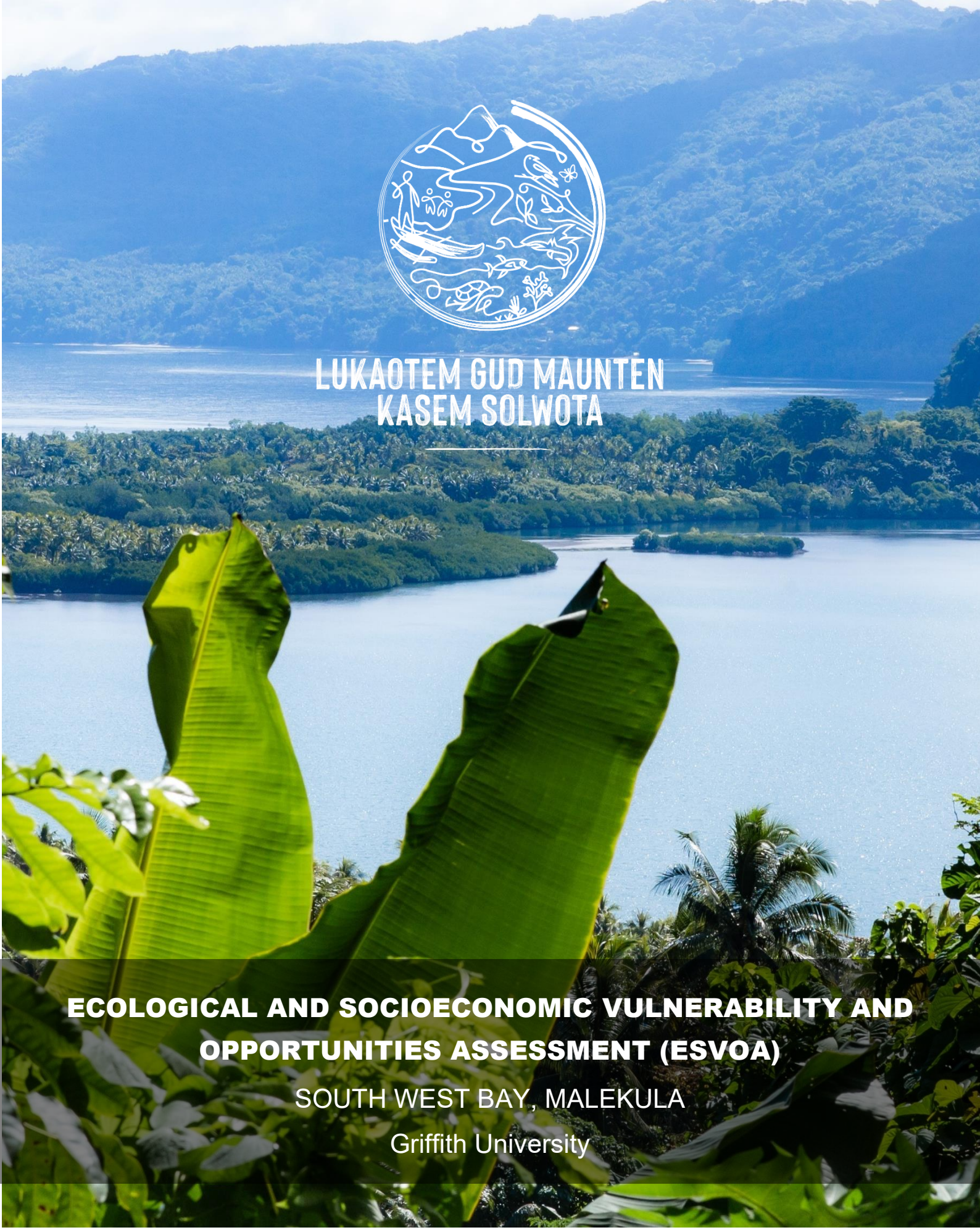

ECOLOGICAL AND SOCIOECONOMIC VULNERABILITY AND OPPORTUNITIES ASSESSMENT (ESVOA)

