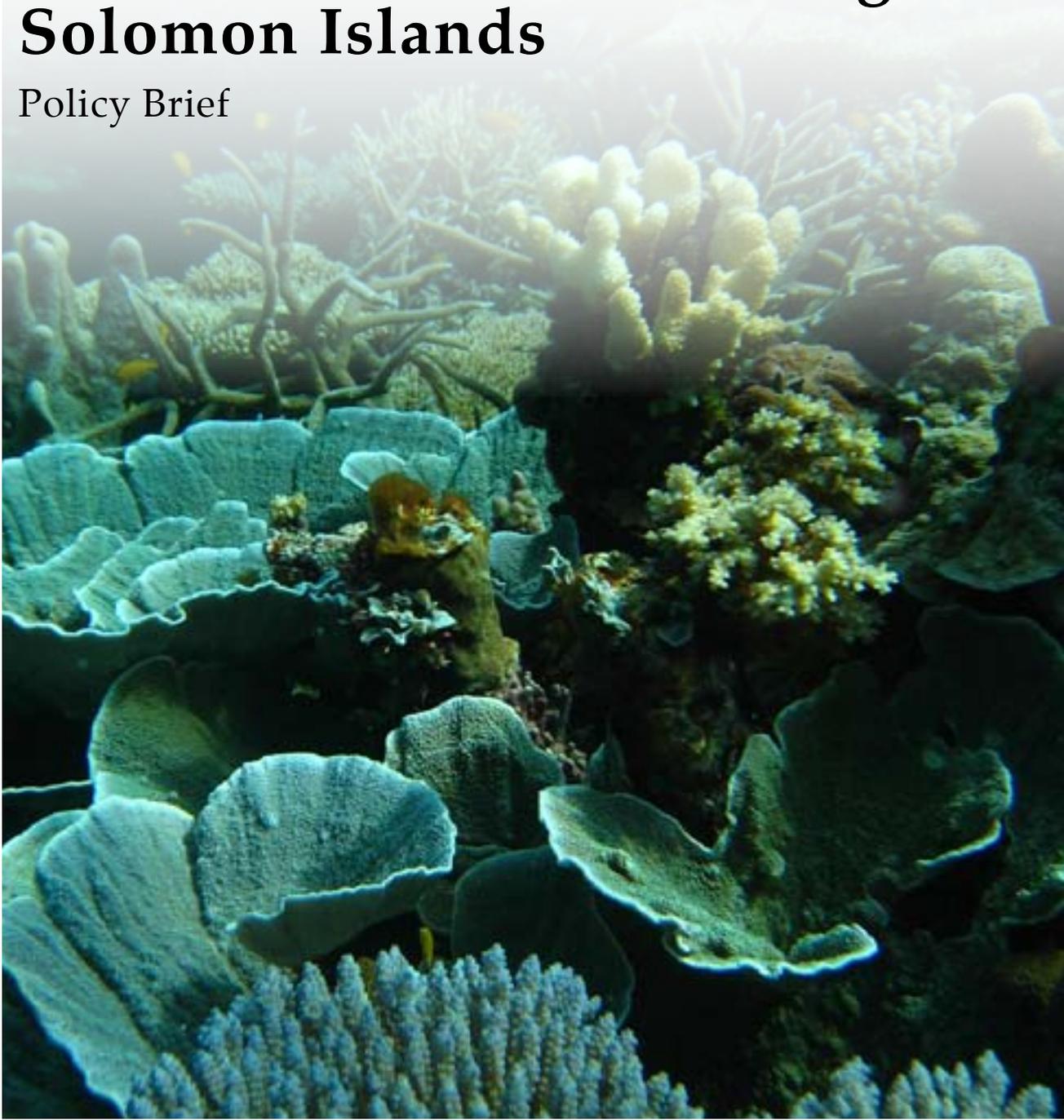


Making a difference in the lives of the poor Making a difference in the lives of the poor

