NATIONAL MARINE ECOSYSTEM SERVICE VALUATION

SUMMARY REPORT

TONGA

KO E ʻOTUA MO TONGA KO HOKU TOFIA

MACBIO

MARINE ECOSYSTEM SERVICE VALUATION

The living resources of the Pacific Ocean are part of the region's rich natural capital. Marine and coastal ecosystems provide benefits for all people in and beyond the region. These benefits are called ecosystem services and include a broad range of values linking the environment with development and human well-being.

Yet, the natural capital of the ocean often remains invisible. Truly recognizing the value of such resources can help to highlight their importance and prevent their unnecessary loss. The MACBIO project provides technical support to the governments of Fiji, Kiribati, Solomon Islands, Tonga and Vanuatu in identifying and highlighting the values of marine and coastal resources and their ecosystem services. Once values are more visible, governments and stakeholders can plan and manage resources more sustainably, and maintain economic and social benefits of marine and coastal biodiversity in the medium and long term.

The MACBIO Project has undertaken economic assessments of Tonga's marine and coastal ecosystem services, and supports the integration of results into national policies and development planning. For a copy of all report and communication material please visit **www.macbio.pacific.info**.

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MACBIO
Marine and Coastal Biodiversity Management in Pacific Island Countries

SPREP
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giz
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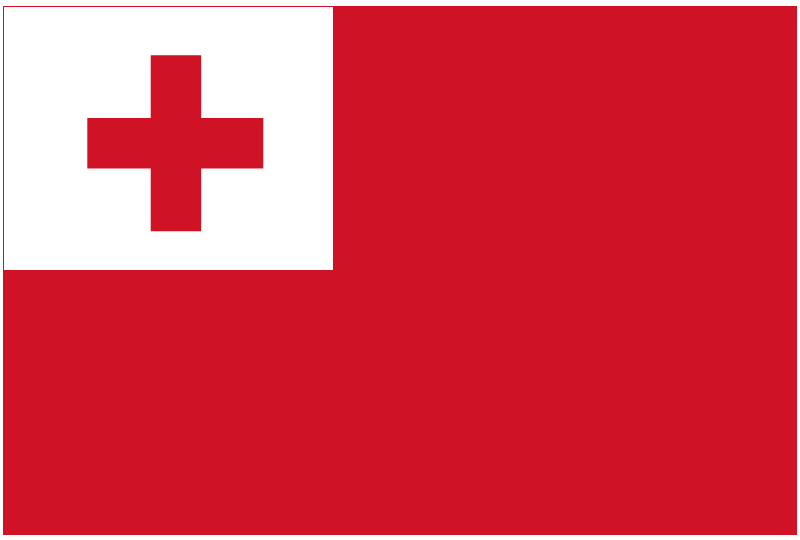

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This study, conducted in 2015, aimed to determine the economic value of seven marine and coastal ecosystem services in Tonga. The study forms part of the broader MACBIO project (Marine and Coastal Biodiversity Management in Pacific Island Countries) that aims to strengthen the management of marine and coastal biodiversity in Pacific island countries.

The role that natural ecosystems, especially marine ecosystems, play in human wellbeing is often overlooked or taken for granted. The benefits humans receive from ecosystems, called *ecosystem services*, are often hidden because markets do not directly reveal their value — nature provides these benefits for free. Failure to recognize the role that marine ecosystems play in supporting livelihoods, economic activity, and human wellbeing has, in many instances, led to inequitable and unsustainable resource management decisions.

The exclusive economic zone of Tonga, nearly 700,000 square kilometers of ocean, is 1000 times larger than the country's land area. Coastal and marine resources provide Tongan businesses, households, and government many real and measurable benefits. This report describes, quantifies and, where sufficient data is available, estimates the economic value of many of Tonga's marine and coastal ecosystem services, in an effort to inform sustainable and equitable management decisions and support national marine spatial planning.

Seven key marine ecosystem services were evaluated in detail: subsistence fishing; commercial fishing; minerals and mining; tourism; coastal protection; carbon sequestration; and marine research and management. Other services are explored as well, including cultural and traditional values associated with the sea, potential future industries and other human benefits that have not yet been developed or analyzed. A scarcity of data about many of these ecosystem services prevents calculation of the total economic value, so the values below should be regarded as minimum estimates. Data gaps are described in detail in the full report.

