

Preliminary assessment of the socio-economic importance of export trade in coral reef resources on Fijian society

L.S.L.Teh¹, L.C.L.Teh¹, B. Starkhouse¹, N. Kuridrani², U.R. Sumaila¹, Y. Sadovy de Mitcheson³, D. Zeller¹

1) Fisheries Centre, 2202 Main Mall, University of British Columbia, Vancouver, Canada

2) Research Division, Fisheries Department, P.O. Box 3165, Lami, Fiji

3) Society for the Conservation of Reef Fish Aggregations and University of Hong Kong, Hong Kong

Abstract. Rising demand for coral reef resources worldwide has led to an active international trade in reef organisms that are sourced primarily from tropical developing countries. Although these trades tend to be lucrative, it is unclear what economic benefit flows to the exporting country. We use Fiji as a case study to quantify the economic benefits of trade in coral reef resources to local communities. The live rock and aquarium fish trades provide the highest net income to collectors. However, the financial benefits of these trades are limited to a few villages. On the other hand, the bêche-de-mer fishery returns lower incomes to participants, but since the fishery has a large geographical coverage, more people are able to participate and obtain financial benefits from it. We find that the coral reef associated export trades generally provide a supplementary, rather than primary, source of income. This indicates that coastal communities should engage in diversified livelihoods. The unsustainable impacts of the export trade on the coral reef ecosystem reinforce the need for communities to be adaptable. As many coastal communities tend to fall back on subsistence fishing when a niche fishery declines, there is a need to better manage the extraction of coral reef resources in order to ensure their sustainability.

Key words: coral reef export trade, Fiji, socio-economics

Introduction

Coral reef resources such as fishes, invertebrates, and corals have long supported subsistence and artisanal fisheries that sustain the dietary and livelihood needs of coastal communities throughout the developing tropics (McManus 1997). It is widely acknowledged that growing populations and coastal development have increased pressure, and in many cases, led to unsustainable use of coral reef ecosystems (Pauly 1993). At the same time, the situation is exacerbated by the lucrative international coral reef trade, which is, in most cases, centered in wealthier, developed regions of the world. Demand for certain reef species for the live reef food fish, aquarium, and Chinese traditional medicine trades, for example, has led to intensive fishing and collection of certain reef species such as groupers, sea cucumbers, seahorses, corals, and butterfly fishes. The negative ecological impacts of these trades have been well documented (Sadovy et al. 2003; Lunn and Moreau 2004; Martin-Smith and Vincent 2006; Scales et al. 2006; Vincent et al. 2007).

What is not as commonly addressed is the extent to which trade in coral reef resources provides economic benefits to the exporting society. We address this question by using Fiji as a case study to examine the

benefits the coral reef resource trade provides to local Fijian communities. Specifically, we look at the spatial extent of the coral export trade, and participants' economic dependence on these trades.

Fiji is an archipelago made up of 844 islands, cays, and islets, of which 106 are inhabited (Vuki et al. 2000). This group of islands is situated in the South Pacific between 15-23°S and 177-178°W, with a terrestrial area of 18,500 km² and a coastline of 1,130 km (CIA 2007). With approximately 1,000 coral reefs supporting about 200 species of corals (Rowlands et al. 2005) and around 1,200 marine fish species (Vuki et al. 2000), Fijian society has traditionally relied heavily on marine resources for subsistence and livelihoods. Marine resources have also become valuable export commodities, with the fisheries sector, inclusive of both coastal and offshore resources, contributing about 2.5% to Fiji's total GDP (ADB 2005).

The trade in marine aquarium organisms includes ornamental fish, invertebrates, coral, and live rock, and has been active in Fiji since the early 1970s (Yeeting 2007). Pacific island nations supply about 18% of the 3.4 million ornamental fishes traded on the international market, with Fiji alone contributing

5% (Wabnitz et al. 2003). Similarly, Pacific island nations supply 25% of internationally traded live corals, with Fiji supplying 4% (Wabnitz et al. 2003). In particular, demand for live rock from Fiji has grown steadily since the late 1990s (Lal and Cerelala 2005), due to its distinctive colour, and Fiji is now one of the major exporters of live rock. Overall, Fiji is ranked fourth after Indonesia, China and the Philippines in the export of marine aquarium products globally (Lal and Cerelala 2005). There are five companies involved in the trade of aquarium products in Fiji. These companies operate in 25 *qoliqoli* (traditional fishing grounds) that are located along the Coral Coast and islands off the Western Division (Lal and Cerelala 2005).

