FINANCIAL ASSESSMENT OF THE MARINE TRADE OF CORALS IN SOLOMON ISLANDS

Padma Lal and Jeff Kinch

May 2005

A Report prepared for the:

Foundation of the Peoples of the South Pacific International, Suva, Fiji

South Pacific Regional Environment Programme, Apia, Samoa

Departments of Fisheries and Marine Resources, and Forestry and Environment and Conservation, Ministry of Natural Resources, the Solomon Islands Government, Honiara, the Solomon Islands

Financed by the Canada South Pacific Ocean Development Programme Phase II C-SPODP II

ACKNOWLEDGEMENTS

The report would not have been possible to complete in the time available without support from many people in the Solomon Islands, Fiji and Samoa.

Generous sharing of knowledge and information with Jeff Kinch, who conducted the fieldwork during late 2004 and early 2005, by the many people involved in the aquarium trade in the Solomon Islands made it possible to complete this project.

Our first and foremost gratitude must go to Willie Veitch and Simon Gower at Aquarium Arts Solomon Islands; and Paul and Wesley Saelea at Solomon Islands Marine Exports for their marvelous assistance.

Assistance by Peter Rex, Selina Lipa and Peter Ramohia at the Department of Fisheries and Marine Resources; and John Pita and Tia Masolo at the Department of Forestry, Environment and Conservation, is also greatly appreciated.

Thanks also to the many people in the Marau Sound: Paul and Nenita, Siria, John, Martin, Claudius, Lawrence, Rose and Charles, Stella and David, and Suluburi; and at Sandlfy Island: Francis and his wife, Clement, Joseph and Elijah; and all the other people that took time to sit, chew and story.

Hugh Govan and Ellie Austin from the Foundation of the Peoples of the South Pacific-International; Michelle Lam and Paul Holthus of the Marine Aquarium Council; Mary Powers formerly of the South Pacific Regional Environment Programme; and Rob Parry-Jones from TRAFFIC provided the impetus and the support for the assessment.

Many thanks finally to the Canada South Pacific Ocean Development Programme Phase II C-SPODP II for financing this work.

ACRONYMS

AASI	Aquarium Arts Solomon Islands
AAUS	Aquarium Arts-United States
BCA	Benefit cost analysis
CITES	Convention on the International Trade in Endangered Species
DFEC	Department of Forestry, Environment and Conservation
DFMR	Department of Fisheries and Marine Resources
FOB	Free on board
FSPI	Foundation of the Peoples of the South Pacific International
GVP	Gross value product
ICLARM	International Centre for Living Aquatic Resources
MAC	Marine Aquarium Council
NGO	Non-government Organisations
SIME	Solomon Island Marine Exports
SPREP	South Pacific Regional Environment Program
SSS	Solomon Sea Stones
USA	United States of America

Padma Lal
Sustainable Development Adviser
Pacific Islands Forum Secretariat
Suva Fiji
Tel: +679 321600 ext 233
email: padmal@forumsec.org.fj

Jeff Kinch
Coastal Fisheries Advisor
Motupore Island Research Centre
University of Papua New Guinea
PO Box 320, University 134, NCD
Papua New Guinea
Tel/Fax: +675 325 4645
emaill: jpk_rcfdp@datec.net.pg

TABLE OF CONTENTS

TABLES

MAPS

FIGURES

BOXES

PLATES

EXECUTIVE SUMMARY

For the Pacific Islands, the aquarium trade based on wild harvest of coral and other marine aquarium products is an important source of livelihoods for rural communities. However, concerns over its environmental effects have led to experimentation with and promotion of the culture of coral and other products.

Until recently, very few studies have seriously investigated the scope, potential, impacts, cost-benefits or long-term financial and bio-economic viability of wild collecting over the culture of marine aquarium commodities, particularly coral, or a combination of both activities.

The Foundation of the Peoples of the South Pacific-International (FSPI) with the support of financial support of CIDA via the South Pacific Regional Environmental Programme, initiated a project on Economic and Financial Viability of Wild versus Cultured Products in Fiji and the Solomon Islands.

This report covers the Solomon Islands financial assessment of wild harvested coral based fishery and culture based fishery. A benefit and cost analytical methodology is used to assess financial viability of wild and cultured coral in the Solomon Islands. Financial viability is assessed from the perspective of the villagers and the industry as whole.

Aquarium trade exports form the Solomon Islands currently accounts for around 4 % of the international coral trade. The main coral supply areas are the Nggela Islands, with smaller amounts supplied from the Marau Sound, and in and around the capital, Honiara. Around 30-40 villagers are involved in supplying live and dead corals to the three exporting companies – Solomon Island Marine Exports (SIME), Aquarium Arts Solomon Islands (AASI), and Solomon Sea Stones (SSS).

All exporters purchase coral products from the suppliers in SI$ and sell in US$. Prices paid to villages for live and dead coral vary with size, quality and species. On average, the purchase price of SIME has remained constant since it began operation in the late 1990s, with the average price for corals being SI$ 1.998/piece. The average price paid by AASI is SI$ 4.02/piece. The exchange rate is SI$ 1.00 = US$ 0.136.

Free on board (FOB) price for corals exported from the Solomon Islands is around US$ 3 or SI$ 22/piece. Retail prices for corals on the international market range from between US$ 35 (SI$ 266.70)-US$ 130 (SI$ 990.55)/piece, depending on species, quality and rarity.

The wild harvest of aquarium organisms by Marau Sound villagers is financially viable but not highly profitable. A villager can expect to earn a gross income of just a little under SI$ 11,000, and can expect to earn a gross margin of about SI$ 7,800. Transportation cost is the single largest cost item, and consumes almost half the gross revenue.

Gross margin is about SI$ 1,336 for cultured corals from the Marau Sound. When all costs are considered, financial profit is negative, with villagers expecting to make a loss of SI$ 1,679. When all costs of operations, including family labour costs, and depreciation, are considered coral farming is financially unviable, again because of the cost of transport. If village coral farmers were to double the output to 2,880 (which is close to the current wild production by one of the wild coral harvesters), the financial viability of cultured coral becomes more attractive. Under such a circumstance, gross margin/person is expected to be about SI$ 8,650/operation or SI$ 4330/person, resulting in an almost 50 % increase in gross margin, primarily because unit transport costs is much lower at this scale. Financial profit is also positive at SI$ 3,340.

Wild harvest of coral is financially attractive for Nggela Islands' collectors, with each collector expecting to earn SI$ 6,580/year in gross margin and a financial profit of SI$ 5,362/year. Transport is the single largest cost and consumes almost a third of the value of coral harvested.

In the Nggela islands, coral farming is financially unviable in the short run (gross margin criteria) or long run (financial net profit). If the scale of production is increased in the Nggela Islands to that produced in the wild, as for the Marau Sound, the financial performance is also positive. Coral farmers can expect to make SI$ 5,500 in gross margin.

Total industry gross revenue earned from the export of live and dead coral, other aquarium products and cultured coral is approximately SI$ 5.0 million/year. Industry financial profit is SI$ 1.6 million/year or 32 % of the FOB value. Operating costs associated with running the warehouse for the two exporters is about SI$ 1 million/year. When deducting the payment to villagers, the net financial profit earned by exporters is SI$ 1.8 million/year.

The financial viability of coral culture, not only depends on local ecological conditions and the growth rate of the species but also on the production technology, the scale of production and the local market conditions.

Coral culture in the Solomon Islands can only be a financially viable option if the following conditions are met: a reasonable scale of operation is adopted, operators keep the number of marketing trips to at least one a month, transport costs are shared with other villagers and the villagers are paid a higher price.

Local transportation and other costs, condition of local infrastructure, availability of air cargo space and regular air flights are also key determinants of the commercial viability of mariculture of coral products for the aquarium trade in the Solomon Islands.

Without consideration of these factors promotion of coral culture in the Solomon Islands will not be a viable alternative to wild harvest.

THE ASSESSMENT

The South Pacific Regional Environment Program (SPREP) has funded the Foundation of the Peoples of the South Pacific-International (FSPI) to conduct the 'Socio-economic and Financial Viability Assessment of the Marine Trade in Corals in the Solomon Islands and Fiji'.

The reasoning for the assessment stems originally from a request by the Fiji government to ascertain non-detrimental findings to meet the Convention on the International Trade in Endangered Species' (CITES) requirements for coral exports[1]. The study was broadened to encompass the Solomon Islands because of FSPI's Coral Gardens program, which operates in both countries. Specific aims of the Coral Gardens-Solomon Islands[2] program is to alleviate poverty and reverse ecological damage in the Marau Sound, the Nggela Islands and Langalanga Lagoon in Malaita, via the establishment of Locally Managed Marine Areas and appropriate mari-culture initiatives such as coral culture. This program has operated for some years now and has just received a further 3-year grant from the Darwin Initiative for the Survival of Species.

Until recently, very few studies have seriously investigated the scope, potential, impacts, cost-benefits or long-term financial and bio-economic viability of wild collecting over the culture of marine aquarium commodities, particularly coral, or a combination of both activities.

This report covers the Solomon Islands component of the assessment and assesses the financial viability of coral culture and compares its financial profitability with the net financial returns villagers receive from the harvest of coral products from the wild.