Coral reef economic value and incentives for coral farming in Solomon Islands

Policy Brief



RESEARCH
PROGRAM ON
Aquatic
Agricultural
Systems

MAJOR FINDINGS FROM FOUR COASTAL SOLOMON ISLAND COMMUNITIES

- Fish, clam, seaweed, trochus, crayfish and shells were the highest ranking (most important) reef derived goods collected for consumption and cash purposes across all study sites.
- Food goods were ranked as equally important for subsistence and cash at 'non-coral trade' communities, while the 'coral trade' communities showed a diversity of reef-derived cash sources, including construction materials (sand, rubble and stone) and trade goods.
- Fish was the highest ranked reef good collected, both for food and cash needs and accounted for 23 – 38% of the total direct use economic value at the two 'non-coral trade' communities and 11 – 17% at the two 'coral trade' communities.
- Aquarium and curio trade represented <3% of the direct economic value of the reef within the two 'coral trade' communities and involved less than 7% of the people in these communities.
- Coral is an important source of lime for the national betel nut coral lime trade contributing up to 19% of the total direct value of goods extracted from reefs. In one of the coral trade villages, the economic value of coral lime was equivalent to the economic value of reef fish.
- Based on the case study communities, coral reefs provide an estimated direct use value of SBD\$580,000 to \$1.3 million (US \$ 75,000 - \$170,000) per km² reef per year (for subsistence and cash). Food and trade goods contribute the greatest amount to this figure, although construction materials are also important.
- Indirect use value of coral reefs, using replacement value of shoreline protection as a proxy has an estimated value of SBD \$936 per km shoreline, resulting in a total value of SBD \$140,000 to \$2.1 million (US \$18,000 - \$270,000) per km² reef per year across the case study communities.
- The non-use value of Solomon Island reefs, estimated from respondents willingness to contribute time, money and/or food to the maintenance of coral reef health, ranged from SBD \$10,000 - \$60,000 (US \$1,200 - \$7,700) per km² reef per year.
- The total economic value (TEV) of case study coral reefs was estimated at SBD \$800,000 to \$3.3 million (US \$100,000 to \$420,000) per km² reef per year in direct, indirect (through coastal protection) and non-use value.
- Coral-destructive extraction of goods (coral for aquarium, lime, curio and collection of sand, stone and rubble) contributed 8 – 22% of the TEV at the coral trade communities and less than 5% of the TEV at the non-coral trade communities.
- The majority of coral harvesters (81%) at the coral trade communities were willing to change practice from wild harvest to farming corals if they received training, knowledge and a price incentive to farm corals.



BACKGROUND

Coral reefs are some of the most diverse ecosystems in the world supporting valuable ecosystem goods including fish, shells, coral and other marine products and services such as fisheries habitat, tourism and coastal protection. Solomon Islands is part of the 'coral triangle' (Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor Leste) an area of global significance as it is the epicentre for marine biodiversity supporting abundant seagrass, mangroves, coral and reef fish. Solomon Islands supports a population of ~570 000 people with the majority of people (80%) living in rural coastal communities. These communities rely heavily on the resources that coral reefs provide for their daily subsistence and cash needs. Solomon Islands' reefs, like those of many other countries, are under pressure from a combination of natural and human induced impacts such as climate change and an increasing population. There is particular concern around direct extraction of corals for a growing international aquarium (live coral) and curio (dead coral) trade, as well as a local demand for lime (made from live coral) which is consumed while chewing betel nut.

Sustainable harvesting and farming of corals is possible, yet the majority (>95%) of the collection of corals in Solomon Islands is based on wild-harvest, ie from non-farmed populations. The wild harvest of coral for the aquarium, curio and lime trades results in the removal of specific coral types which, if over harvested, can cause degradation and destruction of reef habitat, further reducing ecosystem resilience. Negative socio-economic effects can be expected for communities dependent on affected reef ecosystems for food and/or cash. In rural communities of Solomon Islands there is often limited awareness of the long term consequences of coral extraction activities. Ongoing unsustainable extraction of corals today will contribute to increased vulnerability and reduce the ability of the people of Solomon Islands to reap the benefits of coral reefs into the future.

To be able to make better informed management decisions, the Solomon Islands Government, and ultimately the communities that dependent on coral reefs need an understanding of the total value of the goods and services that their reefs provide.



This research project, "*Economic valuation of coral reefs and development of sustainable financing options in the Solomon Islands*" was designed to assess the economic value of coral reefs using the aquarium and curio coral trades as an entry point. Two communities were selected from Central Islands Province, representative of areas with a known history of wild coral harvest for the aquarium and curio trade (referred to collectively in this report as 'coral trade' communities) and two from Western Province, representative of those with no known wild coral harvest (referred to as 'non-coral trade' communities). All four communities harvested live coral for the production of lime.

This project was funded by the Australian Government as part of its support program to the Coral Triangle Initiative and implemented by the WorldFish Center-Solomon Islands in partnership with the Asian Development Bank Knowledge Management Project, the Ministry of Fisheries and Marine Resources (MFMR) and the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) through the Coral Triangle Initiative (CTI) National Co-ordinating Committee.

