Food and Agriculture Organization of the United Nations

Feasibility Study - Appendix 10:

An economic evaluation of the coral reef ecosystem in Fiji

For the GCF-FAO Project "Forest Landscape Restoration for Climate Benefits and Resilience (Fiji FLR)"

Contents

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1. Introduction

Coral reef and coastal ecosystems are considered one of the most productive and economically valuable ecosystems on Earth, providing habitat for a highly diverse species assemblage and livelihoods for the population (Dalzell et al. 1996, Roberts et al. 2002). As the most biodiverse of marine habitats, coral reefs provide a wide range of ecosystem services, including provisioning (e.g., fish), regulating (e.g., coastal protection from tropical storms), cultural (e.g. opportunities for recreation and tourism) and supporting (e.g., Carbon cycle, biodiversity) ones (Lachs and Oñate-Casado 2020). The economic benefits that come from reef ecosystems accrue to local economies and citizens around the globe. Locally, reefs support fisheries, attract scuba diving and snorkelling tourism, are a source of calcium carbonate, and provide important shoreline protection. Globally, the reef is valued for its role in the carbon cycle, for its inherent existence value, and the consumer surplus enjoyed by scuba divers (Pendleton 1995).

This is particularly true in Fiji (O'Garra 2012) where about 90% of the population lives on or near the coast (APN, 2002) and for which tourism represents a fundamental contribution to its economic development (Gassner et al. 2019, Gonzalez et al. 2015).

The tourism industry based on recreational activities such as snorkeling, diving, whale watching, and recreational fishing has been growing in the Pacific islands (e.g., see Asafu-Adjaye and Tapsuwan 2008; Young et al. 2015; Chen et al. 2016). Over the last two decades, tourism has become one of the key drivers of economic growth and sustainable development in many Pacific Island countries (PICs), most notably Fiji, Cook Islands, Vanuatu, and Samoa (Harrison and Pasad 2013) and the importance of tourism to the Fiji economy is unquestionable (Prasad and Narayan 2003; Prasad and Tisdell 2006). Fiji is the largest tourism destination in the South Pacific (Becken 2004, WTTC 2001).

The tourism sector has been a key driver of socioeconomic progress in Fiji Islands since the 1980s (Singh et al. 2021). It is currently the major contributor to national economic development. Indeed, while agricultural sector (including fishery) accounts for 14.5% of GDP, and industry[1] for 16.9%, the services sector (which includes tourism)[2] represents 53.8% of GDP[3].

Fiji is considered relatively well developed in terms of infrastructure and financial services (Kumar et al. 2017). There are 395 licensed hotel properties listed by the Fiji Department of Tourism (2016) ranging from two-room homestays, small island resorts, city, and conference hotels, to large coastal resorts (Mangubhai et al. 2020). Foreign operation of tourist accommodation is pronounced, and international chains are dominant at the upper levels of accommodation (Harrison and Pasad 2013). Fiji's tourism industry and marketing efforts rely heavily on the perception of a pristine coral reef and coastal environment. According to national statistics, 75% of visitors to Fiji swim and

[1] Industry (including construction) corresponds to ISIC divisions 05-43 and includes manufacturing (ISIC divisions 10-33). It comprises value added in mining, manufacturing (also reported as a separate subgroup), construction, electricity, water, and gas.

[2] Services correspond to ISIC divisions 50-99 and they include value added in wholesale and retail trade (including hotels and restaurants), transport, and government, financial, professional, and personal services such as education, health care, and real estate services.

[3] https://www.tradeclub.standardbank.com/portal/en/market-potential/fiji-islands/economy#:~:text=The%20agricultural%20sector%20accounts%20for,lives%20below%20the%20poverty%20line.

60% snorkel in the sea fronting their selected resorts, and 12% of visitors specifically visit to go SCUBA diving (Ministry of Industry, Trade and Tourism 2021).

Coastal (inshore) fisheries[4] comprise 65% of the total value of the fisheries (Gillet 2009). They are vital to the economy of Fiji as it is also a source of income for many local communities (Kitolelei et al. 2011). However, despite numerous studies of Fiji's reef fisheries, the status of reef-associated fisheries at the national level is still uncertain due, mainly, to the lack of dependable data on the subsistence fisheries (Lydia et al. 2009).

Coral reefs and the associated ecosystem (e.g. mangroves) offer physical protection against coastal floods. Coastal areas are of vital importance to Fiji society and its national development. A large proportion of Fiji's coastal villages have access to and utilize mangrove areas. These communities have a significant dependence on mangroves. (Hughes et al. 2003).

