Economic Valuation of Tourism and Fisheries in the Vatu-i-Ra Seascape

Republic of Fiji

Brian Kastl
Stuart Gow

Fisheries and Tourism in the Vatu-i-Ra Seascape in Fiji. Photo: © Stacy Jupiter

1. Executive Summary

The Vatu-i-Ra Seascape in Fiji is a region of valuable natural resource abundance that supports livelihoods and the Fiji economy. Tourism and fisheries are highly dependent on its coral reefs, which can be further protected through integrated policy development that considers the connectivity between terrestrial, inshore, and offshore ecosystems. Establishment of the Vatu-i-Ra Seascape therefore offers an opportunity to capture and maintain the wealth of benefits – ecosystem service values – provided by prolific ecosystems in the seascape. This report aims to illuminate the monetary values of tourism and fisheries production, associated with the coral reef. It also demonstrates the potential costs that can be avoided through informed decision making about oil exploration and mining in the seascape.

The annual value of tourism and fisheries in the Vatu-i-Ra Seascape is estimated at FJ $71,821,300. Interviews with the tourism sector indicated that all 16 providers in the Vatu-i-Ra seascape are heavily reliant on the aesthetics and biodiversity of marine species, especially for dive tourism. Boutique/luxury resorts, generating 50% of gross tourism revenue in 2013, reinforce the reputation of Fiji for world-class coral reef-related tourism. Over the year, dive live-aboard ships, mid-market, high-end, and boutique/luxury all-inclusive resorts employed 767 workers, hosted 35,700 guests, and generated gross revenue of FJ $47,240,700, including FJ $5,919,700 in VAT and FJ $2,160,500 in Service Turnover Tax (STT). Net revenue (producer surplus) was calculated at approximately FJ $5,644,100.

Results on the value of fisheries in the Vatu-i-Ra Seascape indicate that inshore fishing has exceeded the recommended sustainable yield. If recent extraction rates are maintained, available biomass may be depleted and the value of the stock may be lowered over time. The total annual maximum sustainable yield over the seascape's marine area of 26,584 km^2 was estimated to be approximately 5,500 tonnes, valued at FJ $24,097,900. Using representative proportions of commercial versus subsistence fishing quantities from 2007, the annual maximum sustainable commercial catch for the seascape was estimated at 2,030 tonnes and valued at FJ $8,987,700, while the sustainable subsistence catch is estimated at 3,470 tonnes and valued at FJ $15,615,000. In 2007 the inshore catch was at least 6,280 tonnes, representing an overharvest of 17% above the sustainable yield, while the offshore catch was minimal, at a maximum of 140 tonnes and valued at FJ $482,700.

Seascape fish extraction rates may be approaching a threshold for impending reef degradation. The Natovi Fishery Center poses an extreme risk to the sustainability of fisheries in the Vatu-i-Ra Seascape, if unregulated, due to potential increases in fisheries pressure on local marine ecosystems. Similarly, oil exploration in and around the seascape presents a potential high future threat to the stability of reef-dependent tourism and fisheries. It was calculated that an oil spill covering only 20% of the area covered by the Deepwater Horizon Oil Spill of 2010 in the Gulf of Mexico, could cost Fiji an annual loss of ecosystem services worth FJ $1.353 billion. Pollutants from ongoing land-based mining in watersheds, which drain into the coral reef, may also have devastating impacts on the fisheries and tourism industries. Therefore it is highly recommended that future development in the Vatu-i-Ra Seascape take into consideration the ecosystem service values of the seascape, including tourism and fisheries to ensure these services continue to be available and provide for future generations.

2. Introduction

2.1 The Vatu-i-Ra Seascape

Coral reefs are globally known to be ecosystems holding high monetary value, providing benefits to tourism, fisheries, biodiversity, coastal protection and local communities[1]. However, these benefits from nature to people – hereafter called ecosystem services – are challenging to sustain, amongst increasing pressures to coral reefs. Informed planning that leads to improved sustainable fisheries management and effective marine managed areas (MMAs), will ensure that Fiji's coral reef ecosystem services can be maintained for future generations. Currently marine protection is responsible for 5–30% of reef tourism revenue in Fiji through maintaining or improving coral reef health[2]. Future marine managed areas can further support reef-based tourism and the fisheries by encouraging sustainable fishing practices and extraction rates.

Fiji is signatory to the Convention on Biological Diversity and is working towards the Aichi targets to protect 10% of their territorial waters, including the Programme of Work on Protected Areas and the Programme of Work on Island Biodiversity. In 2005, the Fiji Government made a declaration commitment to protect 30% of its inshore and offshore marine habitats by 2020. To date approximately 1.7% of Fiji's exclusive economic zone (EEZ) is effectively managed, and this protection is exclusively from community efforts in inshore managed areas. Therefore a need exists to significantly expand Fiji's marine protected area network by establishing offshore protected areas, if progress is to be made towards the stated government target.

Wildlife Conservation Society (WCS) wishes to work with and support the Fiji Government, industry and the community to explore opportunities for the establishment of offshore marine managed areas within the Vatu-i-Ra Seascape (Figure 1). The ecosystems of the seascape, encompassing the coastal zones of Lomaiviti, Tailevu, Ra, and Bua provinces, support an astounding diversity of life, provide abundant ecosystem services, and sustain coastal and offshore fisheries on which local livelihoods depend. The deep waters of the Vatu-i-Ra passage, strong currents and upwelling contribute to the high productivity of the area, in terms of healthy and flourishing coral reefs, and high fish biomass in Fiji's EEZ[3]. The marine component of the seascape has a surface area of 26,584 km^2, of which 49% is offshore (defined in this report as waters outside provincial boundaries). In the establishment of the seascape, consideration has been made to land-sea connectivity and potential runoff impacts onto coastal environments. For this reason, the land masses of these four provinces are included in the seascape, holding one quarter of Fiji's most intact forest of high biodiversity[4].