DOMESTIC SUBSISTENCE AND SMALL-SCALE COMMERCIAL REEF FISHERIES

Small-scale inshore fishing for home consumption and sale at local markets provides food security and incomes for many Tongan households. Subsistence and small-scale commercial fisheries depend equally on the health and productivity of inshore habitat, including reef, lagoon, and mangrove areas. A minimum estimate of the annual economic value of Tonga's inshore subsistence and domestic commercial fisheries is T$ 10 million (T$ 5.46 million in subsistence fisheries and T$ 4.2 million in domestic commercial fisheries). This value is derived from an annual harvest of between 400 and 1,100 kg of fish and invertebrates per square kilometer of inshore habitat.

SMALL-SCALE COMMERCIAL FISHERIES (PRIMARILY EXPORT)

The deep-sea demersal fishery and the inshore aquarium trade are relatively small but consistent ecosystem services that provide some local employment and export revenue. Gross annual revenues of the aquarium trade and deep-sea demersal fisheries are about T$ 794,000 and T$ 1.1 million, respectively. Costs are high for both sectors so net benefits are much lower (approximately T$ 0.25 million and T$ 0.23 million, respectively). Management plans for these two fishery sectors have been improved over the past 20 years; if enforced, these plans should enable sustainability. The commercial *bêche-de-mer* fishery has been much more volatile. Although this sector has provided occasional spurts of export revenue and employment for Tongan gleaners and divers, sustainable management of the fishery has not been established. Although much of the harvest is done by Tongan households and offers an important source of cash income, much of the value of the resource is captured by export companies, who dry and sell *bêche-de-mer* to Asian markets. Some efforts are being made to encourage fishers to dry the fresh products in order to receive a greater share of the benefits, and one Tongan exporter is now operating.

LARGE-SCALE TUNA FISHERY

The commercial tuna fishery in Tonga is notably smaller than most other Pacific island countries, mostly due to Tonga's location — further south and east of the largest Pacific tuna stocks. Albacore is the dominant commercial tuna species in Tonga, making up 25–50% of the annual catch. Scientists report that yellowfin stocks show signs of overfishing and bigeye stocks are becoming dangerously small (both are caught within Tonga albeit in lower numbers than albacore), but albacore stocks remain healthy. Albacore fishing, mostly done by long-line, is likely to remain sustainable as long as costs-to-returns ratios remain high enough to limit fishing effort; subsidized foreign fishing fleets could threaten this. Although the long-line method is relatively sustainable for albacore fishing, by-catch of sharks and other pelagic species such as moonfish and marlin is substantial.

Despite being smaller than other Pacific island countries, Tonga's offshore tuna industry remains the leading income generator to the government from the fisheries sector and the dominant fisheries export product. The average gross value of the tuna catch for the past 15 years was T$ 8.37 million, although there is significant annual variation around this average. The Forum Fisheries Agency inflates long-line value estimates by 10% to account for by-catch revenue, which would bump this average to T$ 9.21 million. Since by-catch has been estimated to be much higher in Tonga (ranging 26–32%) and because shark meat and shark fin exports have totalled more than T$ 1.5 million in 2012 and 2013, T$ 9.21 million is most likely a conservative estimate of the annual gross value of the industry.

Government revenues of about T$ 1.3 million per year are generated from access fees through licensing, since Tonga started selling licenses to distant-water fishing nation boats in 2012. The net benefits to the industry (gross revenue minus costs) are about T$ 0.9–2.2 million per year, reflecting the high costs of long-line fishing. Much of this benefit goes to foreign vessels, although the industry provides some employment on locally-based fishing vessels, and at landing sites and processing facilities. Locally-based tuna fishing provides benefits to consumers because locally-based boats sell tuna and tuna by-catch within Tonga. No canneries or sophisticated processing facilities exist in Tonga, so Tonga does not capture much value-added benefit. Foreign-based boats only benefit the Tonga government through license fees.

