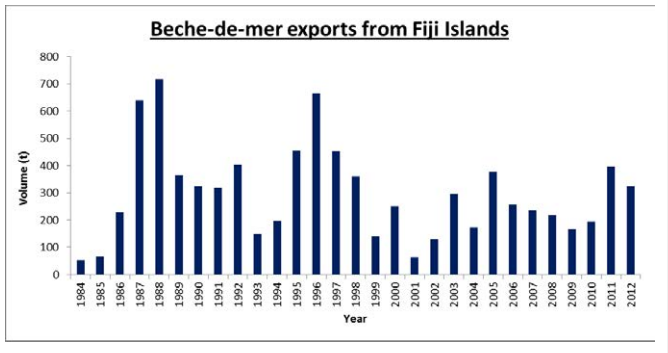

Figure 2: Bêche-de-mer exports from Fiji Islands from 1984-2012 (Source: Ministry of Fisheries and Forests: Fiji)

Common name	Grade	Grades of product	Number of pieces required for one kilogram	Size of sea cucumber in each grade (cm)	Price dry per kg ($USD) in Hong Kong markets*	Actual Price Dry per kg ($USD) offered by Asian marine product agents	Usual Price offered to marine product agents in Fiji depending on quality (USD/ Kg-dry)
White teatfish	High	A+	3-4	17-25	70-75	50-60	35-55
		B	5-6	13-20	50-60	40-45	25-35
		C	9-10	14-21	-	30-35	15-25
		D	14-15	6-15	-	20-25	5-10
Black teatfish	High	A	4-5	12-22	50-55	36-40	28-35
		B	9-10	10-17	40-45	26-30	20-25
		C	14-15	5-14	-	15-20	10-15
Sandfish	High	Banned	Banned	Banned	80-90	Banned	Still sold but price was unavailable from marine product agents
Prickly redfish	Medium	1 grade	3-4	9-23	35-40	26-30	20-25
Stonefish	Medium	1 grade	100-105	2-9	8-12	5-5.5	3-5
Surf Redfish	Medium	A	9-10	7-14	25-30	20-25	15-24
		B	13-15	5-10	20-25	15-18	15-16
Blackfish	Medium	A+	10-12	7-13	35-40	25-30	18-24
		B	18-20	6-11	-	20-24	15-20
		C	24-25	4-8	-	10-14	8-12
Elephant Trunkfish	Low	1 grade	3-4	10-25	5-6	5-5.5	4-5
Greenfish	Medium-High	1 grade	115-120	4-10	50-60	35-40	30-38
Curryfish	Low-Medium	A	9-10	8-17	33-38	25-28	20-25
		B	18-20	5-14	24-28	20-22	18-21
		C	25-30	4-13	-	14-16	10-15
		D (*Geci*)	-	2-5	-	-	-
Amberfish	Low	1 grade	4-5	8-30	6-8	5.5-6	4-6.5
Brown sandfish	Low	1 grade	30-35	5-13	10-12	7.5-9	7-8
Deep water redfish	Low-Medium	1 grade	7-8	6-40	25-35	10-27	15-25
Lollyfish	Low	A	38-40	4-10	6-8	4-5.5	3-5
		B	45-50	4-8	-	3-3.5	2.5-3
Tigerfish	Low-Medium	A	25-35	4-25	30-35	18-24	15-22
		B	50-70	6-15	15-20	8-15	5-11
Snake fish	Low	1 grade	28-30	5-17	6-8	6-7	5-6.5
Pinkfish	Low	1 grade	45-50	5-12	6-8	6-7	5-6.5
Sea cucumber	Low	1 grade	40-60	3-12	-	-	3-10

*Prices obtained from some marine product agents and the Ministry of Fisheries and Forests in Fiji Islands

Table 1: Prices offered to Fijian marine product agents for bêche-de-mer by Asian markets as of December 2008.

fishers and marine agents (Figures 3 and 4). Figure 3 shows that the key contributors to loss of value to fishers are mishandling after harvest (estimated value loss of 20%), overcooking (estimated value loss of 10%), burning of the product during smoke drying (estimated value loss of 40%) and improper drying prior to storage (estimated value loss of 20%).