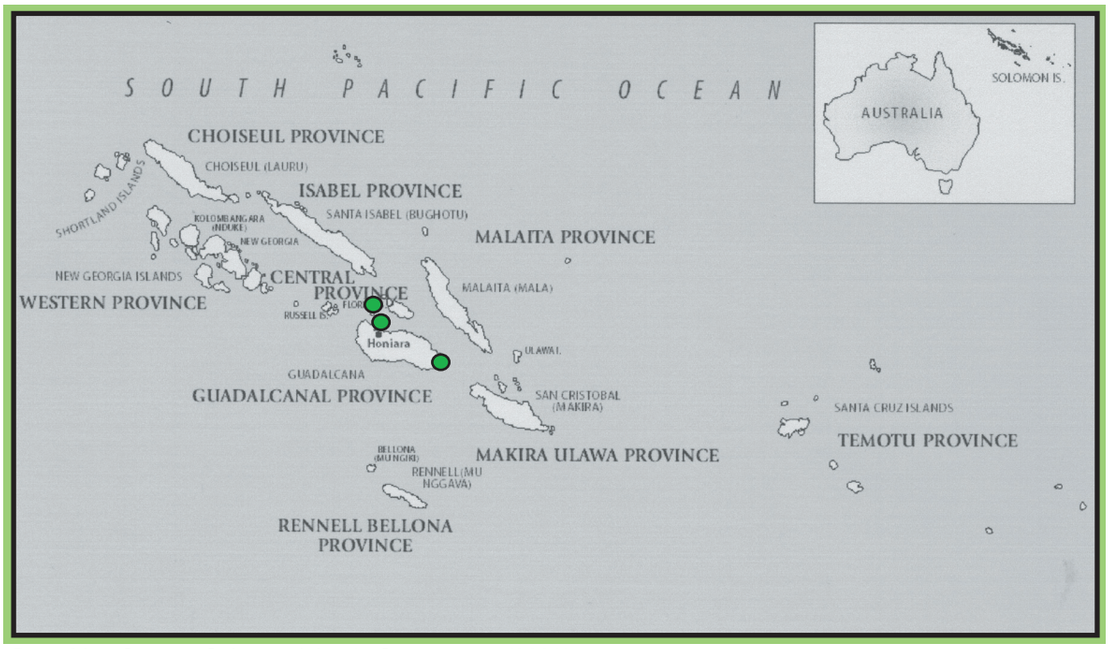
[1] CITES non-detriment findings includes information on the status of the species in trade including an analysis of life history, characteristics and function in maintaining ecosystem health, vulnerability including if it is wild harvested or captive bred, how much trade is proposed and whether trade will impact on the species.

[2] The CGSI enjoys the support of the International Coral Reef Action Network through the SPREP and is executed by the FSPI. The Solomon Islands Development Trust, the Environmental Concerns Action Network of Solomon and Department of Fisheries and Marine Resources (DFMR) all work collaboratively in implementation. The Marine Aquarium Council (MAC) has also worked as a partner.

1. INTRODUCTION

Aquarium trade exports form the Solomon Islands currently accounts for around 4 % of the international coral trade[3] (Wabnitz et al, 2003). Almost 70 species of live coral are regularly exported from the Solomon Islands (Kinch, 2004a), together with 19 species of dead coral. The main coral supply areas are the Nggela Islands, with smaller amounts being supplied from the Marau Sound, and in and around the capital, Honiara.

Map 1: Coral Supply Areas



Base Map Source: Solomon Islands Government (2003).

From this assessment it has been ascertained that around 200 villagers are involved in the collection of aquarium organisms, with approximately 30-40 of these supplying corals to greater or lesser degrees. Exports of live coral averaged 5,920 pieces/month in 2004, involving two exporters - Solomon Islands Marine Export (SIME) and Aquarium Arts Solomon Islands (AASI). A third company, Solomon Sea Stones (SSS), exports dead coral.

The extraction of coral for the aquarium and curio trade is regularly reported to be a contributing factor to coral reef degradation throughout the world (Bruckner, 2001; Bryant et al, 1998) and intense coral collection may cause the replacement of a thriving, coral dominated-system with a low-productivity algal reef (McClanahan, 1995). This, in turn may lead to a subsequent decline in reef fish abundance, biomass and biodiversity (Dawson-Sheppard, 1992; Dulvy et al, 1995); over exploitation of target species[4]; damage to the physical framework of the reef itself[5] (Wells et al, 1994; Jennings and Polunin, 1996) and an increase in sediment mobility.

Exports of corals from the Solomon Islands are now reaching pre-tension levels and are steadily increasing. This increase in harvesting and export now raises some concerns for the Ngella Islands in particular, from where both live and dead coral is harvested. The Ngella Islands are estimated to supply approximately 75 % of all corals exported from the Solomon Islands.

Even though the coral reefs of the Solomon Islands are reported to be the least disturbed reefs in the Pacific[6] (Maragos, 1998) they are continually affected by both natural and anthropogenic

[3] The Solomon Islands also accounted for 12% of all fish entering the international market during the period 1997-2002. From 1998-2003, the Solomon Islands also produced 6% of all invertebrates in trade (Wabnitz et al, 2003). It is important to note here that previously, a large proportion of marine aquarium organisms from the Solomon Islands were exported to Fiji and re-exported by Walt Smith International. In the Fiji case and with respect to CITES, this practice misrepresents Fiji as the source of much more material than is actually the case, thus any comparison of exports with other South Pacific countries during the late 1990s will be skewed (Lovell, 2001; Wabintz et al, 2003).

[4] Many corals targeted by the live aquarium coral market are large-polyped species, some of which are slow growing.

[5] Destructive methods have been noticed when communities collect certain aquarium fish, particularly the breaking of corals to get at blue tangs, Paracanthurus hepatus (Kinch, 2004b).

[6] Sixty percent of the coral reefs in the Pacific have been assessed as being at risk of further degradation in the coming years (Wilkinson, 1999).

[7] A disturbance is defined as a discrete, punctuated killing, displacement, or damaging of one or more individuals (or colonies) in a specific area (Sousa, 1984).

disturbances[7]. Even though Connell (1997) identified that a decline of less than 33 % in coral cover could be regarded as ecological insignificant, the type, scale and duration of disturbance attributable to coral collection is important when trying to understand the impact upon the reef ecosystem because these factors dictate the potential for and speed of recovery[8].

Much of the impacts of coral harvesting in the Solomon Islands are the localized depletion of some species or genera. Although aspects of recruitment such as 'mass spawning' (Babcock et al, 1986) and widespread current-borne dispersal indicate that depleted stocks can be re-established once collection has ceased (if collection occurs over large areas). It is therefore probable that recruitment could keep pace with harvesting, and possibly lead to homeostasis between coral removal and recruitment (Karlson and Hurd, 1993). However, the level of ecological information required to determine sustainable yield for the Solomon Islands is currently lacking.

In response to such environmental concerns, mariculture of coral and other invertebrates has been promoted in the Solomon Islands as an alternative to harvesting from the wild. It has also been promoted as alternative livelihood opportunities, helping to reduce (or eliminate) the prevalence of other destructive practices and over-fishing of live reef organisms.

The culture of aquarium organisms has been promoted in the Solomon Islands since 1997, with encouragement of the International Centre for Living Aquatic resources (ICLARM – now renamed as the World Fish Centre), and FSPI.

Export of cultured coral products from the Solomon Islands has decreased by more than 50 percent in the last five years. Reasons for this decrease relate to the loss of infrastructure in the Marau Sound following the ethnic tension, which erupted in 1999, and the lack of marketing promotion. Today, only only two individuals in the Marau Sound, and one person in the Nggela Islands, a far cry from the 25-30 people involved in the early days, carry out coral culture. In 2004, a total of 443 cultured soft corals and 166 cultured hard corals cultured corals were exported.

Internationally, it is acknowledged that although coral culture is technically feasible, it is the financial viability that determines its sustainability. Furthermore, it is the expected net returns from cultured corals as compared with the net returns from the wild harvest that will determine if coral culture will replace the wild harvest-based fishery at the village level.

Recent studies published by the World Resource Institute (see Parks et al, 2003; Pomeroy et al, 2002, in press), suggests that the culture of live coral (and live rock) is not financially viable except with significant subsidy from the government or other donors. In Fiji, however, a recent assessment by Lal and Cerelala (2005) suggest that coral culture could be financially viable if the right conditions and production times were met.

The primary objective of this assessment for the Solomon Islands is to undertake a financial analysis of the wild harvest based activity of collectors from the Marau Sound and the Nggela Islands and compare it with the culture-based activity in these two areas. The study also estimates net financial benefits to the Solomon Islands generated by the wild harvest–based aquarium industry, net financial benefits earned by the collectors as compared with exporters, and export tax collected by the government.

2. METHODOLOGY

A financial analysis focuses on the financial interests of individuals, families and/or the community directly involved in an activity. An activity is considered financially viable if its profit (defined as total revenue minus total costs, including depreciation) is greater than zero. In the short-term, an activity may be considered viable if total revenue minus variable costs, or gross margin, is greater than zero. Opportunity costs of family labour, depreciation costs and other non-market costs are excluded in gross margin calculations.

When comparing the desirability of the wild harvest of live coral over cultured coral for an individual,

[8] Recruitment plays a critical role in the persistence and resilience of coral reef populations but its relative importance in coral population and community dynamics can vary according to temporal and spatial variations amongst species, depth, habitat, location, seasons and years (Connell et al, 1997; see Harrison and Wallace, 1990 for an overview).

it is common in the short term that the activity that produces a higher gross margin is preferable over the alternative activity with a lower gross margin. In the longer term, the activity that produces higher financial profit is preferable over the alternative activity that produces lower financial profits. Ecological costs and other non-out of pocket costs, other than depreciation, are also not included.

Financial Analysis Formulae

Financial Net Revenue
= Total revenue – Total Costs

Total Revenue = Price * Quantity

Total Costs = Sum (unit cost of input * quantity of inputs) + Depreciation Cost

Operating (Variable) Costs = Costs of all inputs which varies with quantity of output produced

Gross Margin
= Total Revenue minus Operating Costs

Net Financial Profit = Total Revenue– Total Costs

Financial Criteria:
Two activities A (wild), B (culture), if:
Gross Margin (A) > Gross Margin (B) than A is preferable over B

In this study a financial analyses from the point of view of individual villagers is undertaken to identify financial viability of the wild and of the culture-based fishery. Note financial analysis is different from economic analysis, where all costs - direct and indirect - are explicitly considered. In an economic analysis, total economic benefit is the economic market value of the product plus the economic value of the non-marketed products resulting from the same activity. The economic value of a product is measured in terms of unit willingness to pay, or price times the quantity of the products sold. Total economic cost is the sum of direct and indirect costs, including externality costs on other users and the environment.

A 'with and without' benefit cost analysis (BCA) is the appropriate analytical framework to determine relative attractiveness of culture-based coral production over wild harvest based coral production. This involves estimating net benefits of wild harvests of live coral ('with' scenario) and comparing it with the net benefits of the 'without' wild harvest scenario, i.e. culture-based fishery. If the net benefit from cultured products is positive, then the culture-based activity is considered financially viable. However, for communities and exporters to switch to cultured products, the net benefits derived from cultured products would need to be at least equal to or greater than the net benefits derived from wild harvested products.

