



FIJI CORAL REEF RESILIENCE PROJECT

Annex 3: Economic and Financial Analysis

21 July 2026



GREEN
CLIMATE
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1 Purpose and Approach

1.1 OVERVIEW

This report outlines the Economic and Financial Analysis (EFA), which forms an input to the Funding Proposal to the Green Climate Fund (GCF) for the Fiji Coral Reef Resilience (CRR) Project. The EFA aims to determine the relative viability and efficiency of the interventions considered in the Funding Proposal, and demonstrates how the project's financial and economic performance contribute to the six GCF investment criteria.

The **financial analysis** serves to assess the financial profitability of the activities under consideration in the Funding Proposal with and without GCF support. As such, the focus is on examining the net financial cashflows (purely monetary) of the project investment and the operational sustainability of the interventions, and is conducted from the perspective of the project or a single revenue-generating party/entity (e.g. utility company, household).

The following indicators represent the key outputs of the financial appraisal:

- **Financial Net Present Value (FNPV)** – the discounted flow of expected costs deducted from expected return.
- **Financial Internal Rate of Return (FIRR)** – the financial return on the project. The financial rate of return should be above the cost of capital (discount rate).
- **Financial Net Benefit Cost Ratio (FBCR)** – the ratio of the present value of the returns on the project set against the project's costs.

The **economic analysis** is conducted from the perspective of the economy/society as a whole to assess whether the project will have a net positive socio-economic impact. As such, the economic appraisal assesses project costs and benefits beyond financial returns alone and aims to do so at prices equal to their real value to society rather than financial/market prices.

The following indicators represent the key outputs of the economic appraisal:

- **Economic Net Present Value (ENPV)** – the discounted flow of expected investment and operating costs deducted from expected benefits (return)
- **Economic Rate of Return (EIRR)** – the economic return on the project. The economic rate of return should be above the cost of capital (discount rate)
- **Economic Benefit Cost Ratio (EBCR)** – the ratio of the present value of the economic benefits of the project set against the project's costs.

Both the economic and financial analyses take the form of cost-benefit analyses (CBA)¹, carried out within the context of a with- and without-project basis, and hence considers incremental values for the cost and benefits in order to understand whether the proposed project investments are profitable for the intended beneficiaries and will be beneficial for society as whole.

¹ CBA is a systematic approach to evaluating proposed investments in terms of benefits provided relative to costs incurred so as to promote efficient and effective allocation of financial resources, rank alternatives, or report the expected net benefit of a single project (FAO, 2018).

1.2 CBA METHODOLOGICAL STEPS

The following key steps were applied in undertaking the CBA:

1. **Definition of an appropriate baseline (counterfactual) or ‘without intervention’ scenario against which the impacts of the proposed project interventions can be compared over their lifetime.** The baseline is necessarily dynamic, i.e., it recognises that the current situation will not remain static in the absence of the project given the influence of climate change as well as other factors such as population change and socioeconomic conditions. The ‘without intervention’ scenario therefore estimates the annualised costs of losses and damages (including continued flood damages, etc.) incurred as a result of current and projected climate events as well harmful human/economic activities.
2. **Estimation of the costs (including externality effects) associated with each of the types of interventions identified.** The analysis considers the whole life costs associated with each type of intervention including:
 - The capital costs (CAPEX) of providing the necessary infrastructure, or acquiring equipment, technologies and expertise for the construction or implementation of measures;
 - Ongoing operation and maintenance (OPEX) costs;
 - Any projected unintended environmental and social costs (negative externalities) associated with the implementation of the proposed interventions where these are foreseen, are significant (i.e. would have a discernible impact on the decision metrics (Net Present Value, Internal Rate of Return, or Benefit-Cost Ratio) and can be reliably quantified and valued.
3. **Estimation of the financial, economic, social and environmental benefits of the proposed interventions.** Benefits have been quantified and valued in monetary terms as far as possible and where it is proportionate to do so, based on a combination of the evidence and analysis presented elsewhere in the Feasibility Study, a review of the relevant literature – including datasets produced and/or collated by relevant international agencies and institutions such as the World Bank – technical studies to inform the specification of cause-effect relationships (‘production functions’), and economic evidence used to inform the monetary valuation of impacts and effects. In cases where it has not been possible to quantify and value certain material benefits (e.g. where the detailed data necessary to derive estimates is not available), these benefits (and their likely significance) have been described in either quantitative (where possible) or qualitative terms.

It is anticipated that the proposed EbA and GI interventions under consideration will give rise to a range of market and non-market benefits and co-benefits. Market benefits – valued using established market prices – include:

- Increases in income associated with enhanced inshore fishery productivity,
- Income derived from the harvesting, sale and/or use of other provisioning services such as timber and non-timber forestry products from mangrove areas, and

- Enhanced tourism potential from restored areas (mangroves and coral reefs)
- Avoided coastal, fluvial and pluvial flood damages to people, property, agricultural land and infrastructural assets,
- Avoided treatment/remedial costs associated with reducing sediment in river systems.

Non-market benefits include:

- Reduced impacts on ecosystems and the services and benefits they deliver such as carbon sequestration, provision of habitat for wildlife, and non-use benefits (e.g., bequest and existence values).

Non-market benefits are more challenging to value as they rely on scientific understanding and modelling of cause-effect relationships as well as an understanding of local preferences (demand) for the services and benefits in question. The non-market benefits have been quantified and valued as far as possible with reference to values derived in other studies in similar contexts elsewhere, where available and relevant.

Benefits that cannot be monetised (but that can still be described qualitatively to inform decision-making) include but are not limited to: seabed mining, sand and coral aggregate; reduced shoreline erosion; bioprospecting value; reduced heat stress, marine heatwaves and acidification²; food security associated with increased fish harvests; research and education value; land value uplift

For a summary of the valuation basis and accompanying assumptions for all modelled benefits, see Section 3 below.

4. **Discounting and application of the appropriate decision rules.** The costs and benefits have been estimated over the assumed life of the project (30 years), and net benefits have been calculated as the difference between the 'with intervention' and 'without intervention' scenarios converted to measures of Net Present Value, Internal Rate of Return and Benefit-Cost Ratio using appropriate discount rates. The 30-year assessment period is considered sufficient to allow appropriate comparison of options, bearing in mind that many of the costs will be incurred upfront while some of the benefits may take longer to be realised which is especially the case for nature-based solutions.
5. **Sensitivity analysis.** To account for risk and uncertainty, sensitivity analysis has been performed to test the degree to which outcomes change in response to variations in the underlying assumptions, focusing on key input variables with large uncertainties. These include the discount rate, average flood damage values, changes in fish yields, sedimentation remedial (dredging) costs, the shadow price of carbon, the change in tourism visitation rates based on improvements to coral reef health, and the number of beneficiaries under Component 3.

For the purposes of the economic and financial analyses, consideration has also been given to distributional and equity effects, recognising that some costs and benefits may fall more heavily on certain populations than others.

² The impact of climate change tipping points may render the modelled CBA results null.

1.3 CONCEPTUAL UNDERSTANDING UNDERPINNING THE CBA

Fiji's marine, coral reef and coastal ecosystems are vulnerable environmental resources that provide significant economic goods and services. The health of these ecosystems is critical to human well-being; they contribute to the livelihoods, climate resilience and health of millions of people. By accounting for these ecosystem values in management decisions, we can sustain their flow of goods and services in the interest of current and future generations.

Evaluating the economic impacts of marine and coastal management interventions necessitates connecting biophysical processes with the human benefits derived from marine and coastal ecosystems. This connection is effectively framed through the concept of ecosystem services, which refers to the outputs of ecosystems that provide benefits to people (TEEB, 2010). Ecosystem services encompass both “final” goods and services directly enjoyed by people—such as coastal protection and the intrinsic value of biodiversity—and those that serve as inputs in the production of “final” goods, such as wild-caught or farmed fish. Economic and financial analyses of ecological impacts typically focus on quantifying the value of these “final” goods and services. By employing the ecosystem services framework, a clear distinction is drawn between ecosystem functions (underlying processes) and the benefits they provide to humans. The economic and financial analyses conducted in this CBA aim to value the latter.

Using the concept of ecosystem services, the assessment of the impacts of marine and coastal management interventions on economic welfare requires that the impact pathway is understood - that is, the logical pathway linking (1) socio-economic activities and climate change, (2) impacts on the stock of marine ecosystems, (3) changes in the provision of ecosystem services (the flow of input into production and consumption), and finally (4) impacts on human welfare (see Figure 1-1). Note that each of these components in themselves are complex research topics that are characterised by varying degrees of scientific understanding and uncertainty.

The following sections outline the key assumptions for the economic and financial analyses, the assessed benefits and costs, and the modelled CBA results. The report concludes with a discussion and recommendations.

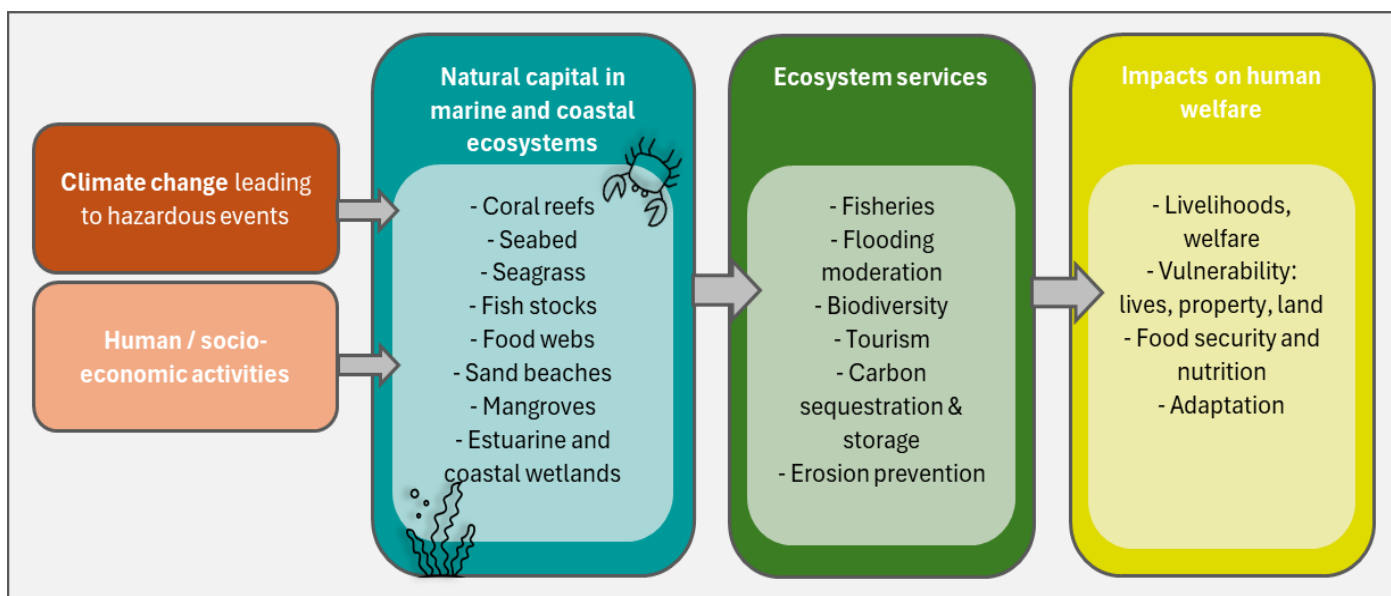


Figure 1-1: CBA conceptual framework

2 Key Assumptions

The CBA is premised on several key input assumptions. These are drawn from technical findings of the Feasibility Study and other relevant project reports, empirical observations in the project area, and peer-reviewed publications/international benchmarks. The table below offsets out the key assumptions underlying the CBA.