[1] Russi D, ten Brink P, Farmer A, Badura T, Coates D, Foerster J, Kumar R, Davidson N (2013) The Economics of Ecosystems and Biodiversity for Water and Wetlands. IEEP, London and Brussels; Ramsar Secretariat, Gland

[2] Pascal N, Seidl A (2013) Economic benefits of marine protected areas: case studies in Vanuatu and Fiji, South Pacific. Research report, AFD/IUCN. French Framework Agreement by CRIOBE (EPHE/CNRS), Moorea, French Polynesia

[3] Marnane M, Allen G, Farley L, Sivo L, Dulunaqio S (2003) Scientific report on an expedition to the Vatu-i-Ra/Lomaiviti passage, 10-24 May 2003. Wildlife Conservation Society, Suva, Fiji, 15pp.

[4] Olson D, Farley L, Patrick A, Watling D, Tuiwawa M, Masibalvau V, Lenoa L, Bogiva A, Qauqau I, Athertonnes J, Cagintoba A, Tokota'a M, Prasad S, Naisilisili W, Raikabula A, Mailautoka K, Morley C, Allnutt T (2009) Priority forests for conservation in Fiji: landscapes, hotspots and ecological processes. Oryx 44:57-70

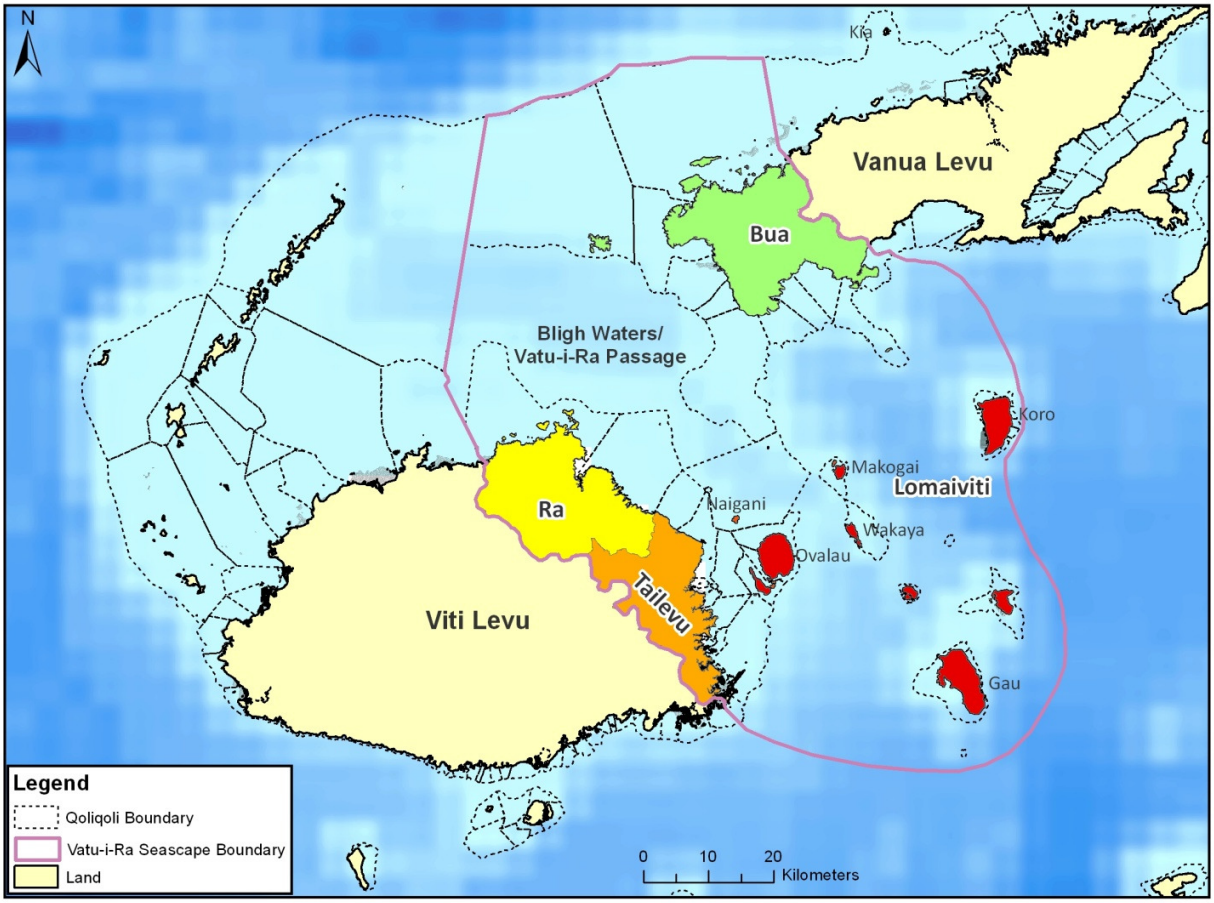

***Figure 1**: The Vatu-i-Ra Seascape, outlined in purple, includes four provinces of the main islands of Fiji. Dotted boundaries represent traditional fishing (i qoliqoli) boundaries, which represent inshore areas. Areas outside the i qoliqoli boundaries are designated as offshore areas.*

2.2 Objectives

The purpose of this study is to provide economic values of tourism and fisheries in the Vatu-i-Ra Seascape to inform discussions on the establishment of marine managed areas.

The following tasks were completed in order to provide insights into the value of ecosystem services provided by the seascape:

a. A questionnaire and data input system was developed to collect primary data from tourism providers in the Seascape;
b. The value of tourism associated with charter boat fishing, diving, and other reef-related activities was calculated;
c. The value of fisheries production was determined at recent harvest rates and estimated maximum sustainable yield, including,
    i. offshore catch by fishers operating under offshore fishing permits, and
    ii. artisanal catch in the inshore and offshore areas;

d. Calculating potential avoidance costs associated with any future petroleum extraction proposals within the seascape.