A 'with and without' analysis in this case is thus based on the assumption that when one wants to replace wild harvest of live coral with cultured products, then the only thing that changes is the process used to produce the products of the same quality. Demand, price and quality are assumed to remain unchanged. This is an important, but not an unrealistic assumption, particularly when the processing of live coral harvested from the wild is the same as live coral obtained from coral farms.

The net financial returns from both wild harvest and cultured products are compared in this study in order to assess whether individual villagers would have financial incentives to switch from wild to cultured products. The criteria, as discussed earlier, may involve gross margin or net financial profits, depending on the period under consideration.

Financial profitability of the aquarium trade to exporters is also assessed. Exporters already own or have access to the necessary equipment for holding organisms, packing and transporting the products to the markets. In addition, the products – live coral from the wild and live coral from culture farms – are not dissimilar as far as the exporter is concerned as there are no differences in the holding and maintenance of coral products. Nor are there any differences in packaging and freight of the two categories of products. The only thing that differs is the supply of products from culture farms as opposed to the harvest from the wild. As there is no differences expected in handling, packaging and transporting of cultured or wild products, the profitability of the cultured products is therefore assumed to be the same as that of the wild products, provided there is no change in the product price[9].

To analyze financial net benefits of 'with and without' wild harvest of live coral, technical production together with financial models for wild harvest and cultured coral are first defined. For these analyses, information/data were gathered using different approaches and methodologies. Purchasing

[9] Consumers of marine ornamentals though may have different preferences for wild versus cultured products, and thus cultured products may fetch different prices to the wild ones.

and export information was obtained from the commercial companies' and the DFMR's export databases. To gain an understanding of the coral trade, a flexible, informal approach based around a questionnaire was adopted in mostly focus group settings. This approach encouraged interviewees to speak freely, with the goal of eliciting specific information on the product and their supply systems, as well as on the structure of the trade. Informants included live and dead coral suppliers, past and present producers of cultured coral, other island and coastal fishers and village residents, company managers and personnel, a former company boat captain, and finally, government and conservation organization project staff.

It is noted here, that accurate information was difficult to gather from those involved in coral harvesting because of the 'part time' nature of activity, a lack of record keeping and the variability encountered when asking village collectors to estimate correctly time spent, product harvested or income generated. Official government records, too, were sketchy and incomplete. Subsequently, the most accurate information obtainable was from company purchasing records. Published literature on Solomon Islands aquarium trade was used to fill in the gaps. When all else failed, 'benefit transfer' method was used and key parameter estimates were obtained from Fiji. Consequently, results presented in this study are only indicative of the orders of magnitude of financial benefits of wild harvest based coral trade as compared with culture based-coral trade.

3. THE AQUARIUM CORAL TRADE

The establishment of the aquarium trade from the Solomon Islands was first mooted in 1975 when the potential of selling aquarium organisms as a source of income for rural communities and export tax revenue for the government was first raised (Boutilier 1975; Biliki, 2002). It was, however, not until the mid-1990s that the live aquarium trade begun. In 1996, exports peaked for that year when 175, 200 pieces of coral were exported (Table 1). Exports declined following the ethnic tension which erupted in early 1999 because of a reduction in air services. With the introduction of the Regional Assistance Mission Solomon Islands in 2003, and the return of law and order in the country, coral exports, have once again began to increase.

Table 1: Live coral exports 1995-2004.

Year	Coral*			
	No. of Pieces	Reference	Value (SI$)	Reference
1995	~45,000	Bruckner, 2001	-	
1996	175,203	Biliki, 2002; Sulu *et al*, 2000	587,584	Biliki, 2002
1997	61,144	Leqata, 2004	289,870	Leqata, 2004
1998	84,755	Biliki, 2002	422,473	Leqata, 2004
1999	58,181	Biliki, 2002	244,645	Leqata, 2004
2000	51,417	Leqata, 2004	201,588	Leqata, 2004
2001	33,250	Leqata, 2004	126,728	Leqata, 2004
2002	40,750	AASI	260,039	AASI
2003	51,627	AASI	438,093	AASI
2004 (Jan-Nov)	71,017	AASI	n/a	

*Includes cultured corals; the year 1995 may also include dead coral.

Cultured corals has only made a small part of total coral exports from the Solomon Islands, making up roughly 1.6 % of the total exports over the last 5 years. Cultured exports though have decreased over time (Table 2).

Table 2: Cultured Coral Exports from the Solomon Islands: 2000-2004.

Year	No. of Pieces	% of Total Aquarium product Exports
2000	1,299	2.5
2001	766	2.3
2002	567	1.4
2003	686	1.3
2004 (Jan-Nov)	439	0.6
Total	***3,757***	

Source: AASI.

3.1 Dead Coral

The dead coral trade in the Solomon Islands began in 1984[10] and has seen sporadic exports up until the mid-1990s[11], when the trade was stopped by the government (Table 3). Coral harvested during this period was mainly form Paruru Plantation in the Marau Sound, and focused on the curio blue ridge coral, *Heliopora corulea* and pipe organ, *Tubestrea spp.*

Table 3: Dead coral exports: 1985-1994

Year	Coral	
	No. of Pieces	**Reference**
1985-1990	~4,000	Bruckner, 2001
1991	~6,000	Lovell, 2001
1992	~8,000	Bruckner, 2001
1993	~5,000	Bruckner, 2001
1994	~15,000	Bruckner, 2001

The dead coral trade was restarted in 2003 under a company called Solomon Sea Stones (SSS). It is licenced to export 19 species. Complete statistics are not available, but the limited export records obtained from the DFMR suggests that the curio coral exports are significant. During the period of April – September 2004, for example a total of 8 shipments containing a total of 20,198 pieces were exported for a value of SI$ 74,482. The total volume of export at this stage is unverifiable.
Fan corals and Black corals are also domestically sold locally by villagers as souvenirs, although the sale of black coral is against Fisheries regulations (Sulu, 2002).

[10] Dead coral is defined as wild harvested coral that are packed in cardboard lined crates for export. The dead coral trade increased rapidly within the Pacific region during the 1970's and 1980's with Fiji, New Caledonia, Kiribati, Samoa, Solomon Islands and the Marshall Islands dominating the regions export during this period (SPREP, 1994).

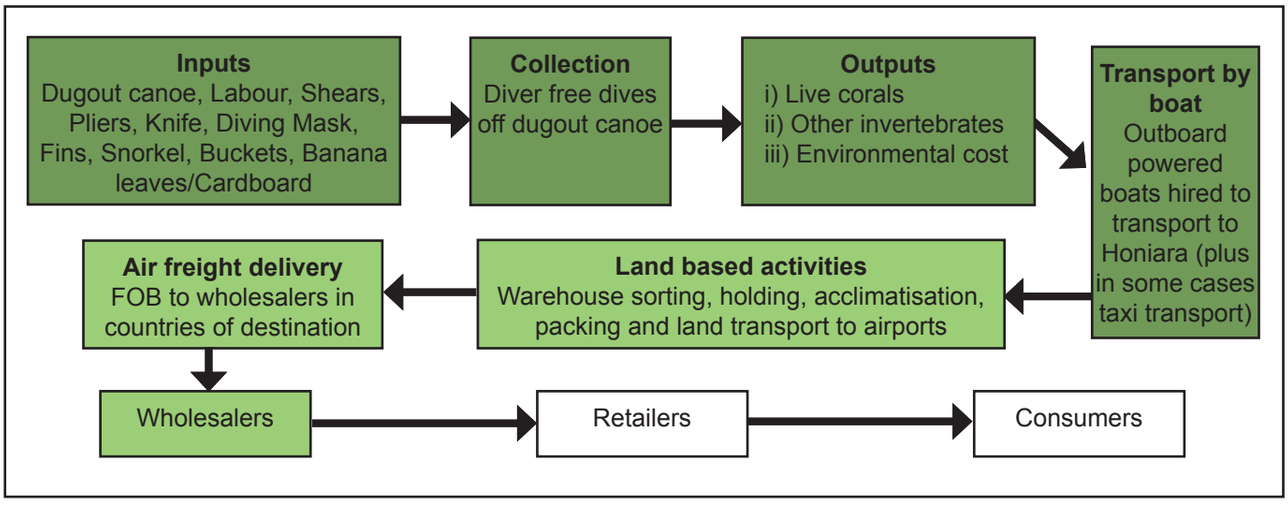
[11] There are no records kept for this period as the DFMR had not yet implemented a database to monitor exports.

4. NET FINANCIAL ANALYSIS OF WILD VERSUS CULTURED CORAL

Financial profit, defined as total revenue from all products harvested minus costs of all inputs, including depreciation, is what a villager or a collector would be interested in when considering financial viability of wild harvest. As discussed earlier, an activity is considered financially viable if its profit is greater than zero, and an activity is more desirable than another activity if its profit is greater than that of the alternative activity. For a villager to switch to producing cultured corals, its financial profits would need to be at least equal to or greater than the financial profit from producing wild products. From the perspective of the society, net economic benefit is the measure relevant for choosing between alternatives.

To compare financial net benefits, 'typical' production model for each of the products – wild coral and cultured coral - was first constructed. The 'typical' model was used to undertake financial and economic analysis of each activity. Two separate models for collectors from Marau Sound and Nggela Islands are provided reflecting differences in their cost structures, although they use the same technology. In both the cases, the production supply chain of the wild coral harvest and export activities, are the same, as illustrated in the following diagram (Figure 1).

Figure 1: Model of Live Coral Production from the Wild



Note: Dark Green shaded boxes represent activities carried out by the villagers;
Lighter green boxes represent activities under the control of exporters.

4.1 Wild Coral Harvest and Transportation by Villagers

It is estimated that around 200 villagers are involved in the collection of aquarium organisms, although only a handful of collectors from Marau Sound and Nggela Islands are regular coral suppliers. Exporting companies in the Solomon Islands are not directly involved in coral harvesting, as is the case in other parts of the Pacific, such as Fiji[12].

Coral harvesting involves villagers paddling out in their dugout canoes to reef sites. This may be an individual activity or may involve one, sometimes two other close relatives or friends. Harvesting of coral pieces is selective, involving the removal of particular size categories, which are demanded by exporters. Extraction of corals from the substrate involves free diving using mask and snorkel, and

[12] AASI does, however, have a couple of diver/collectors that collect live and dead coral, live rock and fish at Nghuhu Island.

removing pieces of coral from the substrate using a hammer and chisel (usually fastened out of an old piece of steel). Pieces that are removed are placed in holding containers in the canoe or left on the substrate for collection when leaving the harvesting site or when ready to transport to Honiara. When ready for transporting, corals are stacked in open trays or buckets, with each layer of coral separated by either banana leaves or cardboard. Fresh seawater is regularly poured over the corals whilst enroute.