Table 2—1: Key CBA assumptions

Indicator	Value	Source, assumptions
General		
Appraisal period	30 years	Wide range (20-100 years) found in the literature. 30 years assumed to be conservative estimate, in line with the rate used in several of the most relevant studies reviewed, but sufficiently long to capture the benefits of NBS..
Project (appraisal) start year	2026	Internal project team discussions: expected inception (planning) Q2 2026
On-the-ground implementation start year	2028	Internal project team discussions: EbA and GI interventions expected to start in early 2028 (implying benefits can start to accrue in 2029).
Benefit accrual start year	2029	
Constant Versus Current Prices		All prices are given in <u>current</u> terms for the financial analysis and <u>constant</u> terms for the economic analysis, as per standard practice
Economic assumptions		
Social discount factor	10%	Discount rates used in marine resource valuations range between 5% and 15% (Gustavson, 2000), whilst the most commonly used discount rate for environmental and development projects throughout the South Pacific is 10% (Holland, 2008). This study will therefore present results using a 10% discount rate. This is at the top end of the range of discount rates applied in other approved GCF Funding Proposals in the region ³ .The sensitivity analysis is then run using discount rates of 3% and 15%.
Financial assumptions		
Financial discount rate	5.45%	Reserve Bank of Fiji ⁴ . Average commercial bank lending rate over 5 period from Jan 2020 to Nov 2024. This has been used as a proxy for the weighted average cost of capital (WACC)
Inflation rate	1.92%	Sourced from the World Bank Databank . Average value over 10-year period to 2023.
Exchange rate (USD:FJD)	2.24	Average rate over 180 days of USD FJD historical data from 08/06/2024 to 03/12/2024; sourced from: https://www.exchangerates.org.uk/USD-FJD-exchange-rate-history.html

³ For example, the recently approved Tonga Coastal Resilience Project (FP234) used a rate of 6%; the Building a Healthy and Resilient Cook Islands Community Project (SAPO34) used a rate of 3%, while projects in Tuvalu (FP015) and Samoa (FP037) used rates of 10%.

⁴ <https://www.rbf.gov.fj/statistics/economic-and-financial-statistics/#1595821677538-f2b8fb22-5259>

3 Key Benefits

The key benefits included in the economic and financial analyses are outlined in Figure 3-1 below and described in detail in the section that follows. The scope of the benefits assessment was determined through mapping the impact pathways associated with the proposed interventions under each of the project components, accounting for positive and negative externalities. These were then prioritised based on their relevance to the project aims and expected impacts and outcomes (as reflected in the Theory of Change), their grounding in existing literature and industry best practice, and, most importantly, the availability and quality of required associated input data. As noted in Section 1.3, benefits are valued in terms of final goods and services to humans rather than changes in the quality or quantity of ecosystem functions (underlying processes).

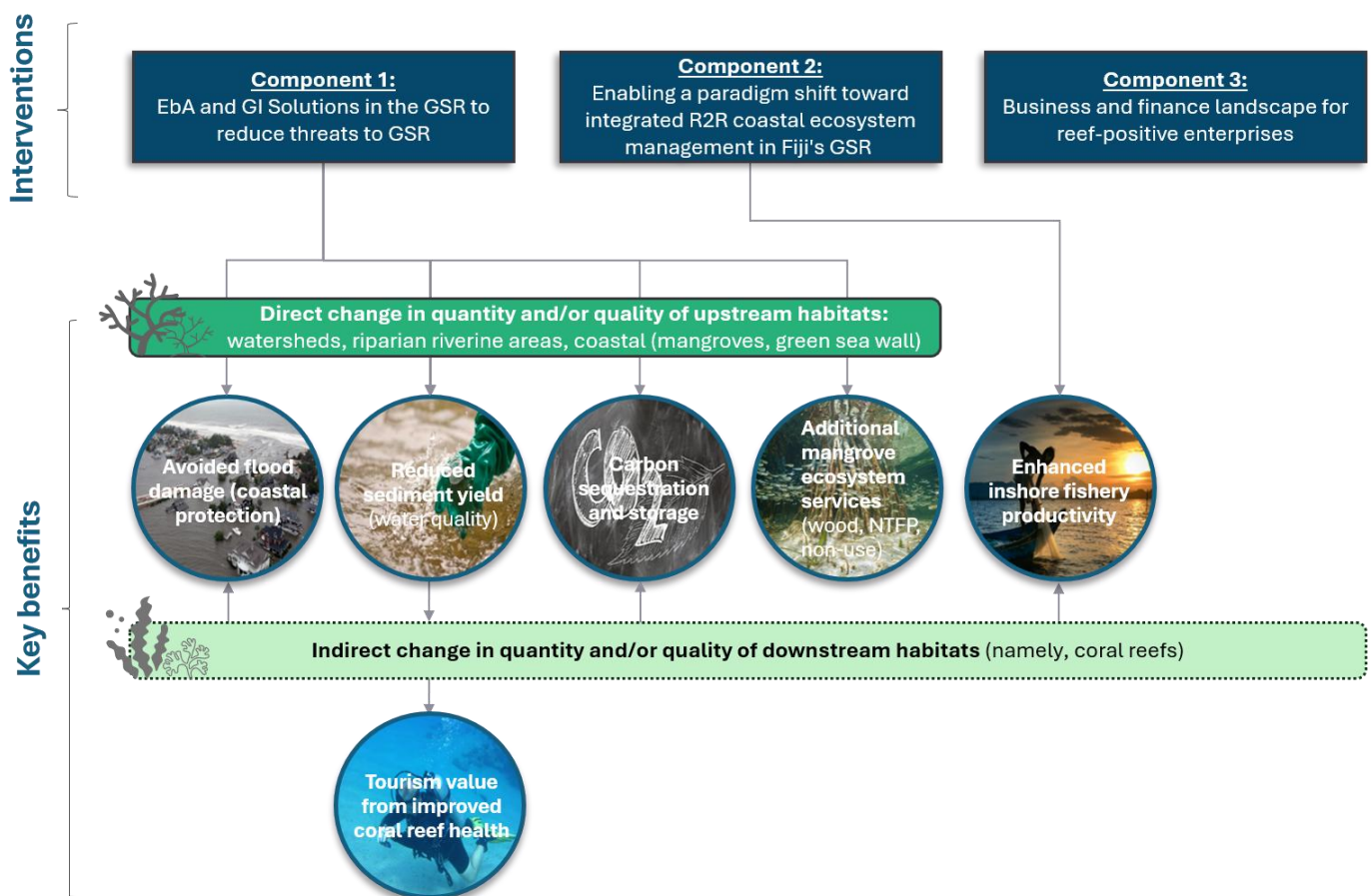


Figure 3-1: Overview of key benefits

Several additional benefit flows have not been quantified due to data limitations or incompatibility with the core aims of the project and project scope. These include, but are not limited to reduced shoreline erosion, induced income effects associated with Component 3, bioprospecting value, mitigation of heat stress, marine heatwaves and acidification, food security from increased fish harvests, research and education value, land value uplift, and various indirect benefits arising from reef-positive outcomes under Component 3. Instead, these benefits are assessed qualitatively in Section 3.3. While not included in the quantitative economic or financial analyses, they remain integral to understanding the project's overall rationale and viability.

3.1 ECONOMIC BENEFITS

3.1.1 Avoided flood damages

Benefit description

The restoration of coastal mangrove areas (EbA) and the construction of green seawalls (green infrastructure) is intended to offer critical coastal protection from flooding. The economic value of this benefit is assessed here as the avoided cost of flood damages to key assets, including housing and infrastructure, provided by the interventions compared to a no-intervention baseline. These benefits are not included in the financial analysis since they are public or societal benefits rather than direct private monetary (income or revenue) gains. The main beneficiaries of avoided flood damages include local community members and businesses, local and national government (in the form of reduced government disaster relief expenditures, or avoided infrastructure repair costs) and local insurance providers (from reduced insurance claims).

Valuation basis

Avoided flood damage costs have been estimated by combining information on the probability and severity (impact) of future flood events (expressed in terms of average annual damage, AAD) and associated costs, with and without project interventions.

Avoided flood damages are calculated as:

$$\text{Avoided flood damages} = P_i (\text{annual probability of exceedance under 1:100 return period}^5) * \text{Change in exposure by asset type (e.g., number of assets/area exposed) from baseline to intervention scenarios} * \text{Average replacement cost by asset type} * \text{Damage factor (flood damage as a \% of construction cost)}$$

Flood modelling and assessment undertaken as part of the Feasibility Study (see Annex 2) was used to simulate the extent of inundated areas (where inundation is greater than 10cm depth) and peak flood heights associated with storm events (cyclones) that made landfall in Fiji for the historical climate (1990-2014 and using the 2014 mean sea level value for Fiji) with no interventions, and the future climate (2040) with and without interventions, using the IPCC Shared Socio-Economic Pathway (SSP)2-4.5 climate scenarios, a projected 2040 mean sea level and a series of plausible synthetic storm tracks. The change in exposure was assessed by examining the future expected impacts for each of the with- and without-project scenario characterised in terms of total area flooded (ha), number of people flooded, area of urban/impervious land flooded (ha), area of cropland/agricultural land flooded (ha), number of buildings flooded, and length of roads flooded (km).