There is a growing awareness that the region's reef resources are under stress and that fishery production is drastically declining (Kronen 2007). Coral reefs are under pressure from a range of anthropogenic activities degrading the habitats (Wenger et al. 2020), among which a strong relationship between land-clearing (deforestation) and sediment runoff exists (Delevaux et al. 2018; Kroon et al. 2012). Degraded coral reef ecosystems yield limited goods and services, which is expected to have significant socio-economic impacts on isolated tropical island communities with strong reliance on coral reefs (Turner et al. 2007) such as Fiji Islands.

Identification and determination of values and benefits at the various scales involved are crucial to the development of much needed sustainable management strategies and in the identification of useful performance indicators (Ahmed et al. 2004).

The aim of this study is to provide inputs towards the economic evaluation of the coral ecosystem services in Fiji and of the possible losses associated to their degradation caused by deforestation, runoff, and sedimentation, with a main contribution related to the loss of economic value of touristic activities in the area.

The work is structured as follows. In the next paragraph, we summarize the findings of a literature review on the the effects of forest degradation, deforestation, and the resulting sedimentation on the loss of coral ecosystems and, consequently, on tourism, fishery, and coastal infrastructure. The methodology and the data used for conducting the analysis presented in this brief are reported in section 3. The analytical results can be found in section 4. The conclusions in section 5.

2. Literature review

Sedimentation from logging activities, smothers corals as it prevents the symbiotic algae and the coral polyps from capturing sun light and plankton respectively — their primary sources of energy and nutrition (Cesar and Chong 2004). Several studies have demonstrated the effects of forest degradation, deforestation (and the resulting sedimentation) on the damage of coral reef and the loss of the associated ecosystems, particularly in the context of Pacific islands, with socio-economic implications (tourism, fishery, coastal management).

[4] In this work we only consider inshore fisheries. Offshore fishery is not considered here since it is not directly related with the status of the coral reef.

Using a case study in the Solomon Islands, Wenger et al (2020) found that sediment runoff from current logging activities threatens the functional integrity and ecosystem services provided by coral reefs (for 89% of coral reef area), causing reductions in live and branching coral cover and increases in turf algae, with loss of ~25% of subsistence fishing.

Delevaux et al. 2018 developed a linked land-sea modelling framework based on remote sensing and empirical data, coupling sediment export and coral reef models at fine spatial resolution; and applied to a case study in Fiji. They found that corals (and their ecosystem) were negatively related to sediment exposure and that conserving forest in priority land areas of watersheds maintain good water quality essential for healthy coral reefs (Delevaux et al. 2018).

[……..]

There are many examples of economic analyses of coral reef ecosystems. Many focused on a limited number of benefits derived from marine ecosystems, primarily those that are relatively easy to measure and convey, such as recreation opportunities in protected areas, and benefits that are ascribed to easily measured market indicators (e.g., fishery). Estimates of non-use values of marine ecosystem goods and services are few (Schuhmann and Mahon 2015).

Cesar et al. (2003) have provided insights on the relative importance of four major ecosystem services (biodiversity maintenance, coastal protection, tourism, and fisheries) generated by coral reefs globally, which were estimated to be worth US$ 30 billion in net benefits in goods and services to world economies annually. Looking at the specific case of Fiji Islands, Gassner et al. (2019), also based on Gonzalez et al. (2015), estimate that the value such benefits amount at about 630 million US$ per year, mostly coming from tourism (80%).

O'Garra (2012) looks at coastal protection and fishery benefits and presents estimates of the economic value of such services in the Navakavu fishing ground (Suva). Using catch surveys, a contingent valuation survey and secondary data sources, the value of fisheries, bequest value and coastal protection function provided by the coral reefs and mangroves within this area are estimated to provide net benefits of about 1.8 US$ million per year. The coastal protection provided by the coral reefs and mangroves makes up the largest component of the total economic value (55%) followed by fisheries (44%).

Kastl and Gow (2014) estimate that the monetary values of tourism (tourist expenditures) and fisheries production (inshore/offshore commercial fishing), associated with the coral reef in the Vatu-i-Ra Seascape of Fiji[5] is about 31.6 million US$ per year (66% from tourism and 34% from fishery). The value for tourism (gross revenue) is associated with charter boat fishing, diving, and other reef-related activities. The value of fisheries production includes offshore catch by fishers operating under offshore fishing permits, and artisanal catch in the inshore and offshore areas.

Pascal et al (2016) estimate the economic value of the physical protection against coastal floods through the annual repair costs of assets (avoided damage cost approach). Devi

[5] The Vatu-i-Ra Seascape in Fiji is a region of valuable natural resource abundance that supports livelihoods and the Fiji economy. It is an area of 7,500 square mile mosaic of forests, mangroves, seagrass meadows, reefs, deep channels, and seamounts, including four provinces of the main islands of Fiji (Viti Levu and Vanua Levu).

(2002) assesses such ecosystem service value through the estimation of the costs for the mangrove ecosystem restoration.

[……..]

