COST-BENEFIT ANALYSIS FOR NATURAL RESOURCE MANAGEMENT IN THE PACIFIC

A GUIDE

SECOND EDITION

August 2016

Aaron Buncle; Adam Daigneault; Paula Holland; Anna Fink; Scott Hook; and Marita Manley

Aaron Buncle	Secretariat of the Pacific Regional Environment Programme	www.sprep.org
Adam Daigneault	Landcare Research, New Zealand	www.landcareresearch.co.nz
Paula Holland	Pacific Community	www.spc.int
Anna Fink	Pacific Community	www.spc.int
Scott Hook	Pacific Island Forum Secretariat	www.forumsec.org
Marita Manley	Gesellschaft für Internationale Zusammenarbeit	www.giz.de/en

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CONTENTS

Appendices

Tables

Boxes

Figures

PREFACE

There has been an increase in interest in the use of cost–benefit analysis (CBA) in the natural resource sectors of the Pacific in recent years. Accompanying this has been an increased demand for expertise to carry out the analysis and numerous requests for training to increase national and sectoral staff skills in managing the CBA process. In the last three years, regional training activities in CBA have, for example, been delivered to support natural resource projects aimed at invasive species management, climate change mitigation and adaptation, environmental conservation, food security and disaster risk mangement.

There is a wide variety of guides and manuals on CBA across the globe. However, until now, there has been no published document that brings together the steps of CBA with an emphasis on the Pacific region. This Guide is intended to fill that gap. It aims to support Pacific government and non-government organisations in their CBA activities, and to support training and capacity development in this area. The Guide is also intended to standardise approaches to CBA by the agencies involved – SPC, SPREP, PIFS, USP, GIZ, UNDP – so that practitioners receive consistent advice and support.

The Guide has been written from the perspective of supporting decisions in natural resource management sectors, but the principles apply broadly to all sectors of the economy and society.

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- The Pacific Resource and Environment Economics Network (PREEN);
- Commonwealth Secretariat (ComSec);
- Pacific Adaptation to Climate Change (PACC) Programme;
- Pilot Program for Climate Resilience (PPCR) – Pacific Regional Track;
- Critical Ecosystem Partnership Fund (CEPF);
- Climate and Development Knowledge Network (CDKN);
- SPC/GIZ Coping with Climate Change in the Pacific Island Region (CCCPIR).

GLOSSARY

Baseline	A measurement or description of a scenario used as a basis for comparison. In CBA, the baseline represents the best assessment of the world in the absence of the action (including government policies or regulations) proposed for assessment. This is sometimes referred to as the 'without' scenario
Benefit	Monetary or non-monetary gain received because of an action taken or a decision made
Benefit-cost ratio (BCR)	The ratio of the present value of benefits from an activity, expressed in monetary terms, relative to the present value of its costs
Cost-benefit analysis (CBA)	A systematic process for assessing, calculating and comparing the advantages (benefits) and disadvantages (costs) of an activity. This includes those costs and benefits that cannot be quantified in monetary terms but are nonetheless valued by society, for example those relating to the environment, safety and nature
Cost-effectiveness analysis (CEA)	A systematic method to find the lowest cost of accomplishing a desired objective
Cost	Monetary or non-monetary loss due to an action taken or decision made
Discount rate (r)	The rate at which future values of benefits or costs are adjusted to express them in present-day values
Discounting	A method whereby the value of future benefits and/ or costs is expressed as present-day values
Ex-ante CBA	A CBA undertaken while a project is still under consideration, before the project is implemented
Ex-post CBA	A CBA undertaken at the end of the project period to evaluate its performance
Externality	A cost or benefit from an activity that affects other parties without this being reflected in the cost of the goods or services involved
Market	An institution in which goods and services are bought and sold
Net present value (NPV)	Sum of the discounted stream of benefits and costs over time
Non-market benefits and costs	Benefits or costs arising from the production or consumption of goods or services that are not traded in markets and either have no monetary price or whose price does not reflect all the benefits and/ or costs
Sensitivity analysis	An assessment of how different values for one (independent) variable will impact a particular dependent variable under a given set of assumptions
Project cycle	Standardised process that project managers use to design and implement evidence-based projects
Weighting	Allowance or adjustment made to values to take account of certain circumstances
With-and-without analysis	Comparison of benefits and costs 'without' the proposed activity (what would happen in any event) and benefits and costs 'with' the activity (which would cause some change)
With scenario	The best assessment of the situation if the action proposed for assessment is pursued
Without scenario	No change option. This the best assessment of the situation in the absence of the action proposed

INTRODUCTION

The importance of natural resources to the economy of the Pacific Island region cannot be overstated. Island communities have unsurprisingly relied heavily on ocean resources for sustenance and economic activities, such as fishing and transport. Land-based resources are also vital at the subsistence level, and are providing increasing development opportunities, for example through forestry and mineral mining.

At the regional level, the Pacific is the most important tuna fishing ground in the world, with commercial fisheries including exports worth an estimated USD 2 billion in 2007 (SPC Oceanic Fisheries Program cited in Bell et al., 2011). At the national level, primary sector activities, such as agriculture, forestry, fishing and minerals constitute as much as a quarter of the GDP in Kiribati and one-third of the GDP for the Solomon Islands[1]. Natural resources also contribute to economic development through the secondary and tertiary sectors (such as tourism, manufacturing and processing).

Reliance on natural resources is also inextricably connected to cultural practices and the identity in Pacific Island nations. At the same time, the cash economy has become more important in most communities over the last century, with the shift from a largely subsistence-based economy to an increasingly market-oriented one. Access to better technology and increased trade with the outside world have, in many cases, resulted in higher income levels and generally improved health and life prospects. However, development in many Pacific Island countries has come at the cost of increased (often unsustainable) production and consumption, resulting in increasing resource scarcity, environmental degradation and pollution problems (Lal and Holland, 2010). Climate change impacts are compounding these natural resource management challenges.

In response to these challenges, an increasing number of development projects are being developed in the region that target the environment, natural resources and/ or climate change adaptation. The success of these projects, however, has been chequered. To ensure that development projects are well targeted and that funds are targeted towards the most effective projects, there has been a call to include economic analysis of projects to improve their efficiency and effectiveness (see, for example, SPREP (1999, 2001), Lal and Keen (2002) and Manley (2013)).

Countries also recognise the need for improved transparency and accountability in government decisions, including evidence-based choices of projects, policies and initiatives. The Forum Compact[2], for example, recognises that improved governance and service delivery are essential in achieving more efficient and effective development.

In response, there has been a significant increase in the use of cost–benefit analysis (CBA) to assess natural resource management projects in the last 5–10 years, addressing a variety of natural resource management sectors (see Appendix 1 for examples). However, the use of CBA to inform decisions and actions within government and non-governmental organisations is often not institutionalised or applied systematically. This can lead to confusion about how and when to use CBA.

Numerous guides already exist to support the systematic application of CBA (for example, Mishan, 1988; Hanley and Spash, 1993; Wills, 1997; European Commission, 1997; HM Treasury, 2003; Boardman, 2006; Tietenberg, 2006; OECD, 2006; Australian Government Department of Finance,

[1] Data available at www.spc.int/prism.

[2] Developed by Forum Leaders and implemented by Economic Ministers.

2006; UNECE, 2007; USEPA, 2010). However, none include local case studies that are relevant to decision-makers in the Pacific. There have, therefore, been numerous requests to SPC, SPREP and other agencies in the region to produce a guide, with regional examples, to help countries plan and deliver CBAs for their development activities (for example, Buncle, 2013).

The purpose of this document is, therefore, to support economic analysis in Pacific Island countries (government and non-government organisations) by:

- illustrating the various steps involved in conducting a CBA, using examples that are familiar to Pacific Islanders in context, content and challenges;
- providing practical tools to support local CBA;
- supporting local capacity to manage the conduct of CBA;
- supporting meaningful participation in the CBA process; and
- promoting a consistent approach to CBA.

The guide directly complements a programme of training activities delivered in the region in the last five or so years under the 'P-CBA' – a collaborative effort among several agencies to target consistent messaging and methodology in CBA.

In light of the many existing guidebooks already available to support CBA, this document is intended only as an introductory guide with a focus on the practical application of CBA in the Pacific. It indicates key questions and issues to address but it does not explain the theoretical concepts underpinning CBA. Readers are encouraged to refer to the many CBA texts referred to earlier for more information on these theoretical areas.

The document is divided into several sections. The next section provides an overview of the purpose of CBA, some of its key features, and describes where CBA can be used in project planning and evaluation. It then sets out CBA as an eight-step process, starting from the determination of a project[3] through to preparation of recommendations. Each of the seven steps is then described in more detail in the following sections. These sections also illustrate key points with the use of a case study example of the application of CBA to a coastal project in Kiribati.

A series of appendices at the end of this document provide supporting material and tools.

Overview of cost–benefit analysis

Cost-benefit analysis (CBA) is an analytical framework for appraising or evaluating a project. Its primary purpose is to help inform strategic decision-making. In particular, CBA helps to inform decision-making around:

- whether to allocate resources to a project proposal or not – and prioritisation of the project proposal amongst other competing uses of government resources; and
- which project option(s) to select – if there are a number of alternative options that could be implemented to address a given policy problem.

[3] In this report, a project is a catch-all term for major activity, policy intervention, or response/ solution to an identified problem.

CBAs can also be used to help inform refinements and improvements to specific aspects of a project design.

The key features of a CBA are:

- all related costs (losses) and benefits (gains) of a project option are considered, including potential impacts on human lives and the environment;
- costs and benefits are assessed from a whole-of-society perspective[4], rather than from one particular individual or interest group (that is, a public and not a private perspective is taken);
- costs and benefits are expressed as far as possible in monetary terms[5] as the basis for comparison; and
- costs and benefits that are realised in different time periods in the future are aggregated to a single time dimension (using a procedure called discounting).

CBA can be used to assess a wide range of projects from different sectors and of different sizes. Examples of CBAs undertaken in the Pacific region are outlined in Appendix 1.

When is CBA used?

CBA may be used at a number of different stages throughout the life of a project, or the 'project cycle'.

The most common stage is as part of project planning – before the preferred 'solution' to a project problem is determined and implementation of the project has started. These CBAs are sometimes referred to as 'ex-ante' CBAs. As outlined above, 'ex-ante' CBAs are used to help determine whether to invest in a project proposal or not; inform selection of the preferred project option; and/ or inform refinements to project design.

The other common stage is at the end-of-project. Such 'ex-post' CBAs are primarily used to help evaluate to what extent the project represented 'value-for-money'. This, in turn, can inform whether further investments in the project area are warranted and is especially useful for projects that seek to trial or pilot a particular approach or technology.