Considering the wealth of ecosystem services that the Vatu-i-Ra Seascape provides, the values from tourism and fisheries represent only a minor component of all ecosystem service values, on which livelihoods and the economy of Fiji is reliant. Benefits from the seascape come from other significant ecosystem services including, but not limited to, coastal protection, carbon sequestration, social and cultural/spiritual/religious meaning. At the land-sea interface of the seascape, watershed services include water supply, sediment retention, and nutrient retention, which are critical in the reduction of land-based impacts on marine ecosystems.

Despite an array of significant ecosystem services provided by the seascape, the focus of this study on tourism and fisheries provides a basis for understanding the direct implications of marine management on economic growth in Fiji. Tourism, ranking as the fourth greatest contribution to gross domestic product (GDP), holds 11.2% of all industry GDP and added FJ $402 million in 2002[5]. Visitors come to Fiji to enjoy the quality of the marine environment. In 2005, 75% of tourists engaged in swimming, 60% in snorkeling and 12% in scuba diving[6]. If coastal waters are poorly managed, debilitating marine health might weaken the tourism sector. However, innovative marine planning of the Vatu-i-Ra Seascape has the potential to set precedence for strengthening reef-based tourism and economic productivity throughout Fiji and to enable the country to maintain its competitive edge against other countries.

3. Tourism

Key Findings

- The estimated gross revenue of tourism providers reliant on healthy coral reef is approximately: FJ $47,240,700.
- VAT (Value Added Tax) generated by tourism operators is approximately FJ $5,919,700.
- STT (Service Turnover Tax) generated by tourism operators is approximately FJ $2,160,500.
- Approximately 35,700 guests visited the Vatu-i-Ra Seascape in 2013.
- Tourism providers in the seascape employed approximately 767 employees in 2013.
- The seascape contributes 6–28% of the value of all coral reef recreational services in Fiji.
- Boutique/luxury resorts account for 50% of gross tourism revenue in the seascape with 16% of visitors staying at these resorts.

3.1 Overview

Tourism in the Vatu-i-Ra Seascape is unique in its focus on all-inclusive luxury accommodations and activities that cater to the marine-based spirit of visitors. Sixteen tourism providers (i.e. hotel and resort operators) have well-established businesses that are heavily reliant on the ecosystem services of the Vatu-i-Ra Seascape, utilizing the aesthetics and biodiversity of the seascape for dive tourism (Figure 2).

[5] Fiji Islands Bureau of Statistics (August 2008) Tourism Satellite Account: 2002 Fiji Islands
[6] Department of Tourism (2007) Fiji Tourism Development Plan: 2007-2016

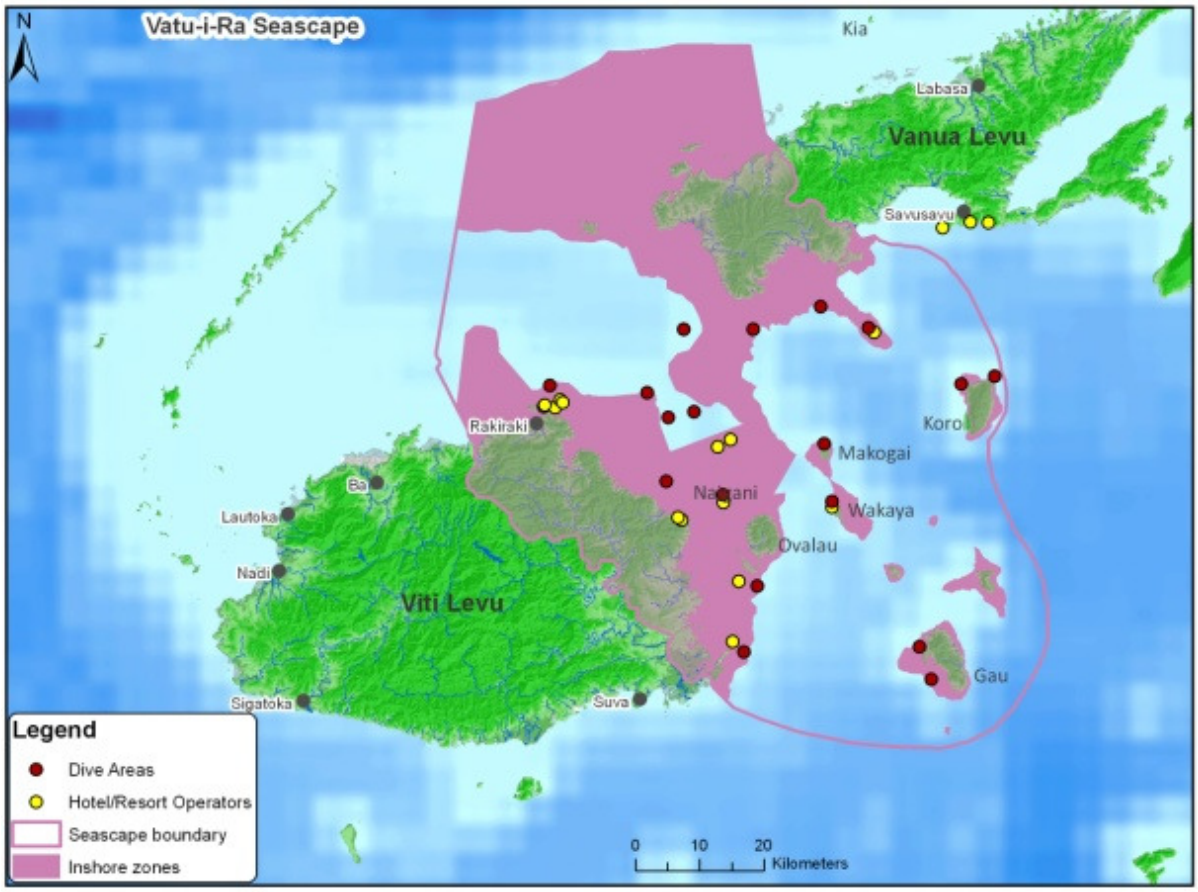

Figure 2: *Locations of all tourism providers that operate in the Vatu-i-Ra Seascape, with associated dive areas. Note that the two centrally-located resort operators represent dive live-aboard ships.*

In order to estimate economic values from all providers, four categories of tourism providers were established: mid-market, high-end, boutique/luxury, and dive live-aboard ships. For tourism providers which could not be surveyed, the number of room nights was determined, and the values for the given category were scaled up in proportion to the number of room nights for the surveyed providers. At least one representative for each surveyed tourism provider was personally interviewed to acquire data on the expenditures in Table 2.