SOLOMON ISLAND CORAL TRADES

Aquarium and Curio Trades

The coral aquarium trade began in Solomon Islands in the early 1990's. It involves the extraction of live corals from a reef before packaging and transporting them live, internationally by air, in sealed insulated boxes. These corals end up in domestic or commercial aquaria throughout the world.

The curio trade (locally referred to as the dead coral trade) began in 1984, before it was stopped by the Government in 1994 and re-opened again in 2003. The curio trade involves the harvest of live corals (primarily *Acropora* sp.) from the reef (from small (< 25cm diameter) to large coral pieces (> 80cm diameter)) which after harvest, are placed on land in the sun to 'die' and bleach white. The corals are then sent to exporters in Honiara prior to being shipped in containers to overseas buyers, often ending up as decorations in large hotels.

There are currently three exporters in Solomon Islands holding valid licences to export corals (2 for the curio trade and 1 for the aquarium trade). Corals are listed under Appendix II of CITES (of which Solomon Islands is signatory), with export and trade being permissible under the premise that the scientific authority of the state advises that the export is not detrimental to the survival of the species in the wild and that the specimens are not obtained illegally. Currently export permits (through MFMR) are allocated on a yearly basis to exporters; permits do not differentiate between farmed and wild harvest corals. CITES permits are maintained by MECDM and are required for each coral shipment. In Solomon Islands the export of corals is currently regulated using a quota approach, which is a recognised approach for placing limits on export. Despite these quotas, little information has been collected on the sustainability of coral harvesting for the aquarium and curio trades.

Betel Nut Lime Trade

Betel nut chewing is a cultural norm that has existed for thousands of years and is still an important custom in Solomon Islands. An important component of chewing betel nut is the addition of lime as calcium hydroxide powder, usually made from live corals



Coral being processed to make betel nut lime

(although other sources of lime can be used e.g. shells). To produce betel nut lime, live healthy coral (*Acropora* sp.) is collected from the reef and burnt on a strong hot fire, the remaining coral (calcium oxide) is hydrated to form calcium hydroxide (betel nut lime). Betel nut lime is usually stored in the household kitchen (to keep it dry) in the village, prior to being packaged in small containers and sold at local markets throughout the country. Betel nut lime is not exported, therefore MFMR does not keep a record of production of this commodity. Under the Fisheries Act (1998) 'the collection of coral for the sole purpose of producing traditional lime for the consumption with betel nut' is allowed.

Construction Materials

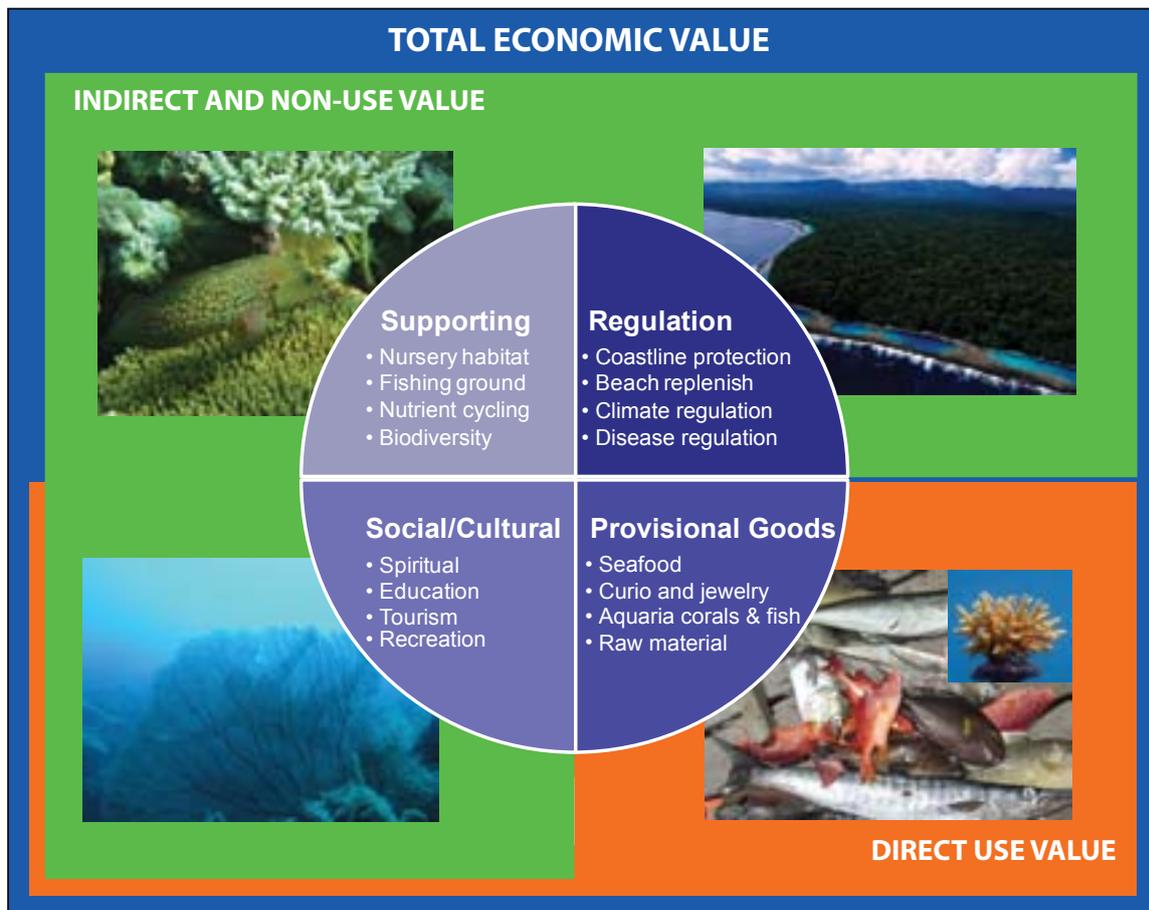
Coral sand, coral rubble (gravel) and coral stone (live and/or dead coral) collected from reefs have traditionally provided an important, regular source of building and construction materials for homes in rural communities. An increasing demand for construction materials for commercial purposes however is resulting in communities removing high volumes of coral (in the form of sand, stone or rubble) at one time and selling it cheaply for quick, but low, economic returns.