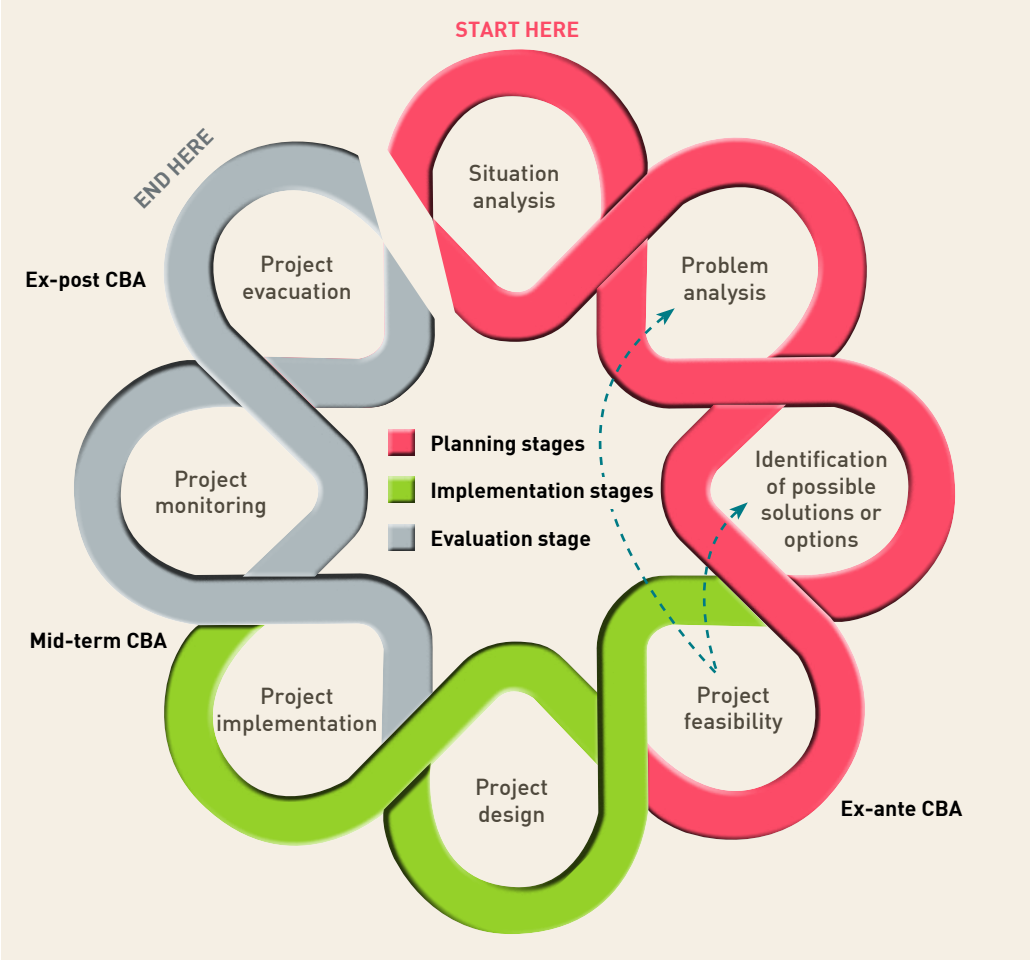
In addition, CBAs are sometimes applied part-way through the project to inform how to modify or adapt the design of the project as it is being implemented ('adaptive management'). This application is most useful for projects which have relatively long life-spans (for example, greater than 10 years) and where there is scope to materially change the design of the project as it is being implemented.

Figure 1 illustrates the key applications of CBA throughout the project cycle.

[4] For this reason, some people refer to CBA as social CBA.

[5] Note that costs and benefits that cannot be quantified in monetary terms are still considered during decison making.

Figure 1. Cost-benefit analysis in the project cycle.



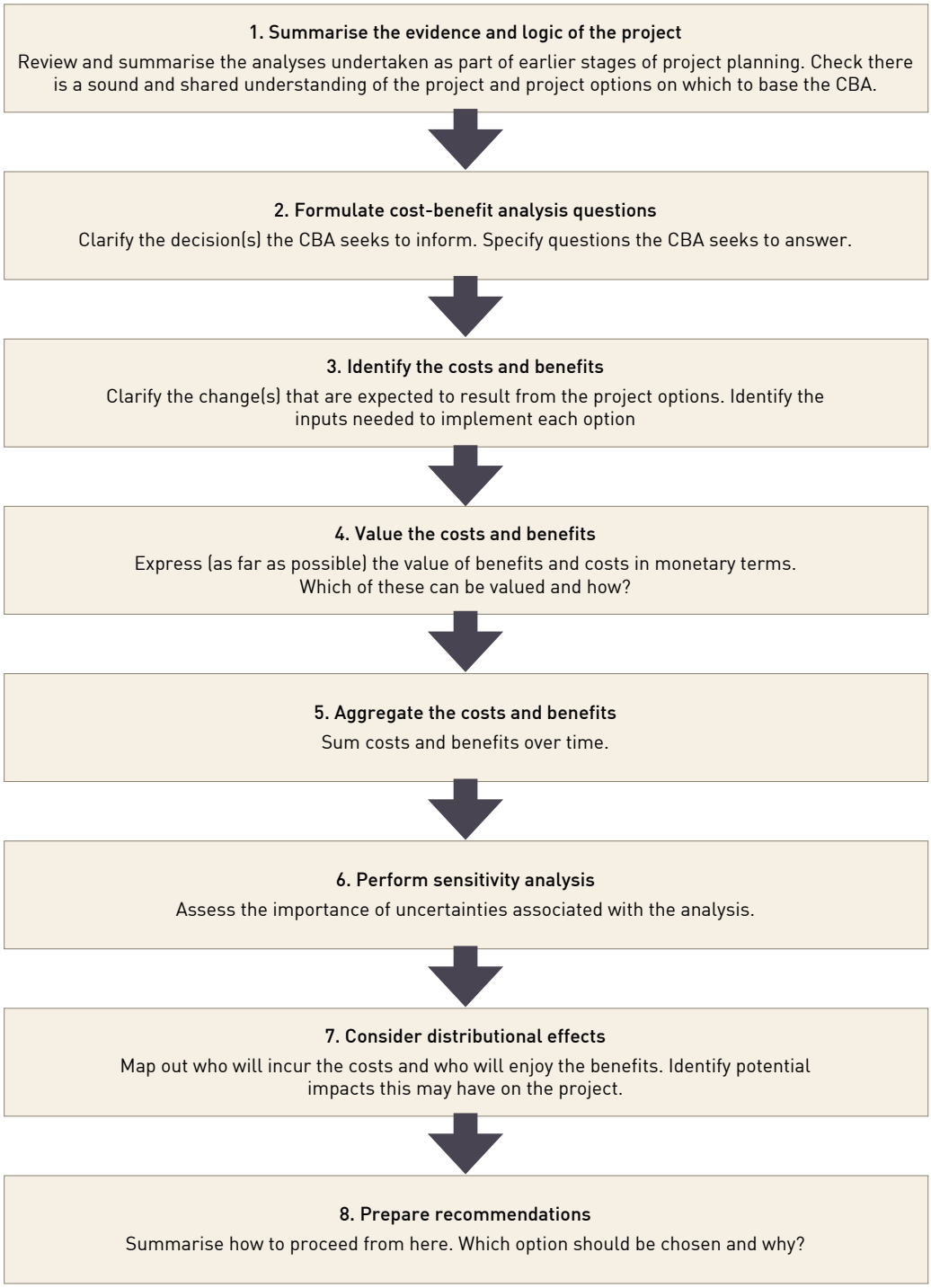
Source: Adapted from Lal and Holland (2010).

The CBA process

The CBA process follows a logical and systematic sequence. This Guide presents this sequence as eight key steps (Figure 2).

The sequence of steps presented is not necessarily rigid. Economic analysts may find it necessary to return to previous steps as more data or information becomes available and the nature of the problem they are investigating becomes clearer. This means that planning and organising a CBA become critical to process. Suggestions on how to establish a work plan for a CBA are provided in Appendix 2. Generic terms of reference for an economic consultant are also provided in Appendix 3.

Figure 2. Key steps of the CBA procedure



The following sections in this document describe the eight basic steps in detail. A case study from Kiribati, in which CBA is applied to coastal management and aggregate supply, is used to illustrate the key points of each step.

STEP 1. SUMMARISE THE EVIDENCE AND LOGIC OF THE PROJECT

In practice, a substantial amount of planning and assessment work is normally undertaken by a government department or agency before a project begins – and before any CBA is conducted. Ideally, this work is reviewed to check the nature, extent and underpinning causes of the project problem so that the identified options clearly link back to the causes of the problem (that is, to confirm that the identified project responses make logical sense) and/ or its symptoms. This will enable the identification of benefits and costs. For example, a climate change project might seek to increase the number of pigs on an island to increase food security. The benefits of the project would be increased food supplies only if the community already uses pigs for food. By comparison, if the community mainly only uses the pigs for occasional cultural purposes (e.g., births, marriages, establishment of a new chief), little, if any, food security benefit is likely to emerge, despite best efforts.

Reviewing the nature, extent and underpinning causes of a problem should be undertaken in partnership with relevant technical experts from the sector or discipline, as well as the government officials responsible for managing the project.

During this review step, the following questions should be answered:

What is the problem?

- What is the nature of the problem? What is the magnitude of the problem? What is the evidence for this? Is the source of this information reliable?
- Who is affected? How many people are affected? Over what geographical area? Is this situation expected to change over time? If so, how?
- What are the underpinning causes and drivers of the problem? Have all causes and drivers of the problem been identified? Have climate factors been considered?
- Are the causes and drivers well understood? What is the relative importance of each of the identified causes and drivers of the problem?
- Is it appropriate for government to address the identified cause(s) of the problem? Or is this the role of the private sector?

What is the project objective?

- What is the stated objective of the project? Does this objective directly link to one or more of the identified causes of the problem?
- Can the stated objective be made more specific or clearer?

What are the alternative project options?

- What options have been identified? How were these options identified? Was this a thorough process, including review of what has been done in other parts of the country and the broader Pacific region? Were consultations conducted with communities? Was particular attention paid to ensuring that all community members (men, women, youth,

children, elderly and those living with disabilities) had the opportunity to feed into project option identification?

- Do these options clearly align with the project objective (and hence causes/ drivers of the problem)?
- Have social and enviornmental effects been considered (safeguards)?
- Are there any financial or budget constraints that may restrict which options can be considered further? Are there any other obvious constraints that may affect the feasibility of identified options?
- If projects similar to the identified options have been implemented previously or elsewhere in the region, were they successful? What were the enablers and challenges? Was a formal evaluation report prepared for these projects and, if so, has this been reviewed?
- Are the number of alternative options identified sufficient to provide the decision-maker with real scope for exercising choice? Are alternatives clearly distinguishable from one another?

The assessment work undertaken by a government department or agency prior to starting a project may not always be sufficient to provide answers to all of these questions. In these situations, it is up to the CBA analyst to ask relevant stakeholders and experts for the needed information and to undertake any further research and/ or identify the scope of other needed assessments.

Furthermore, it is good practice to establish a shared understanding of the nature, extent and causes of the project problem; the project objective; and the logic of the project options at the outset. This will, for example, avoid confusion later among stakeholders on the values generated in the CBA.

To do this, a series of 'statements' could be prepared, defining the project problem, the project objective; and a description of project options to combat the problem. As an example, Box 1 defines the project problem, project objective, and describes options considered for the coastal management and aggregate supply case study in Kiribati.

Box 1: Problem statement, project objectives, and description of options for coastal management and aggregate supply in Kiribati (the 'ESAT' project).

Situation

For Kiribati, a combination of growing population, migration from outer islands, and development investment has resulted in the rapid growth of its capital, which is located on the small atoll of Tarawa. Growth has resulted in an increase in residential developments, as well as larger developments, such as hospitals, schools and government buildings. The construction of these developments requires 'aggregates' – sand, gravel, rip rap or rocks used for construction.

Problem

Aggregates on Tarawa have conventionally been sourced from the the coastline by families (by hand), businesses and the government (using machinery). However, there is only a limited amount of aggregates available and removing too much can contribute to coastal erosion and coastal inundation. This is an increasing concern given sea level rise due to climate change.