The *bêche-de-mer* (sea cucumber) trade has a long history in Fiji dating back to the 1800s. This sector exhibits a 'boom and bust' cycle, with the most recent boom taking place in the mid 1980s when production of dried *bêche-de-mer* in Fiji peaked at an estimated 1,000 tonnes in 1988 (Adams 1992). The collection of *bêche-de-mer* is largely carried out on a small scale in villages throughout Fiji. *Bêche-de-mer* is gleaned from shallow reefs by men, women, and children, or collected by men during dive fishing trips. *Bêche-de-mer* is sold either raw or dried to middlemen. Closer to urban areas, villagers may travel to sell their product, whereas in more remote regions, middlemen make collection trips to the village several times per month. Alternatively, company agents are posted at a village, and are responsible for collecting and bringing the product to market. Middlemen themselves may be agents for an export company, or may export the product directly to overseas markets in China and North America, among others.

The live reef food fishery (LRFF) was established in Fiji in 1998, targeting coral groupers (*Plectropomus* spp.) for markets in Hong Kong and Southeast Asia. It reached a maximum of eight companies before declining to one or two in recent years. Like the aquarium trade, LRFF companies have to negotiate a contract with *qoliqoli* owners. These companies employ fishers from local villages, and use mother vessels to collect fish from locations around Vanua Levu, which are then brought to Nadi for export (Yeeting 2001; Ovasisi 2006).

Coral reef resources provide a valuable source of export revenue to Fiji. From 2002 to 2004, exports of aquarium products, live reef food fish, *bêche-de-mer*, and trochus shells generated between USD 10.8 and USD 13.7 million in annual export revenue per year (Table 1). In comparison, domestic sales of reef-associated finfish and invertebrates in 2004 were estimated to have a gross value of USD 33.4 million (Starkhouse 2009).

Table 1. Export value (USD)^a of coral reef resources 2002-2004, extracted from Fiji Department of Fisheries Annual Reports

Reef resource	2002	2003	2004
Aquarium products ^b	5,535,135	6,540,541	6,486,486
LRFF ^c	972,973	572,973	154,184
<i>Bêche-de-mer</i>	5,945,946	2,702,703	4,324,324
Trochus	1,259,459	978,378	810,811
TOTAL	13,713,514	10,794,595	11,775,805

^a The exchange rate on 31 January 2009 was 1 USD = 1.85 FJD.

^b Includes ornamental fish, live rock, live coral, live invertebrates, live clams, and unworked corals.

^c Data for 2003 and 2004 obtained from Ovasisi (2006).

Materials and Methods

We interviewed 47 fishers and 10 middlemen and reef resource export companies in May and June 2008. Our interview team included two research officers from the Fiji Fisheries Department. Interview sites were chosen to provide a wide geographical coverage of Fiji as well as being inclusive of both artisanal and subsistence fishing communities. Fishers were chosen opportunistically – in most cases, we interviewed fishers who were assembled at a central location at the request of the village headman, from whom we had obtained permission to conduct interviews at the particular village. These included full and part time fishers, both men and women.

The interviews followed a semi-structured format where a prepared questionnaire was used to guide the interview, but respondents were free to elaborate on issues of interest. Our interviews focused on the economic aspects of the live reef food fish and *bêche-de-mer* fisheries, including information on fishers' catch, revenues and costs.

Fisher interviews were conducted in 13 villages and settlements in western and northern Viti Levu, the Yasawa islands, Bua Province in Vanua Levu, and Kadavu island south of Viti Levu. Interviews with middlemen and traders took place in major towns such as Suva, Lautoka, and Labasa. Published and grey literature, and statistics from the Fisheries Department Annual Reports and Secretariat of the Pacific Community were used to provide national level information on the aquarium, coral, and live rock trades.

Results

Spatial coverage and participation

The *bêche-de-mer* trade was the most geographically dispersed (Fig. 1), and involved the most number of participants as it is harvested by both adults and children in coastal villagers throughout Fiji. Fifty-one



Figure 1: Map showing the spatial extent of the coral reef export trades. Note that there is no indicator for the *bêche-de-mer* trade because it occurs throughout Fiji. The other trades are: LRFF=live reef food fish, AQ=aquarium fish, LR=live rock, and LC=coral.

percent of respondents collected *bêche-de-mer*. Of these, 71% also engaged in artisanal or subsistence fishing. In villages where *bêche-de-mer* was harvested, respondents often indicated that most women participated in collecting the invertebrates.