The avoided costs of flood damage to buildings and roads as a result of project interventions were estimated using a replacement cost method. The average replacement cost of a Fijian building (comprising all building classes, including residential, public, commercial and industrial) is \$96,697 per building (2023/2024 prices), based on evidence from World Bank (2011). Acknowledging a wide range in potential road construction costs in Fiji, an

⁵ The analysis showed that the majority (59%) of maximum peak flood heights are caused by tracks associated with 1:100 year event, while around 40% of maximum peak flood heights are caused by tracks associated with a 1:50 year event. A 100m buffer was applied to this extent to ensure that future flood risks from storm surges were completely accounted for. The maximum flood extents (areas where inundation is greater than 10cm depth) obtained by this approach correspond to an approximately 1:100 return period event.

average replacement cost for a rural road of \$54,493 per km (2023/2024 prices) is utilised in the analysis, based on observed costs in The Fiji Times (2015).

Avoided costs of damages to agricultural land is assessed in a bottom-up manner⁶ using a production value approach based on the average profit value (revenues minus costs) per hectare of crop land across a selection of major crop types.

Finally, the avoided indirect costs – the costs associated with provision of emergency response services and clean-up – are assessed using an indirect cost factor (8% of direct costs) derived from a study on the costs of natural hazards and guidance for assessing flood losses (Green, Viavattene, & Thompson, 2011).

Avoided flood damages excluded from the analysis (owing to data limitations) include: bridges and other infrastructure assets (direct tangible damages); deaths, injuries, displacement, physical and mental health effects (direct intangible damages); alternative accommodation costs, increased travel costs (indirect tangible damages); and inconvenience caused by disruption of utility services and loss of social capital e.g., cohesion (indirect intangible damages).

The flood modelling assessment indicates a minimum and maximum flood depth of 0.1m and 4m respectively. The economic analysis takes a conservative average of 1m flooding depth, and applies a corresponding depth-damage factor. Damage factors (flood damage as a percentage of construction costs) are sourced from a global depth-damage functions database (Huizinga, de Moel, & Szweczyk, 2017). Using the average 1m flood depth, the following corresponding damage factors for the Oceania region are used: 53% damage factor for buildings (average value across residential, commercial and industrial buildings); 40% damage factor for infrastructure (roads); and 47% damage factor for agricultural land.

Benefit results

The resulting present value of the reduced flood damages resulting from the implementation of interventions are shown in Table 3–1. The scenarios differ in terms of the discount rates applied as well as average damage/replacement values (10% increase and decrease in best and worst case scenarios respectively).

Table 3–1: Present value of avoided flood damage benefits			
Present Value (USD), discounted – rounded values			
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$2.3 million	\$6.2 million	\$1.3 million

3.1.2 Enhanced fishery productivity

Benefit description

The coastal (inshore) fisheries sector in Fiji plays a vital role in the country's economy, food security, and cultural heritage. Coastal fisheries provide a significant source of income and employment, particularly for rural and

⁶ The average profit value per hectare across major crop types was calculated utilizing average production values by province (Ministry of Agriculture, 2023), average production areas by province (Ministry of Agriculture; FAO, 2020), and average farmgate prices (Ministry of Agriculture, 2023). Crop types considered include cassava, dalo/taro, assorted vegetables, coconut, ginger, yaqona, rice, kumala, banana, eggplant, pawpaw, pineapple, pulses, tomatoes, vudi, watermelon and yams. In lieu of precise itemised agricultural costs, average costs was calculated using a gross margin percentage (62% average across the commodities considered based on evidence from Leslie (2013)) alongside average revenues (calculated using production values and farmgate prices). For further details of this bottom-up approach and the data input value used, please see the accompanying excel-based CBA model.

coastal communities. The sector supports both subsistence and commercial fishing, with key products such as tuna, reef fish, and shellfish contributing to local and export markets. Beyond economic benefits, coastal fisheries are integral to the daily diets of many Fijians, offering a critical source of protein, and the sector is deeply embedded in the cultural fabric of the country, as fishing traditions are passed down through generations and are central to social practices and ceremonies. In recent years, however, inshore fisheries in Fiji have become increasingly strained due to fishing pressure, and with the disruptive effects of climate change on fisheries, estimates of sustainable annual production from the coral reef area suggest that it will not be possible in the future for Fiji to meet forecasted fish needs for food security (Bell, et al., 2009).

Component 2 aims to broadly improve the sustainable management and use of marine and coastal ecosystems (e.g., output 2.3: Improved community fisheries management in the GSR), while a subset of EbA activities under Component 1 are expected to reduce sedimentation yields entering coastal areas, both of which are expected to increase fish sizes and/or numbers in the qoliqolis. This ultimately boosts fish harvests and yields, which in turn is expected to lead to higher household incomes. This benefit is especially significant for women, who make up 80% of fishers (Thomas, et al., 2021)

However, the exact impact of interventions on fish harvests (from Component 2 directly and Component 1 indirectly) remains unclear/speculative in available project documentation, especially as the precise nature of the improvements in community fisheries management have yet to be determined. In lieu of a precise estimation of impact on fish yields, this analysis assumes that the proposed interventions result in impacts to fish yields similar to those observed elsewhere when sustainable fishery practices have been implemented (when compared to a baseline of unsustainable fishing practices and overexploited fish stocks⁷). Sustainable fishery practices⁸ broadly include those associated with Fishery Management Plans (FMPs), Management Protection Areas (MPA)⁹ and Locally-Managed Marine Areas (LMMAs).

Valuation basis

Fisheries are typically valued using a production function approach. This involves estimating the total revenue from fishing (using market prices) and subtracting the costs incurred. The underlying calculation logic is expressed as follows, based on the formula of net benefits used in Salcone, Brander, & Seidl (2016):

$$\text{Fishery value} = (\text{Harvest (kg)} * \text{Price of fish (\$/kg)}) - \text{Harvest costs}$$

Given the challenges in estimating income and harvesting costs (which vary by species, season, distance from fishing grounds, fuel and equipment costs, amongst other things), value added factors¹⁰ – obtained from Starkhouse (2009) – are applied to account for both costs and revenue¹¹.

⁷ This is considered the status quo in the GSR, as argued by (Andradi-Brown, Veverka, Free, Ralifo, & Areki, 2022).

⁸ Sustainable fisheries focuses on reducing by-catch, recycling ghost nets, and implementing effective fisheries management strategies to ensure sustainable practices.

⁹ Specifically, a subset of MPAs that allow some level of fishing within their borders (sustainable-use MPAs).

¹⁰ Value added, an economic term that expresses the difference between the value of goods produced and the costs of materials and supplies, known as intermediate costs, can provide a better indication of fishers' take-home financial benefits than net benefits.

¹¹ The value add factors from Starkhouse (2009) account for a comprehensive array of key input factors required for estimating revenues and costs, including but limited to number of fishers, catch per unit effort (CPUE), all input costs (including opportunity cost), and the relative share of revenues between middlemen, vendors and consumers. This makes the value added factors from Starkhouse (2009) particularly advantageous compared to fully bottom-up calculation approach.

The resulting formula employed in the CBA is as follows:

$$\text{Enhanced fish production value} = \text{Harvest yields by province} * \text{Average increase in fish yields from project interventions} * \text{Value added per tonne of product sold} * \text{Proportion of new qoliqolis factor} * \text{inflation factor}$$

(in the case of financial analysis only)

Enhanced fishery¹² production values are calculated for coastal inshore fisheries only, which can be classified into two main categories: subsistence fishing and artisanal fisheries. Artisanal fishing refers to small-scale fishing that results in the catch being sold in domestic markets, while subsistence fishing refers to fishing that results in the catch being consumed by the fisher or their family, given away as a gift or bartered locally. In this regard, any catch, or portion of catch, that does not enter market driven by monetary exchange is regarded as subsistence catch. Offshore fishing production is excluded since these fisheries mainly target species such as tuna for export markets and because they are unlikely to be located in the *qoliqolis* of interest to this project.

Harvest yields by province are obtained from the 'Economic Value of the Great Sea Reef' report' (WWF, 2014). As this report only provides yields for artisanal fisheries, subsistence yields are estimated by applying the relative share of subsistence fish catches (43%) to commercial catches (57%) (O'Garra, 2012). See accompanying excel CBA model for yield data by province.

The average increase (or upliftment factor)¹³ in fish yields from project interventions is estimated to be 13% per annum, based on a study examining the impact of multi-use MPAs globally (Gill, et al., 2024). A high upliftment factor of 24% (Prince, 2017) and a low factor of 5% (Ovando, Bradley, Burns, Thomas, & Thorson, 2024) are examined in the best and worst case sensitivity tests respectively. It is further assumed that: a) improvements to fish yields accrue from year 6 onwards, in line with evidence observed in MPAs (Pascal (2011); Gell & Roberts (2003)); and b) improvements to yields accrue incrementally for a period of 10 years, at which point they stabilise – based on evidence from UN Environment, ISU, ICRI and Trucost (2018).

In an effort to ensure that yield upliftment factors do not exceed available fish stocks, the analysis considers the maximum sustainable yield (MSY) – that is, the highest possible annual catch that can be sustained over time without depleting fish stocks. In the absence of empirical information on stocks and MSY specific to the project areas, a maximum upliftment factor to fish yields has been estimated by taking the proportional difference between MSY per fishing area (12t/km²/year average in the South Pacific region) from Laurans, et al. (2013) and historical annual finfish yield per area (3.4t/km²/year average across six Fijian reef fisheries) from Jennings & Polunin (1995), resulting in a 238% difference. Dividing by the 10 year growth period of improved fish yields (UN Environment, ISU, ICRI and Trucost, 2018) expected for this project, this presents the capped/ceiling average annual fish yield upliftment rate of 24%/year (i.e., annual increases to fish yields cannot exceed 24% from the previous year). The 13% annual upliftment factor used in the analyses falls within this MSY.

¹² Fish refers to finfish, invertebrates and marine plants, collectively.

¹³ A wide range of proxy values are observed in the literature, from 9.5% (UN Environment, ISU, ICRI and Trucost, 2018) to 488% (Lester, et al., 2009) depending on the geography and the specific sustainable fishing practices employed. As acknowledged previously, the exact impact of interventions on fish harvests (from Component 2 directly and Components 1 indirectly) remains unclear/speculative in available project documentation and broader literature. In lieu of a precise estimation of impact to fish yields, this analysis makes the broad assumption that the proposed interventions result in impacts to fish yields similar to those observed when sustainable fishery practices are implemented (when compared to a baseline of unsustainable fishing practices and overexploited fish stocks). Proxy values are therefore taken from literature examining the impact from FMPS, MPA, LMMAS and No-Take-Zones. Values from the lower end of the range are considered, making the results conservative.

Finally, since FMPs (improved fishing practices) are already present in 12 of the 32 GSR qoliqolis, the analysis assumes that the benefits (improvements in fisheries productivity) of project interventions only apply to the 20 (62.5%) qoliqolis that are not already covered by FMPs. In lieu of detailed information, all qoliqolis are assumed to be approximately the same size.