To minimise the impacts of beach mining, the government has placed restrictions on where miners can operate. However, these rules are not always observed. This may be due to

ignorance of the rules, or attitudes to land (the land on which some families illegally mine is perceived as their own). Many families mine aggregates to sell to supplement their incomes and these families have little incentive to reduce mining.

The supply of aggregates from the beach is sometimes supplemented by imports. However, this is costly and, therefore, not a feasible source for most development needs. Furthermore, importation brings quarantine risks.

For Tarawa to address its development needs, it requires a supply of aggregates that is both safe and affordable, does not exacerbate the threat of coastal erosion and inundation, and does not harm the needs of the local community.

It is now recognised that a substantial supply of naturally occurring aggregates exists in the local lagoon. Hydrodynamic modelling and environmental assessments have been conducted to identify actions that could be introduced to enable the aggregates to be extracted from the lagoon with minimal environmnetnal impact. The government has thus proposed the establishment of an Environmentally Safe Aggregates in Tarawa (ESAT) project to open up access to these aggregates to help meet the growing demand for building materials in Tarawa, while also limiting coastal threats in the face of climate change. However, it needs to know if such an entity can survive financially without ongoing assistance from the government while being an efficient solution to the problem.

Project objective statement

The overall objective of the ESAT project is to secure a sustainable and affordable source of aggregates to underpin economic development in Kiribati in the face of vulnerability and climate change.

Description of project option

The option proposed to achieve the ESAT objectives comprises two interconnected components.

- The establishment of a self-sustaining aggregate company and environmentally safe lagoon-dredging operations to supply aggregate.
- Effective control of beach mining as the present option.

STEP 2. FORMULATE KEY CBA QUESTIONS

The next step of the CBA procedure is to formulate key CBA questions. These are the questions that are most important to primary stakeholders for their decision-making needs. They are what stakeholders[6] 'really need to know' from the analysis.

As mentioned in the Overview section above, CBA is commonly used to inform decision-making around (i) whether to allocate resources to a project proposal or not; and (ii) which project option(s) to select – if there are a number of alternative options that could be implemented to

[6] Stakeholders are funders, government agencies, non-government organisations, other organisations, groups or individuals who have a direct interest in the intervention and its monitoring and evaluation. They potentially include:
- government officials, policy makers, service and contract managers
- funders and donors
- program/ intervention board members, managers and intervention delivery personnel
- service users, clients or beneficiaries
- community interest groups or associations.

address a given policy problem. The types of CBA questions that can be formulated to support these decisions include:

- To what extent does the project proposal represent a worthwhile use of resources? Is this project a high priority for government? Should public resources be directed to this proposal (ex-ante CBA)?
- To what extent are each of the alternative project options expected to generate a net benefit overall? Which option(s) is the best option to address the identified problem? (ex-ante CBA) To what extent did the project represent 'value-for-money'? Should this project be scaled up or replicated in the future? (ex-post CBA)

There may also be other questions that are specific to the problem or project options under consideration, which should also be incorporated. For example, certain stakeholders may be interested in understanding the impact of a project on their specific group so that they can determine what design modifications might be made or what complementary measures might be introduced to ensure equity. Similarly, where climate factors are a major consideration in project design (or are the primary project problem), this may warrant a dedicated CBA question or sub-question. An example of climate related CBA questions that may be incorporated in this step are: *To what extent are alternative project options resilient to coastal flooding hazards? In light of uncertainty about the future intensity and frequency of these hazard events under the effects of climate change, which option represents the best use of resources? Will the project contribute to or exacerbate the negative impacts of climate change?*

CBA questions should be specified clearly and all parties involved should agree on these. The CBA team should play an active role in determining the CBA questions. If the purpose of the CBA is not agreed to in advance, the policy findings may be disputed or even ignored. As examples, Box 2 outlines the CBA questions for the case study ESAT project in Kiribati.

Box 2: Key CBA questions for the ESAT project.

- To what extent is the proposal to dredge aggregate from within the lagoon as an alternative source to coastal mining economically feasible? Is this a sound course of action?
- Are there policy implications for the appropriateness of implementing the proposed government response, such as wider public interest concerns, cost sharing/ subsidisation implications and governance issues needed to support implementation?

STEP 3. IDENTIFY THE COSTS AND BENEFITS FOR EACH OPTION

Step 3 of the CBA procedure is to identify the costs and benefits for each option under consideration. The approach for doing this is to first assess what would happen if the project was not implemented ('without-project' scenario), and then compare this to what would happen if each of the proposed options ('with-project' scenario(s)) were to be implemented. This 'with-and-without' analysis allows the changes (benefits or costs) resulting from a project to be identified.

With-and-without analysis

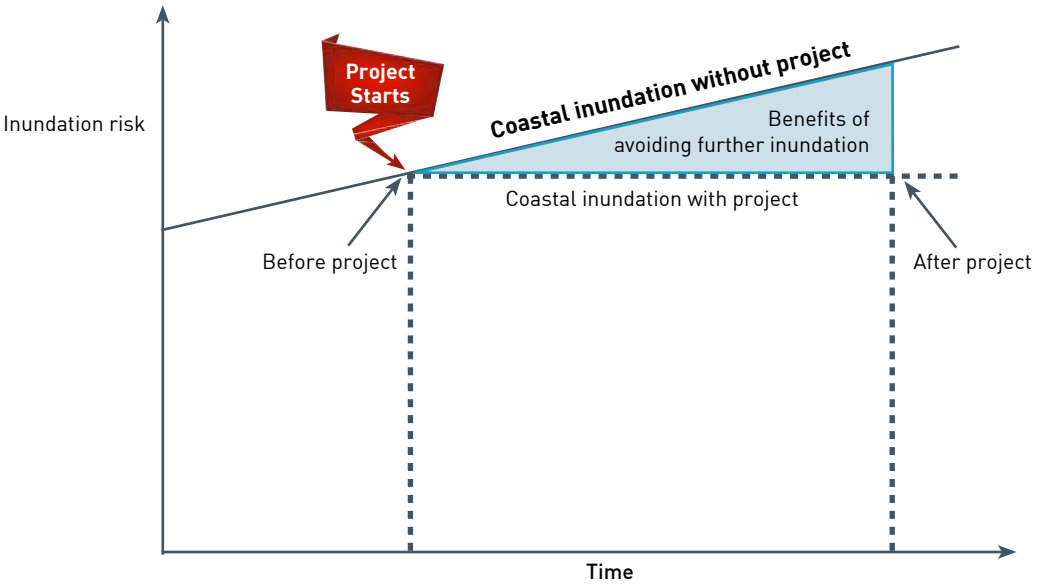
The without-project scenario provides the baseline from which the impacts of a project can be identified and measured. The intention of this analysis is to identify only the changes that are

clearly associated with the project options, and not include changes that would have occurred anyway (Brouwer and Pearce, 2005).

With-and-without analysis should not be confused with 'before-and-after' comparisons. Before-and-after comparisons only look at the change between two single points in time, that is, before the project is implemented and after it has been completed. The with-and-without analysis measures change for every year (or other time increment) across the life of the project. This difference matters because many natural systems are dynamic so the without situation itself may change over time, irrespective of whether a project is implemented.

As an example, coastal erosion and inundation risk in Kiribati is a result of beach mining activity and sea level rise and a number of other factors. Based on sea levels and beach mining today, an assessment of coastal inundation today would reflect the current risk. However, after 10 years with continued beach mining and ongoing sea level rise, the inundation risk would be expected to be higher. A project that keeps coastal inundation at existing levels, therefore, avoids the cost of higher inundation. Yet, this would appear as offering no benefits if the before and after situations were used to value the project (Figure 3). It is, therefore, essential to assess 'with project' and 'without project' scenarios instead.

Figure 3: Dynamic change and 'with' and 'without' analysis



Source: Adapted from Lal and Holland (2010).

To identify the types of costs and benefits that a project generates, with-and-without analysis can be performed in qualitative (descriptive) terms as a start. However, any quantitative (numerical) information that is readily available should also be included as this will later be used to value the costs and/ or benefits in monetary terms (in Step 4).

Items to consider in with-and-without analysis should reflect the inputs (such as labour, materials), outputs (such as aggregate production) and outcomes (such as reduced public health problems) associated with a project. This could be usefully presented in a with-and-without-project table, as illustrated in Box 3 for the Kiribati case study.

Box 3: Without-project and with-project scenarios for the ESAT project in Kiribati.

Present situation	Without lagoon dredging	With lagoon dredging and accompanying ban on beach mining
• Beach mining of coastal aggregates (household mining estimated at 77,000 m^3 per year and Ministry of Public Works and utilities (MPWU) estimated at 6,500 m^3 per year) • Importation of aggregate material from overseas estimated at 5,000 m^3 per year	• Total beach mining increases at 5 per cent per year for next 10 years • Importation of aggregate material increases at 7 per cent per year for next 10 years	• Reduced reliance on coastal mining and importation of aggregate: - Provision of 46,000 m^3 of aggregate per annum, expected to offset 75 per cent of imported aggregates and all aggreates mined by MPWU from the coast. The remainder of the 46,000 m^3 is intended to offset an equivalent quantity mined by communities • Beach mining for large boulders and remaining aggregate needs (21,000 m^3 estimated) continues
• Coastal erosion exacerbated by mining of beach flats, leading to increased risk of inundation, and damage to infrastructure, agriculture and public health	• Coastal erosion continues with resulting ongoing harm to infrastructure, agriculture and public health • Expenditure on protective works (e.g. sea walls) increases by Aus$7,500 per year	• Expenditure on protective works remain at the same level • Reduced damage costs in infrastructure and agriculture • Reduced public health losses • Possible impacts on fisheries?
• Coastal mining supplementing incomes to numerous families, and sole or primary source of income for many	• Continues at same level	• Negative impacts on livelihoods of some community members
• Low compliance with regulations restricting coastal mining (illegal mining in vulnerable areas, low payment of mining royalties)	• Continues	• Increased compliance from some sectors of the community but • Likely on-going noncompliance from some families reliant on beach mining as primary source of income • Possible social unrest due to negative perceptions by community of lagoon dredging (negative impact of livelihoods, environmental impacts etc.)

Source: Calculated by authors from data in Greer (2007).

With-and-without tables

A with-and-without-project table summarises the present situation, the future situation without the project, and the future situation if the project options are implemented.

As indicated, the present situation may not be fixed but may be dynamic and change over time. The present situation column thus describes the present outputs (e.g. production levels) and outcomes (e.g. rate of coastal erosion) from which to consider what may happen in the future.

The without-project column describes what inputs, outputs and outcomes relevant to the project problem are expected to arise without any project options being implemented. Again, these may be different to the present situation inputs, outputs and outcomes because they take into account any ongoing trends that affect outcomes (e.g. beach mining activity, sea level rise). Consequently, in this column, analysts need to forecast the likely level of inputs, outputs and outcomes over time[7].

The with-project column(s) of the table (one for each option) describe the outputs and outcomes of the project with different project options – that is, they describe the changes in outputs and outcomes that would be expected to occur because of the project activities. These columns include the inputs required to implement the project options, such as up-front (i.e. capital investment and establishment) and operational costs of the project option.

Identifying costs and benefits

The inputs, outputs and outcomes identified in the 'with' and 'without' scenarios need to be identified as positive (benefits) or negative (costs). Inputs are costs (negative) while outputs and outcomes may be either positive and or negative.

Typical benefits arising from natural resource management projects include:

- improved productivity levels (e.g. improved agricultural or fisheries production or increased supply of clean water);
- improved health;
- improved environmental quality;
- resilience to climate change; and
- diversification of livelihoods.