SOUTH WEST BAY, MALEKULA

Griffith University

EUROPEAN UNION

Sweden
Sverige

PEUMP
Pacific-European Union Marine Partnership Programme

SPREP
Secretariat of the Pacific Regional Environment Programme

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Disclaimer

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List of acronyms

BIEM	By-catch and Integrated Ecosystem Management
CBA	Cost-benefit Analysis
CCA	Community Conservation Area
CEA	Cost-effectiveness Analysis
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CRC	Convention on the Rights of the Child
CRPD	The Convention on the Rights of Persons with Disabilities
EbA	Ecosystem-based Adaptation
ESRAM	Ecosystem and Socio-economic Resilience Analysis and Mapping
FAD	Fish Attracting Device
FEBA	Friends of Ecosystem-Based Adaptation
FV	Future Value
GEDSI	Gender, Equity, Diversity, and Social Inclusion
IEMP	Integrated Ecosystem Management Plan
IPCC	International Panel on Climate Change
M&E	Monitoring and Evaluation
MCA	Multi-Criteria Assessment
MEA	Millennium Ecosystem Assessment
MFI	Micro-financing Initiative
MPA	Marine Protected Area
NPV	Net Present Value
PACRES	Pacific Adaptation to Climate Change and Resilience Building
PV	Present Value
RCP	Representation Concentration Pathway
RD	Research Deputy
SEEA-EA	System of Environmental Economic Accounting – Ecosystem Accounting
SPREP	Secretariat for the Pacific Regional Environment Programme
SUMA	Special, Unique Marine Areas
TEV	Total Economic Value
TESV	Total Ecosystem Service Value
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organisation

Definition of key terms

Benefit cost ratio	Fraction of present value costs to present value benefits. A benefit cost ratio value of greater than 1 represent a positive return on investment. A benefit cost ratio value of less than 1 represent a negative return on investment.
Discount rate	The rate used to discount future cash flows back to their present value, associated with the time value of money. It is usually expressed as a percentage per annum. Conventionally, the discount rate is assumed to reflect human impatience – the extent to which people prefer to defer costs and obtain benefits sooner, rather than later. It also reflects decision makers' attitudes towards risk and their expectation from alternative investments (the opportunity cost). For the Pacific we recommend applying a discount rate of 10%, with sensitivity analysis undertaken at 5%.
Present value (PV)	Benefit cost analysis compares costs and benefits that arise at different points in time. To compare these values from a present-day perspective, these costs and benefits are converted into their 'present value' by applying an annual discount rate – the rate at which the time value of money erodes over time. Present value benefits and costs are calculated using the standard formula: $$PV = \left({}^{FV}/_{(1+r)}\right) \text{^} t$$ where PV is present value (value in today's money), FV is future value, r is the discount rate and t is the time period.
Net Present Value (NPV)	The value of present value benefits minus the present value costs. A positive NPV indicates, from an economic perspective, a project should proceed. A negative NPV indicates the project does not return a value and should not proceed.
Social costs	The social costs of a project are the sum of the private costs (often expressed in financial terms) and any additional costs borne by people who are not party to any financial transaction in relation to the project. Social costs may be incurred financially or experienced as a loss of a nonmonetary benefit, such as environmental amenity or health impacts. The latter may be quantified in monetary terms using appropriate economic valuation techniques.