Exclusions and limitations

Improvements to fishery production cannot be disaggregated by individual coastal biomes (such as coral reefs) owing to data limitations and the complexity of associated biophysical processes. Rather, they apply to inshore fishing areas (qoliqolis) broadly. In addition, no distinction is made between fishery management area and spillover areas i.e., entire qoliqoli is assumed to be under improved management.

The change in fish biomass over time under baseline conditions is not accounted for in this analysis. While there is evidence of an overall loss in fish biomass extent over time (fish abundance is approximately 33% lower and fish biomass approximately 80% lower compared to historic data for key fish families (Andradi-Brown, Veverka, Free, Ralifo, & Areki, 2022)), the benefit is calculated using the change in fish production yields resulting specifically from the intervention. i.e., the trend in fish biomass loss is the same between baseline and interventions scenarios, and therefore is not necessary for the benefit calculation.

Furthermore, potential disbenefits resulting from the implementation of FMPs (such as restrictions on catch during early implementation years of no-take zones) are not accounted for.

Benefit results

The resulting present value of the enhanced fishery productivity benefits associated with the implementation of Component 2 interventions are shown in Table 3—2. The scenarios differ in terms of the discount rates applied as well as average increase in fish yields (25% and 5% under best and worst case scenarios respectively).

Table 3—2: Present value of enhanced fishery productivity benefits

Present Value (USD), discounted – rounded values			
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$5.9 million	\$35.6 million	\$1.2 million

3.1.3 Reduced sediment yields (improved water quality)

Benefit description

The main aims of the EbA interventions to be implemented within Component 1 are to reduce sedimentation and run-off, improve water quality, and protect communities from flooding. In particular, the restoration of 2,524 hectares of GSR watersheds including the riparian buffers in the four provinces are expected to reduce sediment yields entering downstream water bodies. This reduction yields two primary benefits:

- Avoided treatment costs: Reduced need for dredging operations to remove sediment from reservoirs, dams, or other water infrastructure.
- Avoided loss of water storage capacity: Sediment buildup replaces valuable water storage capacity in dams and reservoirs. By reducing sedimentation, the avoided loss is valued based on the economic opportunity cost of water.

The beneficiaries of reduced sedimentation are local water facilities who are responsible for treating raw water before it is distributed to consumers. The benefits are assumed to accrue over the assessment period, as long as watershed management interventions are maintained.

Although reduced sedimentation can also indirectly benefit hydropower generation capacity through increased water availability, this aspect is excluded from the current analysis due to data limitations. In addition, sedimentation entering the sea adversely impacts coral reefs by smothering corals, blocking sunlight needed for photosynthesis, and disrupting their ability to feed and reproduce. The economic value of this – measured by tourism expenditure for coral reef recreation – is assessed as a separate benefit in Section 3.1.5.

Valuation basis

The economic value of reduced sedimentation is calculated using two approaches:

(i) *Avoided treatment cost (dredging):*

$$\text{Value of reduced sedimentation} = \text{Sediment export reduction} \times \text{Mass-to-volume conversion factor} \times \text{Average sediment remediation cost (dredging)}$$

(ii) *Avoided water storage loss (opportunity cost of water):*

$$\text{Value of reduced sedimentation} = \text{Sediment export reduction} \times \text{Mass-to-volume conversion factor} \times \text{Economic value of residential water tariff}$$

- Information on the estimated sediment export reduction per province as a result of project interventions was extracted from the findings of a sedimentation analysis undertaken by Griffith University (2025) as part of the Feasibility Study (Annex 2):
 - Ba Province: 5,085 tonnes/year
 - Ra Province: 2,578 tonnes/year
 - Bua Province: 997 tonnes/year
 - Macuata Province: 2,777 tonnes/year
- To convert sediment export estimates from mass (tonnes) to volume (m³), a conversion factor of 1.5 tonnes: 1m³ is used¹⁴.
- The average unit cost of dredging (US\$3.23/m³ in 2023/2024 prices) applied in the analysis reflects a global average value¹⁵.

¹⁴ <https://www.researchgate.net/profile/Alan-Short-2/post/How-can-I-estimate-the-economic-valuation-of-bio-diversity-for-a-Biosphere-reserve-area/attachment/59d6259e79197b8077983ef6/AS%3A318080410947584%401452847687378/download/PES+FINAL+REPORT+6+MARCH+08.pdf>

¹⁵ Annandale, G. W., Morris, G. L., & Karki, P. (2016). Extending the life of reservoirs: Sustainable sediment management for dams and run-of-river hydropower. Washington, D.C: World Bank Group.

- Opportunity cost of water¹⁶: The value of water storage capacity is proxied using residential water tariffs, assuming that sediment displaces equivalent water volume in reservoirs. To convert financial tariffs to economic costs, the standard conversion factor for tradable goods (0.8) is used.
- The sensitivity analysis is conducted adjusting discount rates and sediment remediation (dredging) costs (10% higher and lower values, based on author assumptions).

Exclusions and limitations

Indirect impacts on coral reefs, fisheries productivity, and marine ecosystems are excluded to avoid double-counting with enhanced fishery productivity benefits. Furthermore, reduced sedimentation is assessed solely from restored riparian areas; benefits from mangroves are excluded due to modelling limitations.

Benefit results

The resulting present value of reduced sedimentation benefits associated with the implementation of EbA interventions are shown in Table 3—3. The scenarios differ in terms of the discount rates applied as well as average sedimentation remedial (dredging) costs (30% increase and 30% decrease under best and worst case scenarios respectively).

Table 3—3: Present value of reduced sedimentation benefits

	Present Value (USD), discounted		
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$202,475	\$632,561	\$88,370

3.1.4 Increased carbon sequestration

Benefit description

The carbon sequestration benefit refers to the net increase in carbon dioxide removed from the atmosphere due to the restoration of 835 ha of coastal mangroves and 2,524 ha of GSR watersheds, including riparian buffer areas in each of the four provinces. Carbon sequestration is the result of healthy ecosystems capturing carbon through natural processes and storing it in biomass and soils. For this analysis, the focus is on the additional sequestration achieved through the intervention, rather than carbon *storage* or potential carbon release if these ecosystems were degraded or destroyed¹⁷. This approach allows for the assessment of the net benefit from transitioning from a business-as-usual (BAU) scenario (degraded or absent ecosystems) to the improved state resulting from the intervention.

In the economic analysis, the beneficiaries of carbon sequestration include both local communities and the global population due to the climate mitigation benefits. In the financial appraisal, the project implementers are considered the primary beneficiaries. This benefit is not included in the financial analysis since it does not affect

¹⁶ Sediment is valued as the opportunity cost of water, the logic being that the space taken up by the silt replaces the water storage capacity of a dam/reservoir, and that this space is equal to the economic value of the water (opportunity cost of water).

¹⁷ The net amount of carbon sequestered by an ecosystem is the sum of the rate of sequestration of each species and the amount of stored carbon that would be released if the ecosystem were damaged or destroyed, per a given time period. However, since the CBA assesses the net benefit from moving from a BAU (degraded or no mangrove/riparian vegetation area) to intervention (new mangrove/riparian vegetation area), carbon storage is not assessed. Therefore, carbon sequestration remains the focus of this benefit.

household income or cash flows as the potential for trading emission reductions through participation in voluntary or compliance carbon markets is not within the scope of proposed project.

Valuation basis

The valuation of carbon sequestration is based on the following formula:

$$\text{Value of increased carbon sequestration} = \text{Average sequestration rate per area type (biome, e.g., mangroves), and accounting for maturity/growth rate and survival rate} \times \text{Area improved (ha)} \times \text{Average carbon price} \times \text{Annual growth in the cost of carbon}$$

Average carbon sequestration rates, disaggregated by mangrove and riparian areas, are sourced from the GHG modelling report (2025) undertaken as part of the project (which were in turn obtained from the Forest Emission Reference Level reports developed under the National REDD+ Project in Fiji following IPCC recommended approach and methodologies). These sequestration rates account for relevant information such survival rates, maturity/growth rates, and gains from soil carbon accumulation. The value of avoided emissions is calculated using the World Bank's recommended shadow price of carbon (SPC) for use in economic analysis¹⁸. In line with the recommendations of the High-Level Commission on Carbon Prices, the guidance note recommends the use of a low and high estimate of the carbon price starting at US\$40 and US\$80 respectively in 2017, and increasing to US\$50 and \$100 by 2030. Given that the High-Level Commission report does not prescribe any specific carbon price values beyond 2030, the low and high values on carbon prices are extrapolated beyond 2030 using the same growth rate of 2.25% per year that is implicit between 2020 and 2030. The guidance note recommends the use of both the low and high price estimates in economic analyses because of the significant uncertainties arising from the unpredictability of future socio-economic and technological trends, as well as how mitigation costs are expected to be borne in different countries which depends on both the country context as well as willingness of the international community to transfer funds. For the purpose of this analysis, the average of the low and high values was used to present the 'normal case', with sensitivity analysis used to test how the results might change using either a low or high SPC. Since the base year of the recommended SPCs is 2017, the prices have been adjusted to equivalent 2023 prices using the US Gross Domestic Product (GDP) deflator.

Exclusions and limitations

Potential contributions from other ecosystems, such as green sea walls, or seagrass, as well as quality improvements in existing mangrove and riparian systems, were not included due to data constraints.

Benefit results

The resulting present value of carbon sequestration benefits resulting from the implementation of EbA interventions are shown in Table 3—4. The scenarios differ in terms of the discount rates applied as well as carbon price.

¹⁸ The World Bank. (2024). The Shadow Price of Carbon in Economic Analysis: 2024 Guidance Note. Retrieved from https://documents1.worldbank.org/curated/en/099553203142424068/pdf/IDU1c94753bb1819e14c781831215580060675b1.pdf?_gl=1*d347ra*_gcl_au*MzQ3MzE1MDE4LjE3MjQ5NTA.

Table 3—4: Present value of increased carbon sequestration benefits

Present Value (USD), discounted – rounded values			
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$23.5 million	\$82.3 million	\$9.2 million

3.1.5 Tourism value of improved coral reef health

Benefit description

Coral reefs provide a wide range of ecosystem services, including opportunities for tourism and recreation. It is estimated, for example, that reef tourism is worth US\$35.8 billion globally per annum. This includes on-reef tourism (e.g., diving, snorkelling and glass-bottom boat tours), and indirect contributions from reefs to tourism (e.g., calm waters, beaches, views, seafood and their use in advertising (Spalding, et al., 2017). The GSR region of Fiji is a major hub for international tourism, generating over US\$480 million annually and accounting for more than 25% of Fiji's GDP (Andradi-Brown, Veverka, Free, Ralifo, & Areki, 2022). In this context, the proposed project is expected to enhance economic tourism/recreation value associated with improvements to coral reef health from the cumulative implementation of interventions (primarily via reduced threat from sedimentation).