3. Methods and data

3.1 Methodology

The benefits of implementing sustainable management of forest landscapes in Fiji are proxied by the avoided loss of coral ecosystem value. The economic value of an ecosystem is defined as the total value of the goods and ecological services that an ecosystem provides which need to be quantified and monetised. To estimate the economic value of coral reefs and the associated ecosystem services, we refer to the neo-classical foundations of economic value and its relationship with willingness to pay and consumer surplus (see Pearce and Turner 1990). Natural habitats, or ecosystems, can be valued using a 'Total Economic Value' (TEV) approach.

The TEV of a natural resource is composed by the sum of use value (composed of direct and indirect use value plus option value) and non-use value (composed of bequest and existence value). The direct use value reflects the value obtained through a removable product in nature, while non-use value corresponds to the value of using a natural resource without its removal from the environment. The option value reflects the potential future ability to use a resource even though the likelihood of future use is very low. The bequest value linked to the preservation of the environmental good to the benefit of both present and future generations. The existence value is the value placed on a resource that will never be used (it derives from the value of satisfaction from preserving a natural environment).

Thus, the general formula for the TEV's components looks like this:

[1] TEV= [(direct use + indirect use + option) value] + [(bequest + existence) value]

With reference to the economic value of coral reefs, according to Cesar (2002): (i) direct use values come from both extractive uses (fisheries, pharmaceuticals, etc.) and non-extractive uses; (ii) indirect use values are represented, for example, by the biological support in the form of nutrients and fish habitat and coastline protection; (iii) the concept of option value can be seen as the value now of potential future direct and indirect uses of the coral reef ecosystem (e.g., potential of deriving a cure for cancer from biological substances found on reefs; (iv) the bequest value is related to preserving the natural heritage for generations to come where the value today is derived from knowing that the coral reef ecosystem exists and can be used by future generations; (v) the existence value reflects the idea that there is a value of an ecosystem to humans irrespective of whether it is used or not.

In line with Cesar (2002), due to estimation difficulties, it would be possible to assess only the following values: (i) direct use value, obtained as sum of the extractive use (fishery resources can be harvested and sold, creating value added) and the non-extractive use (tourism); (ii) indirect use value consisting of the physical coastal protection (the coastal marine area enables protection of the physical resources in proximity of the coast).

The biggest value (80% according to the literature) is represented by the non-extractive use (i.e., tourism) which is also the most important contribution to the national economy

and GDP. Given the importance of Fiji as global touristic attraction, we consider international touristic flows and its economic value, proxied by the balance between the international tourism receipts (inbound tourism) and the international tourism expenditure by residents (outbound tourism) (e.g., see Kester 2005). This value is assessed using available primary data on international tourism flows. The variable chosen to quantify this value is represented by the earnings gained from the touristic activity.

The remaining 20% of the ecosystem value is determined by fishery production and coastal protection. The corresponding economic values are estimated using secondary data and previous estimates available in the literature.

The year 2017 is chosen as reference year for this analysis. Value data are converted into constant US$ 2017 using US inflation rates for the years considered.

3.2 Data

A) TOURISM

Touristic flows have been steadily increasing over the past 20 years (Ministry for Industry, Trade and Tourism 2021).

Data about the number of arrivals are available from the Fiji Bureau of Statistics. By considering the pre-covid period to avoid the distortions to touristic flows caused by the pandemic, in 2019, Fiji received 894,389 visitors. Such number is in line with data from the Yearbook of Tourism Statistics (Compendium of Tourism Statistics and data files) of the World Tourism Organization Data according to which arrivals in 2019 were around 969,000 (see Table 3). The arrivals include cruise tourism but do not include transit passengers.

In 2017, holiday/vacation visitors made up 69% of arrivals, highlighting the importance of holiday visitors to Fiji's tourism industry. Also, most Fiji's tourism earnings were from 'holiday' visitors, accounting for 73% of all spending. Indeed, holiday visitors are a valuable market for Fiji, as their spending is higher than the average for all visitors (Ministry for Industry, Trade and Tourism 2021). Data about tourism earnings from the Fiji Bureau of Statistics are reported in **Table 1** and **Table 2**. The years 2012-2019 have been taken into account for the analysis (pre-pandemic).

Table 1 – Evolution of tourism in Fiji, earnings by year, 2012-19

Evolution of tourism in Fiji, 2012-2019									
Variable	Unit of measure	2012	2013	2014	2015	2016	2017	2018	2019
International tourism, earnings	current million US$	572	580	665	741	802	847	885	909
Source: our elaborations using data from the Fiji Bureau of Statistics									

Table 2 – Value of tourism in Fiji, average earnings 2017-19

Value of tourism in Fiji, average 2017-19		
International tourism, earnings	million constant US$ 2017	860
Source: our elaborations using data from the Fiji Bureau of Statistics		

Data about international tourism receipts and expenditures are available from the World Tourism Organization. They are reported in **Table 3** and **Table 4**. Following Kester

(2005), the economic value of internation tourism is proxied by the value of the international tourism balance, computed as difference between international tourism receipts (*expenditures by international inbound visitors)* and expenditures (expenditures of international outbound visitors in other countries), including *same-day visitors*[6]. Both receipts and expenditures *include payments to national carriers for international transport, other prepayment made for goods or services received in the destination country, and, except when these are important enough to justify separate classification. For some countries they do not include receipts for passenger transport items*'.