CHAPTER 1: PURPOSE OF THIS DOCUMENT

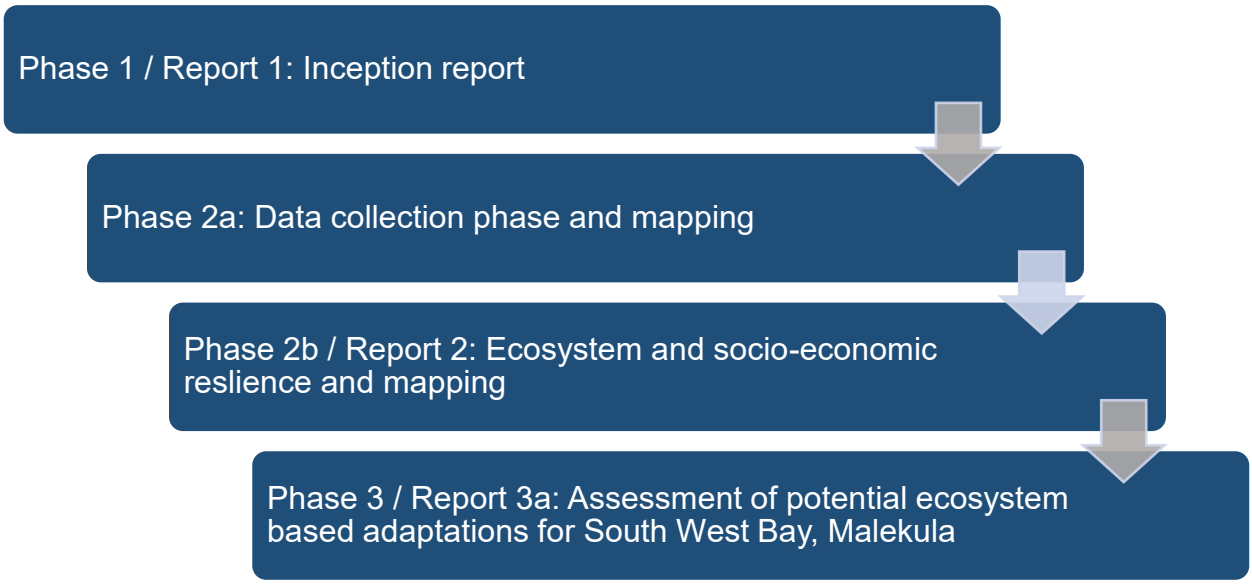
The objective of an Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) process is to generate a robust planning baseline to inform the identification of ecosystem-based adaptation (EbA) options for strengthening the socio-ecological resilience of communities to the impacts of climate change and other direct anthropogenic impacts. The purpose of this report is to provide a comprehensive overview of Phase 2a and 2b activities that contribute towards the Integrated Ecosystem Management Plan for South West Bay (on Malekula Island), with other reports providing similar overviews for the communities of Laone (Pentecost Island) and Tenmaru and Wiawi (on Malekula Island) (see Figure 1). As such this report provides a:

1. Synthesis of data and lines of evidence for South West Bay extracted from the main report.
2. Detailed options assessments specific to South West Bay.
3. Implementation considerations.

Each report contains a more detailed assessment of the recommended EbA projects from the second phase report. The assessment uses a hybrid combination of cost-benefit analysis (CBA) and multi-criteria assessment (MCA) to rank each of the recommended EbA projects, in terms of priority for implementation. Each project has been costed to an appropriate scale for each of the communities, therefore the cost-benefit analyses are subtly different for each community. Each report also contains a sensitivity analysis, which assesses whether changes to key assumptions alters project ranking. Each report also makes recommendations on appropriate stakeholder engagement to ground-truth the assumptions in each of the EbA projects and to design an implementation plan.

Note that this report contains key background information and definitions from the Phase 2 report, so that it may act as a stand-alone document for the relevant community. Appendices provide data from the data collection activities (household survey and go-along survey) conducted during Phase 2.

Figure 1: Locating current report.



CHAPTER 2: PROJECT CONTEXT

2.1 OVERVIEW

Pacific island communities, assisted by their governments, have a long history of resilience and adaptation to environmental variability (Barnett, 2011), yet their rural communities face a range of chronic threats to the sustainable management of natural resources. These threats are exacerbated by a rapidly warming climate and new climate-related risks, such as increased incidence of extreme weather events and sea level rise (Kossin et al., 2020; Pachauri et al., 2014). The increasing pressures on their natural resources from population growth (in most instances), tourism development (in some instances), falling agricultural productivity, and over-harvested fisheries are being magnified and compounded by climate-related impacts, including more severe tropical cyclones, ocean acidification, coral bleaching, droughts, increasing coastal inundation, and erosion (Faivre et al., 2022; Fleming, 2007; Mackey et al., 2017).