The change in tourism value is premised on the assumption that the loss in quantity or quality of coral reefs in the absence of project interventions is likely to make destinations providing reef-related tourism less attractive and result in a decline in tourist visits. The associated economic impacts will be reductions in revenues and profits for businesses (producer surplus approach) that provide tourist services (e.g. dive operators, hotels, resorts, restaurants, transport) and employment for people working in the sector. The economic consequences of the loss of coral reefs also includes a decrease in welfare for tourists in terms of their enjoyment of reef-related activities (consumer surplus approach). This assessment examines the producer surplus approach only, owing to data limitations related to the consumer surplus approach. Beneficiaries of project interventions that protect or enhance tourism value are local tourism operators and associated businesses (on-reef and reef-adjacent).

The impact of improved coral reef health on fish biomass (and therefore fishing yields) is not assessed since this is conceptually accounted for in the 'improved fish production' benefit. Indirect multiplier effects or enhanced government revenue from VAT associated with improved tourism expenditure are not considered in this analysis.

Valuation basis

A wide range of valuation approaches are evident in existing literature, the choice of which is dependent on the project and location context. Bottom-up approaches (such as those used in Salcone, Brander, & Seidl (2016) and Pascal (2011)) utilise detailed data and assumptions, including average tourist numbers, average spend etc., to calculate net tourism revenues and costs. A similar comprehensive bottom-up approach has already been used to estimate the tourism value from coral reefs in Fiji (Gonzalez, et al., 2015). The values presented in this 2015 study have been adopted and adjusted for use in this analysis.

$$\begin{aligned} \text{Tourism value of improved coral reef quality} = & \text{Tourism value added expenditure (producer surplus) from} \\ & \text{coral reefs} * \% \text{ change to number of visitors based on 10\% quality improvement in coral reef areas} * \\ & \text{Change in coral reef area under improvement} * \text{Maturity rate} \end{aligned}$$

- Fiji-specific tourism value added expenditure (producer surplus) from coral reefs of \$860/hectare of coral reef/year (in 2023/2024 prices) obtained from Gonzalez, et al., (2015).
- Modelling conducted by Griffith University (2025) indicates a marginal reduction (~2%) in sediment reaching coral reefs. Based on this, the analysis assumes an average 5% improvement in coral reef health as a result of the interventions. This slightly exceeds the 2% reduction to account for additional, yet unmodeled, positive impacts from improved fishery practices and mangrove restoration. A range of lower and higher estimates for coral reef health improvement is considered in the sensitivity analysis.
- The full coral reef areas within each Province are assumed to experience improvements in overall quality owing to the high dispersal rate of sediments in coastal waters, as per the sedimentation analysis in the modelling report from Griffith University (2025).
- Tourism benefits are assumed to accrue to Ba and Ra Provinces only, since the volume of tourism in Bua and Macuata Provinces is much lower.
- Change in tourism value from coral reefs can come from a change in quantity (or area extent) or quality (or condition) of the coral reef base. Since it is unclear that the proposed interventions will alter the quantity of coral reefs, tourism value in this assessment is premised on changes in quality. To this end, the impact of changing coral reef quality on tourism value is expressed via a change to visitation rates (premised on the assumption that the loss of coral reefs is likely to make destinations providing reef-related tourism less attractive and result in a decline in tourist visits)¹⁹. Quality-based visitation is based on Schuhmann, Skeete, & Waite (2017), who conducted a choice experiment to understand the impact of changing coral reef conditions on the likelihood of tourists revisiting coral reefs in Barbados.²⁰ They found that a 5%, 10% and 25% increase in coral reef health results in a 15%, 22% and 30% increase in tourist visitation rates respectively. An average of a '5% increase in coral health' – corresponding to 15% increase in visitation rates – is assumed to adequately reflect the condition information provided by the project team (changes to condition are expressed as "reduced threat from sedimentation") under normal case conditions. Lower and higher rates are used in the sensitivity analysis.
- Benefits are assumed to accrue incrementally over 7 year period, after which this accrue fully, based on growth trends of live coral cover from Halford, Cheal, Ryan, & Williams (2004).

Exclusions and limitations

The change in coral extent over time under baseline conditions is not accounted for in this analysis. While there is evidence of an overall loss in coral extent over time, the benefit is calculated using the change in coral reef extent resulting specifically from the intervention. i.e., the trend in coral reef loss is the same between baseline and interventions scenarios, and therefore is not necessary for the benefit calculation.

A further limitation relates to the tourism benefit estimate, which is derived via benefit transfer from a choice experiment conducted in Barbados (Schuhmann, Skeete, & Waite, 2017). As this study reflects a Caribbean tourism market, structural differences in visitor profiles, destination substitutes, and the role of reef quality

¹⁹ This is a simplistic, albeit necessary, assumption. In reality, visitors may base visitation on numerous factors.

²⁰ Few studies examine how changing coral reef condition (rather than reduced reef area) affects tourism value, making this source the most relevant available. The estimate is applied to Fiji via benefit transfer from this Caribbean study; given differences in visitor profiles and tourism dynamics between the Caribbean and the Pacific, it should be treated as indicative rather than definitive. This caveat is discussed further in the Exclusions and Limitations section below.

within the broader tourism offering mean the assumed visitation response should be treated as indicative rather than definitive when applied to Fiji's Pacific tourism context. Given this uncertainty, the lower-bound sensitivity result for this benefit should be given particular weight when interpreting the robustness of the tourism benefit and the wider economic case.

Benefit results

The resulting present value of the enhanced tourism benefits associated with improvements to coral reef health are shown in Table 3–5. The scenarios differ in terms of the discount rates applied as well as change in visitation rate (22% and 10% under best and worst case scenarios respectively) based on % changes in coral reef quality.

Table 3–5: Present value of enhanced tourism benefits associated with improved coral reef health

Present Value (USD), discounted – rounded values			
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$1 million	\$3 million	\$0.6 million

3.1.6 Other ecosystem services from mangroves

Benefit description

The restoration of mangrove ecosystems delivers a range of additional²¹ ecosystem services beyond those explored above. These services include provisioning services (e.g., raw materials, excluding enhanced fishery productivity previously explored) and non-use values such as existence and bequest values.

While certain benefits (e.g., mangrove-related honey production, education, water regulation, aesthetic value) are excluded due to uncertainties in their linkage to the project, the analysis focuses on measurable and attributable benefits of restored mangroves, such as:

- Provisioning services: Raw materials such as wood extraction and NTFPs from new mangrove areas.
- Existence and bequest values²²: The non-use value for associated with the preservation of coastal ecosystems, included mangrove areas, fishing grounds and coral reefs.

Provisioning services (e.g., timber and NTFPs) will primarily benefit local community members, while bequest values are assumed to benefit both local community members as well as the global community. A financial assessment is not undertaken for this benefit since there are no notable revenue-generating entities.

Valuation basis

The economic value of 'other ecosystem service's is calculated using a unit/benefit transfer approach based on the most relevant literature and ESVD (Ecosystem Service Valuation Database). The formula for valuation is as follows:

²¹ Climate regulation (carbon sequestration), coastal protection, and water quality benefits are excluded from this section to avoid potential double counting, as they are assessed elsewhere in the cost-benefit analysis.

²² Perceived preservation value of resources for future generations.

$$\text{Value of other ecosystem services} = \text{Relevant ES unit value (\$/ha/year)} \times \text{Change in mangrove area (ha)} \times \text{Survival rate} \times \text{Maturity rate}$$

The average economic value per hectare for each ecosystem service is drawn from existing literature or databases, representing the best available estimates.

- Timber production from restored mangroves is \$409/ha/year²³ (in 2023/2024 prices), based on an international average.
- Non-timber forestry products (NTFP) from restored mangroves is \$90/ha/year²⁴ (2023/2024 prices), based on an international average.
- Bequest value of coastal ecosystems (including coral reefs, fishing grounds and mangroves) is \$26/hectare/year (2023/2024 prices), based on the average willingness to pay (WTP) for similar coastal area in Navakavu Locally Managed Marine Area (LMMA) in Fiji. The calculation therefore assumes that this WTP value broadly represents/mirrors the targeted project provinces. In lieu of project- and location-specific, this unit transfer implies this benefit is indicative only.
- Benefits increase gradually during the 15-year growth period, reaching full value at maturity (Botoman, 2022). Additionally, mangrove restoration projects are assumed to exhibit a 90% survival rate (U.S. Department of Agriculture, 2025).
- To account for uncertainty, a sensitivity analysis is conducted by adjusting discount rates only.

Benefit results

The resulting present value of additional mangrove provisioning services resulting from the creation of new/restored mangroves are shown in Table 3—6. The scenarios differ in terms of the discount rates applied.

Table 3—6: Present value of additional mangrove provisioning services

Present Value (USD), discounted – rounded values			
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$1.7 million	\$5.1 million	\$0.9 million

3.2 FINANCIAL BENEFITS

The financial appraisal serves to identify the net financial return (purely monetary) to the project investment, and is conducted from the perspective of relevant revenue-generating project entities. In this regard, only a single financial benefit is assessed: increased income from fishery production under Component 2. Carbon benefits are excluded from the financial appraisal, as voluntary carbon markets are not considered relevant to this project. In addition, any increase in income for beneficiaries under Component 3 of the grant facility is not

²³ Su, J., Friess, D.A. & Gasparatos, A. (2012). A meta-analysis of the ecological and economic outcomes of mangrove restoration. Nat Commun 12, 5050. <https://doi.org/10.1038/s41467-021-25349-1>

²⁴ Ibid.

included. This is consistent with CBA best practice, including HM Treasury Green Book guidance, which advises against incorporating induced effects due to the risk of double counting and the implicit assumption of underutilised resources.

3.2.1 Enhanced fishery productivity

The financial value of improved fishery productivity is estimated using the same rationale, approach and methodological considerations as those outlined in the economic appraisal (see Section 3.1.2), with three key exceptions:

- First, the financial appraisal does not include the standard conversion factor for tradable goods (0.8), or apply a shadow wage rate²⁵.
- Second, the financial appraisal utilises the commercial lending rate²⁶ as the financial discount rate, whereas the economic appraisal adopts the social discount rate.
- Third, the financial appraisal includes the effect of inflation.

With these exceptions in mind, please refer to Section 3.1.2 for the methodological approach to estimating the financial value of the enhanced fishery productivity benefit.