On average, in 2004, villagers involved in coral harvesting from the Nggela Islands made one trip/ month. All wild harvested corals from the Nggela Islands are sold to SIME. Nggela villagers are also the main suppliers of cultured corals and ornamental fish to AASI.

Based on a three month purchasing record of SIME for the period September to November 2004, it is estimated that eleven suppliers sold 420 pieces per month of coral and other ornamentals to SIME, and when extrapolated for the whole year gives an estimate equating to 5,037 organism possibly collected by each supplier for 2004. In contrast, each of the three main collectors from the Marau Sound on average harvested 1,375 pieces of coral and other ornamentals from the wild per annum since 2002. In 2004, these three main collectors supplied 4,130 pieces of coral and other aquarium products (1,690 organisms to AASI each)[13]. Marau Sound villagers supply their products to AASI.

Apart from the use of fixed capital items, such as dugout canoe, hammer, chisel, masks and snorkel, etc, the cost of which is small when compared with the total cost of operation (as discussed below), villagers' major other input is the use of motorized canoe to transport coral products to Honiara.

Various business arrangements exist whereby expenses (fuel, dinghy and engine hire) are shared amongst 3-4 other villagers. In some cases, villagers hire motorized canoe and pay for fuel. Since late 2003, because of an increase in the cost of fuel, AASI has provided its suppliers a fuel subsidy of 30 % of the value of coral harvested to a maximum of SI$ 300. In other cases, such as the Marau Sound, motorised boat operators may charge 30 % of the gross value of coral products transported. This is markedly different to what used to happen before 2004, when AASI used its own vessel, the MV Rhinopias, to collect aquarium trade products particularly from the Marau Sound. This ship had four large holding tanks (2 small, 2 large), which had seawater pumped on a continuous cycle when in use. In 2002 and 2003, the majority of corals purchased by AASI were transported on this vessel. The MV Rhinopias has been out of commission since January 2004.

Some of the live coral harvesters also supply dead coral[14], using essentially the same production method, including transportation to Honiara. Thus, harvest of live and dead coral is treated as joint production for the purpose of financial analysis.

Once delivered to the exporters, coral is sorted before collectors are paid. In the case of villagers supplying SIME, they may have to wait in Honiara between 1-4 days before being paid. During which time villagers stay either on the beach or with friends and relatives, which also adds to the cost of collection and transport to the villagers. Villagers supplying corals to SIME, sometimes have to hire a taxi to take their products from the beach landing in Honiara to the warehouse.

4.2 Exporters

As noted above, there are three companies involved in the aquarium trade, two specializing in live products, and the third, exporting dead coral. The oldest is Solomon Islands Marine Export (SIME), which is owned and managed by a local Solomon Islander, Paul Saelea, although it was started with the assistance of an expatriate consultant and investor, David Palmer in 1995. David Palmer later left SIME to form Aquarium Arts Solomon Islands (AASI) with another local Solomon Islander, Simon Gower in 1998 (Kinch, 2004a). David Palmer also holds a significant share in Pacific Aquafarms in Fiji, which is affiliated to Walt Smith International, although, now run as a separate company. Simon Gower also operates Solomon Sea Stones (SSS) as a separate company exporting dead coral. All the companies have their warehouses situated in the Ranadi industrial area of Honiara.

SIME focuses on the live coral trade while AASI handles mostly ornamental fish. Both companies

[13] Does not include dead coral.

[14] There are 5 suppliers of dead coral, 3 of these are based in the Nggela Islands - 2 from Sandfly and the other from Hagalu village on Nggela Sule. The other two suppliers are from the Marau Sound. The collectors from the Marau Sound specialise in supplying pipe organ, whilst the Ngella Islands supply all other species.

also export invertebrates. Although SIME is the oldest company in the Solomon Islands, it exports its product under AASI, for a fee equivalent to 25 % of the FOB value of products. AASI is responsible for all export requirements and mostly exports aquarium products to its parent company, Aquarium Arts-United States (AAUS)[15], wholesale facility in Los Angeles, United States of America (USA), which then distributes the products internally to retail pet stores. Occasionally exports are made to other destinations.

Box 1: Company Profiles

SIME has a 900 m² warehouse that is situated several hundred metres from the sea. They have 17 large fiberglass holding tanks and have a closed seawater system and protein skimmers. Fresh seawater is delivered on a regular basis.

AASI has a warehouse with an area of 1,100 m² and is situated opposite the seashore. They have five self-contained holding systems. Because of their proximity to the seashore, fresh seawater is pumped directly into facility when needed (around 40 % of seawater is exchanged weekly) and undergoes ultra-violet treatment and protein skimming. The products brought to the warehouse are kept in the holding tanks before sorting, packaging in boxes and transported to the airport for export.

SSS operates from a large open-air property, so as to allow sun drying and bleaching of corals.

Currently, there are 43 people employed by the two companies exporting live products. Staff wages at AASI range from SI$ 3.68-SI$ 6.18/hr depending on responsibilities, capabilities and type of employment (part-time or full-time). SIME pay staff daily rates with casuals receiving SI$ 30. SSS employs four full-time employees for grading and packing and two managers (including the owner) that oversee all operations and shipping.

Company	Main Commodity Exported	Managers	Full-time	Part-time	Casuals
AASI	Aquarium fish	2	12		6
SIME	Aquarium coral	3	4	6	10
SSS	Dead coral	2	4		
	Total	5	16	6	16

Plates 1 and 2: Facilities at Solomon Islands Marine Exports (source: Kinch, J. 2004a).

Plates 3 and 4: Facilities at Aquarium Arts Solomon Islands (source: Kinch, J. 2004a).

[15] AAUS also purchases aquarium organisms from other companies and countries.

4.3 Marketing of Live and Dead coral

All exporters, purchase coral products from the suppliers in SI$ and sell in US$. Prices paid to villages for live and dead coral vary with size, quality and species.

On average, the purchase price of SIME has remained constant since it began operation in the late 1990s, with the average price being SI$ 1.00-SI$ 2.00[16]. The average price for corals at SIME is SI$ 2.00/piece. The average price paid by AASI is SI$ 4.02/piece. The exchange rate is SI$ 1.00 = US$ 0.136.

Individual pieces of corals (as are all live aquarium organisms) are exported in individual plastic bags filled with oxygenated seawater, tied with rubber bands and packed in styro-foam boxes[17]. Frozen bags of water are also placed in the boxes for export to lower the overall temperature to minimize stress of the organisms being exported. Hard corals can survive transit periods of up to 30 hours, soft corals, due to their morphology and presence of stinging tentacles are difficult to ship and are usually shipped with travel times that do not exceed 24 hours.

FOB price for corals exported from the Solomon Islands is around US$ 3 or SI$ 22/piece. In Fiji, exporters receive an average of US$ 5/piece. A Google search of the Internet found several companies that sell Solomon Island corals. Retail prices for corals range from between US$ 35 (SI$ 266.70)-US$ 85 (SI$ 647.65)/piece, with some retailing as high as US$ 130 (SI$ 990.55)/piece.

Similarly, for dead coral the weighted average price recorded during April – September 2004 by the Department of Fisheries is SI $3.50/piece. Dead corals are shipped, mainly to an importer, Tidelines, in Los Angeles, USA. They are packed in small crates made from timber and 80 crates are packed in a container.

During 2002-2003, AASI/SIME exported to a wide range of destinations but with the bulk of its exports to the USA. In 2004 and to present, AASI is still shipping mostly to the USA, with minor shipments to other destinations.

There are two routes for export out of the Solomon Islands – via Vanuatu and Fiji or Australia. The first main route is via Port Vila, Vanuatu and then to Nadi, Fiji. Once reaching Fiji, there are regular flights to Los Angeles, USA because Fiji's tourism industry. The second route is via Brisbane, Australia and then on to Los Angeles (Table 4).

Table 4: Flights used by AASI/SIME for Exporting

Day	Airline	Destination	Time
Tuesday	Air Pacific	Honiara-Port Vila Port Vila-Nadi	13.40-15.35 16.35-19.05
Tuesday	Air Vanuatu	Honiara-Brisbane	15.00-17.00
Wednesday	Hevi-lift*	Honiara-Cairns	(Every 2nd week)
Thursday	Air Vanuatu	Honiara-Brisbane	15.00-17.00
Saturday	Air Vanuatu	Honiara-Brisbane	18.20-20.20

*Used only for the export of live rock. Source: Solomon Airlines, Hevi-lift.

Improvements in flight frequency and air cargo space could have a further positive impact on the expansion of the marine ornamental exports for both cultured and wild collected coral products.

4.4 Export and Government Regulations

The Solomon Islands is currently not a signatory to CITES[18]. When the aquarium trade first started in the Solomon Islands it was enabled under the *Fisheries Act*[19] and therefore managed by the DFMR[20], however, the Department of Forestry, Environment and Conservation (DFEC) is the designated authority that issues Wildlife Export Permits, the CITES equivalent permits. Normal customs and quarantine requirements also apply.

[16] This means a coral costing S$2 in 1995 (exchange rate of 3.4059) was worth US$0.59 but is now only worth US$0.26 (exchange rate of 7.6197).
[17] Total box cost including bags and rubber bands is around US$ 6 each, a packing fee of US$ 9/box is charged to the customer to recover costs.
[18] Fiji, Papua New Guinea and Vanuatu are currently the only Pacific island countries that are signatories to CITES.
[19] Current fisheries regulation on use and extraction of dead or live coral and rock are limited to no harvesting from Marine Protected Areas and the use of heavy machinery (Ramohia, 2002). Coral lime production is exempted.
[20] A license to purchase aquarium organisms costs SI$ 5,000 from the DFMR.

For the export of aquarium products, exporters need a fisheries permit from the DFMR. Based on this permit, DFEC issues an export permit. Each permit costs SI$ 50, which, however, does not fully cover the costs of management of the trade and the permitting system (Biliki, 2002).