In this study, the financial values of tourism were measured to determine the benefits to tourism operators. The net factor income method was used to estimate the producer surplus or the value of the ecosystem services by subtracting tourism provider fees, taxes, employee wages and costs of production[7] from the gross revenue. This study made the assumption that tourist expenditures are equal to gross revenue of tourism providers. In this case the producer surplus is represented by the net revenue.

[7] Beukering, P. van, Brander, L., Tompkins, E. And McKenzie, E. (2007a). Valuing the enviornment in small islands. An environmental economics toolkit. Joint Nature Conservation Committee. Peterborough (UK)

The proportion of tourist time spent on primary activities was asked of each surveyed tourism provider. Activities included charter boat fishing, diving, snorkeling, and beach lounging. Surveyed operators were asked to state the proportion of time that tourists devote to each activity. All activities are considered 100% related to the reef, with the exception of beach lounging, which is considered indirectly related to the reef, and a value of 25% of tourist expenditures from this activity are used[9]. These results were then integrated into the results of Table 2.

Data from 2013 was collected from 14 providers**.** The quality of the coral reef aesthetics and the biodiversity of marine species are of the utmost importance to these businesses. While the number of guests staying in the seascape is relatively low in comparison to other areas of Fiji, the expenditures per guest are significantly higher than elsewhere in Fiji. In 2013, approximately 35,700 guests visited the seascape and spent an average of FJ $1,320 per person. They generated gross revenue of FJ $47,240,700 for the tourism providers (Table 1).

Table 1*: Total expenditures of guests visiting the tourism providers are represented by gross revenue. VAT = Value Added Tax. STT = Service Turnover Tax. Net revenue was the only item not acquired through interviews, but instead calculated by subtracting all provider expenses.*

Expenditures	Seascape Totals (FJD)
Gross Revenue	47,240,700
Inbound Operator Fees	1,015,500
Wholesaler Fees	3,521,200
VAT	5,919,700
STT	2,160,500
Employee Earnings	9,569,300
Cost of Production	19,144,000
Loans and Debt Paid	266,400
Net Revenue	5,644,100

3.2 Contributions to National Tourism Revenue

Gross tourism earnings in 2013 for all of Fiji reached FJ $1.318 billion[8]. Using 15.5% and 70.1% as the lower and upper boundary limits for the proportion of tourism gross revenue that is associated with coral reef use[9], the value of recreational services provided by coral reefs throughout Fiji was FJ $166,100,000–786,200,000 in 2013. Considering the gross revenue of reef-based tourism of approximately FJ $47,200,000 for the Vatu-i-Ra Seascape, the seascape contributes 6–28% of the value of all coral reef recreational services in Fiji. While these values are relatively low in comparison to the proportion of coastal waters that the seascape encompasses, these tourism providers emphasize

[8] Fiji Bureau of Statistics: http://www.statsfiji.gov.fj/index.php/migration-a-tourism
[9] Korovulavula, I, O'Garra, T, Fong, P, Ratuniata, R (2008) Economic Valuation: Iqoliqoli-tourism Study Support for Fiji, The University of the South Pacific

high quality dive tourism, and therefore are more heavily reliant on healthy and diverse coral reefs than providers in areas outside of the seascape.

Although boutique/luxury resorts host only 16% of visitors to the Vatu-i-Ra seascape, these providers account for 50% of gross revenue in the seascape (Figure 3). This disparity underscores the high quality of boutique/luxury resorts and the willingness of visitors to pay for these resorts, which are situated in the most beautiful environments of the Vatu-i-Ra Seascape. Strong global competition exists between boutique/luxury resorts in the tropics to accommodate the wealthiest visitors. Among the most significant factors in acquiring their business is the aesthetic quality of the natural environment. Tourism providers in Fiji therefore have an advantage in the world-renowned coral reef quality and experience. However, with this emphasis on coral reef quality comes a heightened need to minimize negative impacts to the reef. Improved management plans for the Vatu-i-Ra Seascape are therefore crucial in maintaining and further improving the market for tourists of the highest economic status. These tourism benefits additionally reach the mid-market, high-end, and dive live-aboard categories, due to the reputation that luxury tourism holds in Fiji.