Although the main marine agents may reprocess semi-dried product purchased from the fishers, considerable value is already lost because of initial damage to the semi-dried product (Figure 4). Figure 4 represents the processing steps conducted by the main BDM agents and shows that the losses generally occur when products have to be reprocessed to improve their overall appearance and shape (i.e. in an attempt to improve the quality of BDM purchased from fishers). In addition to these losses, BDM processing at the main agents is done with bulk quantities compared to the fishers who process very few sea cucumbers at a time. Boiling large numbers of sea cucumbers in a pot, however, leads to some sea cucumbers being overcooked resulting in bursting of the body-wall and/or semi-disintegration of the sea cucumbers. Instead of discarding such individuals, the agents remove them, dry them and class them as low grade product before exporting. Errors by the agents result in losses in income (Figure 4) which collectively account for a 5-20% overall loss based on the final quality of the product (Figure 5). Lower prices received by exporting agents vastly affect the distribution of revenue from the agents to the primary producers (fishers) (Table 2). Figure 6 shows the supply and value distribution chain for bêche-de-mer in the Fiji Islands and illustrates the relationships between fishers, middlemen and marine products agents (exporters). In some cases the involvement of middlemen in the supply chain further affects revenue distribution because the middlemen purchase items for less (Table 3) from the primary producers and demand higher prices [23] from the exporters or other middlemen involved in the supply chain (Figure 6).

Usually most Fijian sea cucumber fishers lack transportation to deliver their produce to the marine product agents and this situation is exploited by middlemen who buy sea cucumbers from fishers in a perishable state and process them to receive better value from the marine product agents. It seems that there are more middlemen operating in remote areas such as the outer islands where there are no marine product agents. Each fisher is only able to earn <$FJD 50 per

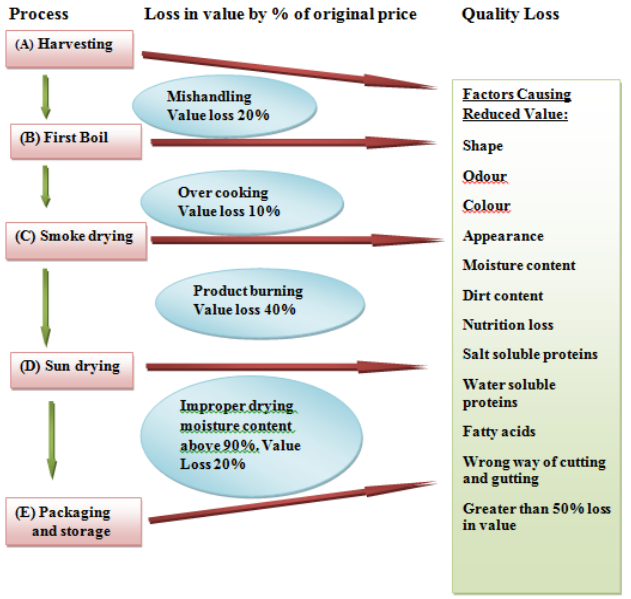

Figure 3: Schematic representation of bêche-de-mer processing done by the indigenous people of the Fiji Islands showing the various stages of processing with an estimation of the value lost at each stage, and the resulting impacts of product quality.