Coral collected from the reefs to be used for construction

BOX 1. TOTAL ECONOMIC VALUE

A suite of terms have been derived to describe the values that coral reef ecosystems provide. Coral reefs provide a range of goods (provisional goods) and services (regulating, supporting and social/cultural). Ecosystem goods (including provisional goods and tourism) have a direct use economic value. *Direct use value* describes the value acquired from any reef resource that is directly used (such as fish or construction materials), and includes extractive (e.g. fish, shells) and non-extractive (e.g. tourism) uses. Ecosystem services (supporting, regulating and social/cultural) have an indirect and non-use value. *Indirect* and *non-use values* generally relate to the ecological functions performed by coral reefs and include services such as shoreline protection and climate regulation respectively. The total economic value (TEV) of a coral reef is the sum of direct, indirect and non-use values (see figure below). In this study direct use value was calculated from national statistics and data collected from key informant interviews. Indirect use value was calculated from literature values using the cost of providing artificial coastal protection as a proxy. ‘Willingness to pay’ was used to derive non-use value through a process which “creates an artificial market” for ecosystem services. To determine willingness to pay, we identified whether an individual was familiar with, or assigned some importance to, ecosystem services. If so, they were then asked what they would be ‘willing to pay’ to keep coral reefs ‘healthy’ for future generations.



ECONOMIC VALUE OF CORAL REEF GOODS AND SERVICES

Interviews with coral reef users showed a strong reliance of the four case-study communities on a range of coral reef resources. Based on the relative ranking of direct goods, the main reef-derived food goods across all study communities were fish, clams, seaweed, trochus, crayfish and shells (mainly spider conch (*Lambis lambis*) and stromb shells (*Strombus sp.*). In the ‘coral trade’ communities there was greater importance placed on the value of construction materials for personal use and for sale (sand, rubble and stone), and other traded goods including clam shell, shark fin and corals, compared to the non-coral trade communities. All corals harvested for curio and aquaria are sold for cash. In all study communities, coral lime was considered important for both personal use and for cash.

Community-derived economic data showed that coral reefs provided on average SBD \$18,000 to SBD\$75,000 (UD \$ 2,300 to \$6,600) per respondent per year (or SBD \$580,000 to \$1.3 million per km² reef per year) in direct use value. Over all sites food was the greatest contributor to the direct use value, with fish considered the most important reef good harvested - accounting for 23 – 39% of the total direct use value at the two ‘non-coral trade’ harvest communities and 10 – 18% at the two ‘coral trade’ communities. At the two coral-trade communities trade goods provided an equally important contribution to the food value although interviews highlighted that most trade goods - including aquarium coral, curio coral, clam shell and shark fin - generate a high income, but for only a few people.