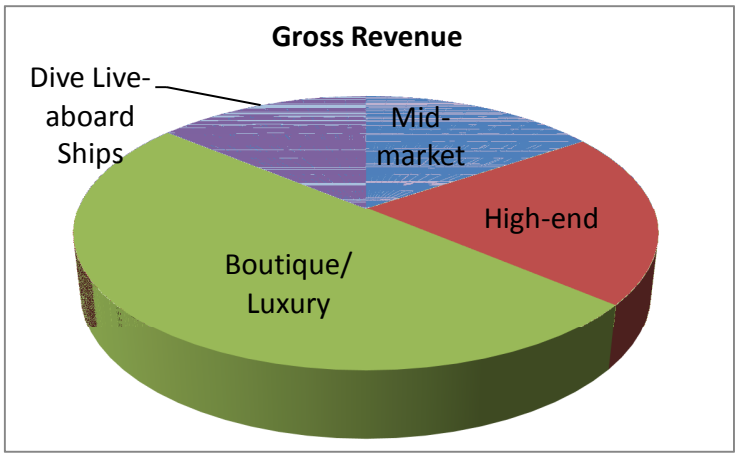

***Figure 3**: Proportions of gross revenue, according to category of tourist provider*

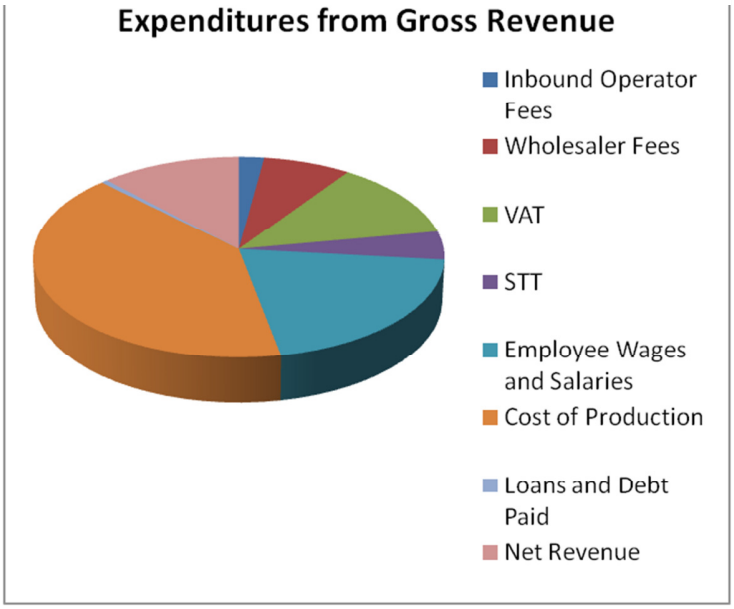

***Figure 4**: Averaged expenditures and net revenue of 16 tourism providers surrounding and utilizing the Vatu-i-Ra Seascape.*

Of gross revenue, the greatest expenditures by tourism providers include the cost of production[10] (41%), employee earnings (20%), and taxes (17%) (Figure 4). The majority of bookings for the tourism providers came through four major wholesalers, travel agents, and inbound operators. These commissions are paid on the all-inclusive bookings. Loans and debt paid in 2013 were only reported by mid-market resorts and represent a low estimation because some tourism providers may be hesitant to disclose this information. Because of this data sensitivity, providers were not asked to report net revenue. It was instead calculated by subtracting provider expenditures from gross revenue. Therefore, the net revenue approximation represents an upper limit, due to the possibility of undisclosed expenditures of the tourism providers.

[10] Includes raw materials and labor

***Table 2**: Tourist expenditures are represented by gross revenue, provider expenses, and net revenue for all categories of providers. Values are in FJD.*

	Guests	Employees	Gross Revenue	Inbound Operator Fees	Wholesaler Fees	VAT	STT	Employee Earnings	Cost of Production	Loans and Debt Paid	Net Revenue
mid-market	2390	285	7,387,100	184,700	591,000	963,500	307,400	1,385,100	2,954,800	266,400	734,200
high-end	26350	218	9,680,300	242,000	580,800	1,392,400	463,300	1,800,100	3,872,100	-	1,329,600
boutique/luxury	5790	214	23,551,300	588,800	1,413,100	3,499,900	1,164,500	4,524,900	9,420,500	-	2,939,600
Dive Live-aboard Ships	1190	50	6,622,100	-	936,400	63,900	225,400	1,859,100	2,896,600	-	640,700
TOTALS	**35720**	**767**	**47,240,700**	**1,015,500**	**3,521,200**	**5,919,700**	**2,160,500**	**9,569,300**	**19,144,000**	**266,400**	**5,644,100**

4. Fisheries

Key Findings

- The annual maximum sustainable total yield (combined reef and pelagic fish) for the Vatu-i-Ra Seascape was estimated to be approximately 5,500 tonnes; the value of this stock is approximately FJ $24,580,600.
- Available inshore fish biomass in the seascape is approximately 95,610 tonnes over 1071 km^2 of exposed and fringing reef.
- Sustainable inshore catch (combined subsistence and commercial) is estimated to be 5,360 tonnes per year, valued at approximately FJ $24,097,900.
- Inshore catch (combined subsistence and commercial) in 2007 was estimated to be at least 6,280 tonnes, an overharvest of 17% above the sustainable yield.
- The upper boundary estimate of offshore harvest for 2007 was approximately 140 tonnes; the value of this stock is FJ $482,700.
- An annual sustainable commercial yield of 2,030 tonnes per year was calculated, valued at FJ $8,987,700 per year.
- The commercial harvest (combined inshore and offshore) in 2007 was 2,360 tonnes, exceeding the annual maximum sustainable yield estimate by 16%.
- Extraction in the seascape is reaching a threshold, and rapid depletion in fish populations is leading to loss in fisheries productivity. The development of the Natovi Fisheries Center poses extreme risk to the sustainability of the local fisheries if sustainable yields are not set or well-managed moving forward.

4.1 Inshore Fisheries

The fishing contribution to GDP in Fiji was at least 1.9% in 2007, during which time coastal (inshore) fisheries comprised 65% of the total value of the fisheries[11]. The Vatu-i-Ra Seascape is amongst the greatest contributors to this coastal fishery productivity, holding some of the highest concentrations of coral reef fish in the country[12].

The available inshore coral reef fish biomass in the seascape was estimated using biomass data collected using underwater visual census methods from 233 sites in the Vatu-i-Ra Seascape (excluding Ovalau, Vatu-i-Ra, and seamount sites) by the Wildlife Conservation Society. The average total fish biomass from these data of 89,272.6 kg/km^2, (standard error 84.32 and standard deviation 1287.14) was multiplied by the total inshore area (exposed and fringing reef) of 1071.02 km^2, providing the total available inshore biomass of approximately 95,610 tonnes.