Typical costs include:

- up-front costs:
  - research, design and development costs;
  - capital expenditure;
  - labour; and
  - use of government-owned land, facilities, or machinery.
- operating and maintenance costs for the entire expected economic life of the project
  - costs of regular inputs (fuel, materials, manufactured goods, transport and storage, etc.); and
  - on-going labour.
- negative impacts arising from the project, e.g. health effects or environmental damage, costs of relocation due to inundation, loss of livelihoods, etc.

Impacts such as health, social and environmental benefits or costs are commonly not marketed (that is, these items are not purchased or sold in markets) or are characterised by prices that reflect less than their full value. Market prices will, therefore, unlikely reflect the economic value of these types of impacts from a project. Nevertheless, it is important that these items are included in the analysis. At a minimum, they should be discussed and described in qualitative

[7] The analyst will need to consider the timeframe that the CBA will reflect. Regardless of whether the CBA is intended to reflect values over 1, 10 or 50 years, the same timeframe will need to applied for each column.

terms. Indications for how to assign a monetary value to these types of impacts are noted in Step 4.

The types of costs and benefits identified for the case study ESAT project in Kiribati are shown in Box 4.

Box 4: Identifying costs and benefits for the ESAT project in Kiribati.

From Box 3, several benefits can be expected from coastal management associated with lagoon dredging. These are:

- an increase in supply of locally produced aggregates, offsetting some coastal mining and imports. This would reduce costs in:
  - maintenance and replacement costs for infrastructure;
  - loss of agriculture production; and
  - public health.

On the other hand, some negative impacts (costs) of lagoon dredging may be expected:

- possible impacts on fisheries;
- possible negative impacts on the livelihoods of community members might result in negative perceptions of the project and obstruction [these distributional issues will be considered in Step 7]; and
- standard costs associated with dredging include the cost to build a barge to extract and transport the aggregates to shore, fuel and labour to run the barge, and costs of sorting the aggregate collected.

STEP 4. VALUE THE COSTS AND BENEFITS

As far as practicable, the costs and benefits identified under the different project options should be valued in monetary terms. This allows a direct comparison of the different costs and benefits under each option. This activity involves:

- quantifying the inputs, outputs and outcomes for each of the project options. The costs and benefits quantified in this way must be those that would result from the project activities; and
- assigning dollar figures to these inputs, outputs, and outcomes.

Assigning dollar values

Where an active and effective market exists for an item (such as a large local market for agriculture produce), the market price for those items provides a good indication of the true economic value[8] of that item. Market price information is publicly available and is, therefore usually easy to access. For this reason, market prices provide the easiest means to put an economic value on an item.

In some cases, however, market prices may not reflect the true economic value of an item accurately and, in other cases, market values may not exist at all. This occurs where (i) markets for items exist but their costs are subsidised or taxed or (ii) where markets do not function properly or at all for a good or service.

[8] That is, the value of the item from a social, whole-of-society perspective.

What to do when goods and services are taxed or subsidised

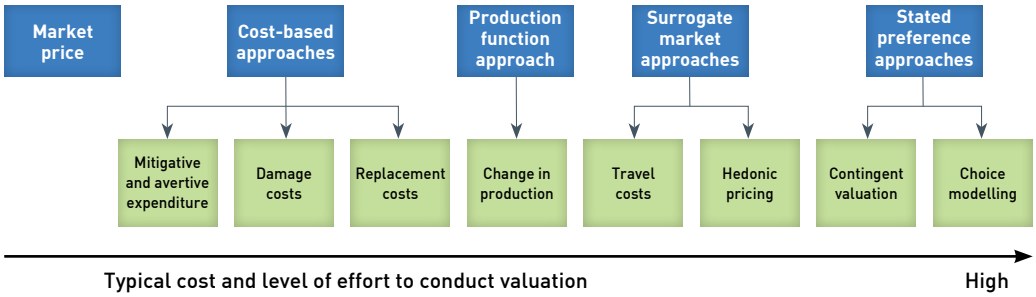
Where goods and services are taxed or subsidised, the economic value of the item is not given in their price. Items that are taxed (such as many imports) appear to cost more economically to produce than they actually do. Conversely, items that are subsidised (such as many health services) appear less valuable than their true economic value. If items are included in the analysis using these prices – that, is, if they incorporate taxes or subsidies – this will lead to errors in the analysis and potentially wrong conclusions and decisions.

To provide for an accurate analysis, adjustments need to be made to the existing market prices to reveal the true value. Broadly speaking, this means excluding the cost of taxes or subsidies from relevant items. The most commonly used approach to make adjustments in developing country contexts is to use world prices – prices at which goods are bought and sold internationally. For details, see Boardman et al. Chapter 16 (2006).

What to do when markets do not function (properly or at all)

Markets may not function fully or not at all for a variety of goods or services. This includes environmental or social services (such as water). Economic approaches to put a monetary value on costs and benefits that are not (fully or at all) marketed do exist. Common approaches are illustrated in Figure 4. A short description of these methods, together with examples of their use and the relative level of effort (time and/ or money) they require, is provided in Appendix 4 and standard CBA texts.

Figure 4: Methods to value costs and benefits.



Source: Based on Emerton and Bos (2004).

Analysts may choose one or serval of these approaches to assign economic values for the inputs and/ or outputs for a project. Ideally, all benefits and costs should be quantified and reflected in dollar terms unless it is impractical to do so. Situations where it may be impractical to value in monetary terms include:

- when physical or monetary values cannot be reliably measured or established;
- when cost or benefit items are not significant to the analysis; and
- when it is judged that the cost of attempting to value them outweighs the benefit of including them in the analysis.

Omitting values from a CBA for such reasons of practicality is not ideal. Nevertheless, in some cases, it may be possible to determine the way forward even though some values are missing[9].

[9] For example, imagine the benefits of a $0.5 million water improvement project include $10 million in health benefits. To determine whether the project is worthwhile, it would not be critical to value the benefits to marine ecosystems as well because it would be apparent that the benefits of the project far exceed the costs.

Even so, items that are not quantified in a CBA should still always be listed and described, so that they can be still factored into the decision-making process.

Data collection

Data collection for CBAs can be time-consuming and costly. For some costs and benefits, it may not be worth the effort and expense to collect the empirical data needed for an accurate estimation of the values. The CBA analyst needs to make a judgement about this.

There are no hard and fast rules for determining the accuracy of cost and benefit estimation and hence the data that is needed. A general rule of thumb is that the detail and accuracy of cost and benefit valuations should be commensurate with the size and importance of the project proposal. It is also useful to ask whether *conclusions and/ or recommendations are confidently made without undertaking a detailed and accurate monetary estimation of this cost or benefit item. Analysts should ask themselves: is this information actually needed to answer the questions the CBA aims to answer*.

As already indicated, where key costs or benefits are not valued, a qualitative assessment of the values must be provided. In the CBA report, the following information should be provided (qualitatively and/ or quantitatively):

- the uncertainties associated with the key values;
- the assumptions made;
- a description of any costs and benefits that have not been included so that policy makers can see the limitations to the assessment; and
- where possible, a sensitivity analysis of key uncertain variables as a way to work out what uncertainty means for the project (Step 6).

The methods used for valuing costs and benefits for the ESAT project in Kiribati are shown in Box 5.

Inflation

Costs and benefits should be valued in real terms (constant prices) over time, rather than in nominal terms (prices at the time the goods or services were provided). In other words, the impact of inflation should be removed from the CBA (for example by using the same nominal price over the course of the assessment) so the costs and benefits are measured in a common money value over time. Prices and costs should only be adjusted over time if the price of a particular good or service is expected to increase or decrease relative to all other goods and services. For example, if a project was expected to flood the market with fish and cause the price of fish to fall next year, the price of fish this year should not be used to estimate the economic value of the fish produced. In this case, a lower value would be used. Generally speaking, activities in the Pacific that dramatically affect the economic value of goods or services in this way are not common.

Box 5: Valuing costs and benefits of the ESAT project in Kiribati

With lagoon dredging	Cost or benefit	Valuation method
Operation of the dredge (and its accompanying ban and reduced reliance on coastal mining and importation of aggregate)	Cost	Market prices: Used market prices to estimate costs of dredging Adusted market price of labour to 75 per cent of average wage rate to reflect true economic costs of labour (limited employment opportunities in Kiribati) Adjusted market price of fuel costs to reflect long-run untaxed fuel price (based on World Bank forecasts)
Avoided cost of aggregate production from household beach mining and MPWU beach mining; as well as avoided costs of imports	Benefit	Cost-based approach: Used market prices to estimate costs of production for household mining, MPWU beach mining; and market prices for imported aggregate Adjusted market price of labour to 75 per cent of average wage rate to reflect true economic costs of labour (limited employment opportunities in Kiribati) Adjusted market price of fuel costs to reflect long-run untaxed fuel price (based on World Bank forecasts)
Reduced damage costs in infrastructure - avoided expenditures on protective works - avoided costs	Benefit	Cost-based approach: Used market prices to estimate the value of costs avoided or to estimate expenditures that would need to be avoided to prevent costs arising (mitigative and avertive expenditure method): • estimate value of loss in infrastructure that would otherwise have to be protected by coast: Cost of replacing costal protection = price of seawall x length of seawall needed • loss of land, buildings, personal property, damage to utilities – telephone, electricity, water supply and sewage, roads, etc., would continue: Cost of damage avoided = annual estimated costs x expected increase in costs avoided
Reduced damage costs in agriculture Reduce public health losses Possible impacts on fisheries?	Benefit Benefit Cost	Described, not valued Described, not valued Described, not valued
Negative impacts on livelihoods of some community members (reduced access to aggregates for sale)	Cost	Described, not valued
Reduced non-compliance from some sectors of the community but • likely on-going non-compliance from families reliant on beach mining for primary sources of income • Possible social unrest due to negative perceptions by community of lagoon dredging (negative impact of livelihoods, environmental impacts etc.)	Benefit Cost Cost	Described, not valued

Source: Derived from Greer (2007).

STEP 5. AGGREGATE THE COSTS AND BENEFITS

'Aggregation' of costs and benefits refers to bringing together all the different costs and benefits from a project over its life, and presenting them as one number (value or ratio). Specifically, it takes all the costs and benefits arising from a project in the future ('future values') and presents them as present-day values ('present value[10]'). The purpose of this step is to facilitate comparison of the different costs and benefits across different options.

Aggregating costs and benefits is done in two parts: (i) converting costs and benefits realised at different points in time into present-day values (discounting); and (ii) summing the present-day values of each cost and benefit category into a single measure known as net present value (NPV).

Discount benefits and costs to obtain present values

The lifetime of projects can stretch over many years. This affects how values are summed because people typically place more weight on those costs and benefits that accrue earlier in the life of a project than those that occur later. (In economic terms, people are said to have generally a 'time preference'.) To convert the benefits and costs achieved over time to an equivalent or comparable value, 'discounting' is conducted. This renders benefits and costs occurring in different time periods to present-day terms.

Discounting is done by multiplying future values by a discount factor $1/(1+r)^t$. That is:

$$PV = FV/(1+r)^t, \text{ where}$$

PV = present value
FV = future value of benefits or costs
r = discount rate
t = time period

The present value of costs and benefits can vary significantly depending on the chosen discount rate, r (see Table 1). The choice of discount rate in the Pacific is challenging for two reasons. First, there is still considerable debate in the global economics community about how to select a discount rate (see Harrison (2010) for more information). Second, in the Pacific there is no standard discount rate available to follow. Some Pacific Ministries of Finance, such as Samoa, publish their preferred discount rate; others do not have an official rate.