Management of the coral trade in the Solomon Islands is rather *ad hoc* at present, and there is currently no specific regulation, policies or management plans in place. The purpose of the *Wildlife Protection and Management Act 1998*, which was gazetted in September 2002, was to move the Solomon Islands forward with compliance with CITES[21], even though there are no restrictions on the export of corals in the act. Currently there are no impact assessments and no quotas. There is also no proper procedure for maintaining records of exports. At present AASI gives both DFMR and DFEC a summary of its exports. The DFMR compiles all statistics relating to the trade and files all copies of export documents. Live coral is recorded in terms of pieces whilst live rock and dead coral are recorded as weight. Since there is no indication of size or weight of individual corals, there is no reliable means of converting these units to a measure that is useful for coral reef management[22]. Coral that are lumped as *Scleractinia*[23] may also include unidentified taxa of stony corals, live rock, or reef substrate with attached (non-listed) soft corals.

Even though the Solomon Islands is not yet a signatory to CITES, it does have to comply with importation rules of CITES member countries. Currently, the USA Fish and Wildlife Service is enforcing CITES Notification, No. 2003/20 for all coral imports, which requires corals to be identified to species level[24] if listed in Schedule I or genus if listed in Schedule II. In addition, since 1999, the European Union has placed a ban on the importation of certain species, notably *Catalaphyllia jardinei, Cynarina lacrymalis, Nemenzophyllia turbida, Trachyphyllia radiata* (Amblard, 2004).

Box 2: International Trade Mechanisms for Management

Overall, 98 genera of Indo-Pacific corals are listed in the CITES reports, with 20 dominating the trade. All species of black coral (Antipatharia) and hard coral in the order Coenothecalia (blue coral), Milleporina (fire coral), Scleractinia (stony coral), Stolonifera (pipe organ coral) and Stylasterinia (lace coral) are listed in Appendix II. Anemones and false corals (Subclass Zoantharia), soft corals (Order Alcyonaria) as well as sea fans, sea plumes and deep-water precious coral (Order Gorgonacea) are not currently listed.

One problem for the trade in cultured corals is that there is little or no agreement or understanding on the proper and consistent application of CITES source codes for them. This situation has arisen because of stony corals' multiple reproductive methods; the diversity of culture techniques, and different interpretation of CITES resolutions on captive breeding. The lack of agreement on codes and marking systems to separate cultured corals from wild corals prevents an accurate assessment of different components of the global coral trade and confounds efforts to assess the magnitude and impact of wild coral harvest within range countries (CITES, 2002).

Following incorporation in 1998, the MAC is now established as an independent, third party institution whose goal is to transform the marine aquarium industry into one that is based on quality and sustainability. It has been assumed by the MAC that most aquarium hobbyists want to support an industry that produces quality products using sustainable practices (for ethical, environmental and personal reasons). Most marine aquarium hobbyists are, however, a discriminating group, whereby size, price, colour and shape of corals all play a role in decision making when it comes to purchases. Many retailers do not carry cultured corals, as they are considered 'too small' or 'too expensive'.

The usefulness of MAC Certification needs to be assessed as a 'green premium' on sales may possibly increase viability performance for cultured products over wild-collected ones (see Pomeroy et al, in press) but certification will only make commercial sense if expected benefits of doing so are greater than the costs associated with the certification process itself.

[21] If the Solomon Islands was to become a CITES signatory, the designated authority would be obligated to make a finding that the trade in that particular species is not detrimental to its survival in the wild before issuing an export permit.

[22] In Fiji, industry records suggest an average weight of 0.588 kg per piece of ornamental products, including fish (Walt Smith International pers. comm. September 2004).

[23] Within one genus, the abundance of different species varies widely and each species maybe affected differentially by varying threats. By only reporting trade to genus, there is the potential to extirpate an uncommon species by over-collection (Bruckner, 2001).

[24] Because of well recognised complexities of coral identification, this is impractical for the majority of coral species.

4.5 Aquarium Trade from the Marau Sound

The Marau Sound includes the outlying islands and a stretch of coastal lands extending approximately 5 km inland at the far eastern tip of Guadalcanal. Marau Sound has good tidal and current flow, clear waters with minimal terrestrial inputs, and good coral diversity. It was/is also a good site for coral culture.

4.5.1 Financial viability of Wild Harvest

The people of the islands of the Marau Sound are Malaitan emigrants[25] they have fishing rights to the Marau Sound, which extends from Tavanihau in the northwest to Waimea/Kolotabu in the south (Wairiu and Lam, 2003). Coral reefs and adjacent coastal areas are owned under a clan, known as Iora. Thus, the companies do not have to pay any goodwill or access fees to the reef areas, unlike in Fiji (see Lal and Cerelala 2005).Before the tension, the economy of the Marau Sound was active[26] and there were regular flight and shipping services. Today there are no regular shipping services and collectors have to hire motorized canoes to take their produce to Honiara.

Suluburi is the most prolific harvester. He is also the most efficient producer and his production is thus taken here as the typical model, and is referred to below as Suluburi's Production Model. Other wild production characteristics used for determining the financial aspects of wild harvesting in the Marau Sound are listed below:

- Collectors use dugout canoes for collecting; 25 percent of the cost of the canoe is attributed to the aquarium trade, with the rest of the time used for other purposes, including subsistence fishing;
- Collectors own their own dive gear, such as mask, snorkel, knife and shear, each lasting between 5 years (see Table 5);
- To benefit from economies of scale, each collector shares the larger cost item of transport to and from Honiara, with at least two other villagers;
- Collectors free-dive (do not use scuba tanks) to harvest coral;
- Each person collects his own coral with the help of at least one relative;
- Each person makes 16 trips[27] in a year and collects on average 2,736 pieces of coral equivalent (live coral, other ornamental products and dead coral); and
- Each sells the products to AASI, who pays on average SI$ 4.02 /piece, plus 30 % of gross value as fuel subsidy, up to SI$ 300 a trip, whichever is the lower.

Table 5: Input, Output, and their Unit Prices per Villager Involved in Live Coral Harvest from the Wild

Activity		Unit/ comments
No. of coral pieces on average harvested per team	2,736	Pieces per year
No. persons working in the team	2	Spending a day for collection and a day for marketing
No of trips per 12 months	16	Trips
Price per piece	$4.02	$/piece
Labour rate	30	$/day
Fixed Cost		
Knife	$20	/unit and lasts for 3 years
Masks	$165	/unit and lasts for 5 years
Fins	$115	/pair and lasts 5 years
Dugout canoe	$910	Each but 25% of its cost attributable to aquarium trade related activities
Operating Cost		
Hire of boat for collection ($1420/ three persons)	196	$/person/trip, net of fuel subsidy

[25] According to Spanish records, Mendana stopped at Marau Sound on the 24th May 1568, which was then part of the Greater Are'are of Malaita.

[26] Mackay (1988) reports that during the 1980s about 35% of households were engaged in food crop marketing, 28% were earning an income from sale of fish and 13% from the sale of shellfish. Another 15% of households were engaged in marketing of copra and cocoa. The village economy was also diverse in that 23% of households engaged in some form of business enterprises, 18% were members of marketing cooperatives and 8% had a skilled trade or profession.

[27] At times villagers may give their products to others to take to the market place, thus further reducing their transportation cost.

4.5.1.1 Results

Wild harvest of coral and live fish[28] products by Marau Sound villagers is financially viable but not highly profitable. A villager collecting 2,736 pieces of coral and aquarium fish each year, making 16 trips to Honiara can expect to earn a gross income of just a little under SI$ 11,000, at an average price of $4.02/piece. A villager can expect to earn a gross margin of about SI$ 7,800. Transportation cost is the single largest cost item, and accounts for almost half the gross revenue, even after including the subsidy of 30 % of the gross value of coral products (up to SI$ 1,000 of product).

Total Revenue (TR) = Price Quantity

Gross Margin = TR – Operating Costs

Financial Profit = TR - Operating Costs - Depreciation

Operating Costs = variable costs, costs which vary with the quantity of products harvested

Depreciation = annual decrease in the value of fixed items allowed in accounting

If wild coral harvest were treated as a business venture, then it is relevant to also consider the opportunity cost of labour and depreciation costs of fixed items. Under this scenario, the financial profit is SI$ 470/year per operation or SI$ 235/person; which is lower than the per capita Gross Domestic Product of SI$610[29] (UNDP, 2002)

Actual gross margin of the three person from whom detailed information were available, ranges from SI$ 3,750-SI$ 7,810/year. Their financial profit ranged from SI$ 1,650-SI$ 6,720/year (Table 6).

Table 6: Financial Returns for Individual Operators and 'Typical Marau' Operator for Wild and Culture

Activity	Collector A	Collector B	Collector C	Marau Typical
No of pieces	2107	2,736	2,205	2,736
No of trips	22	16	14	16
No of pieces per trip	97	171	157	171
No of people	3	2	2	2
Coral Revenue	2,454	574	1,027	574
Other ornamental	5,621	10,414	6,154	10,414
Gross revenue	8,075	10,988	7,180	10,988
Weighted average price				4.02
Transport: Marau-Honiara-Marau	3,782	2,773	2,427	2,773
Depreciation	138.1667	138.1667	138.1667	138
Labour	1,963.636	960	840	960
Gross margin	3,748	7,814	4,404	7,814
Gross margin per person	1,249	3,907	2,202	3,907
Financial Profit	1,646	6,716	2,202	6,716
Financial profit per person	549	3,358	1,713	3,358
Gross margin per piece	1.78	2.86	2.00	2.86
Financial profit per piece	0.78	2.45	1.00	2.45
Gross margin as a percentage of gross revenue	46%	71%	61%	71%
Financial profit as a percentage of Gross revenue	20%	61%	31%	61%

It is clear, from the above analysis, financial profitability depends on the economies of scale, particularly in relation to the transportation between the Marau Sound and Honiara and return. The larger the production scale, such as is the case with Suluburi, the higher is the gross margin. Gross margin as a percentage of gross revenue ranges from 46 % (Peter) to 71 % for Suluburi. Similarly financial profits as a percentage of gross revenue ranges from 20 % to 61 % for Suluburi with lower number of trips but higher volume of products.

[28] Villagers involved in coral harvest also collect ornamental fishes and other invertebrates, and it is difficult to separate the two activities because of their joint production.

[29] 1999 figure.