Typical of many households in rural Vanuatu, most food for households on the island of Malekula is produced on a subsistence-basis by both female and male farmers (Vanuatu National Statistics Office, 2009). Human well-being is, therefore, directly related to ecosystem service delivery (the benefits people receive from nature), which is affected by climate change impacts, which in turn, risk food insecurity, malnutrition and capacity to respond to severe weather events (Carpenter et al., 2006; MEA, 2005; Savage et al., 2019). In addition, in Vanuatu, non-climate change related risks such as seismic and volcanic activity further increase sudden-onset disruptions in ecosystem service delivery. Social and economic development and demographic pressures also play their part (Buckwell, Fleming, Muurmans, et al., 2020).

2.2 BIODIVERSITY CONSERVATION

Biodiversity is under growing pressure from the interplay between climate change risks and human impacts. Whilst the population of Malekula Island remains relatively dispersed ecosystems of inland and coastal areas are becoming under pressure. In response, governments are acting to adapt to climate change so that people avoid or minimise the harmful impacts of a rapidly changing climate. Care needs to be taken to ensure that adaptation actions do not cause even more loss and degradation of natural environments nor exacerbate harmful impacts upon members of socially disadvantaged groups. For example, in response to rising sea levels and storm surges, governments and communities can seek to replace natural coastal ecosystems, such as mangrove forests, with sea walls, which might protect coastal assets but has ecosystem impacts in terms of biodiversity regeneration and carbon sequestration (Mackey & Ware, 2018), and has negative impacts on women and girls' food security because these are environments where they collect shellfish. Another example of a perverse climate change action is where natural forests, which provide significant ecosystem services, are being cleared to develop commercial agriculture to generate cash incomes, which impacts the wider community's capacity to sustain itself through natural resource harvesting.

To prioritize management and protection of Vanuatu's marine habitats, local marine experts came together to identify and document areas in Vanuatu's waters that are special and/or unique, referred to as Special, Unique Marine Areas (SUMAs) (Gassner et al., 2019). The areas of interest in this Integrated Ecosystem Management Plan exercise include these SUMAs and host communities have previously expressed an interest in protecting these areas as

Community Conservation Areas (CCAs). Further engagement with the communities has been conducted by SPREP since to confirm their support for further work towards CCAs.

Vanuatu law relating to customary ownership of natural resources is based on the fundamental concept, enshrined in the Constitution (Chapter 12, Article 71), that all land and in-shore reefs are the inalienable property of the Ni-Vanuatu (Amos, 2007). In support of customary management, the *Vanuatu Environmental Management and Conservation Act 2002* allows for establishment of CCAs. Creating such areas must follow an established procedure, which allows for community consultation, biodiversity audits, community approval of a management plan, notification of neighbouring communities and support from both the island Council of Chiefs and the provincial government. Whilst this legislatively established procedure provides checks and balances to create equitable, sustainable, and worthwhile conservation areas, the technical, managerial and logistical demands are barriers to their establishment. Further, these areas are often subject to significant criticism on the basis that their establishment focuses on the interests and skill sets of the international NGO community, which benefits from being seen to establish formal conservation, without obligation for ongoing resourcing at the expense of local communities who risk the loss of control of their resources with no ongoing benefits (Hickey, 2008; Ruddle & Hickey, 2008). In contrast, informal CCAs are widespread and have proven to be highly effective (Buckwell, Ware, et al., 2020).

2.3 THE BENEFITS OF ECOSYSTEM-BASED APPROACH

The key to dealing with climate change without compounding pressures on natural systems is to take an ecosystem-based approach. Functioning ecosystems provide a range of overlapping benefits to communities – often referred to conceptually as a 'basket of benefits' (Morgan et al., 2021). An ecosystem-based approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. By allowing natural ecosystem processes to unfold, preventing further damaging land uses, and restoring degraded habitats, the full mitigation and adaptation benefits of healthy ecosystems can be realised. In addition, natural ecosystems sequester carbon dioxide from the atmosphere and securely store carbon in trees and soil.