Benefit results

The resulting present value of the enhanced fishery productivity benefits associated with the implementation of Component 2 interventions are shown in Table 3—7. The scenarios differ in terms of the discount rates applied as well as average increase (%) in fish yields (25% and 5% under best and worst case scenarios respectively).

Table 3—7: Present value of enhanced fishery productivity benefits in financial appraisal

Present Value (USD), discounted – rounded values			
	Normal case scenario	Best case scenario	Worst case scenario
All Provinces	\$17.3 million	\$51.4 million	\$3.8 million

The financial present value of the fishery benefit (US\$17.3 million) is substantially higher than its economic equivalent (US\$5.9 million). This gap reflects methodological differences between the two appraisals rather than a real difference in the underlying benefit: the financial analysis applies a lower discount rate (5.45%, versus 10% in the economic analysis), includes inflation, and does not apply the 0.8 conversion factor used to convert market prices to economic values. Readers should therefore interpret the financial and economic fishery estimates as distinct, methodologically consistent measures, not as conflicting results.

3.3 NON-QUANTIFIABLE BENEFITS

It is important to note that some of the expected benefit flows from project interventions have been omitted from the economic and financial analyses because the data necessary to reliably quantify and value them was not available, or because the effort required to derive value estimates was considered disproportionate to the

²⁵ The shadow wage rate reflects the opportunity cost of labour given the employment rate, wage laws, and taxes.

²⁶ Used as a proxy for the weighted average cost of capital.

size and scale of benefits at stake. While not included in the quantitative economic or financial analyses, these benefits do nevertheless make an important contribution to the overall ecological and socio-economic impact of the project and are thus described in qualitative terms here.

Component 1

Under Component 1, ecosystem-based adaptation and green infrastructure interventions support a variety of long-term environmental and socio-economic benefits directly, as well as those benefits associated with enhanced coral reef resilience indirectly. Interventions are expected to help **reduce shoreline erosion**, preserving coastal habitats that are essential for biodiversity. Restored coastal ecosystems also contribute to the **mitigation of marine heat stress, acidification, and heatwaves**, all of which threaten coral reef resilience (although the extent to which proposed interventions can mitigate these threats remains uncertain to the global nature of ocean warming and acidification). Furthermore, protection and restoration of coastal and marine ecosystems enhance opportunities for **bioprospecting and research and development**, as healthy and diverse habitats provide valuable genetic and biochemical resources for medicine, science, and innovation. Enhanced environmental conditions may also lead to **land value uplift**, benefiting local communities and economies.

Component 2

Component 2, which focuses on improved fishery management and sustainable fishing practices, delivers vital **food security and nutrition benefits**. By preventing overfishing and promoting sustainable harvests, the project helps maintain fish stocks that are essential for local diets. This ensures a more stable and reliable protein source for coastal communities, reducing dependence on external food supplies and enhancing overall dietary quality. This, in turn, may reduce any morbidity or treatment costs associated with poor nutrition. Additionally, a healthier marine ecosystem supports a more diverse and resilient fish population, further securing long-term food availability.

Component 2 is also expected to support improved marine management through the development and implementation of a Marine Management and Use Plan, akin to those practices observed under MPAs. A growing literature base suggests that **MPAs can enhance tourism revenues** (and that this does not necessarily come at the expense of fishery yields), since tourism potential is linked to the quality of the marine environment (Viana, Halpern, & Gaines, 2017). This result challenges previous findings that marine reserves are not part of the optimal economic solution when the fishery is well managed.

Component 3

The project is expected to generate a range of indirect benefits through improved ecosystems, enhanced resilience, and broader economic spillovers. These indirect benefits arise from the coastal improvement activities undertaken by the supported enterprises, reinforcing the project's long-term ecological and socio-economic impact. However, these indirect Component 3 benefits cannot be quantified at this stage for several reasons. First, as the specific enterprises to be supported have not yet been identified, the precise nature and scale of their activities remain uncertain. Second, while case studies of existing reef-positive enterprises provide strong indications of the types of benefits expected – particularly in sectors such as mariculture, forestry, and ecotourism – there is insufficient data to estimate the magnitude of change with confidence. As a result, this section provides a qualitative discussion of the potential indirect benefits associated with Component 3 (Table 3–8), drawing insights from case studies of existing Fijian enterprises as outlined in the Component 3 Feasibility Report. These examples offer a preliminary understanding of the kinds of ecosystem and resilience benefits that similar enterprises may generate, though the full range of benefits will ultimately depend on the specific enterprises selected for support.

In addition to the indirect benefits discussed above, an increase in income for beneficiaries under Component 3 of the grant facility was also considered as a potential benefit but has not been included in the core CBA. Under Component 3, reef-positive beneficiary enterprises are expected to receive financial support through the small grants facility, alongside institutional and technical support. This financial support is expected to translate directly into improved incomes for enterprise employees, relative to a baseline of not being employed at these enterprises, whether unemployed or employed elsewhere – a critical part of the rationale for Component 3 and for the project as a whole. Since this financial support already features as a cost to the project, the relevant benefit is not the wage differential itself but the induced income effect generated by that differential through an income multiplier²⁷. Consistent with CBA best practice, including HM Treasury Green Book guidance, induced effects of this kind are excluded from the core analysis due to the risk of double counting and the implicit assumption of underutilised resources in the wider economy. A preliminary estimate of this induced income benefit has nonetheless been prepared and is reported here separately for information: under the normal case scenario, it is valued at approximately US\$2.6 million in economic terms and US\$3.6 million in financial terms. This estimate is not included in the core cost-benefit analysis.

Table 3—8: Potential indirect benefits from supported reef-positive enterprises under Component 3

Sector	Potential benefit	Benefit supported by case study
Enhanced mariculture production	Enhanced fishery/mariculture production (household income)	No
	Additional employment (household income)	Yes – case study enterprise confidential
	Reduced pressure on wild fish stocks	No
	Enhanced agricultural yields and/or avoided fertiliser costs from seaweed-based fertiliser production	Yes – case study enterprise confidential
Sustainable forestry	Additional employment (household income)	Yes – case study enterprise confidential
	Increased rent to landowners	Yes – case study enterprise confidential
	Reduced soil erosion (water quality) from reforested areas	Yes – case study enterprise confidential
	Additional ecosystem services (e.g., carbon sequestration, NTFPs)	No
Ecotourism	Increased producer surplus from tourism revenues	No
	Coral rehabilitation funded by ecotourism fees/revenues	Yes – case study enterprise confidential
	Increased fish production/yields from expansion to MPAs, decreased marine poaching, funded by tourism fees/revenues	Yes – case study enterprise confidential
	Financial support to implement waste water treatment plant (WWTP) (benefits associated with avoided treatment costs, avoided health treatment costs)	Yes – case study enterprise confidential

The potential indirect benefits of supporting reef-positive enterprises are promising, suggesting that such businesses could play a meaningful role in enhancing ecosystem health and economic resilience. However, there are also cases where similar initiatives have failed due to structural challenges. A fragmented approach to enterprise development – exacerbated by labour market constraints and limited coordination – has often hindered success, as highlighted in the Component 3 Feasibility Report. To ensure long-term viability, a carefully

²⁷ An "income multiplier" refers to the economic concept where an initial injection of income into a community or economy leads to a larger overall increase in income due to subsequent rounds of spending, creating a ripple effect throughout the system; essentially, a dollar spent by one person becomes income for another, who then spends a portion of that income, further stimulating the economy.

planned, strategic, and integrated approach to enterprise support is essential. This requires not only financial investment but also capacity-building, market access facilitation, and supportive policy frameworks.

Component 3 addresses these challenges by providing targeted grant funding to reef-positive enterprises, enabling them to become viable and self-sustaining. Without initial financial support, many of these enterprises would struggle to launch, let alone scale to a point of operational sustainability. Early-stage funding is critical for incubation, allowing businesses to develop their models, refine operations, and establish revenue streams. However, access to finance remains a key barrier, with traditional lending institutions often reluctant to invest in unproven, high-risk sectors. By bridging this gap, the project helps de-risk investment and positions enterprises to leverage additional funding from public, private, and philanthropic sources. Over time, successful businesses may attract further capital, unlocking greater economic and environmental benefits while reinforcing the case for sustainable, reef-positive development in Fiji.

4 Costs

The costs considered in the CBA comprise both the direct implementation costs of the proposed project, including CAPEX and OPEX, and any potential adverse social, economic, or environmental effects that may arise within the project context. These negative impacts are captured within the benefits assessment as "disbenefits" and incorporated into the overall economic appraisal.

Project costs are based on the detailed budget presented in Annex 4, with total expenditure of approximately US\$42.8 million over Years 1-10 across Components 1-3, Monitoring and Evaluation, and Project Management. Continued operational expenditure is recognised as critical to sustaining the EbA and living shoreline interventions over the 30-year project lifespan, implementing the 10-year Land and Marine Use Management Plan, and supporting the operation of the Great Sea Reef (GSR) Management Unit (MU) following completion of GCF financing. Consequently, in addition to the O&M costs incurred during the period of project implementation (years 1-10) and which are reflected in the Annex 4 budget, the economic analysis also includes estimated operation and maintenance (O&M) costs of approximately US\$2 million beyond the GCF project period from years 11-20²⁸, taking the total costs to US\$44.8 million. Estimates of costs beyond year 10 are indicative and will be refined during project implementation in collaboration with the Ministry of Environment and Climate Change (MECC). This process will include the development of a long-term financing strategy covering government budget allocations, fundraising requirements, and partnerships with local stakeholders, including WWF Pacific. Further information on institutional responsibilities, financing arrangements, and long-term OPEX planning is provided in Section B6 (Exit Strategy) of the Funding Proposal. No costs have been included beyond Year 20, as the 10-year Land and Marine Use Management Plan is expected to have been fully implemented by that stage and decisions regarding future management arrangements will rest with the Government of Fiji. Nevertheless, it is assumed that the ecological, social, and economic benefits generated by the restoration and management interventions implemented during the preceding years will continue to accrue throughout the remainder of the 30-year appraisal period.

For the economic analysis, project costs have been converted from nominal to real terms to remove the effects of inflation. Furthermore, the economic analysis applies a shadow wage rate factor of 0.65²⁹ for unskilled labour to reflect the relatively high rate of Fiji's working age population, particularly in rural areas, who are informally employed (78.7%) or engaged in subsistence-only work (31.2%)³⁰ and from which unskilled labour for restoration activities would most likely be drawn.

The financial analysis focuses on impacts on beneficiary cash flows and the financial viability of project-supported income-generating activities. Accordingly, only costs directly attributable to these activities, namely those associated with Components 2 and 3, together with an apportioned share of project management and monitoring and evaluation costs, are included in the financial assessment.