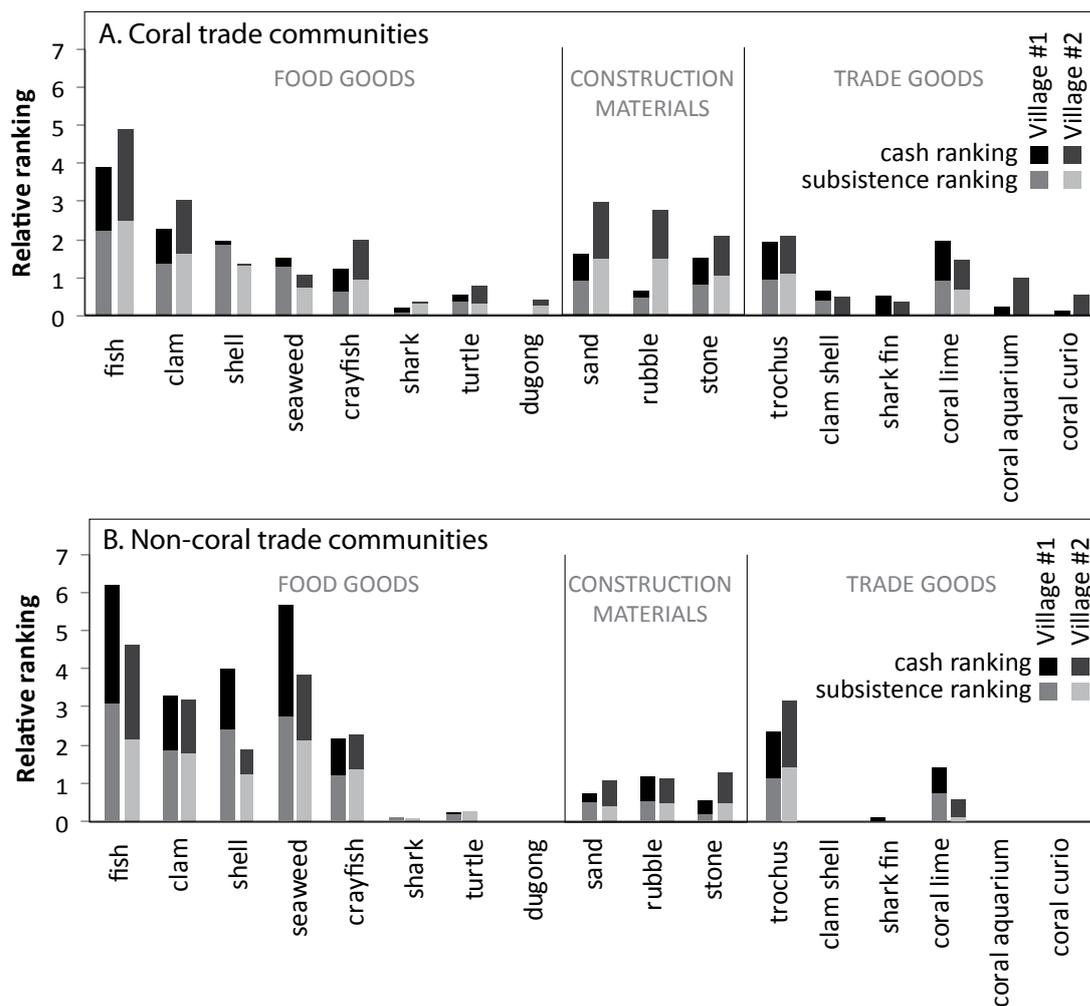


Figure 1. Relative ranking (importance) of direct use of reef goods for food (subsistence) and cash across: A) the two ‘coral trade’ communities, and B) the two ‘non-coral trade’ communities.

Indirect use values were estimated using the replacement cost of shoreline protection as a proxy. Based on data from a study in the Marshall Islands to build a protective seawall (with a lifetime of 25 years), replacement cost is estimated to be SBD \$936 per km of shoreline per year. Using the length of shoreline needing protection (ie where the villages are located) and the cost per km for replacement, the indirect use value of the reefs of the study communities ranged from SBD \$140,000 to \$2.1 million (US \$18,000 to \$270,000) per km² reef per year.

The non-use value of the study reefs was estimated from respondents willingness to contribute time, money and/or food to the maintenance of coral reef health. Willingness to pay was surprising high across the study communities given the limited options to earn cash in rural Solomon communities. 50 – 80% of respondents stated that they would be willing to contribute time, 23 – 70% were willing to contribute money and 25 - 90% were willing to contribute food to assist the cause. The non-use value was calculated from the number of days respondents were willing to contribute and the legal minimum wage rates for the Agriculture and Fisheries Sector (SBD \$3.20/hour or \$25.60/day, resulting in a non-use value ranging from SBD \$10,000 to \$60,000 (US \$1,200 to \$7,700) per km² reef per year across the study sites.