[11] Gillett, R (2009) Fisheries in the Economies of the Pacific Island Countries and Territories. Asian Development Bank, Manila, Philippines, 521pp

[12] Jupiter, S, Fox, M, Cakacaka, A, Caginitoba, A, Askew, N, Qauqau, I, Weeks, R, Prasad, S, (2009) Building Provincial-level Integrated Coastal Management Plans: Outcomes from the Vatu-i-Ra Seascape Stakeholders Workshop. Wildlife Conservation Society, Suva, Fiji, 46pp

***Table 3**: Estimated annual sustainable yield and value of the stock in the Vatu-i-Ra Seascape.*

	Inshore		Offshore		Combined (Inshore + Offshore)	
	Quantity (t)	Value (FJD)	Quantity (t)	Value (FJD)	Quantity (t)	Value (FJD)
Commercial	1,890	8,505,000	140	482,700	2,030	8,987,700
Subsistence	3,470	15,615,000	0	0	3,470	15,615,000
TOTAL	5,360	24,097,900	140	482,700	5,500	24,580,600

A sustainable inshore yield of 5,360 tonnes/year for the Vatu-i-Ra Seascape was calculated by multiplying the inshore area by the accepted sustainable yield of 5 tonnes/km/year for island coral reef fisheries[13]. It represents 5.6% of the total available inshore biomass, slightly exceeding the 5% annual fish biomass removal rate, which has been suggested to be the sustainable extraction limit before significant structural changes in Fijian reef fish communities are expected[14]. Both of these proxies for sustainable yield are in close agreement, indicating the reliability of sustainable extraction rates. The value of the inshore fisheries yield of approximately FJ $24,097,900 was calculated by multiplying the annual catch limit by the price at market per kg, that fishers receive for B grade fish in late 2012 (FJ $4.50/kg). The inshore fishery value range of FJ $21,420,360 – $29,452,995 for the seascape was similarly determined by using the lower and upper fish market prices of FJ $4.00 and FJ $5.50, for C and A grade fish, respectively.

An inshore catch of 6,280 tonnes in 2007 was estimated for the seascape by using the 2007 combined coastal subsistence and commercial fisheries quantities (26,900 tonnes)[10]. It was calculated by multiplying by 0.2335, the proportion of EEZ inshore areas within the seascape[15]. The estimated inshore catch of 6280 tonnes for 2007 is 17% greater than the sustainable inshore yield of 5360 tonnes/year. Due to the high productivity of the seascape, both the actual annual catch and the sustainable yield may be higher than these averages for the entire EEZ. However, the inshore catch calculation is likely an underestimation because a 2012 study of the reconstructed catch in Fiji estimated that 72.9% of subsistence catches go unreported[16]. Subsistence catches are a significant proportion of total inshore catch, considering that subsistence catches accounted for an estimated 65% of total catches in 2007[10] and 45% of total catches in 2009[17]. These extraction rates emphasize that the seascape is approaching a threshold for impending reef degradation. Therefore the increased fishing pressures, likely associated with the development of the Natovi Fisheries Center, poses extreme risk to the sustainability of local fisheries, if sustainable yields are not set or well-managed moving forward. Improved management in the Vatu-i-Ra Seascape would improve the sustainability of inshore fishing, thereby securing the fisheries for future generations.

[13] Newtonnes, K, Cote, Isabelle, M, Pilling, G, Jennings, S, Kulvy, K (2007) Current and Future Sustainability of Island Coral Reef Fisheries. *Current Biology*: 17:655-658
[14] Jennings, S, Polunin NVC (1996) Effects of fishing effort and catch rate upon the structure and biomass of Fijian reef fish communities. *Journal of Applied Ecology* 33:400-412
[15] Wildlife Conservation Society unpublished data
[16] Zylich, K, O'Meara, D, Jacquet, J, Harper, S, Zeller, D (2012) Reconstruction of marine fisheries catches for the Republic of Fiji (1950-2009). Fisheries Centre University of British Columbia. Working paper #2012-02
[17] DeMers, A, Kahui, V (2012) An overview of Fiji's fisheries development. Marine Policy 36:174-179

4.2 Offshore Fisheries

The 2007 offshore harvest of 140 tonnes for the Vatu-i-Ra Seascape was calculated using known quantities for the EEZ. In this regard, the offshore EEZ total for 2007 of 14,240 tonnes was multiplied by the proportion of the seascape that lies within the total EEZ offshore areas (0.01012) to attain an estimate for the 2007 offshore harvest. The offshore fisheries value of FJ $482,700 in the seascape was similarly calculated by multiplying the 2007 offshore fishery value of FJ $47,714,000 for the EEZ[10] by 1.012%. In these calculations, the assumption is made that harvesting yields are equal per unit area between the seascape and the high seas. However, due to the challenges in navigating interspersed reef in the seascape, the seascape experiences minimal tuna harvest. The vast majority of tuna catch is from outside the seascape, and the harvest and value calculations therefore represent upper boundary estimates. For this reason, the estimated 2007 offshore harvest is considered sustainable. Given the low tuna yield in the seascape, increased protection associated with the improved management of the Vatu-i-Ra Seascape would pose minimal economic impact on the tuna industry with low opportunity cost.

4.3 Commercial and Subsistence Fisheries

Data from 2007 on offshore and inshore harvests[10] were used to estimate the 2007 Vatu-i-Ra Seascape commercial harvest of 2,360 tonnes. To attain these results, the 2007 inshore commercial harvest (9,500 tonnes) and value (FJ $54,100,000) were independently multiplied by the proportion of EEZ inshore areas within the seascape (0.2335). The 2007 offshore commercial harvest (14,236 tonnes) and value (FJ $47,714,000) of the EEZ were independently multiplied by the proportion of the EEZ that the seascape covers (0.01012). The resulting harvest subtotals were added and the value subtotals were added to achieve the total commercial harvest and value.

An additional technique was implemented to complement the method above. Using 2013 fisheries export data from the Fiji Islands Revenue and Customs Authority (FRCA), an average annual 2010-2012 harvest of 600 tonnes and value of FJ $2,420,820 was calculated for the Vatu-i-Ra Seascape. Data from the average of three years on annual harvest (28,932.58 tonnes) and value (FJ $117,085,492) were collected from 27 commercial export companies. These quantities were then multiplied by the proportion of the EEZ that the seascape covers (0.021), providing the estimated commercial catch and value for the seascape. However, FRCA data do not include all commercial companies and catch, and the results of this method therefore only confirm that the initial method is not an overestimate.