AGGREGATE AND DEEP-SEA MINING

Dredging of sand and aggregate from beaches and lagoons provides benefits to the construction industry and consumers who benefit from concrete roads and buildings, but the negative impacts of dredging could not be assessed by this research. Probable impacts include destruction and siltation of reef and lagoon habitat, which may harm Tonga's largest domestic marine ecosystem service: inshore fisheries. Lagoon dredging offers modest benefits to the Ports Authority. Beach mining for domestic purposes contributes a small amount of revenue to the natural resources division; benefits to Tongan households could not be quantified without a robust survey. The impacts of beach mining and lagoon dredging to inshore fisheries and tourism are potentially significant and warrant further assessment.

Exploration for deep-sea mining opportunities is already providing significant benefits to Tongan government from various fees, but no real benefits to Tongan households or the general economy. A comprehensive Deep-Sea Mining Act paves the way for oversight and benefit sharing if mining operations take place down the road. The magnitude of threats to whale migration and tuna and deep-sea demersal habitat cannot yet be quantified, but must be considered. Tourism, tuna, and deep-sea snapper industries provide substantial sustainable benefits to Tonga and may be impacted by deep-sea mining.

TOURISM

Tourism is a growing industry in Tonga that depends largely upon healthy marine and coastal ecosystems. These ecosystems contribute T$ 9–22.5 million in annual economic activity in Tonga; a minimum estimate of the net value of those expenditures (25%) would be T$ 2.2–5.5 million each year. The net benefits from tourism are second only to coastal protection. Tourism benefits a variety of businesses and their employees and provides government tax revenue of T$ 1.31–3.28 million. Tourism can be a sustainable ecosystem service if managed and regulated. Mining and fishing, particularly destructive types of inshore fishing, could negatively impact tourism benefits. One example is shark tourism which has the potential to be far more lucrative than shark fishing.

COASTAL PROTECTION

Fringing reef, mangroves and seagrasses protect Tonga's coasts from erosion and flooding. The *avoided costs* method is used to analyze their value. Because many of the commercial and residential properties in Tonga are near the coast, protection from flood and erosion damage from healthy coral reefs could be quite significant, from T$ 11.7-19.5 million annually in Tongatapu.

CARBON SEQUESTRATION

Tonga's mangroves also provide carbon sequestration benefits to the world, worth about T$ 1.4 million per year. Carbon sequestration benefits of seagrasses could not be quantified for lack of data about the extent of seagrass in Tonga. If protected, areas of mangroves at risk for destruction could be marketed and sold as carbon offsets, but the costs of verifying and managing the protected areas would need to be assessed on a case-by-case basis.

RESEARCH, MANAGEMENT, AND EDUCATION

Marine and coastal areas attract foreign aid and research funding that benefits Tongan government, bringing in T$ 540,000 to the Fisheries Division alone in 2015. Investment in marine and coastal biodiversity includes many projects run through the Environment Division also, so the total benefit from aid and research is much greater. Money spent by individuals and institutions that research marine and coastal ecosystems, or advocate for their protection, benefits government mostly, although aid expenditures trickle through many sectors of the economy much like tourism expenditures. Marine research and protection projects also bring technical assistance and capacity development.

Other marine and coastal ecosystem services include handicrafts, bioremediation, cultural identity and aesthetic beauty. These services have not been quantified by this study because of a lack of data and human and financial resources, but they indeed provide benefits to Tongan citizens and the rest of the world.

CONCLUSIONS

The sum of ecosystem services valued by this study range from T$ 30 million to T$ 47 million per year. Some of this value, particularly foreign-caught tuna and *bêche-de-mer* and aquarium exports, accrues to foreign fishers and exporters, not Tonga. Carbon sequestration is a global benefit, with no related economic activity within Tonga. The majority of Tonga's marine ecosystem service benefits come from subsistence and small-scale commercial fishing, tourism, and protection from erosion and flooding (avoided costs).

MACBIO's formal link with the Tongan government is through the Department of Environment, but from the onset the project has made an effort to support and assist all Departments relevant to marine and coastal resource use and management. The Fisheries Division, in particular, is responsible for oversight of many key marine ecosystem services, and was instrumental in deriving the values above. Throughout this research, the authors endeavored to share information about the economic value of marine ecosystems with all the Departments that have a role in marine resource use and management. These discussions indicated an awareness and understanding that economic valuation information can inform development policy, legislation, and regulation of marine activities.