The total economic value (TEV) of the case study reefs in Solomon Islands indicates that coral reefs provide an estimated SBD \$800,000 to \$3.3 million (US \$100,000 to \$420,000) per km² reef per year in direct, indirect (through coastal protection) and non-use value. Direct and indirect use values were the greatest components of the TEV.



Seaweed (*Caulerpa sp*) for sale in local market

The direct value of coral-destructive activities (ie extraction of coral for lime, aquarium and curio, as well as sand, stone and rubble) was separated out from non-destructive activities (table below). Coral-destructive extraction of goods comprised 9 – 21% of the TEV of reefs at the coral trade communities but less than 5% of the TEV at the non-coral trade communities.

The contribution of coral destructive activities to the TEV as the two coral-trade communities was more than double the value at the non-coral trade communities. This indicates that the coral trade communities are deriving a higher economic value from activities that result in damage to coral. If harvesting reaches unsustainable levels, it is likely that there will be a decline in fisheries and other economic aspects that rely upon a healthy reef system.

Table 1 Total Economic Value (TEV) for the four case-study communities based on reef area (SBD per km² per year)

	Coral trade communities		Non-coral trade communities	
	Community 1	Community 2	Community 1	Community 2
Direct Use Value	\$ 1,300,868	\$ 827,623	\$ 583,906	\$ 1,149,607
<i>Non-destructive</i>	\$ 1,013,013	\$ 614,265	\$ 542,754	\$ 998,882
<i>Coral destructive</i>	\$ 287,855	\$ 213,358	\$ 41,152	\$ 150,725
Indirect Use Value	\$ 1,923,076	\$ 141,666	\$ 209,923	\$ 2,083,333
Non-Use Value	\$ 60,438	\$ 13,933	\$ 10,899	\$ 22,742
TEV	\$ 3,284,383	\$ 983,223	\$ 804,729	\$ 3,255,682

THE FUTURE OF CORAL TRADE IN SOLOMON ISLANDS

In Solomon Islands the wild harvest of coral for the aquarium and curio trades are relatively small in economic value compared to other direct use reef goods, and at this stage the trade is confined to specific regions. In 2007, it was estimated there was <200 people involved in the coral aquarium trade and in 2011 there were only eight communities involved in the curio trade (in the case study sites less than 8% of the people were involved in these trades). On the other hand, the extraction of coral for the production of betel nut lime was widespread across the study sites with up to 50% of respondents involved in this trade.

At the case study level, information derived from aquarium and curio harvesters suggest that the harvest of corals is confined to certain reef areas and they have observed declines in abundance of some corals. Based on the current market, on a national scale, reef impact is likely to be localized and limited. Taking into consideration the other coral-destructive activities (that are contributing up to 22% of the TEV at some sites) as well as other pressures on coral reefs in Solomon Islands (e.g. terrestrial runoff, climate change impacts, over-fishing herbivores) there is currently an opportunity for Solomon Islands to create a 'farmed only' coral policy for the country.

A significant body of research exists on the sustainable farming of corals. In Solomon Islands

coral farming as a technical alternative to wild extraction is now well enough established for the aquarium, curio and betel nut lime trades. With a relatively small technical input, sustainable farming alternatives could be undertaken by communities.

During the current study, specific questions were asked of the coral harvesters with regards to their willingness to change practice from wild harvest of corals to farming. In total, 75% of people were interested in farming corals; 64% of respondents said they would farm corals if they received a higher price for farmed corals; and 81% of respondents said they would farm corals if they received training, knowledge and the necessary equipment. Interestingly however, if coral became short in supply 87% of coral harvesters interviewed said they would do something else rather than farming corals. The main reasons mentioned by those not willing to change practices was the fact that farming coral is more labour intensive than harvesting from the wild, and currently the price of farmed coral is not high enough to warrant the investment of time.

Sustainable coral farming methods are more labour intensive; they do have an initial start-up cost and the monetary value received is currently not substantially dissimilar to wild-harvested commodities. Yet coral farming will result in the protection of traded commodities for future reef resilience, while maintaining a source of cash income for communities.



Sustainably farmed coral for the curio (dead coral) trade



Sustainably farmed coral for the aquarium trade



Solomon Islanders measuring the status of their reefs

RECOMMENDATIONS

Governance and Education

- Capitalise on **communities desire to manage** their reefs.