While the two methods above provide actual catch, a *sustainable* commercial yield of 2,030 tonnes per year with a stock value of FJ $8,987,000 is calculated for the Vatu-i-Ra Seascape (Table 3). This recommended annual harvest was reached by multiplying the sustainable inshore harvest, previously calculated in this report, by the 2007 proportion of inshore commercial catch[10], then adding the 2007 offshore harvest estimate of this report. The 2007 commercial harvest of 2,360 tonnes, calculated above, exceeds this sustainable yield by 16%. Subsistence quantities and values were determined by using the 2007 proportions of commercial versus subsistence catch[10]. However, while the total sustainable yield for the Vatu-i-Ra Seascape is ecologically grounded, the proportion of commercial versus subsistence harvest is a political matter and beyond the scope of this report; these recommended proportions are based only on the 2007 harvests.

While tuna catch is minimal in the seascape, deepwater snapper are commonly caught around seamounts in the seascape[17] and had a value of FJ $250,000 for the EEZ in 2003. By partitioning this value according to the area of the seascape, the deepwater snapper have a value of at least FJ $2,500, although this value is likely far higher, due to the high concentration of snapper in the seascape. Additionally, the value of snapper has markedly increased between 2003 and 2014.

Given the previous calculations of the Vatu-i-Ra sustainable inshore yield, offshore yield, and the partitioning between sustainable commercial and subsistence catch, Table 3 separates out these sustainable yields accordingly. It also demonstrates that the Vatu-i-Ra Seascape maximum annual sustainable yield is 5,500 tonnes and the value of this stock is estimated at FJ $24,580,600.

5. Potential Mining Impacts

While the ecosystem service values for tourism and fisheries in the Vatu-i-Ra Seascape are apparent, these values may be lost in the event of a disaster. Among possible disasters in the seascape, oil exploration poses a significant threat to ecosystem services. Oil exploration licenses have been granted to approximately 35% of the seascape and oil exploration applications have been made for another 40% of the seascape[18]. Although all measures to prevent an oil spill from an active site are expected to be followed in Fiji, the possibility of a catastrophe cannot be entirely eliminated, as has been evident from numerous international oil spills. The Deepwater Horizon Oil Spill in the Gulf of Mexico on April 20, 2010 resulted in the release of nearly 200 million gallons of crude oil into the marine ecosystems over an area of 128,750 km^2. Virtually all ecosystem services were at least temporarily lost thereafter, due to the closure of fishing, which resulted in the loss of food, employment, and recreation[19]. The impacted area in the Gulf of Mexico is five times the marine area of the Vatu-i-Ra Seascape and a spill much smaller than the Deepwater Horizon Oil Spill could therefore directly impact the entire seascape.

If such an oil spill occurred in the Vatu-i-Ra Seascape, the value loss of ecosystem services would reach US $740 million (FJ $1.353 billion) assuming the same value of ecosystem services as in the Gulf of Mexico EEZ. However, the fisheries productivity and tourism density of the seascape exceeds that of the Gulf of Mexico, and the economic loss could therefore be greater. The value above was calculated by multiplying the value of ecosystem services in the United States Gulf of Mexico EEZ (US $19.7 billion per year)[19] by the proportion: Vatu-i-Ra Seascape area / United States Gulf of Mexico EEZ area (26,584 km^2 / 707,832 km^2).

In addition to the risks associated with oil exploration, land-based mineral extraction poses additional threats to the marine ecosystems of the seascape. A mining lease was granted for extraction of bauxite at Nawailevu, within Bua Province. An environmental impact statement (EIA) is underway[11]. However, only a fraction of the potential loss of ecosystem services is reported in an EIA. For example, strong connectivity exists between upstream terrestrial ecosystem processes and downstream coral reef health. Foresight into the impact of the lime-based runoff on marine seamount habitat in this ridge-to-reef system is therefore required in planning. The economic gains from mining in Fiji need to be balanced against the economic loss from environmental impacts and loss of key ecosystem services. If marine-based oil exploration and land-based mining operations move forward, the bequest values – benefits of the ecosystem that can be preserved for future generations – may be lost. Alternatively, improved management in the Vatu-i-Ra Seascape has the potential to harness the marine and terrestrial ecosystem service values for years ahead.

[18] License map of the Fiji Ministry of Mineral Resources, Nabua Suva
[19] Ocean Studies Board, National Research Council (2012) Approaches for Ecosystem Services Valuation for The Gulf of Mexico After the Deepwater Horizon Oil Spill: Interim Report, The National Academic Press, Washington DC

6. Inshore-offshore Connectivity

Economic benefits from the ecosystem services of the Vatu-i-Ra Seascape will be amplified through integrated management approaches that support linkages between inshore and offshore ecosystems. Throughout tropical islands improved coral reef resilience and fishery productivity is reliant on biomass transfer between inshore nursery habitats, fringing reef ecosystems, offshore areas, and pelagic zones[20]. For example, lagoon protection has been demonstrated to prevent potentially devastating macroalgae on offshore reefs, which often follows disturbances, by supporting the grazing of herbivore fish that move offshore or deeper reefs later in life, to control macroalgae growth[21]. In Fiji, inshore-offshore connectivity in coral reef ecosystems is exemplified by the spillover and larval dispersal benefits around established MMAs, which has resulted in value greater than FJ $8.8 million per year[22]. For similar reasons, it is critical to consider best land management practices to maintain healthy connectivity between land and sea that currently exists in the seascape. These results indicate that policy improvements, including adherence to sustainable yield recommendations in inshore and offshore zones in large-scale MMAs, will maximize the annual value of the fisheries and maintain reef aesthetics to support the tourism industry. It is projected that the sustainable yields can be maintained annually, but if yields in excess of the sustainable yield are extracted, there is a risk of that yields lower than the sustainable yield will be experienced in the following years.