What follows next is an exploration of a culture-based villager producing cultured coral equivalent to the number of pieces of coral and ornamental fish collected from the wild. That is, the coral culture model constructed below assumes a production scenario where the villager would produce the same gross income as the villagers engaged in the wild harvest of the joint product, coral, aquarium fish and dead coral. Suluburi's Production Model is also used here as the typical scenario.

4.5.2 Financial Viability of Coral Culture

The 'typical' coral model is constructed using information gathered from discussions with those involved in past and ongoing coral culture in the Marau Sound. Coral farming first started in July 1997 when the owner of AASI, assisted two women from the Marau Sound to culture coral specifically for the aquarium trade. Initially, 12 different species of hard corals and a couple of soft corals were trailed. A coral farming workshop was conducted shortly thereafter in November 1997, with the assistance of Austin Bowden-Kerby under the auspices of ICLARM. The culture technique discussed included a 'new biscuit and tray' method whereby coral fragments were attached to cement disks using fishing line and then tied to wire mesh, allowing for self-attachment rather than the use of expensive glue. Follow-up visits by Bowden-Kerby took place in 1998 and 1999. The twenty-five women trained in the methods in 1997 were financed by AASI and these women managed to have some 30,000 corals under production by early 1998. Eventually, 40 species were under cultivation with an additional 35 under consideration (Paletta, 1998). The main villages at this time involved in coral culturing were Niu Island, Taspa and Naohanua on Tawahi Island; Tavanipupu; and Suhairato on Simeruka Island. Production of cultured coral from the Marau Sound has decreased over time (Table7).

Table 7: Cultured Coral Purchases from the Marau Sound: 2000-2004

Year	Number	Value (SI$)
2000	1299	3897.00
2001	766	4021.50
2002	94	493.50
2003	21	175.25
2004	24	192.00

Box 3: Coral Culture Methods

The culture of hard or soft corals is a simple procedure based on coral fragmentation whereby either nubbins (pruned pieces from tips or middles) of branching parent colony hard corals or pie-sliced segments obtained through parent colony soft coral biopsy are affixed to a base (substrate) using epoxy, string, wire, or mesh or hung from monofilament line suspended in the water column and then grown out until achieving a marketable size, often fist-sized.

Grow-out times for market range from 6-18 months (McLeod, 2001; Lindsay et al, 2003) and are dependent on location, depth and current. Generally, the stronger the current and the greater the depth, the quicker the cycle will be.

Previously when coral culturing was an activity in the Marau Sound, women usually had five trestles with four cages each holding 72 corals each, equating to 1,440 corals (Table 8).

Table 8: Characteristics of Trestle for the Culture of Coral Species

Object	**Measure**	
Length of trestle	4.4 m	
Width of trestle	1.4m	
No of rows in an area of 6.16 sq.m	9	
No of coral pieces per row	8	
No of pieces in 6.16 sq.m rack	72	
No of cages per tressell	4	
No of tressell per farm	5	
No of coral per 'farm' operated by one person	1,440	
Material	**Price SI$**	**No required**
40 kg bag of cement	56	2
Pliers	89	1
Hammer	65	1
Inner tyre tube	10	2
5/8 steel rod-rebar (6 m)	81.65	15
Wire mesh (roll)	385	1
Labour to make tressles	30	2
Price of cultured coral	SI$ 4.02 and SI$ 8.00/piece	weighted average of wild coral; and stated cultured coral price

4.5.2.1 Results

For the base scale of operations – 5 trestles and 1,440 coral pieces - gross margin is about SI$ 1,336. When all costs are considered, financial profit is negative, with villagers expecting to make a loss of SI$ 1,679. That is, at this scale of operation, coral culture is financially just barely viable in the short term. When all costs of operations, including family labour costs, and depreciation, are considered coral farm is financially not viable. The single most important reason is the cost of transport, and the inefficiency in transport modality of 1 trip/month.

4.5.3 Financial Viability at a Larger Production Scale of Coral Farm

If village coral farmers were to double the output to 2,880 (which is close to the current wild production by one of the wild coral harvesters) and used double the number of trestles, the financial viability of cultured coral becomes more attractive (Table 9). This assumes that the two persons who were involved in the wild harvest worked together and produced cultured coral, and they rationalized their visit to Honiara, making only one trip per month or 12 trips/year. They also shared the transport cost of production shared with two other producers and the exporter subsidizes transport cost, at a rate of 30 % of GVP or SI$ 300/trip whichever is lower.

Under such a circumstance, gross margin/person is expected to be about SI$ 8,650/operation or SI$ 4330/person, resulting in an almost 50 % increase in gross margin, primarily because unit transport costs is much lower at this scale. Financial profit is also positive at SI$ 3,340 making coral culture an attractive venture for residents of the Marau Sound.

Table 9: Financial Profitability of Cultured Coral at Different Production Scales and Number 0f Marketing Trips

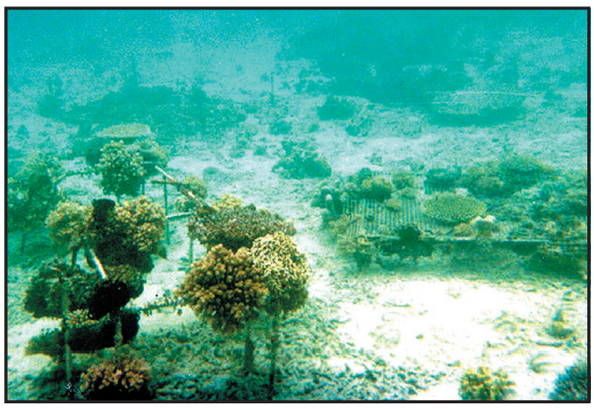
Activity	Culture			
	Basic	Scale1	Scale 2	Scale3
No of pieces	1,440	2,736	2,736	2,880
No of trips	12	16	12	12
No of people	2	2	2	2
Gross revenue ($)	5,783	10,988	10,988	11,566
Weighted average price ($)	4.02	4.02	4.02	4.02
Transport:				
Marau -Honiara-Marau($)	3,945	4,677	2,684	2,510
Depreciation ($)	435	850	850	870
Labour ($)	2,580	4,595	4,355	4,440
Gross margin ($)	1,336	5,916	7,909	8,652
Gross margin per person ($)	668	2,958	3,955	4,326
Financial Profit($)	-1,679	470	2,704	3,341
Financial profit per person ($)	-840	235	1,352	1,671
Gross margin per piece ($)	0.93	2.16	2.89	3.00
Financial profit per piece ($)	-1.17	0.17	0.99	1.16

Note: Basic: 1440 coral pieces and 12 trips; Scale 2: Equivalent to Wild (Suluburi model); Scale 3: Suluburi model with 12 trips; Scale 3: double the Basic with 12 trips

When a 6-month grow-out period is assumed, coral culture becomes financially attractive at all scales (Table 10). Coral culture can also compete with the wild harvest when one considers coral culture as a commercial venture.

Table 10: Financial Profitability of Coral Culture in Marau, Assuming a 6-Month Grow-out Period.

Activity	Wild	Base culture: 6 months	2,736 pieces and 16 trips: 6 months	2,736 pieces and 12 trips	2,880 pieces and 12 trips
Gross margin	7814	7217	16508	18502	19813
Gross margin per person	3907	3608	8254	9251	9907
Financial Profit	6716	2342	7529	9762	10783
Financial profit per person	3358.101	1171	3765	4881	5392



Plates 5 and 6: Remnants of coral farms and 'new' coral farm in the Marau Sound (photos: Kinch, J. 2004).

4.6 Financial Model of Coral Trade from the Nggela Islands

As noted above, the Nggela Island is the main source of coral from the Solomon Islands and SIME is the main exporter. There are approximately 18 suppliers from the Nggela Islands with about a dozen of these situated at Sandfly Island. The production model for Nggela collectors is essentially the same as described above for producers in the Marau Sound, except that collectors in the Nggela Islands, at times stockpile their coral in the area of collection for later retrieval closer to the time of shipment. This is done to lessen incidents of theft and to maintain the quality of coral. Corals removed to the village area tend to lose their color, and thus their quality. Coral once ready for shipment are stacked in open trays or buckets, with each layer of coral separated by banana leaves or cardboard.

Due to the management system used by SIME individual purchasing documents were not available, although it was possible to retrieve a 3-month data window, September-November 2004, of purchasing records from the Nggela Islands (Table 11). Therefore using the following three-month record, annual production estimates were determined for a typical collector.

Table 11: Wild Coral Purchases from the Nggela Islands: September-November 2004

	Sep-04		**Oct-04**		**Nov-04**	
Species	No. of Pieces	Value (SI$)	No. of Pieces	Value (SI$)	No. of Pieces	Value (SI$)
Soft Coral	1,118	5,988	814	1,684	804	1,691
Hard Coral	4,798	8,933	3,758	8,012	4,041	8,242
Total	**5,916**	**14,921**	**4,572**	**9,696**	**4,845**	**9,932**

Source: SIME.(figures are rounded off to nearest dollar)

During this period, 11 men from Sandfly in Nggela Island sold coral, with most making at least one trip/month. SIME has now instituted a rotational buying system because of the number of suppliers (there are no formal contracts or agreements, and recently SIME dropped the numbers of suppliers) whereby; suppliers are given an order to fill and a date to return. Some suppliers do specialize in specific corals and invertebrates. Thus the following scenario is assumed for the financial model:

- Each collector makes 12 trips/year;
- Each person spends equivalent of three days/trip – 1 day for harvest, 1 day for transport and 1 day is spent waiting to be paid by SIME;
- Collectors use dugout canoes for collecting; 25 % of the cost of the canoe is attributed to the aquarium trade, with the rest of the time used for other purposes, including subsistence fishing;
- Each collector collects 5,037 pieces of corals and invertebrates a year;
- Average weighted price received by collectors in 2004 was $1.998/piece. In addition, SI$ 4.02/ piece is also used – price the villagers could expect to receive if they sold their products in Honiara to AASI. In this study, the weighted average price of $1.998 is used;
- Each collector shares the cost of hiring motorized boat with two other collectors; the cost of canoe hire, including fuel, is SI$ 1,060/ trip and there is no fuel subsidy; and
- Collectors hire a taxi once in Honiara to transport the coral from the shore to the SIME warehouse.

4.6.1 Results

Wild harvest of coral is financially attractive for Nggela Islands' collectors, with each collector expecting to earn SI$ 6,580/year in gross margin and a financial profit of SI$ 5,362/year. Transport is the single largest cost, despite the closeness of the Nggela Islands to Honiara, even when three persons share the cost of hiring the motorized boat. It is still almost a third of the value of coral harvested (Table 12).