Appendix 1 indicates discount rates used in some recent studies conducted in the Pacific. Many of these studies use an initial rate of between 7 and 10 per cent. Some development partners may have preferred discount rates (e.g. ADB). If a project is being supported by a partner, it pays to check whether they have any specific requirements on this.

Table 1: Present values of $100 over five years using discount rates of 0%, 5% and 10%

Discount rate (r)	Year 0 (today)	Year 1	Year 2	Year 3	Year 4	Year 5
0%	$100	$100	$100	$100	$100	$100
5%	$100	$ 95	$ 91	$ 86	$ 82	$ 78
10%	$100	$ 91	$ 83	$ 75	$ 68	$ 62

[10] Present Value (PV) is the current worth of a future sum of benefits and costs given a specified rate of return. Future values (FV) are present value of benefits and costs, discounted at the discount rate. (See for example, Investpedia (2016) and Wikipedia (2016).

It is ultimately up to the analyst to choose a discount rate that is appropriate and can be backed up with a logical explanation. It should be recognised that the discount rate used will affect the assessed feasibility of a project. This is because using a high discount rate significantly reduces the magnitude of the present value calculated for impacts that are realised in the longer term. Thus, some projects with large benefits forecasted over the long run (such as habitat protection) may be rendered infeasible if the discount rate is high.

Alternative discount rates can be used in a sensitivity analysis (see Step 6) to assess to what extent this changes the assessed feasibility of the project or the rank of options under consideration.

A CBA should always use the same discount rate for both benefits and costs and for different project options, in order to maintain the objectivity of the analysis.

Calculate the Net Present Value (NPV) of each option

Once costs and benefits accruing in different time periods are discounted to their present value, they can be aggregated to a single measure, the NPV. This is done for each option.

The NPV of a project option is simply the present value of benefits minus the present value of costs, summed over the lifetime of the project. This can be represented mathematically as:

$$NPV = \sum_{t=0}^{T} PV(Benefits - Costs)_t$$

, where T is the total number of project periods to aggregate over.

A project with an NPV greater than zero provides net economic benefits to society. This means that overall – from a whole-of-society perspective – the gains generated from the project outweigh the losses incurred. Conversely, a project with an NPV less than zero means that the project will generate a net loss for society – that is, the losses incurred outweigh the gains generated. Further, the greater the NPV, the more efficient the outcome, meaning more benefits are generated from the costs of the resources used.

Economic efficiency, as reflected in the NPV, is the principal criterion used in CBA for determining whether to invest in a project or not; and for informing selection of the preferred project option. In general:

- For a single project option, a project should be recommended for investment if its NPV is positive.
- For multiple alternative options, the alternative with the highest NPV should be recommended – providing it is higher than 0.
- For multiple options that affect each other, the combination of options that maximises NPV should be recommended, subject to any given budget constraint.

Critically, an NPV calculation only reflects those benefits and costs which are quantified. If for any reason some benefits or costs are not quantified and, therefore, not reflected in the NPV, it is essential, as noted already, that those items are listed and described. This is to ensure that the significance of those impacts is not overlooked.

As an example of an NPV, a simplified calculation of the NPV for the ESAT case study in Kiribati is presented in Box 6. For precise calculations of the NPV for this project, see Greer (2007).

Box 6: Calculation of NPV for the ESAT project in Kiribati.

	Economic results (2006A$)
	Lagoon dredging and strengthened regulations of mining in beach flat areas
Present value of costs (T=20, r= 10%)	
Production costs of dredging	21,431,732
Environmental impacts	Not valued
Total costs	21,431,732
(2) Present value of benefits (T=20, r= 10%)	
Avoided costs of production of hand excavation, mechanical excavation and imported aggregates	21,842,497
Avoided expenditures on protective works	678,237
Avoided damages to infrastructure and property	226,076
Avoided losses to agriculture	Not valued
Avoided health impacts	Not valued
Total benefits	22,746,813
(3) NPV	
(3) NPV (T=20, r= 10%) = (2) – (1)	1,315,081

Source: Derived from Greer (2007).

Other measures of economic efficiency sometimes calculated in a CBA are the benefit–cost ratio (dollars' worth of benefits gained for each dollar cost), the internal rate of return (the discount rate that renders the net present value of all cash flows to zero), and the cost-effectiveness of an activity. More information on these measures is provided in Appendix 5.

STEP 6. PERFORM SENSITIVITY ANALYSIS

How can uncertainty about some of the values in the analysis be accounted for? To what extent are results considered 'robust'? The sixth step of the CBA procedure is to investigate uncertainties by performing sensitivity analysis.

Uncertainty arises where there is a lack of information. This may occur where data has not been collected or because it is difficult to predict how parameters that affect costs and benefits will change in the future. A good example of the latter is a climate event, such as a cyclone. In the medium to long term, the likelihood of a cyclone occurring would be expected to change due to climate change. However, the extent and direction of this change is unknown[11].

[11] The reason for this uncertainty is, among other things, (i) global climate models do not indicate with a sufficient degree of confidence by how much temperature and precipitations will increase from a given increase in greenhouse gas emissions; and (ii) global climate models are limited in their ability to predict climate at the regional and local levels. The further into the future analysts look, the greater this uncertainty is.

A sensitivity analysis tests how results change if the value of uncertain parameters changes. This, in turn, helps us to understand whether the recommendations from a CBA would change and whether the conclusions or recommendations drawn from the CBA can be made with confidence.

The suggested procedure for conducting a sensitivity analysis comprises four key stages as follows.

- Identify the key parameters that are uncertain.
- Determine alternative values for these parameters, drawing on available studies, expert opinion, etc. A simple way to do this is to determine feasible upper and lower limits for the parameter.
- Re-calculate the project's NPV using the alternative parameter value.
- Based on the new NPV, determine whether the recommendations from the CBA would remain the same or change. If they remain, the CBA is robust to uncertainty. However, if they change, the CBA is not robust and the project is 'risky' as far as that parameter is concerned.

Box 7 shows the results of a sensitivity analysis performed for the Kiribati ESAT case study on: (i) the cost of producing aggregate from dredging the lagoon (an increase in the unit cost of dredging by 10 per cent was modelled); and (ii) the frequency of damaging coastal flooding events (an increase in frequency from 1 in 5 years to 1 in 4 years for the period beyond 2035)[12].

As can be seen in the table, the sensitivity results highlight that the dredging operation may not be feasible (negative NPV of –AUD 724,515) if the real cost of production increases by 10 per cent beyond that estimated by the project team. On the other hand, it also shows that if future coastal flooding turns out to be worse than expected, the project will generate materially higher payoffs. In other words, the CBA suggests that the economic feasibility of the project differs if different conditions apply. This means that drawing recommendations from the CBA would need careful consideration, including discussion on what the likelihood is in practice that costs may increase.

Box 7: Sensitivity results for the ESAT project in Kiribati

Assumption	Primary NPV results (2006A$)	Sensitivity test results (2006A$)
(i) Production costs of dredging is 10% higher	1,315,081	–724,515
(ii) Frequency of severe coastal flooding events (1 in every 4 years instead of 1 in every 5 years, for the period beyond 2035)	1,315,081	1,827,653[13]

[12] This is a hypothetical sensitivity test for illustrative purposes only. In practice, it is very important to base climate parameter values used in CBAs on best-available science. Pacific Island country meteorology offices and the SPREP Pacific Met Desk are a good source of information/ expert advice on these matters.

[13] This is a hypothetical figure for illustrative purposes only

STEP 7. CONSIDER DISTRIBUTIONAL EFFECTS

The basic measure of economic social benefit in a CBA (NPV) reflects economic efficiency, that is, the net gain (or loss) to society as a whole. However, it does not take into account who incurs the costs and who enjoys the benefits. Step 7 of the CBA process considers the distributional impacts of the proposed project.

The distribution of costs and benefits of a project is important in CBA for two main reasons:

- Distribution can impact project feasibility. For example, the analysis of the ESAT project in Kiribati shows that banning coastal mining could make some families worse off because they would be unable to generate income from selling hand-mined aggregates. As 'losers' of the project, their incentive to cooperate with the new regulations might be low (Box 8) and this could potentially jeopardise the realisation of the project's benefits and, consequently, the project's success.
- Decision-makers may want to achieve, or contribute to, certain equity objectives through the proposed project. Decision-makers may have priorities to direct benefits to (or divert costs from) certain groups – categorised by income, ethnicity, geographical location, etc. This is especially common in the Pacific context where other systems of wealth distribution (e.g. tax) tend to be weak. The distribution of benefits and costs from a project may, therefore, be as important to governments and societies as the total size of those potential benefits (efficiency).

Box 8 summarises some of the distribution-related issues for the ESAT project in Kiribati.

Box 8: Distribution of benefits and costs from the ESAT project in Kiribati.

The distributional implications of the ESAT project initially posed feasibility risks. The project involves establishing aggregate mining from the lagoon while banning beach mining. At the time the project was being developed, approximately 1,200 households in South Tarawa were estimated to engage in mining at least once a week, often for supplementary income, with around 150 households relying entirely on selling aggregates for their livelihood. Banning household mining would reduce aggregates sourced in this way by around 30,000 m^3 per annum, valued at approximately AUD 1.5 million, meaning an average loss of AUD 1,250 per year for each of the 1,200 households for whom mining was currently a major source of income.

This would have represented a major redistribution of benefits from the domestic household economy to a government-owned business. Such a redistribution would have created disincentives for households to comply with the ban on beach mining. Furthermore, non-compliance would mean that the lagoon mining company would have to compete for business and might not achieve the sales needed to ensure on-going production. Consequently, the cost to mining households would have had the potential to undermine the feasibility of the project.

In order to address this, the CBA report recommended that steps be taken to redistribute some of the gains of the project back to the mining households, by for example:

- providing assistance to mining households to develop alternative income-generating activities through agriculture and fishing; and
- providing small retailers, families and on-sellers with dredged aggregate at a subsidised rate so that they can resell the aggregate and secure earnings.

Consideration of who benefits from the project and who bears the costs needed to secure those benefits is, therefore, a key part of CBA. In the Pacific, two simple ways are commonly used to do this:

- mapping out the distribution of costs and benefits between stakeholders; and
- weighting the costs and benefits according to social priorities.

Mapping the costs and benefits

The distributional impact of a project can be laid out to clarify who experiences the benefits from a project and who bears the costs. This can be done in a matrix that links benefits and costs to different affected groups. A simplified example of a matrix is provided for the Kiribati ESAT project in Box 9 below.

Stating the expected equity and feasibility concerns of a project through a distributional matrix enables decision-makers to make an informed choice. They can then decide between efficiency and equity considerations in line with social and political priorities.

In practice, it is not always possible to perfectly identify the winners and losers from a project. In some cases, impacted parties may not belong to distinct groups and may be dispersed between different social and economic groups. Equally, the benefits or costs of a project may be difficult to value (for example, the health-related impacts of a pollution project) so that it is tricky to prove that one group substantially gains more benefits or bears more costs than another. Nevertheless, the principle still stands that impacts on key groups should at least be described, if at all possible.

Box 9: Benefit and cost mapping for the ESAT project in Kiribati.