The live reef food fish trade (LRFF) is concentrated in one village on Tavea Island in Bua Province, Vanua Levu, where around 25 fishers participate in the fishery. The aquarium and live rock and coral trades are concentrated along the Coral Coast, and in 3 to 4 villages around Suva and Navua (Fig. 1). In a typical live rock operation along the Coral Coast, around 8 collectors were observed harvesting live rock. However, the number of harvesters varies, and can range from 2 or 3 to 8. Table 2 provides a summary of the spatial distribution of the coral reef trades in Fiji.

Table 2. Summary of spatial distribution of coral reef trades in Fiji.

TRADE	SPATIAL DISTRIBUTION	LOCATION
<i>Bêche-de-mer</i>	Widespread	Coastal villages throughout Viti Levu, Vanua Levu, Kadavu, Yasawa, Lau
Live reef food fish	Limited	1 village in Bua Province, Vanua Levu
Aquarium fish	Limited	Villages along Coral Coast & Lautoka
Live rock	Limited	3 villages along Coral Coast, & 3-4 villages around Suva and Navua*

* Source: Why and Tuwai (2005).

Economic benefits

Thirteen percent of respondents relied on a coral reef export trade for their main source of income, while for the rest it was a supplemental form of income (Table 3). The majority of those who depended on an export trade for their primary source of income were involved in the live reef food fish trade. *Bêche-de-mer* was the most common provider of supplemental income, and on average accounted for 29% of total fishing income.

Table 3. Level of dependence on coral reef export trades as a source of income

TRADE	INCOME SOURCE	
	Main	Supplemental
Live reef food fish	√	
<i>Bêche-de-mer</i>	√	√
Aquarium fish	√	
Live rock		√
Live coral		√

The net weekly income for collectors of reef resources for each coral reef trade is shown in Figure 2. Collection of aquarium fish generated the highest net weekly income (USD265), while harvesting live coral provided the least income (USD39). However, when compared to the 2002/2003 Fiji National Basic Needs Poverty Line income of USD97 (FJD178) household⁻¹week⁻¹ (http://www.fiji.gov.fj/publish/page_5838.shtml), only the aquarium and live rock trades provided sufficient income to meet this baseline.

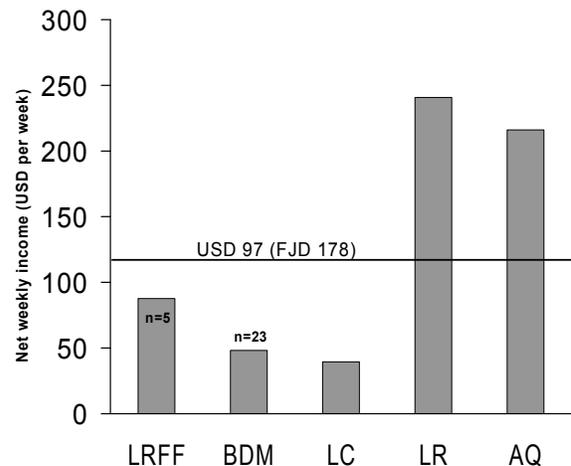


Figure 2: Net weekly income for participants in the coral reef export trades. The line shows the national basic needs poverty line income of USD97 household⁻¹week⁻¹. Results for LRFF (live reef food fish, mean \pm standard deviation=USD87 \pm 26) and BDM (*bêche-de-mer*, USD48 \pm 11) are derived from fisher interviews, with sample sizes (n) indicated. Results for AQ (aquarium fish, USD 216) are based on an interview with an aquarium fish exporter in Fiji. Data for LC= live coral (USD40) and LR=live rock (USD241) are from Lal and Cerelala (2005).

Discussion

We aimed to quantify the economic benefits of the export trade in coral reef resources to Fijian communities. Our findings indicate that on the whole, the coral reef resources export trade provides economic benefits to coastal villagers in the 8 study sites. We recognise that our small sample size may limit the ability to generalize this study to Fiji as a whole. However, the consistent responses we obtained from interviewees across a wide geographical coverage indicate that our findings are likely applicable throughout Fiji. In any case, this study is useful for providing a preliminary overview and identifying broad patterns of how the trade in coral reef resources affects communities in different parts of Fiji.