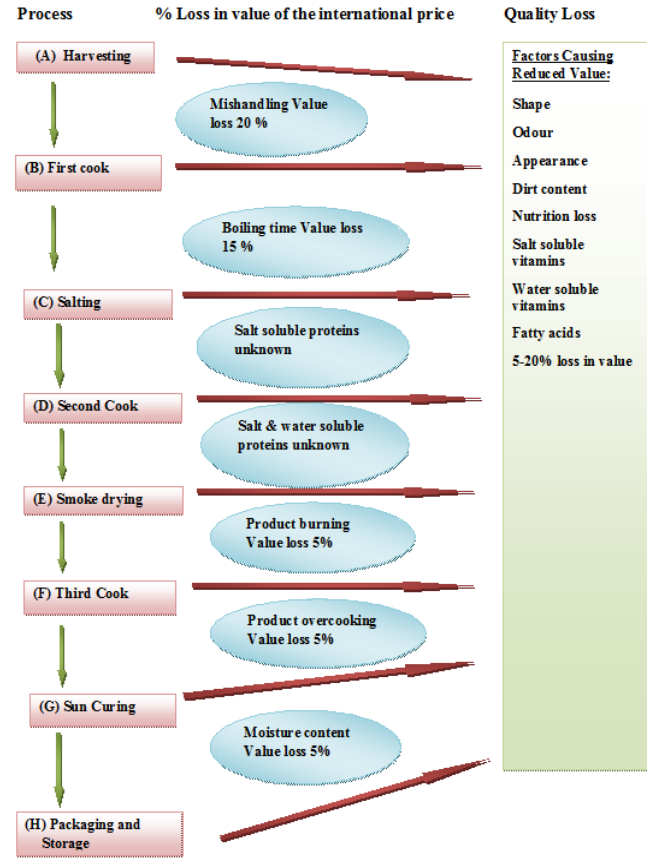

Figure 4: Schematic representation of bêche-de-mer processing done by marine agents of bêche de-mer in Fiji Islands showing the various stages of processing and estimated losses in income and the resulting impacts of product quality at each stage.

Figure 5: Different quality grades of a high value bêche-de-mer species, White Teatfish (*Holothuria fuscogilva*). Grade A (A), Grade B (B), Grade C (C) and Grade D (D)

week through middlemen, even though the product would contain an adequate number of high value species that could earn them greater income if sold directly to the main exporters who pay much more than the middlemen. Maximising the income of sea cucumber fishers in Fiji requires development of stronger links between them and the main exporters. The BDM exporters receive their income in US dollars and this income then filters down the chain to the fishers who receive relatively little (Figure 6). For example, the BDM exporters buy White Teatfish from the suppliers at (FJD$ 50-70 per piece), however the middlemen advise the fishers that the value of the product is only FJD$ 4-10 per piece. Middlemen encourage the fishers to deal with them directly, rather than any other buyer, telling them that they offer the best price. This is a successful strategy because fishers are often unaware of actual market prices. Dealings between the middlemen often result in a discrepancy of around FJD$ 10-15 per piece. 'Middlemen 2' (Figure 6) are sometimes Chinese nationals operating in smaller designated areas in Fiji who purchase the products from other middlemen and sell to the main exporters for higher revenue.

Price fluctuations in Fiji reflect those in the global export market. Such variations have a drastic effect on the fishers who receive varying income from the marine product agents as a result. During winter months when harvests are low, the price of BDM increases and in summer as supply improves, price falls. In Fiji the trading of marine invertebrate resource (e.g. trochus and bêche-de-mer) with international markets is an important source of foreign revenue. One problem is that there is improper stock monitoring of these fisheries and poor record keeping relating to production and export. Indigenous fishers in Fiji own much of the "*qoliqoli*" or traditional fishing ground, but they lack basic skills required for proper management of the supply of marine resource to the market [20,24]. This situation is exploited by middlemen and marine product agents in Fiji.

In addition, the issues of community–based resource management are generally complex in Fiji and there is a need to improve environmental awareness and sustainable management of marine resources. People need to actively participate in the management programs run at village level [25] and for better use of marine resources, resource-based education and awareness needs to be addressed allowing local people to acquire greater control over their resources