Stakeholder	Costs description	Value of costs (2006A$)	Benefit description	Value of benefits (2006A$)	Net benefit (2006A$)
Households that carry out beach mining	Lost income from sale of aggregates	15,754,912	Avoided cost of mining	11,816,184	- 3,938,728
Households that participate in fishing	Environmental impact of dredging on fishery - lost fishery harvest	Unknown			Unknown
Households that participate in agricultural activities			Avoided damage and loss to agriculture	Unknown	Unknown
Households located in erosion/ coastal inundation hazard zone			Avoided damages and loss to (private and public) infrastructure	226,079	226,079

Stakeholder	Costs description	Value of costs (2006A$)	Benefit description	Value of benefits (2006A$)	Net benefit (2006A$)
Government of Kiribati	Additional costs of producing aggregate	7,253,131	Additional income from sale of aggregates Avoided imports of aggregate Avoided expenditure on public works Avoided damages to (private and public) infrastructure	15,754,912 5,847,711 678,237 This benefit has been allocated to households located in erosion hazard zone but is partly attributable here	5,027,730

Impacts on community Impacts on government

Weighting the costs and benefits

If governments have a commitment to target the well-being of specific groups in society, the costs or benefits estimated in a CBA could be weighted in favour of these groups.

Weighting means scaling up or down the value of costs and benefits affecting a specific group. This, therefore, changes the NPV and may ultimately change the decision on whether the project is still socially beneficial.

For this reason, weighting is broadly founded on income/ consumption levels, for example, being based on the marginal rates on income tax or the ratio between the income of different income groups and that of the national income (both of which tend to favour the poorer in society. See Mishan and Quah (2007) for further information). Of course, final selection of weighting for public investment would ultimately need to reflect the consensus of decision-makers which means that there likely to be an influence of government/ national priorities and development objectives.

Examples of how to conduct weighting for social reasons can be found in European Commission (2008a) and Evans et al. (2005); a hypothetical illustration is provided in Box 10.

Box 10: A hypothetical example of weighting.

Imagine a government wished to weight the benefits or costs affecting low income families. It would need to choose weights that reflect how importantly it valued changes in that group. It might, for example, refer to its own income tax rates and note that a high-income person faced a tax rate of $0.50 on the last dollar of income earned while a low-income person faces a tax rate of $0.25 on the last dollar earned. The government might then infer that an additional $0.25 for a low-income person is worth the same as an additional $0.50 for a high-income person. In other words, it chooses to value additional income for low-income people at twice that of a high-income person. In this way, government weights income gains or losses for low-income people as twice those for high-income people.

This example is purely for illustration. In practice, tax rates are not set purely according to social priorities of wealth redistribution but can also reflect other priorities, such as encouraging business growth or employment.

Unlike mapping, which is an objective exercise that uses logic to deduce where costs and benefits are expected to fall, weighting of costs and benefits for specific groups is a subjective exercise, based on – as noted – the judgement of society (government) of the needs of different groups. Because weighting is subjective, reaching agreement on what the weights should be can be challenging as it may be difficult to 'prove' that the weights are the most appropriate. Transparent processes to select weights (say, securing the consensus of a panel of experts in social needs and sharing their recommendations more widely for feedback) could lead to acceptability of final weights and analysis. On the other hand, this approach is certain to take time and effort. By comparison, it will be more expedient to assign weights without providing a rationale. However, this is likely to lead to disputes about the credibility of the selected weights and resulting analysis. As a result, it would seem most logical that a strong case for any weights assigned should be presented, and both the weighted and unweighted results should be presented to indicate the implications of the weighting.

As a final word on distributional issues, some development partners have specific guidelines and resource materials for environmental and social safeguard procedures. It is good practice to inquire with development partners about their policies.

STEP 8. PREPARE RECOMMENDATIONS AND WRITE THE REPORT

Recommendations

The rationale for recommending the preferred option should be clear and defensible. There should be sufficient evidence for the reason a given option is selected.

From an economic efficiency perspective, the project (or option within a project) that is the most desirable and should be selected is that which offers the highest NPV (refer Step 5). In cases where most or all of the costs and benefits have been quantified in the CBA, the most desirable option (or combination of options) is relatively straightforward to identify.

In other cases, some costs or benefits (such as environmental change) may not have been quantified and so are not reflected in the calculated NPV. Here, the project that is most desirable is that which appears to offer the most valuable combination of quantified (NPV) and unquantified (qualitatively described) benefits.

Importantly, a project which has the highest NPV in the central analysis but is highly risky may not, in fact, be an efficient use of resources – that is, it may not actually deliver the NPV estimated in the CBA. Here, 'risk' refers to major findings from a sensitivity analysis (refer to Step 6) and/ or any major threats arising from significant inequalities/ distributional implications (refer to Step 7). In these situations, decision-makers will need to be presented with information on the nature and extent of any risks associated with an option or options. Recommendations should thus highlight:

- the project (or combination of projects) with the highest apparent NPV, highlighting any important non-quantified benefits or costs. Specific reasons why the quantitative findings from the CBA have been overridden or vice versa need to be made clear;

- any major threats or assumptions that may affect the success of the project;
- any major distributional issues; and, in light of this,
- recommendations for next steps (such as potential changes to the project design, etc.).

Recommendations for the Kiribati ESAT project based on the CBA are summarised in Box 11.

Box 11: Recommendations for the ESAT project in Kiribati.

The results of the CBA indicated that the lagoon dredging project and strengthened beach mining regulations would likely generate a net benefit for the South Tarawa community. As shown in Box 6, NPV was estimated to be significantly positive (AUD 1,315,081), and this result did not include potentially significant benefits of avoided health impacts.

The positive NPV result was robust to changes in assumptions about the extent to which dredging aggregate would substitute for imported aggregate. However, the analysis showed that the Kiribati community would incur a net loss if the real cost of aggregate production using lagoon dredging increased substantially, say, by 10 per cent. Therefore, it was recommended that further research on the cost of producing aggregate using dredging techniques be undertaken before implementation started.

An important qualification was that potential environmental impacts of the dredging operation were not captured in the quantitative analysis – although an environmental impact assessment did indicate that this impact was likely to be minor provided appropriate management measures are implemented. It would be prudent, however, to closely monitor environmental impacts of the operation and take an adaptive management approach.

Another important consideration for this project was the loss of income for households from beach mining of aggregates. At the time of the CBA, around 1,200 households around South Tarawa were supplementing their incomes from mining activities and a further 150 households – mostly in the villages of South Tarawa Temaiku and Bonriki – were relying entirely on selling aggregates for their livelihood. If the social consequences of this loss of livelihood were not properly considered and addressed, then it is likely that households would not comply with the ban on beach mining. Non-compliance would also mean that the company running the offshore mining operation would have to compete for business and might not achieve the sales needed to enable on-going production.

A key recommendation of this analysis was, therefore, that steps be taken to address this distribution issue, and also to introduce a public awareness plan to increase people's knowledge and awareness about the environmental consequences of beach mining and the need to develop and use alternative supplies of sand and aggregate. Steps to address distributional issues could include, but are not limited to, assistance to affected families to help them develop alternative livelihoods; and/ or access to aggregates at an affordable (subsidised) rate.

Providing (i) further research was undertaken to confirm costs of production, (ii) environmental impacts of the dredging operation were closely monitored and (iii) steps were taken to address distributional issues; it was recommended that the Kiribati Government progresses the project to dredge aggregate from the lagoon and strengthen beach mining regulations.

Writing the CBA report

Below is a sample structure for a report on the CBA process and conclusions which may be prepared for decision-makers. Analysts may wish to also use additional products and modalities to communicate the results and findings of the CBA, for example, policy briefs, presentations, and cabinet submissions. In the interest of ensuring comprehension and accuracy, analysts will likely find it worthwhile sharing the report for review and feedback by relevant stakeholders (such as the project proponent, experts in the field) before finalising it and the recommendations.

Executive summary. This provides:

- an overview of the project proposal and purpose of the cost-benefit analysis (that is, the CBA questions);
- summary of key results and findings; and
- study conclusions and recommendations.

Introduction and key CBA questions. This section provides some contextual information about the project, the stakeholders who have supported it to date, and the purpose of the CBA study (that is, specify the questions which the CBA will seek to answer). This section should also make linkages to relevant strategic planning documents (e.g. National Strategic Development Plan, sector plans or equivalent) and strategic planning processes.

Project background. This section should provide some more detailed background information about the project. In particular, it should:

- define the project problem;
- define the project objective; and
- describe each of the project options under consideration.

Methodology. This section should explain the methodology employed for the CBA. Depending on the audience, this could firstly be an overview of the CBA framework.

It then should outline:

- the types of costs and benefits considered for each option;
- the methodology employed to value each of the cost and benefit categories;
- key assumptions and other information used to estimate the costs and benefits of each option in monetary terms; and
- a qualitative description of important costs and benefits that are not valued in monetary terms.

Results and sensitivity analysis. This section presents the results of the quantitative analysis, including key sensitivity tests. This information should be presented in easy-to-understand tables and graphics.

Distribution of costs and benefits. This section should show how costs and benefits are distributed across different stakeholder groups. A matrix showing who receives the benefits from the project and who incurs the costs is recommended here.

Discussion. This section discusses the key results of the CBA for each option, focussing on key areas of interest or concern. It should cover:

- key areas of uncertainty;
- the risks associated with each option, measures to address these risks, and how the risks have been reflected in the values of the costs and benefits considered in the financial and economic analyses;
- importance of non-quantified costs and benefits;
- importance of distributional implications; and
- discussion of broader policy considerations as appropriate.

Conclusion and recommendations. This section should seek to answer the CBA questions, drawing on the relevant (quantitative and non-quantitative) aspects of the analysis.

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APPENDIX 1. RECENT COST-BENEFIT ANALYSES IN THE PACIFIC

Sector	Country	Topic	Discount rate (%)	Timing	Reference	Link to report
Water	Niue	Water supply	3, 7, 10	Ex-ante	Ambroz (2011)	http://ict.sopac.org/VirLib/TR0447.pdf
	Palau	Water safety planning	3, 7, 10	Ex-ante/on-going	Gerber (2010)	http://www.sopac.org/sopac/docs/TR440%20final.pdf
	Republic of Marshall Islands	Water resources	3, 7, 10	Ex-ante/on-going	Gerber (2011)	http://ict.sopac.org/VirLib/TR0438.pdf
	Tuvalu	Water supply	3, 7, 10	On-going	Gerber et al. (2011)	n/a
	Niue	Water safety planning	3, 7, 10	Ex-ante/on-going	Talagi (2011)	http://ict.sopac.org/VirLib/TR0443.pdf
Coastal management	Tuvalu	Aggregate supply	3, 7, 10	Ex-ante	Ambroz (2009)	http://ict.sopac.org/VirLib/ER0137.pdf
	Kiribati	Aggregate supply	10	Ex-ante	Greer Consulting Services (2007)	http://ict.sopac.org/VirLib/ER0071a.pdf
Disaster risk	Fiji	Flood early warning	3, 7, 10	Ex-ante	Holland (2008)	http://ict.sopac.org/VirLib/ER0122.pdf
	Samoa	Flood mitigation	7	Ex-ante	Woodruff (2007)	http://ict.sopac.org/VirLib/ER0069g.pdf
	Fiji	Flood impacts on the sugar belt	n/a	Ex-post	Lal et al. (2009)	http://cmsdata.iucn.org/downloads/flood_report_final_compressed.pdf
	Solomon Islands	Climate change and infrastructure design	8,10	Ex-ante/ex-post	Cardno ACIL (2010) Lal and Thurairajah	
	Niue Republic of Marshall Islands Tuvalu Solomon Islands Palau Cook Islands Samoa	Climate change risk in the water, agriculture, and coastal infrastructure sectors	4, 8	Ex-ante/mid-term/on-going	Buncle (2013)	http://www.pacificclimatechange.net/index.php/eresources/documents?task=showCategory&catid=121