Table 3 - Evolution of tourism in Fiji, arrivals, receipts and expenditures by year, 2012-19

Evolution of tourism in Fiji, 2012-2019									
Variable	Unit of measure	2012	2013	2014	2015	2016	2017	2018	2019
International tourism, number of arrivals	000 people	741	769	781	869	963	1027	1058	969
International tourism, receipts	current million US$	989	966	1,091	1,094	1,149	1,243	1,370	1,345
International tourism, expenditures	current million US$	110	105	99	115	119	138	160	174
International tourism, balance	current million US$	879	861	992	979	1,030	1,105	1,210	1,171
Source: our elaborations using World Tourism Organization data									

Table 4 - Value of tourism in Fiji, average 2017-19

Value of tourism in Fiji, average 2017-19		
International tourism, balance	million constant US$ 2017	1,136
Source: our elaborations using World Tourism Organization data		

In this study, we use the gross tourism earnings (gross revenue) as proxy of the value of the tourism and recreation ecosystem service from coral reef in Fiji. 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 (see Kastl and Gow 2014, Korovulavula et al. 2008), the value of recreational services provided by coral reefs throughout Fiji ranges 133.4-603.2 million constant US$ 2017. Considering an extension of the coral reef area equal to 6,704 Km^2, those values correspond to 19,895- 89,977 constant US$ 2017 per sq Km.

[……..]

B) Fishery

The official statistics published by the Fiji Bureau of Statistics (FBOS) showed that fishing and aquaculture contributed FJD 61.1 million to Fiji's real GDP in 2020, a decline about 8% in comparison to 2019 contribution. The sector also contributed to GDP growth in the manufacturing industry in 2020. According to Ministry of Fisheries (2021), in 2020, the combined fisheries-related activities within the fisheries sector contributed about 30 million US$, corresponding to 0.8% of the national real GDP. Since inshore fishery is found to contribute 65% to the economy of the fishery sector, the economic value of the inshore fisheries production amounts at 19.5 million US$ in 2020.

[……..]

[6] See https://data.worldbank.org/indicator/ST.INT.ARVL?locations=FJ

C) Coastal protection

In line with Devi (2002), we estimate the coastal protection ecosystem value of coral reef using the restoration costs as a proxy variable using the results of a study from Mazzoli (2023).

With reference to the case of Vanuatu, which can be considered an environmental and socio-economic context like Fiji, Mazzoli (2023) estimated the restoration costs per type of ecosystem in Vanuatu. He employed the benefit transfer technique to quantify the ecosystem benefits, transferring estimates and average (or median) values from past studies to the evaluation site. He found that the economic value of coastal protection from coral reefs amounts at 645 US$ per ha and per year (in 2021). The corresponding value of coastal protection in Fiji has been estimated using the benefit transfer method and considering the coral reef area of 6,704 sqKm.

[……..]

4. Preliminary results

Some preliminary findings about the TEV of coral reef in Fiji are summarised in **Table 5**.

Table 5 – Total economic value of coral reef in Fiji

Total economic value of coal reef in the Fiji Islands					
TEV components	Year	Unit of measure	Lower bound	Upper bound	Average
International tourism earnings	2017-19	million constant 2017 US$	133.4	603.20	368.3
Inshore fishery	2020	million constant 2017 US$			18.5
Coastal protection	2021	million constant 2017 US$			390.79
Total		million constant 2017 US$			777.5
Source: our elaborations					

To assess the value loss caused by coral reef degradation to international tourism earnings we look at the % of area affected by sedimentation. Such area can be quite vast, as it was demonstrated in the Solomon Islands by Wenger et al (2020) [89% of the area was damaged]. The effect of the coral reef area damaged on the touristic activity should be quantified. However, it is plausible to assume that touristic flows will drastically be reduced, as effect of the ecosystem degradation. Similarly, to assess the value loss caused by coral reef degradation to coastal protection we look at the % of area affected by sedimentation and at the costs for restoring such area. However, more. data would be needed to conduct such assessments. To assess the value loss caused by coral reef degradation to international tourism earnings it is possible to consider a 25% loss, as in Wenger et al (2020), i.e. about 4.6 million US$ (constant 2017).

[……..]

5. Conclusions

Conclusions and recommendations for the EFA

[……..]

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Annex

Organized database that includes the collected data and displays the respective estimates

See separate file