The main response from people interviewed from each of the four study communities about how to keep coral reefs 'healthy' was that the communities needed to "look after" or manage their marine resources. The desire for communities to better manage their own marine resources is in line with MFMR and MECDM adoption of a community-based strategy to deliver on the goal of the Solomon Islands Coral Triangle National Plan of Action: "Solomon Islands sustainably manages marine and coastal resources to ensure food security, sustainable economic development, biodiversity conservation and adaptation to emerging threats through community based resource management approaches supported by government agencies and other partners." Communities said they were willing to contribute (money, food and time) to the maintenance of coral reef health which indicates a readiness for more organized community conservation and management efforts. There is a need to capitalize on this desire to manage Solomon Islands coral reefs through building knowledge and capacity at the community level.

- Strengthen **community awareness** about the importance of corals.

Although there was good knowledge across the study communities on the importance of coral reefs as a habitat for fishing, there was a limited understanding that the physical removal of corals can contribute to the demise of coral reefs resulting in the longer term loss of fisheries productivity. Awareness materials need to be prepared and made available to communities via MFMR Provincial Fisheries Offices and Solomon Islands Locally Marine Managed Area (SILMMA) network.

- Improve **enforcement** of existing policies on the use of **dynamite fishing**.

The use of dynamite fishing is banned under the Fisheries Act (1998) and is punishable through a \$1000 fine or 12 month imprisonment. Despite this, dynamite fishing continues to occur in parts of the country, including the study sites in Central Province. Enforcing existing regulations for dynamite fishing and selling dynamite fish at markets is essential. Increasing the ability to enforce 'no dynamite fishing' at a community level through increased legislative support for community resource management plans may assist in empowering communities to help control this destructive fishing method. Isolating and removing access to materials used to make the dynamite would also decrease this destructive activity.

- Coral baseline assessments will be an important part of a **National Coral Management Plan**.

There is very limited information on the current status of the coral reefs in areas where extraction for the coral is occurring. During interviews, respondents identified specific species and locations where corals for these trades are becoming in low supply. Some isolated surveys have been conducted by MFMR over past years but as part of a proposed National Coral Management plan, comprehensive and well planned baseline coral assessments will be required at primary harvest sites, focusing specifically on coral species targeted for these trades (separately for each of the trades). An assessment design that is developed in partnership with government, industry, NGO's and communities will be the most robust in the long term, with ownership from all parties. Incorporating local communities in the assessments would also improve understanding of the impact of unsustainable coral harvesting.



Community members learning how to farm coral

- Promote **coral farming** at the community level.

Communities will require training, equipment and knowledge to change from wild-harvest to farming technologies. This could be implemented through MFMR Provincial Fisheries, through the development of demonstration farms in target areas where coral harvesting ongoing.

Legislation

- Improve **legislation and enforcement** for the extraction of 'stone and gravel' (dead and live coral) for **commercial use**.

The current high level of extraction of corals for commercial use will result in the rapid loss of habitat for coral reef fisheries and a reduction in the coastal protection value of coral reefs. Regulations and policies need to be revised to take these findings into consideration and should be included within the proposed National Coral Management Plan.

- **Review existing legislation** on harvest of coral for the production of betel nut lime.

The results from this study indicated that in some locations the harvest of lime for selling at markets is resulting in localized depletion of targeted species. Strengthening community awareness about sustainable techniques for the harvest of coral for lime and mechanisms for farming corals for making lime are easily available techniques that may help reduce impacts, however it may be prudent to also consider reviewing existing policies on the harvest of live corals for the betel nut lime trade, once detailed baseline surveys have been undertaken.

- Review **export quotas** for the coral aquarium and curio export trades.

Currently national export quotas are set for the aquarium and curio trades based upon the total number of pieces of certain species being traded. There is no limit on size. For the curio trade in particular, the size of individual pieces can range from < 20 cm to more than 80 cm diameter. Without putting a cap on the number of large pieces of coral extracted, an entire reef could be easily destroyed in just one coral shipment. Once baseline surveys have been completed thereby providing information about specific species, it would be prudent to review the definitions pertaining to the coral export quotas.

- Implement coral management regulations now in a view to **phase out the wild harvest of corals**.

Within the existing aquarium and curio coral trades in Solomon Islands, there are a limited number of community members (estimated to be ~ 400 individuals) that are benefiting from these trades.