Sector	Country	Topic	Discount rate (%)	Timing	Reference	Link to report
	Fiji	Climate Change, flood mitigation, ecosystem-based adaptation	1,3,7,10	Ex-ante	Rao et al (2013)	https://www.sprep.org/publications/lami-town-fiji-ebatechnical-report
	Fiji	Climate Change, flood mitigation, ecosystem-based adaptation	4, 8, 12	Ex-ante	Daigneault et al (2016)	http://www.sciencedirect.com/science/article/pii/S092180091500467X
Fisheries	Republic of Marshall Islands	Tuna sector	n/a	n/a	Vunisea (2005)	http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/WIF/15/WIF15_03_Vunisea.html
	Regional	Fish aggregating devices	n/a	n/a	Sharp (2011)	http://www.spc.int/DigitalLibrary/Doc/FAME/InfoBull/FishNews/135/FishNews135_27_Sharp.pdf
Biodiversity	Fiji	Live and cultured coral reef extraction	5	Ex-ante/ex-post	Lal and Cerelala (2005)	n/a
	American Samoa	Coral reefs	3	n/a	Jacobs (2004)	n/a
Pollution	Palau	Solid waste management	3, 5, 9	n/a	Hajkowicz et al. (2005)	http://archive.iwlearn.net/www.sprep.org/solid_waste/documents/Economic%20costs%20of%20waste%20-%20%20Palau.pdf
	Tonga	Solid waste management	10	n/a	Lal and Fakau (2006)	http://www.sprep.org/att/publication/000521_IWP_PTR33.pdf
	Tuvalu	Liquid waste management	n/a	n/a	Lal et al. (2007)	http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/financing%20IWRM/LIQUID%20MANAGEMENT-TUVALU.pdf
Recycling	Kiribati	Solid waste management	n/a	n/a	IWP-Kiribati (2005)	n/a
Agriculture	Fiji	Fair trade	n/a	n/a	Bower (2012)	n/a
	Samoa Vanuatu	Germplasm	n/a	n/a	MacGregor et al. (2011)	n/a

Sector	Country	Topic	Discount rate (%)	Timing	Reference	Link to report
Forestry	Solomon Islands	Forestry certification	10	n/a	Pesce and Lal (2004)	n/a
	Fiji	Biofuel	15	n/a	Zieroth et al. (2007)	http://www.rotuma.net/os/Publications/Biofuel_Rotuma.pdf
Invasive Species	Fiji	Invasive species management	4, 8, 12	Ex-ante	Daigneault et al. (2013)	http://www.isinz.com/documents/CEPF-valuing-invasives.pdf
	Fiji	African Tulip Tree	4, 8, 12	Ex-ante	Brown and Daigneault (2014)	http://www.sciencedirect.com/science/article/pii/S1462901114000513
	Fiji	Small Indian Mongoose	4, 8, 12	Ex-ante	Brown and Daigneault (2015)	http://ageconsearch.umn.edu/bitstream/225652/2/ARER2015%2044x3%2005Brown.pdf
	Fiji	Taro Beetle	4, 8, 12	Ex-ante	Brown and Daigneault (2014)	http://jee.oxfordjournals.org/content/107/5/1866.abstract
Mining	Cook Islands, Papua New Guinea, Marshall Islands	Deep sea minerals	3, 7, 12	Ex-ante	SPC (2016)	http://dsm.gsd.spc.int/images/pdf_files/PIR_CBA_Report.pdf

APPENDIX 2. COST–BENEFIT ANALYSIS WORK PLANNING

To help organise the conduct of a CBA it is recommended to prepare a work plan. CBA work plans essentially map out the types of information and that need to be collected, where the information will be collected from, and the timeline for undertaking the activities and preparing the report. CBA work plans are also a good way to facilitate inter-disciplinary involvement and input in the CBA process, which in turn helps to ensure all relevant information and data are included. This also promotes ownership and understanding of the CBA results and thus helps ensure that the CBA results and findings effectively inform decision-making.

If a consultant is being engaged to carry out the technical elements of the CBA, it is recommended that the project management team first develops the CBA work plan. This will clarify for managers the types of information and issues that should be considered in the consultancy and promote ownership of expected outcomes. Start by developing a target timeline such as the one presented here to organise your work. You may then refine this after completing Steps 1, 2 and 3 in the template provided below.

Timeline

Action	Date	Responsibility
Data collection		
Data analysis		
Draft CBA report		
Peer review		
Final CBA report		
Briefing paper on CBA report		
Presentation on CBA report to xyz		
Incorporation of CBA report results and findings in project proposal and cabinet submission		

1. Summarise the evidence and logic of the project

Problem Statement

Write a short statement defining the problem that the project is trying to address. This should include information on the nature, extent, and underpinning causes of the problem - making sure to reference sources of this information. Note also, there are typically multiple causes and drivers contributing to a given problem.

Write a short statement of the project aim. If possible, this aim should be specific and directly linked to one or more of the causes of the problem.

Project Objective

Write a short statement defining the project objective. If possible, this aim should be specific and directly linked to one or more of the causes of the problem.

Description of Project Options

List and briefly describe each of the options that have been identified to achieve the stated aim. Also check that these options:

- were identified through a thorough process, including review of what has been done in other parts of the country and the broader Pacific region as well as consultations with communities;
- clearly align with the project objective (and causes/drivers of the problem);
- are feasible given the budget constraint for the project (if applicable);
- options are clearly distinguishable from one another;
- there are enough options identified to provide the decision maker with real scope for exercising choice.

2. Formulate cost–benefit analysis questions

Based on the above information on the problem, objective and options, formulate key CBA questions. These are the questions that are most important to primary stakeholders for their decision-making needs. They are what stakeholders[14] 'really need to know' from the analysis.

For most CBAs, questions will be something like:

- To what extent does the project proposal represent a worthwhile use of resources? Is this project a high-priority for Government? Should the Government invest in this proposal? (ex-ante CBA)
- Which option is the best option to address the identified problem? (ex-ante CBA)
- To what extent did the project represent 'value-for-money'? Should this project be up scaled or replicated in the future? (ex-post CBA)

There may also be other questions that are specific to the problem or project options under consideration, which should also be incorporated. For example, the party commissioning the analysis may also be interested in understanding potential environmental impacts of a project proposal and, if substantial, what design modifications can be made or complementary measures introduced to improve the project. Similarly, where climate factors are a major consideration in project design (or is the primary project problem), this may warrant a dedicated CBA question or sub-question.

The CBA questions should be clearly and correctly specified at the outset, and all parties involved should agree on them. This provides the direction and specific focus for the analysis work.

[14] Stakeholders are funders, government agencies, non-government organisations, other organisations, groups or individuals who have a direct interest in the intervention and its monitoring and evaluation. They potentially include:
- Government officials, policy makers, service and contract managers
- Funders and Donors
- Program/Intervention Board Members, managers and intervention delivery personnel
- Service users, clients or beneficiaries
- Community interest groups or associations

3. Identify the costs and benefits

This section lists the various costs and benefits that need to be considered for each of the options identified to achieve the stated project objective (and thus address the identified problem). Importantly, one of the options should be the status quo or baseline scenario (i.e. costs and benefits that will be experienced if none of the project options is implemented – the without-project scenario).

Summarise this information in a with-and-without analysis table:

Baseline – without project	Project option 1	Project option 2	Project option 3
	Costs		
	Benefits		

The left hand column of this table qualitatively describes what inputs, outputs, and outcomes/impacts relevant to the project problem are expected to be experienced without any project options being implemented. That is, what would likely happen if the 'business as usual' pattern was followed, taking into consideration:

- any observed trends relevant to impacts/outcomes;
- any observed trends relevant to the identified causes and drivers of the problem including population growth; and
- whether any other activities are planned which seek to address the same or similar problems in the same area.

The right hand columns of the table describe these same inputs, outputs and outcomes/impacts for the scenario where the proposed project options are implemented relative to the without-project scenario (i.e. what changes the project will result in against 'business as usual'). The right hand columns also include the additional inputs required to implement the project options. These are the up-front (i.e. capital) and operational costs of the project option.

The right hand columns further include any other outcomes or impacts associated with the project options that are either not the intended focus of the project or are experienced by third party stakeholder groups. These can be either positive (a benefit) or negative (a cost).

4. Value the costs and benefits

This section should detail the data or information needed to estimate each of the costs and benefits identified in the with-and-without analysis in monetery terms, and list where this data or information can be sourced. It should also state the intended method that will be used to value each of the cost and benefit items identified.

Summarise this information in a table like the one below.

Project option 1

Cost/benefit	Valuation method	Data required	Source of data
Cost 1			
Cost 2			
Benefit 1			
Benefit 2			

Note that some cost and benefit items may be too abstract to measure or too small a consideration to justify going to the effort of collecting data and undertaking valuation analysis. For these such items, the table should list 'qualitatively describe and discuss' and briefly outline the reasons why this item will not be valued in monetary terms.

5. Aggregate the costs and benefits

This section details how costs and benefits will be aggregated over time. Key points include:

- The choice of discount rate; and
- The (economic efficiency) measures that will be estimated (most commonly for government projects this is net present value (NPV) and benefit–cost ratio (BCR).

6. Perform sensitivity analysis

- List key parameters (e.g. length of drought period) for which there is uncertainty;
- Describe how these uncertainties will be tested through a sensitivity analysis, (e.g. through testing of upper and lower bound values of these parameters).
- Outline the basis/method for selecting values used in the sensitivity analysis (e.g. value referenced in a report or study, advice from experts).

7. Consider distributional effects

Identify which stakeholder groups will incur costs and which stakeholder groups will accrue benefits for each major cost and benefit category.

Summarise this information in a table like the one below.

Cost/benefit	Stakeholder group 1	Stakeholder group 2	Stakeholder group 3
Cost 1			
Cost 2			
Benefit 1			
Benefit 2			

Comment/assess whether impacts on certain stakeholder groups may merit special consideration (e.g. costs borne by low socio-economic groups).

Further comment on whether distributional effects will likely cause political or other issues that may threaten the successful implementation of the project, and could benefit from refinements to project design.

8. Prepare recommendations

Make note of the different values, what was not calculated (stating if it was important) as well as distributional implications. Note how robust the findings are to change. Generally speaking, it is unwise to recommend a project where outcomes may be highly changeable (check the sensitivity analysis).

Recommendations should then highlight:

- The project (or combination of projects) with the highest apparent NPV, highlighting any important non-quantified benefits or costs. Specific reasons why the quantitative findings from the CBA have been overridden or vice versa need to be made clear;
- Any major threats or assumptions that may affect the success of the project;
- Any major distributional issues; and, in light of this,
- Recommendations for next steps (such as potential changes to the project design etc.).

APPENDIX 3. GENERIC TERMS OF REFERENCE FOR A COST–BENEFIT ANALYSIS CONSULTANCY

TERMS OF REFERENCE

Cost-Benefit Analysis of the project

The [country] Government seeks to hire an Economist to undertake a cost–benefit analysis (CBA) of [project/options]. This is to be done in collaboration with a team of [country] Government officials.

Background:

Describe background of project here.

Approach to cost–benefit analysis:

The [country] Government is developing capacity in the use of CBA to help improve the quality of project proposals and related investment decisions.