English name	Fijian name	Price received by fishers Dry per kg ($FJD)	Actual price that should be paid by marine product agents (dry/kg) ($FJD)	Price received by fishers Raw per piece ($FJD)	Actual price that should be paid by marine product agents. Raw per piece ($FJD)
White teatfish	*Sucuwalu*	25.00-$35.00	15.00-70.00	4.00-$25.00	5.00-55.00
Black teatfish	*Loaloa, lolo*	10.00-$20.00	20.00-45.00	5.00-$10.00	2.00-6.00
Sandfish*	*Dairo, tero*	8.00-$15.00	-	5.00-$10.00	-
Prickly redfish	*Sucudrau*	10.00-$30.00	25.00-35.00	3.00-$6.00	4.00-6.00
Stonefish	*Dri-vatu, Ki*	2.50-$10.00	10.00 -20.00	0.20-$0.30	0.10-0.30
Surf Redfish	*Tarase*	2.50-$12.00	18.00-25.00	1.00-$3.00	-
Blackfish	*Driloli*	2.00-$8.00	20.00-40.00	1.50-$3.00	-
Elephant Trunkfish	*Dairo-ni-cakau*	7.00-$15.00	7.00-10.00	1.00-$2.00	1.00-$2.00
Greenfish	*Tarasea*	20.00 -$30.00	40.00-52.00	-	-
Curryfish	*Laulevu*	10.00-$30.00	18.00-36.00	0.50-$1.00	0.50-2.50
Amberfish	*Dri-volavola*	7.00-$10.00	6.00-10.00	1.00-$2.00	-
Brown sandfish	*Vula*	2.50-$10.00	5.00-11.00	0.60-$0.80	0.50-2.00
Deep water redfish	*Dri-tabua*	15.00-$25.00	25.00-36.00	1.50-$3.00	4.00-10.00
Lollyfish	*Loliloli*	0.50-$5.00	5.00-9.00	-	-
Sea cucumber	*Mundra, midro*	3.00-$10.00	5.00-9.00	-	-
Snake fish	*Loliloli*	0.50-$4.00	5.00-9.00	-	-
Tiger fish	*Vula-ni-cakau*	6.00-$12.00	10.00-15.00	0.30-$0.80	2.00-5.00

*Species with fishing ban in Fiji Islands but priced for local consumption

Table 2: Prices paid by marine product agents to sea cucumber fishers in Fiji Islands in 2008.

English name	Fijian name	Raw per piece ($FJD) offered as buying price by middleperson	Prices received by the middleperson from the marine product agents ($FJD) when product sold dry
White teatfish	*Sucuwalu*	$4.00-$10.00	50.00-60.00
Black teatfish	*Loaloa, lolo*	$1.50-$2.50	22.00-35.00
Sandfish	*Dairo, tero*	Banned	-
Prickly redfish	*Sucudrau*	$.50-$2.00	30.00-40.00
Stonefish	*Dri-vatu, Ki*	$1.00-$2.00	30.00-38.00
Surf Redfish	*Tarase*	$1.00-$2.00	13.00-28.00
Blackfish	*Driloli*	$0.80-$2.00	20.00-30.00
Elephant Trunkfish	*Dairo-ni-cakau*	$0.20-$0.80	5.00-7.00
Greenfish	*Tarasea*	$0.20-$2.00	40.00-50.00
Curryfish	*Laulevu*	$0.50-$2.50	22.00-30.00
Amberfish	*Dri-volavola*	$0.10-$0.80	5.00-7.00
Brown sandfish	*Vula*	$0.60-$0.80	7.00-11.00
Deep water redfish	*Dri-tabua*	$1.50-$2.00	25.00-30.00
Lollyfish	*Loliloli*	$2.00-4.00/kg dry	5.00-6.00
Sea cucumber	*Mundra, midro*	$1.00-$2.00	4.50-5.50
Snake fish	*Loliloli*	$2.00-4.00/kg dry	5.00-5.50
Tiger fish	*Vula-ika*	$0.30-$0.80	14.00-16.00

Table 3: Prices paid by middlemen to Fijian fishers for raw sea cucumber product in Fiji Islands in 2008.

to ensure longer term economic benefits [8]. There is also a need for fair agreements relating to fisheries resources and proper management programs that could provide a greater and more sustainable source of revenue for the local communities [25].

This study has highlighted some important issues for sea cucumber management in the Fiji Islands and a number of recommendations are suggested on this basis:

(a) Sea cucumber fishers should be educated about the ecological importance of sea cucumbers through extension activities. Hands on training programmes on processing and handling techniques for sea cucumbers should be taught to the fishers to improve the quality and value of bêche-de-mer product [26-28].