Subsequently, at a national level this trade provides little economic return and there is relatively low national exploitation of reefs for this trade. The trade of corals is currently limited by the low prices that villagers receive (it is estimated that they receive < 2% of the value chain). To limit a possible future unsustainable increase in the exploitation of coral reefs for the curio and aquarium coral trades (e.g. if there is an increase in price) the implementation of incentives for coral harvesters to farm corals and disincentives for the wild harvest of corals now, could act as a preventative measure.

Economic Incentives

- Consider **farmed and wild-harvest coral as separate entities.**

There are currently no economic incentives for coral harvesters to farm corals. To enable the development of incentives for farmed corals (or disincentives for wild harvest coral) there needs to be a mechanism for this to occur. If for example there are separate CITES and fisheries export permits for farmed and wild-harvest corals, incentives for farmed coral could be considered. Incentives may include: reducing permit fees for farmed corals (or increasing fees for wild-harvest corals), removing government 10% sales tax on farmed corals, having higher quotas for farmed corals (and reduced quotas for wild harvest corals) with a 5-10 year plan to phase out wild-harvested corals.

Further Research

- Working towards a **national economic evaluation** of Solomon Islands coral reefs.

We have deliberately not scaled up the economic value of coral reefs from the four case study sites to estimate the national level value of coral reefs. Solomon Island is a diverse country in terms of ecology, culture and economy, with transport and access to markets being a major driver for use and harvest of certain coral reef resources. Prior to a national level assessment on the total economic value of Solomon Islands' coral reefs more case studies are required especially in more remote areas and within other provinces, to determine the direct use value and total economic value of coral reefs to Solomon Island coastal communities.

- Undertake detailed **coral value and market chain analysis** for wild harvest and farmed corals.

Due to the lack of detailed current information on the trade of corals in Solomon Islands there remains a need to further validate how substantial the current and perhaps more importantly the potential future impacts of the coral trade on rural economies and whether costs, including costs to the environment outweigh the economic return. Comparative analysis of wild harvest and farmed corals will enable an accurate calculation of economic incentives required to promote the farming of corals for the aquarium and curio trades in Solomon Islands.



Participant receive their certificate for successfully completing coral farming training.



RESEARCH
PROGRAM ON
**Aquatic
Agricultural
Systems**

The CGIAR Research Program on Aquatic Agricultural Systems is a multi-year research initiative launched in July 2011. It is designed to pursue community based approaches to agricultural research and development that target the poorest and most vulnerable rural households in aquatic agricultural systems. The Program is partnering with diverse organizations working at local, national and global levels to help achieve impacts at scale. The CGIAR Lead Center of the Program is the WorldFish Center in Penang, Malaysia. For more information, visit aas.cgiar.org



Australian Government

This project was managed by the WorldFish Center, funded by AusAID, and administered by the Australian Department of Sustainability, Environment, Water, Population and Communities as part of the Australian Government support program for the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security.



**CORAL TRIANGLE
INITIATIVE**
ON CORAL REEFS, FISHERIES AND FOOD SECURITY

This brief was completed as part of the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) National Program in the Solomon Islands. The Solomon Islands Government through the Ministry of Environment, Climate Change, Disaster Management and Meteorology (MECDM) and Ministry of Fisheries and Marine Resources (MFMR), and CTI partners, seek to ensure marine and coastal resources are sustainably managed, to secure the long term improvement of the livelihoods of Solomon Islanders.

Contact Details

CGIAR Research Program on Aquatic Agricultural Systems

The WorldFish Center
Jalan Batu Maung, Batu Maung,
11960 Bayan Lepas, Penang, MALAYSIA
Tel: +(60-4) 626 1606
Fax: +(60-4) 626 5530

WorldFish Office, Solomon Islands

P.O. Box 438,
Honiara, Solomon Islands
Tel: +(67-7) 250 90
Fax: +(67-7) 232 96
Email: aas@cgiar.org

Printed on 100% recycled paper



Find out more by scanning this QR code with your smartphone's QR code reader.

Design and layout
WorldFish Office
Solomon Islands

Photo credits:
Front cover, Fred Olivier
Page 2 & 8: Simon Albert
Page 1, 3, 4, 6, 7, 9 & 10:
The WorldFish Center,
Solomon Islands

This publication should be cited as: Albert, J.A., Trinidad, A., Boso, D. and Schwarz, A.J. (2012) Coral reef economic valuation and incentives for coral farming in Solomon Islands. Policy Brief. CGIAR Research Program on Aquatic Agricultural Systems. Penang, Malaysia. AAS-2012-14.

© 2012. The WorldFish Center. All rights reserved. This Brief may be reproduced without the permission of, but with acknowledgement to, the WorldFish Center.