An inter-disciplinary team has been formed to oversee a CBA of the [project] proposal. A draft work plan has also been developed by the '[project] CBA team' to help do this. A copy of this draft CBA work plan is in Attachment 1.

The intention of the CBA work plan is to:

- Ensure there is agreement amongst the [project] CBA team on key elements of the analysis – for example, objective) of CBA and valuation technique used;
- Facilitate engagement of the [project] CBA team in the conduct of the [project] CBA and thereby contributing to CBA capacity building objectives;
- Ensure all relevant information and data is inputted to the analysis;
- Ensure timely delivery of analysis; and
- Maximise understanding and ownership of CBA findings by the [project] CBA team and thus the usefulness of the CBA for informing decision making.

Objectives and purpose of the assignment:

The main purpose of this assignment is to assist the [project] CBA team and the [country] Government to conduct a CBA of options identified for the [project] proposal. This assignment is to build on the draft CBA work plan already developed for the [project].

Underpinning the [project] CBA work plan are the objectives of:

- Building capacity in [country] Government to conduct CBAs;
- Completing good quality CBAs, needed to inform selection/design/evaluation of [project] option(s).
- [Also list any other objectives of the CBA.]

Key activities to be carried out:

The overarching activity is to assist and advise the [project] CBA team in implementing the draft CBA work plan.

Key activities under the draft CBA work plan include to:

- Revise and finalise the CBA work plan[1];
- Prepare a draft CBA report;
- Prepare a final CBA report;
- Prepare a PowerPoint presentation summarising the CBA report and key insights;
- [optional] Prepare a Ministerial Briefing summarising the CBA method, results, and recommendations/conclusions;
- [optional] Prepare a Cabinet Submission for the project proposal, incorporating key CBA information; and
- [optional] Prepare a donor proposal for the project, incorporating key CBA information.

CBA reports are not expected to be extensive – approximately 15 pages, excluding annexes. Reports should be clear and succinct, and use simple and understandable language.

Qualifications of experts:

A consultant with the following qualifications and experience shall be engaged to undertake the assignment:

- International/regional/local consultants with academic and professional competencies in the economics and fields related to [sector/issue/problem];
- Over 10 years of experience in assessing and supporting community-based development and related institutional processes;
- Familiarity and experience with the challenges that developing countries and small island states face in [sector/field];
- Very good knowledge of [country] and preferably have worked in [country] and understand physical/geological, social and economic situations; and
- Excellent written and oral communication skills.

Reporting:

The consultant will, in collaboration with the [project] CBA team, prepare and submit/present the following to [lead Government agency/contract manager]:

- A presentation to key government and non-government stakeholders at the start of the country visit. This will outline the purpose of the CBA exercise and the planned activities to complete it, including stakeholder consultation activities [date];
- A revised CBA work plan [date];
- A second presentation to key government and non-government stakeholders at the end of the country visit. This will outline preliminary findings of the CBA and remaining steps to complete the CBA and the process to be followed for using CBA findings to inform decision making [date];
- A draft CBA report [date];

[1] The final CBA work plan should be sufficiently developed such that the nature and extent of the problem the project is trying to address is clearly demonstrated; the causes and drivers of the problem are well-understood; the objective(s) of the project is clear and specific; and the options identified are appropriate. It should also specify data collection needs, sources of this data, and valuation techniques to be used and justifications for this, among other things.

- A final CBA report [date];
- A presentation summarising the final CBA report [date].

Proposed schedule:

The assignment will be initiated by [date]. It will be for a period up to [number] days and will comprise:

number] days background research pre-country visit;

- [number] days in-country collaborating with the [project] CBA team. This will be some time between [date] and [date];
- [number] days travel to and from [country];
- [number] days post-country visit to finalise report [date];
- [number] days for any unexpected work tasks (to be agreed by contract manager).

APPENDIX 4. METHODS FOR VALUING COSTS AND BENEFITS IN ECONOMIC ANALYSES

Assessment approach	Method	Description	Example
Market price Used to estimate value where inputs and outputs are readily available in a market setting, such as taro or bananas produced during an agriculture project. Market prices are generally applied to tangible goods and services. Labour wages and capital costs can also be determined from market prices.	Market price	The amount it costs to buy, or what it is worth to sell a good or service in a market	The price of taro or bananas at the local market
Cost based approaches estimate the value of goods and services that may be harmed by a proposed activity. That is, the cost to acquire the services Any some other means indicates the value of the benefits (lost) from the service. This is done by assessing the cost of other products, infrastructure or technologies that would need to be acquired to replace those goods and services.	Mitigative and avertive expenditures	The cost to mitigate or avert economic losses resulting from the loss of a specific good or service	Household surveys on time and money spent for healthcare
	Damage costs	The value a good or service provides by reducing the damage that would otherwise have occurred under an alternative scenario	Reduced damage to crop yields by invasive species as a result of anintegrated pest control programme
	Replacement costs	The value of a good or service is determined by estimating the cost of man-made products, infrastructure or technologies that could replace a non-market good or services	The cost of a seawall is used as a proxy to estimate the benefit of mangroves for coastal protection
Production function approaches estimate the value of goods and services affected by an activity by drawing on the cost of marketed activities that have similar effects.	Production function	The relationship between changes in the quality or quantity of a particular good or service with changes in the market value of production	Value of additional clean water to a community estimated from the cost of constructing rainwater tanks
	Travel cost method	Survey or observations are used to calculate the value of a recreational experience from trips to a particular site	How much visitors are willing to pay for access to a resource, considering travel time, fuel, lodging, and entry fees

Surrogate market approaches draw on the value of (related) goods that are marketed to estimate the value of the non-marketed goods.	Hedonic pricing	Market transactions are compared for goods or services that differ primarily because of the influence of the non-market good or service that is of interest	Sales prices of similar homes could be compared where some overlook a healthy salt marsh and others do not. This comparison could estimate the value of the salt marsh to the market value of the homes that surround it
Stated preference approaches typically survey-based approaches where stakeholders are asked to state their preferences for trading off costs and benefits for well-defined scenarios or activities. The approach can simulate a market by estimating a consumer's willingness to pay for a good or service or their willingness to accept compensation to tolerate a negative or bad economic outcome.	Contingent valuation	Surveys are used to help respondents estimate personal willingness to pay for non-market goods or services	Phone survey on willingness to pay to protect native forest
	Choice experiments	Stakeholders are given a series of alternative options, each of which is defined by various attributes including price, amenities, and quality	In-person survey on willingness to pay for various degrees of water quality
	Benefit transfer	Estimate of value derived from a study of one area can be adapted for use in another area	The value of fishing that will result from the restoration of fisheries in Nadi could be estimated using studies of similar fisheries near Lautoka (both in western Viti Levu, Fiji)

APPENDIX 5. ALTERNATIVE EFFICIENCY MEASURES

There are several different methods that can be used to compare relative costs and benefits besides using NPV. Three common alternatives are the benefit-cost ratio (BCR), the internal rate of return (IRR), and cost-effectiveness analysis (CEA).

BCR is the ratio of the NPV of benefits associated with an activity, relative to the NPV of the costs of the same activity. The ratio indicates the benefits expected for each dollar of costs. This ratio is not an indicator of the magnitude of net benefits though, as two projects with the same BCR can have vastly different estimates of benefits and costs. In general, any project with a BCR greater than 1 should be considered a viable alternative.

The IRR is the maximum discount rate that could be applied to all monetised costs and benefits for a project that would still allow for it to break even (i.e. to have an NPV of zero). In the case study example for calculating NPV, it was shown that the project with an assumed discount rate of 8 per cent yielded a net benefit of $44,100. Calculating the IRR for that same project would reveal that the discount rate would have to be about 35 per cent for the activity to break even, or yield no net benefits. Because the IRR is estimated to be quite high, it reinforces that this option should be preferred over the do-nothing scenario.

CEA is an approach often used to rank intervention options when one cannot derive monetary benefits from key categories in a given project. In this approach, monetary costs of options are typically compared with physical changes (benefits). Examples of when CEA could be used include:

- Health benefits: cost per lives saved from hazard mitigation (e.g. flood control);
- Environmental benefits: cost per unit reduction of pollution (e.g. GHG emissions);
- Conservation: cost per species or geographic area protected (e.g. native birds, conservation park).

Cost-effectiveness is estimated by dividing the NPV of the costs of an intervention by a non-monetised benefit category to estimate the average cost per unit of the benefit created from a given intervention. This ratio can then be used to rank options in terms of cost per physical unit of benefit. This is expressed mathematically as:

$$CE = \sum_{t=0}^{T} PV(Costs)_t \Big/ \text{Benefit}_t$$

, where *CE* is the cost-effectiveness of the project option, *PV* is discounted (present-day) monetised values over the lifetime of the project. The smaller the *CE* ratio, the greater is the cost-effectiveness of an intervention.

CEA is different from CBA in various ways. First, the benefits are expressed in physical units and not monetary units. Second, the need to divide by a physical unit means that the options being assessed must be similar in nature. Third, the theory of discounting is only applied to the monetary cost component of the estimate. This means that the effectiveness component of the calculation for each option must be consistently estimated at the same point in time.

An example of how to use CEA to assess two options for a forest conservation project is shown in the box.

Estimating the most cost-effective option for forest conservation

Consider the following example where two specific areas in two forests are being considered for forest conservation and species protection. One is 17 hectares and the other is 10 hectares. Option 1 produces an annual stream of timber that creates an NPV of $2,000 over the next 30 years. Option 2 produces an annual stream of timber that creates an NPV of $3,000 over the next 30 years. Protecting the forest would remove the timber from production and hence be considered a cost.

Activity	NPV ($)	Area protected (ha)	Cost-effectiveness ($/ha)
Option 1	2000	10	200
Option 2	3000	17	176

Despite the impact on the local economy, the government still sees a benefit from protecting the forest and is willing to compensate landowners for their loss in production. In many cases, analysts will not have the data to put a non-market value on the benefit of protecting the forest, so they must resort to a CEA to guide their decision making. However, their budget of $3000 is only large enough to implement one of the projects. Option 1 costs $200 per ha protected, while Option 2 costs $176 per ha. Based purely on cost-effectiveness, Option 2 is the preferred option.

APPENDIX 6. TIPS FOR COST–BENEFIT ANALYSIS

Common misconceptions

False	Fact
Discounting is done to remove inflation	Discounting is conducted to reduce all money values to a single point in time
Because CBA puts everything in $$ terms, it doesn't capture important environmental and social factors	A CBA framework should consider all costs and benefits. Valuing social and environmental costs and benefits may be more difficult but all benefits and costs should at least be described in a CBA. That way even those that are not valued in money terms can be considered. Important values can also be weighted where valuation is not possible to ensure that they are given appropriate consideration in decision-making
Only economists are involved in conducting a CBA	A good CBA should involve a multi-disciplinary team since they will act as key sources of data. The analysis will only be as good as the technical data and information underpinning it

Include or exclude?

Benefits	Include all benefits in the year they occur
Costs	Include all costs in each year they occur (capital, labour, operating, maintenance, training and all other input costs)
Environmental and other externality costs	Include
Capital (credit) costs	Include when capital is invested
Depreciation	Exclude (because these are accounting charges)
Taxes	Generally exclude
Subsidies on production cost	Generally exclude
Government or donor costs	Include
Family labour	Include as opportunity cost
Unpriced benefits and costs	Include
Environmental and health costs	Include

Source: Adapted from Australian Government Department of Finance (2006), Sinden and Thampapillai (1995, p. 61).

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