6. Management Recommendations

The role of government, industry, non-governmental organizations (NGOs) and communities is crucial for effective management of the Vatu-i-Ra Seascape, sustainable tourism development, and maintaining productive fisheries. In fact, partnerships between conservation organizations and government to protect coral reefs are not uncommon. The Ministry of Tourism recognizes the value of collaborating with conservation NGOs to improve coral reef conservation to strengthen tourism and fisheries in a win-win situation. For example, the Coral Cay Conservation provided recommendations for a multi-user Marine Protected Area, the value of which the Ministry of Tourism recognized before it committed to restoring coral reef in 2002.[23] Unified efforts between the Ministry of Tourism, Department of Fisheries, industry, NGOs and communities are therefore strongly encouraged in order to ensure that management plans are optimized. If these integrated management plans for the Vatu-i-Ra Seascape are followed, the ecosystem services that support tourism, fisheries, and livelihoods can be protected for future generations.

[20] Mumby PJ, Hastings A (2008) The impact of ecosystem connectivity on coral reef resilience. J of Appl Ecol 45:854-862.
[21] Adam, TC, Schmitt RJ, Holbrook SJ, Brooks AJ, Edmunds PJ, et al. (2011) Herbivory, Connectivity, and Ecosystem Resilience: Response of a Coral Reef to a Large-Scale Perturbation. PLoS ONE 6(8): e23717. Doi:10.1371/journal.pone.0023717
[22] Pascal N, Seidl A (2013) Economic benefits of marine protected areas: case studies in Vanuatu and Fiji, South Pacific. Research report, AFD/IUCN. French Framework Agreement by CRIOBE (EPHE/CNRS), Moorea, French Polynesia
[23] 2007, Fiji Tourism Development Plan: 2007-2016. Department of Tourism

7. Conclusion

The Vatu-i-Ra Seascape is exceptionally valuable in its natural resources that contribute substantially to the Fijian livelihoods and economy. It holds some of the highest biodiversity and concentrations of coral reef and fish in the country. Luxury tourism and highly productive fisheries in the seascape are heavily dependent on this coral reef quality and fish quantity. The estimated gross revenue of tourism providers reliant on healthy coral reef in the seascape is approximately FJ $47,240,700, and the value of the annual maximum sustainable total yield (combined reef and pelagic fish) for the seascape is approximately FJ $24,580,600. However, these benefits from nature to society – ecosystem services – are not guaranteed. Their value can be lost if not properly managed. Poor watershed management and mining can devastate the coral reef, while unsustainable fishing can deplete all future fish stocks. Increased pressure on the reef and fisheries may be added by the Natovi Fishery Center. However, an integrated approach of ridge-to-reef management and improved marine management has the potential to maintain, and even enhance, the value of tourism and fisheries. Concerted efforts between the Department of Fisheries and the Department of Tourism are recommended in order to capture the full value of this ecologically, culturally, and economically rich piece of Fiji: the Vatu-i-Ra Seascape.

Acknowledgements

This report was made possible through the funding and insights of key organizations and the dedicated work of numerous individuals. The Department of Fisheries deserves a special thank-you for their support and time investment. The authors are also grateful for the support from the Department of Tourism. Direct support and collaborations were provided by the Wildlife Conservation Society Fiji. Dr. Sangeeta Mangubhai worked tirelessly to streamline the process and advise the project. Director Dr. Stacy Jupiter gave much of her time to offer direction and provide key information. Mr. Manoa Malani assisted with organizing government meetings, and advising on data availability. Mr. Jacob Salcone provided critical information on the economics of Fiji. Ingrid Qauqau delivered rapid technical expertise on spatial analysis. Lastly, this project could not have been completed without the data kindly provided by anonymous operators and funders.

Appendix:

Tourism Operator Survey

Official use: Date_____ Interviewer_____ Location_____

The Wildlife Conservation Society (WCS) of Fiji is gathering information to protect the coral reef in Fiji, in order to sustain its fisheries and natural beauty. By filling out this questionnaire on the tourism and recreational uses of Fiji's marine waters as accurately as possible, you will help WCS and the residents of Fiji to attain the shared goals of maintaining productive marine ecosystems.

Full name _____ Name of business_____
Address of Business_____

(Please circle answers to multiple choice questions or fill in the blank)

1. In which province(s) does your business operate?
   Circle all that apply: Lomaiviti Tailevu Ra Bua
   Other (*please list*): _____

2. In which location, or near which of the following locations, does your business operate?
   Circle all that apply : Vatu-i-Ra Island Moon Reef Viwa Island Namenalala Islands
   Other (*please list*): _____

3. Please circle the marine features that your business depends on:
   mangroves seagrass intertidal areas coral reefs sand banks

4. What percentage of your guests are from:
   a. Fiji: _____% (recreation)
   b. Outside Fiji: _____% (tourism)

5. What percentage of your total number of guests have:
   a. Experiences that are enhanced by the presence of the coral reef?
   _____%
   b. A primary purpose in visiting your business that is associated with the coral reef?
   _____%

6. Please rate the impact that that a moderate decline in coral reef health would have on your business (0 = very low, 1 = low, 2 = medium; 3 = high, 4 = very high)
   Circle : 1 2 3 4 5

7. Rate the threat that overfishing poses to the coral reef in your area and your business (0 = very low, 1 = low, 2 = medium; 3 = high, 4 = very high)
   Circle : 1 2 3 4 5

8. Rate the threat that climate change poses to the coral reef and your business (0 = very low, 1 = low, 2 = medium; 3 = high, 4 = very high)
   Circle : 1 2 3 4 5

9. Please provide estimates for the following revenue characteristics of your business for the year 2013 in Fijian dollars:

	# of guests	# of employees	Gross Revenue	Inbound operator fees	Whole-saler fees	VAT	STT	Cost of production*	Additional costs Please list: _____	Net revenue (profit)
Charter boat fishing										
Whale/dolphin watching										
Diving										
Snorkeling										
Sailing										
List other marine activities										
List other marine activities										
List other marine activities										
Total for your entire business ^										

*Includes material costs, employee wages, and third-party costs
^Includes non-marine activities and services, not listed above, as well

Thank you very much for your time during this questionnaire. Your responses are greatly appreciated.
For further information, please contact Brian Kastl (kastlb@aplp.eastwestcenter.org).