²⁸ These are not reflected in the Annex 4 budget which only covers the 10-year period of GCF financing (years 1-10).

²⁹ In the absence of a project-specific Fiji SWRF for coastal/environmental restoration labour, this analysis adopts a SWRF of 0.65 (sensitivity range 0.60–0.75), derived by applying ADB's standard 0.5–0.75 range for unskilled labor in surplus economies (ADB 2017 Guidelines for the Economic Analysis of Projects) and positioning within that range using Fiji-specific rural labor market evidence (ADB/ILO 2015 Fiji: Creating Quality Jobs), which documents high rural informal employment (78.7%) and subsistence engagement (31.2%) relative to urban areas

³⁰ Asian Development Bank (2015) Fiji: Creating Quality Jobs Employment Diagnostic Study [\[online\]](#)

Table 4–1: Project costs

Indicator	Value (US\$)
Project costs stated in Annex 4	
Component 1: EbA and GI Solutions to reduce threats to the GSR.	\$28,549,233
Component 2: Enabling a paradigm shift toward integrated R2R coastal ecosystem management in Fiji's GSR.	\$6,283,030
Component 3: Business and finance landscape for reef-positive enterprises	\$4,627,075
Monitoring & Evaluation	\$1,456,202
Project Management	\$1,856,235
Operation & Maintenance (Years 11-20) ³¹	\$2,000,000
Total	\$44,771,775
Project costs utilised in economic appraisal (real prices)	
Component 1: EbA and GI Solutions to reduce threats to the GSR.	\$19,448,602
Component 2: Enabling a paradigm shift toward integrated R2R coastal ecosystem management in Fiji's GSR.	\$5,648,423
Component 3: Business and finance landscape for reef-positive enterprises	\$4,142,785
Monitoring & Evaluation	\$1,308,719
Project Management	\$1,663,517
Operation & Maintenance	\$1,491,615
Total	\$33,703,660
Project costs utilised in financial appraisal (nominal prices, activities pertaining to revenue-generating activities only)	
Component 1: EbA and GI Solutions to reduce threats to the GSR.	\$0
Component 2: Enabling a paradigm shift toward integrated R2R coastal ecosystem management in Fiji's GSR.	\$6,283,030
Component 3: Business and finance landscape for reef-positive enterprises	\$4,627,075
Monitoring & Evaluation	\$402,625
Project Management	\$513,230
Operation & Maintenance	\$2,000,000
Total	\$13,825,960

Note: Annex 4 offers costing data at a more granular (activity and sub-activity) level. The costing information presented here is summarised at the broader component level.

³¹ Note that these costs are reflected separately as they are indicative costs for the 10 years after the GCF project period and therefore not reflected in the Annex 4 budget.

5 Results

5.1 ECONOMIC ANALYSIS

The economic analysis demonstrates that the project is a viable investment at a 10% discount rate. It provides an ENPV of \$13.7 million, a EBCR of 1.65, and an EIRR of 18% (indicating the discount rate at which NPV equals zero).

While these results are promising, the actual economic outlook may be even more favourable. The analysis considers only a limited set of economic benefits and excludes non-monetized (qualitatively assessed) benefits. These omitted benefits are difficult to quantify due to data limitations, yet they could further enhance the project's overall economic desirability. Therefore, in practice, the project's economic return is likely to be even greater than indicated by the current assessment.

Table 5–1: Economic analysis results

Indicator	Value (USD)
Total costs of interventions, undiscounted (US\$)	\$35.6 million
ENPV (US\$)	\$13.7 million
EBCR	1.65
EIRR (%)	18%

Figure 5-1 illustrates the spread of annual economic costs and benefits over the assessment period. Increased carbon sequestration contributes the largest share of benefits, followed by avoided flood damages and increased fishery productivity. Carbon sequestration alone accounts for roughly 68% of gross discounted benefits (US\$23.5 million of US\$34.6 million), making it the single most important driver of the project's economic case. This reliance is expected for a reef restoration project, where carbon co-benefits are typically substantial, but it also means the results are closely tied to the assumed shadow price of carbon and sequestration rates. The project's payback year – when cumulative benefits exceed costs – occurs around year 11.

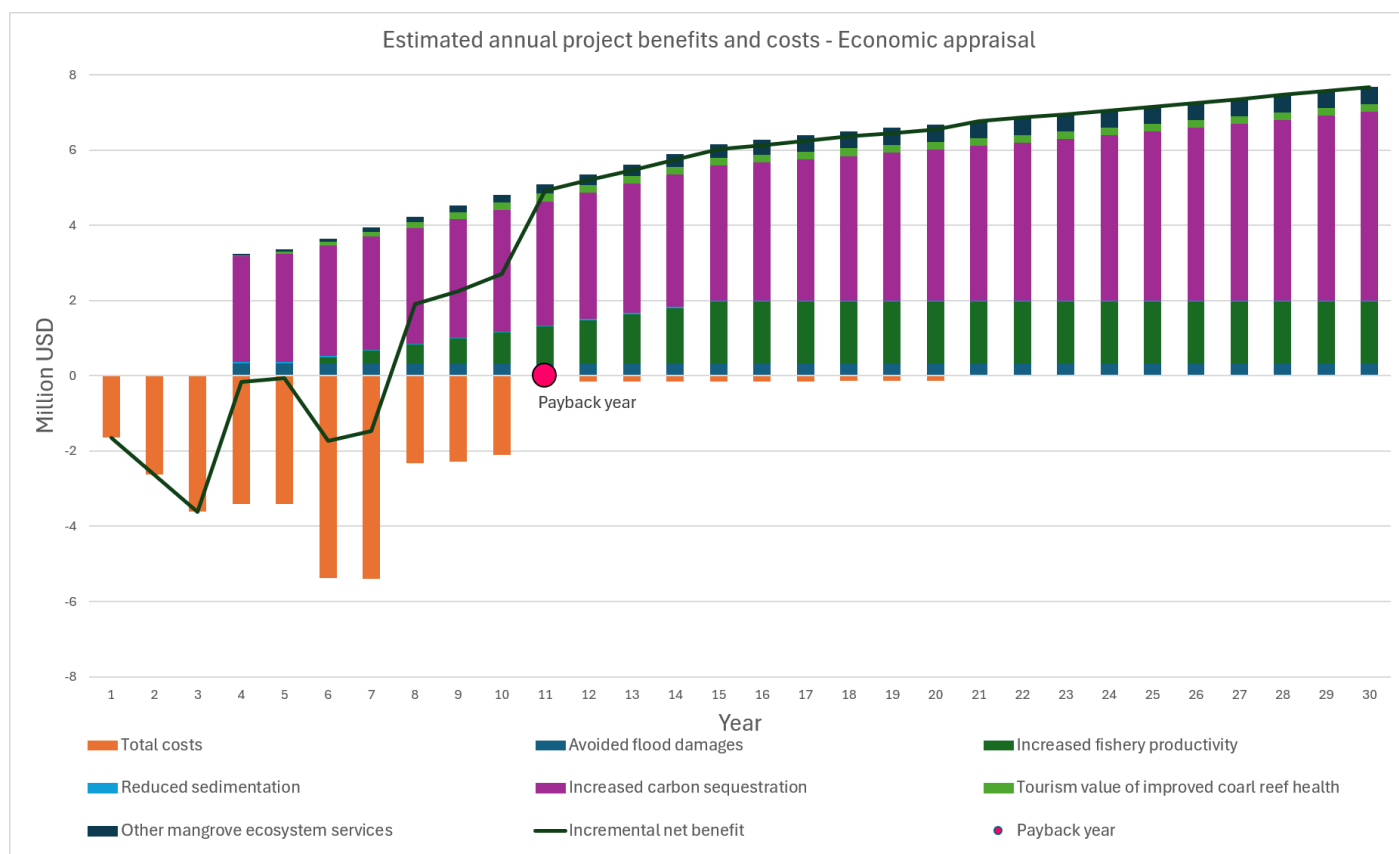


Figure 5-1: Estimated annual project benefits and costs, Economic Appraisal

5.2 FINANCIAL ANALYSIS

The financial analysis demonstrates that the project interventions associated with revenue-generating activities (namely, increased fishery productivity) are profitable at a 5% discount rate. It provides an FNPV of \$7.62 million, a FBCR of 1.79, and an FIRR of 11% (indicating the discount rate at which NPV equals zero).

Table 5–2: Financial analysis results

Indicator	Value (USD)
Total costs of interventions, undiscounted (US\$)	\$13.83 million
FNPV (US\$)	\$7.62 million
FBCR	1.79
FIRR (%)	11%

Figure 5-2 illustrates the spread of annual financial costs and benefits over the assessment period. The project's payback year occurs at year 15.