The *bêche-de-mer* trade provides the most widespread benefits, as it occurs near shore and in most cases requires no specialized gear¹, such that almost all members of society are able to participate in it. In fact, Fijians have been involved in the *bêche-de-mer* trade for over a century to supply the international demand for these invertebrates (Adams 1992).

In contrast, the live reef food fish trade is limited to around 25 participants in one village, and although it provides the primary source of income for these participants, the trade only makes a limited contribution to Fijian communities on the societal level. Similarly, the economic benefits of the aquarium fish and live rock trades are limited to villagers in a specific region of Fiji. The relatively low level of participation in the aquarium and live reef food fish trades can be attributed to the need for special skills. Aquarium fish collectors use SCUBA equipment to collect the target fish species. The equipment, as well as SCUBA training, is provided by the aquarium fish company. Similarly, live reef food fish fishers were trained on how to handle live fish, as fishing for live fish is not a traditional Fijian fishing technique. On the other hand, the collection of live rock and coral is constrained to distinct villages along the Coral Coast due to the presence of fringing reefs along this area.

Our preliminary findings indicate that overall, coral reef export trade is a supplemental, rather than primary, source of income for coastal villagers. In fact, as shown in Figure 2, in most cases, depending on one export trade alone for income is not sufficient to meet minimal household expenditure needs. For example, we observed that women tended to use proceeds from selling *bêche-de-mer* to pay for day to day household

requirements, while big ticket items tended to be purchased and paid off from the domestic sale of fresh fish. This indicates that for participants in the coral reef export trades, it is critical to pursue a diversified livelihood strategy, and, therefore, that the condition of reef resources in coastal areas is important for all fishing community members. Our findings, as well as those of other surveys (e.g., see van Beukering et al. 2007; Veitayaki et al. undated), show that many villagers do in fact adopt a diversified livelihood strategy. For instance, the vast majority (71%) of respondents who collected *bêche-de-mer* also engaged in other fisheries. Moreover, in addition to participating in the reef export trades, many respondents also engaged in multiple subsistence activities such as planting crops and handicraft making, or finding temporary paid employment.

Engaging in a variety of income-earning activities is consistent with socio-economic studies in other parts of Fiji (Veitayaki et al. undated; Turner et al. 2007), and is an important strategy for ensuring sustainable livelihoods (Allison and Ellis 2001). Having the ability to adapt to another livelihood is particularly important given the ecological concerns connected with the coral reef export trades (e.g., Kolm and Berghund 2003; Sadovy et al. 2003; Rowlands et al. 2005; Why and Tuwai 2005).

The sustainability of *bêche-de-mer* exploitation in Fiji has been a concern since the 1990s (Adams 1992), as holothurians tend to be susceptible to overfishing (Uthicke and Conand 2005). In at least two villages we visited, villagers no longer collected *bêche-de-mer* as the invertebrates could not be found anymore. Similarly, adverse ecological impacts have been documented in connection with the collection of live rock and aquarium fish in Fiji (Sykes et al. 2003; Why and Tuwai 2005). Likewise, the live reef food fish trade has led to the collapse of these targeted fisheries in parts of Southeast Asia (Sadovy et al. 2003; Scales et al. 2006). There are indications that the live reef food fish fishery based in Bua Province is experiencing a decline too, as interviewed fishers claim that it is increasingly difficult to catch the targeted grouper species.

When an export market fails, for example through local species extirpation or the departure of a buyer, fishing provides a safety net for villagers. This was the case when a live reef food fish company departed from a village in Vanua Levu, and when the *bêche-de-mer* fishery collapsed in other villages. As such, protecting the health of marine resources in Fiji is crucial not only to maintain economic benefits from the export trade in coral reef resources, but also, to maintain the survival of coastal communities when that same trade fails.

¹ In some villages, fishers may use SCUBA gear to collect *bêche-de-mer* species that occur at greater depth.

In conclusion, the coral reef export trade in Fiji can be considered economically beneficial to coastal communities. However, for many participants these trades are mainly a source of supplemental, rather than primary, income. The bêche-de-mer trade provides the most widespread benefits to communities throughout Fiji in terms of being accessible to the greatest number of participants. The live rock and aquarium fish trades provide the highest net income to collectors, but the benefits of these trades are limited to a few villages. The ecological impact of coral reef export trades, together with the fact that it cannot provide a primary source of income, underlines the importance of pursuing a diversified livelihood. At the same time, management policies should be strengthened to ensure the sustainability of inshore fisheries resources, as villagers continue to rely on these marine resources as their safety net when certain coral reef export trades fail.

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