This study is a step towards a national process of recognizing the human benefits of natural ecosystems, which will lead to more equitable and sustainable management of Tonga's marine assets. These results can serve as an inventory of current information about the economic value of Tonga's marine and coastal assets and as a starting point for more in-depth valuations of each of the ecosystem services discussed above. More generally, Tonga should consider making steps towards accounting for natural capital in order to ensure the sustainable prosperity of the Kingdom.

TABLE 1 • Annual economic value of marine and coastal ecosystem services in Tonga (2013)

Sector	Ecosystem service	Beneficiaries	Net annual value[1,2] (2013 adjusted) m = million	Sustainability[3]
Fisheries	**Subsistence fishery**	Tongan households, particularly rural and low income	T$ 5.46m (US$ 3.05m)	Sufficient inshore habitat for sustainable subsistence harvests, but localized overfishing has reduced productivity, threatening sustainability
	Domestic commercial inshore fishery	Tongan fishers, Tongan consumers, some restaurants and businesses (only value to fishers is estimated)	T$ 4.2–7.3m (US$2.3–4.1m)	Sufficient inshore habitat for sustainable harvests (for local demand), but localized overfishing has reduced productivity, threatening sustainability
	Bêche-de-mer	Mostly export companies and foreign consumers, some small-scale fishers/divers, some government revenue (value includes exporters, fishers, and government)	T$ 0.45m (US$ 0.25m)	Over-harvesting has led to periodic closures; export of some species competes with subsistence food security
	Aquarium trade	Mostly foreign export companies, some government benefits (not included in value)	T$ 0.25m (US$ 0.14m)	Sustainable management plan, if enforced. Damage to habitat threatens inshore commercial and subsistence
	Offshore tuna	Locally-based and foreign fishing boats, government, some local consumers and workers (value includes local and foreign boats and government revenue)	T$ 2.3–3.5m[4] (US$ 1.3–2m)	Albacore long-line fishing sustainable, yellowfin threatened and bigeye overfished. By-catch threatens sharks and some pelagic fish
	Deep-slope demersal	Tongan fishers, domestic consumers, export companies and foreign consumers, modest government benefits (not included)	T$ 0.23m (US$ 0.13m)	Sustainable management plan, if enforced. Threatened by deep-sea mining
Mining	**Sand and aggregate**	Data only for modest government benefits. No data for benefits to households, construction companies, and everyone who uses concrete structures and roads	Insufficient data	Beach mining for construction is unsustainable; lagoon dredging needs monitored to prevent diminishing fishing and tourism ecosystem services
	Deep-sea minerals	International mining companies; government and local economic benefits depends upon taxes, royalties, and business operations	Insufficient data	Potential destruction of deep-sea demersal habitat. Risks to tourism (whales), pelagic fisheries are unknown
Tourism	**International tourism and recreation**	Tongan businesses and government; benefits to international tourists not included	T$ 3.5–8.8m (US$ 2–4.9m)	Sustainable, if pollution and damage from tourism development and tourist activities controlled
	Domestic recreation and tourism	Tongan citizens	Insufficient data	Sustainable, if pollution and damage from recreation activities is controlled
Regulating Services	**Coastal protection**	Citizens and visitors, in particular owners of coastal property (measures avoided repair costs)	T$ 11.7–19.5m (US$ 6.5–10.9m)	Sustainable if reef and mangroves are healthy
	Carbon sequestration	Global benefit from mangroves only (lack of data on seagrass and algae). Potential benefit to communities from carbon credits (not included in value)	T$ 1.4m (US$ 0.77m) Gross export value	Sustainable, if mangroves are protected
Foreign Investment	**Research, education, and management**	Mostly government, but some aid money trickles through economy	>T$ 0.54m (>US$ 0.3m) Gross export value	Depends on international relations and agreements related to nature conservation

1 Different beneficiaries (local, foreign, producer, consumer, government) are included in the value estimates; read beneficiaries column for explanation and exceptions. Gross values do not reflect costs. Throughout the report an exchange rate of US$ 1 = T$ 1.79 is used.

2 Unless otherwise indicated.

3 Sustainability refers to whether the values presented can be expected to decrease (unsustainable), increase, or stay the same (sustainable) with current human behaviours.

4 This value includes revenue to government from licence fees and resource rent.