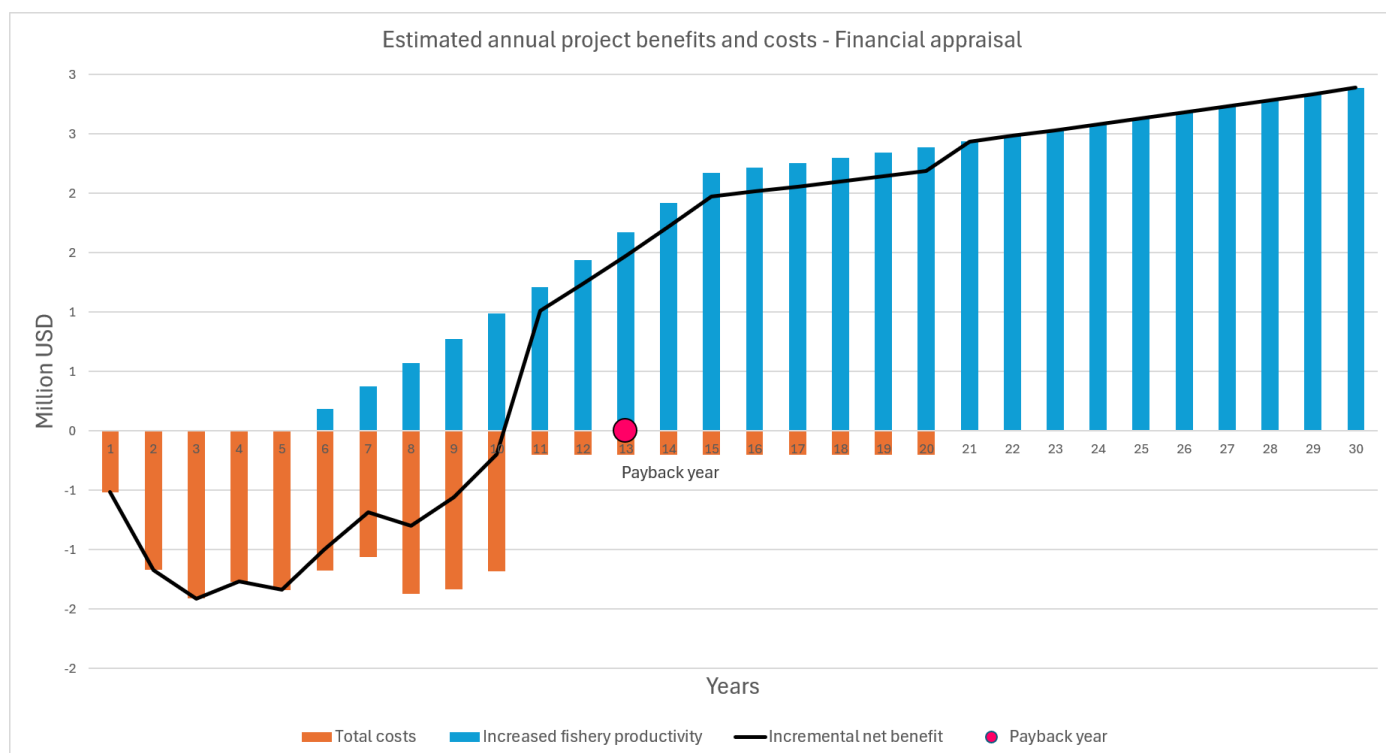


Figure 5-2: Estimated annual project benefits and costs, Financial appraisal

5.3 SENSITIVITY ANALYSIS

A sensitivity analysis is conducted to assess the extent to which key assumptions drive the results. This includes changing the discount rate (from 10% under normal conditions to a 3% under a best-case scenario and 15% under a worst-case scenario for the economic appraisal, and 3% and 9% under best and worst case scenarios compared to 5% under normal conditions in the financial appraisal). Similarly, sensitivity is tested for:

- Average flood damage values: 10% increase and decrease under best and worst case scenarios respectively.
- Average increase in fish yields: 25% and 5% under best and worst case scenarios respectively compared to 15% under normal conditions.
- Average sedimentation remedial (dredging) costs: 30% increase and 30% decrease under best and worst case scenarios respectively.
- Shadow price of carbon: \$107/tCO₂e under a best-case scenario and \$53/tCO₂e under a worst-case scenario compared to \$80/tCO₂e under normal conditions.
- Change in visitation rates based on improvements to coral reef health: 22% and 10% increase in visitation rates under best and worst case scenarios respectively compared to 15% under normal conditions.

The overall impact of the best- and worst-case scenarios on projects results is summarised in Table 5—3 below. This analysis reveals that, in both the economic and financial analyses, the project remains viable under normal- and best-case scenario but becomes unviable under a worst-case scenario.

Table 5–3: CBA sensitivity analysis

Indicator	Normal-case scenario	Best-case scenario	Worst-case scenario
Economic appraisal			
Total costs of interventions, undiscounted (US\$)	\$35.6 million	\$35.6 million	\$35.6 million
ENPV (US\$)	\$13.7 million	\$103.0 million	-\$3.6 million
EBCR	1.65	4	0.79
EIRR (%)	18%	25%	11%
Financial appraisal			
Total costs of interventions, undiscounted (US\$)	\$13.83 million	\$13.83 million	\$13.83 million
FNPV (US\$)	\$7.6 million	\$40.1 million	-\$4.2 million
FBCR	1.79	4.56	0.48
FIRR (%)	11%	18%	3%

In addition to assessing the best- and worst-case scenarios, the sensitivity analysis also considers elasticities – that is, the impact of a 1% change in an assumption shown as a percentage change in the project’s NPV. As Table 5–4 demonstrates, economic results are most sensitive to the choice of economic discount rate, followed by average increase in fish yields and shadow price of carbon. This sensitivity to the carbon price reflects the scale of carbon sequestration benefits within the overall benefit stream: given that a single non-market value drives such a large share of results, the project's economic viability depends materially on the assumptions underpinning it. Conversely, average flood damage costs have negligible impact on overall results. With fewer benefits assessed, financial results are equally sensitive to the financial discount rate and average increase in fish yields.

Table 5–4: CBA sensitivity analysis of elasticities

Assumption	% change in ENPV	% change in FNPV
Economic discount rate	24%	
Financial discount rate		15%
Average flood damage costs	0.2%	
Average increase in fish yields	4%	15%
Shadow price of carbon	2%	

6 Conclusion

Efficiency and effectiveness

A comprehensive economic analysis was conducted to assess the cost-effectiveness of the project from the perspective of the broader economy and society. The analysis compares a scenario with the project against a no-intervention baseline and quantifies key benefits, including: flood risk reduction through enhanced coastal protection; increased fishery productivity driven by sustainable fishery management practices; reduced sediment yields; carbon sequestration; tourism value linked to improved coral reef health; and additional mangrove ecosystem services, including provisioning and non-use (bequest) values.

The economic appraisal indicates that the project represents a viable and cost-effective investment at a 10% discount rate, generating an Economic Net Present Value (ENPV) of \$13.7 million, an Economic Benefit-Cost Ratio (EBCR) of 1.65, and an Economic Internal Rate of Return (EIRR) of 18%. As the EIRR exceeds the assumed social discount rate and the EBCR is greater than 1, the project is expected to deliver net positive economic benefits.

These findings are consistent with a growing body of global evidence demonstrating that investments in coral reef conservation and restoration can generate substantial economic returns while enhancing the resilience of coastal communities. Healthy coral reef ecosystems provide protection against climate-related coastal hazards, including storms, wave action, erosion, and flooding, while supporting fisheries, tourism and a range of other ecosystem services that underpin local livelihoods and economic activity. Importantly, the economic analysis presented here captures only a subset of the project's potential benefits. Several important values, including biodiversity conservation, cultural heritage, and non-use ecosystem values, were not quantified due to data limitations. As a result, the estimates presented are likely to be conservative, and the project's overall economic contribution may be higher than reported.

It is, however, important to note that carbon sequestration is the largest contributor to the quantified benefits, accounting for approximately 68% of total discounted benefits (US\$23.5 million of the US\$34.6 million total). This is consistent with the benefit profile of many large-scale ecosystem restoration initiatives, where climate regulation services represent a significant share of the total economic value generated. However, it also means that the robustness of the economic case is sensitive to assumptions regarding sequestration rates and the shadow price of carbon, as highlighted by the sensitivity analysis.

Sensitivity testing further indicates that project viability is influenced by the choice of social discount rate and the magnitude of projected increases in fish yields. While the project remains economically justified under the central-case assumptions, changes in these parameters have a material impact on the results. Under the worst-case scenario tested, the project generates an ENPV of negative US\$3.59 million, an EBCR of 0.79, and an EIRR of 11%, underscoring the importance of achieving anticipated ecological outcomes and maintaining the broader enabling conditions required for success. Under the central-case assumptions, the project has a payback period of approximately 11 years, reflecting the long-term nature of ecosystem restoration investments, where benefits accumulate gradually and increase over time as ecological systems recover and mature.

A financial analysis was undertaken to assess the project's financial viability and the sustainability of revenue-generating interventions from the perspective of participating beneficiaries and enterprises. The analysis compares the net financial cash flows under the project scenario against a business-as-usual (no-intervention) scenario. The principal financial benefit arises from increased fishery productivity, with sustainable fisheries management measures implemented under Component 2 leading to the recovery of fish stocks and higher incomes for community fishing households.

The results indicate that the revenue-generating interventions are financially viable at a 5% financial discount rate, yielding a Financial Net Present Value (FNPV) of US\$7.62 million, a Financial Benefit-Cost Ratio (FBCR) of 1.79, and a Financial Internal Rate of Return (FIRR) of 11%, exceeding the commercial lending rate used as a proxy for the weighted average cost of capital. The project reaches its financial payback point in year 15. These results are driven primarily by improvements in fishery productivity, which generate sustained increases in household incomes and support the long-term economic resilience of coastal communities.

The analysis further demonstrates the importance of GCF support in overcoming existing market barriers. In the absence of concessional financing, limited access to capital, high perceived investment risks, and weak incentives for sustainable resource management would constrain the uptake of sustainable fishing practices. This would likely result in continued degradation of marine ecosystems, reduced fish stocks, and the loss of significant economic opportunities for local communities.

However, the financial performance of the project is sensitive to several key assumptions, particularly the financial discount rate applied and the scale of fisheries yield improvements achieved. Sensitivity testing shows that changes in these parameters can significantly affect project returns. Under the worst-case scenario assessed, the project generates a negative FNPV of US\$4.16 million, an FBCR of 0.48, and a FIRR of 3%, illustrating the importance of achieving the anticipated productivity gains and maintaining enabling conditions that support sustainable fisheries management over the long term.

Paradigm shift potential

The economic and financial results show that the project generates lasting benefits beyond the 10-year implementation period, with economic and financial returns projected to continue throughout the 30 year assessment period. Both analyses indicate that these benefits not only persist but also expand over time, demonstrating that the interventions are sustainable and capable of continuing once the initial funding period ends (assuming that interventions are sufficiently scaled within the 10-year implementation period).

As the financial analysis shows, a key factor in the project's long-term viability is its role in establishing new market and livelihood opportunities, namely in fisheries and community-based enterprises. The transition to sustainable fishing practices directly improves catches and incomes for fishing households, enhancing food security and increasing household spending power. These economic gains have the potential to create further opportunities, including integration into more formal supply chains, which strengthens the resilience of the local economy. Beyond fisheries, although not quantified in the CBA, the project under Component 3 supports reef-positive businesses with technical assistance, capacity building, and improved market access, ensuring that these enterprises can grow independently. Because they generate their own revenues, they are envisioned to finance their operations beyond the project's lifespan, continuing to drive local economic activity and support the project's objectives after GCF funding ends. By strengthening economic resilience at both the household and enterprise level, the project ensures that its benefits are not only sustained but also self-reinforcing.

Adequacy of financial structure

The project relies on grant funding as the primary financial mechanism, given the nature of its interventions and the urgency of securing coral reef resilience. The need for grant-based funding is particularly evident in Components 1 and 2, which focus on planning, institutional strengthening, and creating an enabling environment for sustainable ecosystem management. These activities do not generate direct financial returns or cash flows that could attract commercial or leveraged investments. While Component 3 envisions supporting reef-positive enterprises, the specific businesses and their financial viability have yet to be fully defined. Without a clear understanding of their potential revenue streams, securing private co-financing at this stage is not feasible. However, as these enterprises develop, there is future potential to attract private investment and leveraged finance, particularly once their business models and cash flows are more clearly established. In this potential future scenario, GCF funding would play a catalytic role by de-risking the initial investment and laying the groundwork for additional investor engagement.

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