(b) Seasonal closures or changing of harvesting sites would reduce pressures on wild sea cucumber stocks. Allowing sea cucumbers to spawn at least once prior to harvest and changes in the fishing grounds would support more sustainable harvesting practices [28,29].

(c) Bêche-de-mer fishery laws should be enforced properly since current regulations are not being followed by sea cucumber fishers and marine product agents in Fiji. Illegal sale of Sandfish, for example, still occurs without monitoring. Furthermore undersized sea cucumbers are harvested and sold.

(d) Total Export Limits (TEL) by species should also be instituted for each buyer in Fiji or for total exports from Fiji that could be in a range of 200-300 tonnes per annum. Once this limit is reached the export should cease until the following harvesting season.

(e) There should be restrictions on issuing SCUBA licenses and law enforcement on the non-usage of "hookah system" by sea cucumber fishers to reduce over-exploitation of stocks. SCUBA operator's exemption certificates have increased from 9 in 2010 to 25 in 2013 in Fiji and the use of SCUBA should be completely banned to avoid the

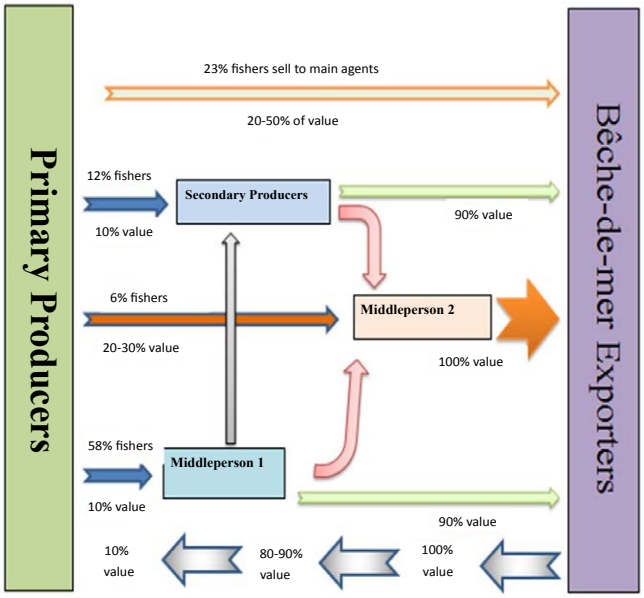

Figure 6: Supply and value distribution chain of bêche-de-mer in Fiji Islands showing the relationships between fishers, middlemen and marine products agents (exporters) and the values of transactions between them.

risk of over-exploitation [19].

(f) Further research is required on harvesting yields of sea cucumbers in the Fiji Islands and, based on the results obtained, group quotas, fisher's quota and industrial quotas should be allocated to protect the current stock from depletion [28].

Conclusion

The quality and value of bêche-de-mer are significantly impacted by negligence during processing by sea cucumber fishers and marine products agents in the Fiji Islands. The loss of value due to poor quality of the final dried product in Fiji ranges from 10% to 50% reflecting the broad number of people involved in the supply and distribution chain of sea cucumbers in Fiji. Sea cucumber fishers in Fiji need to adopt improved processing techniques that support production of a better quality product, improved yield and greater income. This could be achieved through a well-targeted extension program supported by extension materials such as processing manuals. In addition, communities involved in the sea cucumber fishery in Fiji need to be educated on the sustainable use of the marine resource and the ecological importance sea cucumbers in the marine ecosystem. Although aquaculture of tropical sea cucumbers [30-33] may offer an opportunity to improve supply of sea cucumbers for the BDM trade in Fiji while potentially reducing fishing pressures on wild stocks, in the short-term, a number of steps could be taken to improve the sustainability and Fiji sea cucumber fishery – these include enforcement of current fisheries legislation, seasonal closures or rotation of fishing sites, introduction of fishing quotas and export limits, and prohibition and enforcement relating the use of SCUBA and hookah equipment by sea cucumber fishers.

Acknowledgement

The authors would like to acknowledge village communities, sea cumber fishers and bêche-de-mer exporters of Fiji Islands, and the Ministry of Fisheries and Forests in Fiji for assisting with data collection.

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