Table 12: Financial Viability of Coral Harvest from Nggela Waters under Two Price Scenarios

Activity	Wild	Wild Scenario 2
No of trips per year	12	12
No of pieces per year	5,037	5,037
Weighted Price	2.00	3.59
Depreciation	138	138
Gross revenue	10,060	18,084
Transport cost per year	3,480	3,480
Labour costs	1,080	1,080
Gross margin	6,580	14,604
Financial profit	5,362	13,386
Gross Margin per person	6,580	14,604
Financial Profit per person	5,362	13,386
Gross margin per piece	1.31	2.90
Financial profit per piece	1.06	2.66

4.7 Financial Viability of Coral Culture from the Nggela Islands

In the Nggela Islands, two men previously were involved in coral culture, although only one of them produced cultured coral regularly (Table 13). Recently he, too, had stopped for reasons not known, although he recommenced coral farming earlier this year. Coral culture supplements his income with the harvest of invertebrates from the wild as the main source of income.

Table 13: Cultured Corals Purchases from Walter: 2002-2004

Species	2002		2003		2004 (Jan-Nov)	
	No. of Pieces	Value (SI$)	No. of Pieces	Value (SI$)	No. of Pieces	Value (SI$)
Cultured (Hard)	186	1,395	475	3,561	63	506
Cultured (Soft)			45	285	485	3,180
Total culture based activity	186	1,395	520	3,848	548	3,695
Collection of invertebrates		4,961		1,774		4,180

Source: AASI.

For the financial analysis of cultured coral, the base production model promoted in the Marau Sound is used. Four different scenarios are examined, assuming a 12-month grow-out period. In scenario 1, the base culture where the culture of 1,440 pieces of coral using 5 trestles and current weighted average price of SI$ 1.998/piece are assumed. Second scenario is used where the same number of coral is produced but the price received is SI$ 4.02/piece, the average price paid by AASI exporter. In scenario 3, the scale of production is increased to reflect the number of pieces of coral each operator currently harvests in the wild, but at the two different prices, SI$ 1.998 and SI$ 4.02/piece.

Under the Base scenario, coral farming is financially not viable, either in the short run (gross margin criteria) or long run (financial net profit), as both these measures are negative. Only when at the higher AASI price (Scenerio 1), or when production levels increase (Scenerio 2 and 3) does the coral culture become financially viable (Table 14).

Table 14: Financial Gross Margin and Financial Net Profit of Cultured Coral under Different Scenarios

Activity	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Price of cultured Coral	1.997076	4.02	1.997076	4.02
Number of coral	1,440	1,440	5,037	5,037
Gross Value of Coral	2,876	5,774	10,059	20,198
Fixed cost depreciation	435	435	1,522	1,522
Annual material cost	305	305	1,067	1,067
Annual labour cost	1,860	1,860	6,506	6,506
Transport to Honiara	3,480	3,480	3,480	3,480
Gross margin	-909	1,989	5,512	15,652
Financial profit	-4,067	-306	-2516	7,623
Gross margin per piece	-0.6314	1.381528	1.094383	3.107307
Financial profit per piece	-2.82437	-0.21233	-0.49947	1.513453

Note: Base culture = scale where 1440 pieces are cultured and Price = $1.997; Scenario 2: 1440 pieces but AASI price of $4.02/piece; Scenario 3 is 5037 pieces and $1.997/piece; Scenario 4 = 5037 pieces and $4.02/piece

If the scale of production were increased to that produced in the wild – that is 5,037 pieces were produced - but still with only 12 marketing trips per year, financial performance of coral culture is highly attractive. Coral farmers can expect to make SI$ 5,500 in gross margin. However, even at this scale, the financial net profit is negative. Only when at the larger scale and higher price that both gross margin and financial net profit are positive. On the other hand, if villagers produced 1,440 pieces of coral as has been promoted by Non-government Organisations (NGOs), but cultured coral fetched SI$ 8/piece (the buying price for cultured corals at AASI), then gross margin and net financial profits are highly attractive. It compares with the situation when the scale of production was 5,037 and AASI weighted average price for wild products of SI$ 4.02 were assumed.

Similarly, even if a six month grow-out period is assumed, and at average SIME price, gross margin is positive for the base scenario, although the net financial profit is still negative. Only at higher price of SI$ 4.02 that both gross margin and financial profits become positive when 6 month grow-out is assumed (Table 15).

Table 15: Financial Net Returns for Nggela Typical Culture Producers at 12 Month Grow-out and 6-Month Grow-out

Activity	No of pieces per year	SIME price = SI$ 1.998		AASI price = SI$ 4.02	
		Gross margin	Financial profit	Gross margin	Financial profit
Wild - SIME price	5,073	6,580	5,362	14,604	13,386
Base culture -12 month	1,440	-909	-4,067	1,662	-306
Base culture -6 month	2,840	1,662	-2,494	7,459	3,304
Large scale-12 month	5,073	5,512	-2,516	15,652	7,623
Large scale - 6 month	10,146	14,505	-30	34,783	20,249

4.8 Comparison of Financial Viability of Wild and Cultured Coral

For Nggela Islands' residents, financial returns (gross margin) on cultured products cannot compete with the wild harvest, if the grow-out period is 12 months and the sole exporter pays the same weighted average price as for the wild.

Only at a higher scale of production does the culture of slow growing coral species becomes viable at least in the short term. However, for species of coral that can be harvested in 6 months, coral culture is financially viable in the short and longer term. If growers 'planted' the same number of pieces of coral as they harvested from the wild, and harvested cultured coral in 6 months, growers

can expect to receive a financial profit of $20,000. This is greater than what they would have earned from the wild.
Coral culture can thus compare with wild harvest based fishery when a higher scale operation is adopted, operators keep the number of marketing trips to at least one a month, transport costs are shared with other villagers and the higher price paid by AASI is received.

5. Industry Net Benefits

Total industry gross revenue earned from the export of live and dead coral, other aquarium products and cultured coral is approximately SI$ 5.0 million/year. Industry financial profit is SI$ 1.6 million/year or 32 % of the FOB value. This analysis of profitability of exporters is based on information obtained from AASI and SIME about their operating costs, management fees charged by AASI of SIME to handle their products, and the FOB price of SI $22 (or US $3)/piece. Operating costs associated with running the warehouse – in wages, electricity, water, communication and rent – for the two exporters is about SI$ 1 million/year (Table 16). Importers pay for freight and associated costs.

Table 16: Warehouse Operating Costs for the Two Live Aquarium Organisms Exporters

Commodity	AASI Costs	SIME Costs
Wages	32,000	16,000
Electricity	4,000	1,500
Water	1,000	500
Communications	8,000	1,500
Rent	13,000	4,000
Total monthly	58,000	23,000
Total Annual	696,000	276,000

Exporters on the other hand, pay for packing, transport to the airport and custom documentation, which is assumed to be 25 % of the FOB value of coral products. This is the fee that AASI charges SIME for packing, handling, transport and documentations, etc.
The payment to villagers is estimated to be SI$ 639,000/year or 13 % of the GVP. Deducting these 'costs', the net financial profit earned by exporters is SI$ 1.8 million/year (Table 17). Compared with village collectors, exporters in the Solomon Islanders make a reasonable level of profit from the aquarium trade.

Table 17: Exporter Profitability in the Solomon Islands Aquarium Trade

Activity	FOB Value (SI$)
Gross value of coral, dead coral and others	5,046,752
Operating cost for the industry	972,000
Management Cost (includes documentation, handling, transport to airport, etc.)	1,261,688
Export levy @ 10% of declared value	504,675
Payment to villagers	687,159
Net financial profit of exporter	1,794.776
Exporters' financial profit as a percentage of GVP	33

6. Discussion

The aquarium trade based on either wild or cultured products in the Solomon Islands is financially a profitable venture for the exporters, but not as much for the village collectors. The total exporter's gross profit, considering all costs, including 'normal' returns to management, is estimated at SI$ 1.8 million/year or 33 % of the GVP. On the other hand, a typical operator harvesting coral products from the wild can expect to receive a profit of about 7-8 % of the GVP of the coral products they harvest.

Individual operations in the Nggela Islands and the Marau Sound earn approximately similar gross margin and financial profits, despite the differences in prices paid by the two exporters (Table 18). Nggela Islands' villagers compensate for their lower unit price they receive from SIME, as compared to what Marau Sound residents receive from AASI, by harvesting more coral and other products.

Table 18: Financial Return per Typical Operator from the Marau Sound and the Nggela Islands

Activity	Marau	Nggela
Number of coral and other products harvested from the wild	2736	5073
Price of coral equivalent	4.01	2.00
Gross revenue	10,988	10,060
Gross margin	7,814	6,580
Financial Profit	6,716	5,362
Gross margin as % of GVP	9.0%	8.3%
Financial Profit as % of GVP	7.7%	6.7%

There are two main reasons for the low returns to villagers: the price they receive from the exporters and the transportation cost. The price paid by exporters is low when compared with the FOB prices received by the exporters. For suppliers of SIME, the weighted average price paid is SI$ 1.998 or 9 % of the FOB price. On the other hand, AASI suppliers receive 18 % of the FOB. Marau Sound collectors not only receive a higher price, they also enjoy the benefit of the fuel subsidy.

If the concern is one of environmental effects of the harvest of coral products from the wild, particularly from Nggela Islands' waters, it is possible for villages to reduce the volume of coral products they harvest from the wild without reducing their income. To do this they would have to demand a higher price from SIME. Based on the available information, there appears to be sufficient margin to accommodate such a price increase. A second alternative could be coral culture, only if strict conditions are satisfied.

Coral culture is financially a viable option for Nggela Islands' residents if a reasonable scale of operation is adopted, and the villagers are paid a price equivalent to at least what is paid by AASI. It is also a viable option if fast growing species are grown and villagers share the cost of hiring motorised boats to bring their products to Honiara. However, at the small scale promoted by NGOs and slow growing species – 12 month grow-out period – is cultured, gross margin is positive but only just. Financial profits are negative. Only when the number of coral grown is almost doubled, fast growing species of coral are cultured and the number of marketing trips is limited to 12 or less, can Nggela Island's residents expect to get positive gross margin and positive net financial profits.