2.4 ECOSYSTEM-BASED ADAPTION TO CLIMATE CHANGE

EbA to climate change describes a potentially fruitful class of climate change adaptation interventions. EbA is the deployment of biodiversity and ecosystem services to help communities adapt to the adverse effects of climate change – it is not simply habitat conservation for its own sake (Andrade et al., 2011; FEBA, 2018; Munang et al., 2013; Nalau & Becken, 2018; Nalau et al., 2018). EbA is the key to helping species adapt to a rapidly changing climate, maintaining the resilience of ecosystems, and providing critical ecosystem services to local communities including climate change adaptation benefits. Removing other stressors from habitats such as industrialisation, unsustainable use, invasive species and pollution, results in healthier ecosystems that are naturally more resilient to climate impacts and can provide a more reliable supply of services and benefits.

Supporting the conservation and high integrity functioning of habitats and ecosystem is therefore vital for the continuation of efforts to improve livelihoods of the people of the Pacific. Strategies to manage climate change impacts provide a significant opportunity for communities on Pentecost and Malekula to simultaneously deal with climate change-induced risks and progress towards the 2030 Agenda for Sustainable Development, the goals set out in the Convention on Biological Diversity and Vanuatu's own National Sustainable Development Plan (Republic of Vanuatu, 2016). Strategies can also be aligned with Vanuatu's ratified core human rights treaties, which include The Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), The Convention on the Rights of Persons with Disabilities (CRPD), and The Convention on the Rights of the Child (CRC) to ensure the human rights of all members of the community are supported and addressed in climate change planning and management (https://www.un.int/vanuatu/vanuatu/human-rights, accessed 7/2/2023).

2.5 ECOSYSTEM AND SOCIAL RESILIENCE AND MAPPING

The objective of this IEMP process is to generate a robust planning baseline to inform the identification of EbA options for strengthening the socio-ecological resilience of selected areas in Vanuatu to the impacts of climate change and human activities.

The process involves the collation and collection of information and data through interviews, training, and observation of communities. The training component is to train community members including women, men and youth in the design, implementation, and reporting of ESRAMs through theoretical and practical exercises.

The scope is to train and engage trained community members, civil society and provincial officers who can contribute to designing a system or process of socio-ecological resilience governance. The scope includes identification and mapping of their natural resources and existing systems, including those which are working or need reviewing, identifying other community services and goods that can impact the sustainability of the socio ecological resilience of the sites, identify and document the trend for the status of the conservation systems and also identify partners and stakeholders who can help the communities surrounding the sites to support their socio-ecological resilience governance.

CHAPTER 3: FIELD TRIP ACTIVITIES

3.1 PLANNING

The in-field team undertook several tasks, in liaison with government and local authorities, in terms of planning and gaining approval for data collection. First, we sought approval through a letter to the Secretary General of the two provinces and copied in the Director of Local Authorities. We further engaged with Area Secretaries of the four communities regarding logistics and informing them of the plan of activities by the team. The arrangements were made two months before the travel date. The team worked with the Department of Local Authorities, provincial governments of MALAMPA and PENAMA, including Area Councils of the nominated communities visited. The process included:

1. Arrangement and management of logistics including organising of protocol meetings, transportation including boats, land transport, food, accommodation to the sites.
2. Identification of community representatives and ensuring the list was inclusive of women, youth, girls and people living with disability.
3. Briefing of the team and their familiarisation with the questionnaires, Code of Conduct, Consent Forms and the governance system of each island.
4. Discussion, familiarisation and training, ensuring field officers fully understood their roles and responsibilities, and were comfortable in being actively involved in each assessment and mapping exercise.
5. Confirmation of the photos and videos to be taken during the survey that showcase the survey work and the ecosystems surveyed.