For Marau Sound residents, they can compete with wild harvest, in the short run if they coral culture at base scale and with AASI prices. The gross margin of the two activities are similar, assuming the same number of products are produced in a year and 12 marketing trips are made. However, if one considered financial profits, cultured products can compete in the short run if fast growing species are grown.

When coral culture is considered as a commercial venture, and all costs are considered, including the opportunity cost of labour and depreciation costs, coral culture at low scale of operations cannot compete with wild harvest.

These results contrast with the findings of Pomeroy et al (in press), which concluded, that based on a more high tech production technique compared with the technology adopted in Fiji and the Solomon Islands, that coral culture is not a viable option for the Pacific without subsidisation from governments or donors. For Fiji however, Lal and Cerelala (2005) have found that coral culture is indeed financially viable, even at low scale of operations, although it cannot compete with the wild fishery unless cultured coral fetched higher prices. Lal and Cerelala (2005) also noted that even if higher prices were received, coral culture is only viable if feasibility factors – such as regular work ethics, regularity of supply and maintenance of quality are also maintained.

These results suggest that even though coral farming is technical feasible, financial viability of coral culture will depend on not only local ecological conditions and the growth rate of the species but also on the production technology, the scale of production and the local market conditions. Local transportation and other costs, condition of local infrastructure, availability of air cargo space and regular air flights are all key determinants of commercial viability of mariculture of coral products for aquarium trade.

Without consideration of these factors coral culture in the Solomon Islands will not be a viable alternative to wild harvest.

REFERENCES CITED

Amblard. 2004. Amblard Overseas Trading S.A. *New Venture: Culture Corals-Lombok Frags*. Paper prepared for Amblard Overseas Trading S.A., Mazamet, France.

Armstrong, J. and Crawford, J. 1997. Convention on International Trade in Endangered Species of Wild Flora and Fauna. In Hartziolis, M.; Hooten, A. and Fodor, M. (eds.). *Coral Reefs: Challenges and Opportunities for Sustainable Management*. Washington, D.C.: World Bank.

Babcock, R.; Bull, G.; Harrison, P.; Heyward, A.; Oliver, J.; Wallace, C. and Willis, B. 1986. Synchronous Spawnings of 105 Scleracterian Coral Species on the Great Barrier Reef. *Marine Biology*. 90: 379-394.

Biliki, M. 2002. Solomon Islands Aquarium Industry. In Power, M. and Fisk, D. (eds.). *Sustainable Management of the Marine Aquarium Trade*. Pacific Regional Workshop Proceedings, 4-8 Feb, 2001, Nadi, Fiji. Pp: 35-41. Apia: SPREP.

Boutilier, J. 1975. Solomons' Reefs may be a Vast Laboratory for the Experts. *Pacific Islands Monthly*. 46 (8): 65-67.

Bruckner, A. 2001. Tracking the Trade in Ornamental Coral Reef Organisms: The Importance of CITES and its Limitations. *Aquarium Sciences and Conservation*. 3 (1-3): 79-94.

Bruckner, A. 2002. Trends in International Trade in Stony Corals: A Synopsis of CITES Data. In Bruckner, A. (ed). *Proceedings of the International Workshop on the Trade in Stony Corals: Development of Sustainable Management Guidelines*. Pp:56-57. Silver Spring: NOAA.

Bryant, D.; Burke, L.; McManus, J. and Spalding, M. 1998. *Reefs at Risk: A Map-based Indicator of Threats to the World's Coral Reefs*. Washington, D.C.: World Research Institute.

CITES. 2002. *Coral Production Systems: Report of the Coral Working Group*. Paper prepared for the 18th Meeting of the CITES Animals Committee, San Jose, Costa Rica.

Connell, J.; Hughes, T. and Wallace, G. 1997. A 30-Year Study of Coral Abundance, Recruitment, and Disturbance at Several Scales in Space and Time. *Ecological Monographs*. 67 (4): 461-488.

Dawson-Sheppard, A. 1992. An Analysis of Fish Community Responses to Coral Mining in the Maldives. *Environmental Biology of Fishes*. 33:367-380.

Dulvy, N.; Stanwell-Smith, D.; Darwall, W. and Horill, C. 1995. Coral Mining at Mafia Island, Tanzania: A Management Dilemma. *Ambio*. 24: 358-365.

Harriott, V. 1999. Coral Growth in Subtropical Eastern Australia. *Coral Reefs*. 18: 281–291.

Harrison, P. and Wallace, C. 1990. Reproduction, Dispersal, and Recruitment of Scleractinian Corals. In Dubinsky, Z. (ed). *Ecosystems of the World: Coral Reefs*. Pp: 133-207. Amsterdam: Elsevier.

Jennings, S. and Polunin, N. 1996. Impacts of Fishing on Tropical Reef Ecosystems. *Ambio*. 25: 44-49.

Karlson, R. and Hurd, L. 1993. Disturbance, Coral Reef Communities, and Changing Ecological Paradigms. *Coral Reefs*. 12: 117-125.

Kinch, J. 2004a. T*he Marine Aquarium Trade in the Solomon Islands, with Specific Notes on Marau Sound, Guadalcanal*. A Report prepared for the Marine Aquarium Council and the Foundation of the Peoples of the South Pacific-International, Suva, Fiji.

Kinch, J. 2004b. *The Marine Aquarium Trade in the Western Province, the Solomons Islands*. A Report prepared for the Marine Aquarium Council and the Foundation of the Peoples of the South Pacific-International, Suva, Fiji.

Lal, P. and Cerala, A. 2005. *Financial and Economic Analysis of Wild Harvest and Cultured Live Coral and Live Rock in Fiji*. A Report prepared for the Foundation of the People of the South Pacific International, Suva, Fiji; and the South Pacific Regional Environment Programs, Apia, Samoa.

Leqata, J. 2004. *Solomon Islands Country Report*. Paper prepared for the Seminar on Fisheries Development and Environment, 6/01-21/02, Yokohama City, Japan.

Lindsay, S.; Ledua, E. and Stanley, J. 2003. *Regional Assessment of the Commercial Viability for Marine Ornamental*

Mariculture within the Pacific Islands (Giant Clams, Hard and Soft Corals, Finfish, Live Rock and Marine Shrimp). Noumea: Secretariat of the Pacific Community, Noumea, New Caledonia.

Lovell, E. 2001. *Status Report: Collection of Coral and Other Benthic Reef Organisms for the Marine Aquarium Trade in Fiji*. Suva: WWF.

Mackey, E.C. 1988. *Socio-Economic Survey of Smallholder Farming Systems in Solomon Islands, Marau Sound, Guadalcanal Province*. Honiara: Ministry of Agriculture and Lands.

McClanahan, T. 1995. A Coral Reef Ecosystem-fisheries Model: Impacts of Fishing Intensity and Catch Selection on Reef Structure and Processes. *Ecological Modeling*. 80: 1-19.

McLeod, T. 2001. *Tivua Aquafarms*. General Report, July 2001. Lautoka: Pacific Aquafarms.

Paletta, M. 1998. Coral Farming. *Seascope*. Spring Volume: 1-2.

Parks, J.; Pomeroy, R. and Balboa, C. 2003. The Economics of Live Rock and Live Coral Mariculture. In Cato, J. and Brown, C. (eds). *Marine Ornamental Species: Collection, Culture and Conservation*. Pp: 185-208. Iowa University Press.

Pomeroy, R.; Parks, J. and Balboa, C. 2002. *Farming the Reef: Is Mariculture a Solution for Reducing Fishing Pressure on Coral Reefs?* Revised Internal Review Draft Report, 31st October 2002. Washington, DC.: World Resources Institute.

Pomeroy, R.; Parks, H. and Balboa, C. in press. Farming the Reef: Is Mariculture a Solution for Reducing Fishing Pressure on Coral Reefs? *Marine Policy*.

Ramohia P. 2002. A Brief Country Report: Status of Trade in Stony Coral in the Solomon Islands. In Bruckner, A. (ed). *Proceedings of the International Workshop on the Trade in Stony Corals: Development of Sustainable Management Guidelines*. Pp: 83-86. Silver Spring: NOAA.

Sousa, W. 1984. The Role of Disturbance in Natural Communities. *Annual Review Ecological Systems*. 15: 353-391

SPREP. 1994. *Environmental Guidelines for Reef Coral Harvesting Operations*. Apia: SPREP.

Sulu, R. 2002. *Status of the Solomon Islands' Coral Reefs: 2002*. Draft Report prepared for the Global Coral Reef Monitoring Network, Townsville, Queensland, Australia.

Sulu, R.; Hay, C.; Ramohia, R. and Lam, M. 2000. S*tatus of the Solomon Islands' Coral Reefs: 2000*. Report prepared for the Global Coral Reef Monitoring Network, Townsville, Queensland, Australia.

The Nature Conservancy. 2004. S*olomon Islands Marine Assessment: Key Findings*. Paper prepared by The Nature Conservancy, Honiara, Solomon Islands.

United Nations. 2002. *United Nations Development Assistance Framework (2003-2007): Solomon Islands*. Suva: United Nations.

Wabnitz, C.; Taylor, M.; Green, E. and Razak, T. 2003. *From Ocean to Aquaria: The Global Trade in Ornamental Species*. Cambridge: UNEP/WCMC.

Wairiu, M. and Lam, M. 2003. *Marau Communities Association From War to Peace: Towards Reconstruction and Resuscitation of Biodiversity for a Vulnerable Society*. Paper Presented at the 1st Regional Session of the Global Biodiversity Forum for the Pacific, 4-5th July 2002, Rarotonga, Cook Islands.

Wells, S. and Barzdo, J. 1991. International Trade in Marine Species: Is CITES a Useful Control Mechanism. *Coastal Management*. 19: 135-154.

Wells, S.; Holthus, P. and Maragos, J. 1994. *Environmental Guidelines for Coral Harvesting Operations*. SPREP Reports and Studies, No.: 75. Apia: SPREP.

Wilkinson, C. 1999. Global and Local Threats to Coral Reef Functioning and Existence: Review and Predictions. *Marine and Freshwater Research*. 50: 867.78.

Wood, E. 2001. *Collection of Coral Reef Fish for Aquaria: Global Trade, Conservation Issues and Management Strategies*. Washington, DC.: Marine Conservation Society.

Report Layout and Design: Isabel Fox