The team emailed on July 28, 2022, to seek approval from the provinces of MALAMPA and PENAMA and copied in the Director of Local Authorities. The email introduced the team and the purpose of their field assessment and the objective. The Presidents provided their verbal approval for the team to visit the sites and conduct assessments and run training with the community members and civil society in each site.

3.2 TRAINING

Our Vanuatu based field team led recruitment and training during the survey phase. Ms Linda Kenni, as in-country manager, supervised training, and data collection, supported by two in-country facilitators (Ms Jennifer Kausei and Mr Lester Makikon).

The Pacific Research Guidelines and Protocols developed at Massey University (2017) guided all field activities, respecting people and place, empowering the researcher, and focusing on local researcher collaboration and reciprocity. The Pacific Gender and Climate Toolkit (SPC, 2012) was a further guiding document, supporting the team's recognition that gender equality is central to achieving a sustainable and resilient future for the Pacific Islands and that gender must be incorporated into all aspects of policy, programming and project work. In this project the concept of gender was expanded to include disability and social inclusion, i.e., the domains of gender, equity, diversity, and social inclusion (GEDSI) were all considered.

CHAPTER 4: CONTEXT

4.1 CLIMATE PRESSURES

Vanuatu is one of the most vulnerable nations in the South Pacific. Climate change is both a direct threat and a threat accelerator. Hazards include droughts, floods, extreme temperatures, volcanic eruptions, earthquakes, tsunamis, and cyclones. Our climate risk data is drawn from a range of sources, including reports from the World Bank (World Bank Group, 2021), WHO and UNFCCC (2020), the Vanuatu government (2015, 2016, 2018; 2018), the IPCC (2022), and the Pacific Gender and Climate Toolkit, from SPC (2015).

4.1.1 Projections

Atmosphere, temperature, rainfall

1. Vanuatu is expected to continue to warm, at least to the end of the 21st century. Downscaling estimates of warming are limited by model capabilities but is expected to be in the range of 0.7°C–2.9°C depending on emissions scenarios. Up to the 1990s there was limited warming in the region, but from 1995 onward warming accelerated, and temperatures between 2014 and 2018 were averaging around 0.5°C–0.6°C above the long-term average. Temperatures have been rising in the region at around 0.1°C per decade since the 1970s (World Bank Group, 2021).
2. Under a high emissions scenario (RCP8.5), the number of hot days will increase from ~20% (2010) to almost 100% of days on average by the end-of-century. If emissions decrease rapidly, about 60% of days on average are 'hot' (RCP2.6) (WHO & UNFCCC, 2020).
3. Rainfall projections are influenced by natural variability between years, even decades and remain difficult to predict. Best predictions in all scenarios suggest little change in main rainfall but a significant increase in variability. Under a high emissions scenario, the proportion of total annual rainfall from very wet days (about 30% for 1981–2010) could increase a little by the end-of-century (to almost 35% on average with an uncertainty range of approximately 20% to 50%), with little change if emissions decrease rapidly. This manifests in fewer cyclones overall but more extreme weather events are likely to increase in intensity, though the science underpinning this is still emerging.

Impact on oceans and ocean habitats

4. Sea level is projected to increase. While Vanuatu's volcanic islands have higher elevation than some Pacific Island nations, long-term sea-level rise, in combination with local tectonic movement (Faivre et al., 2022), threatens coastal livelihoods and infrastructure. Sea levels are predicted to rise between 0.4 and 0.9m by 2090.
5. Warming oceans will induce coral bleaching events, which is a significant risk to local reefs. Given the high rates of dependencies on reef fisheries this will impact local economies, livelihoods and subsistence activities (Hafezi et al., 2020).
6. Ocean acidification from increased atmospheric concentrations of carbon dioxide will produce consequences for coral growth and shell-forming organisms (Turley & Gattuso, 2012).

Socio-economic and health impacts

7. Generally, adaptation and disaster risk reduction efforts are hampered by Vanuatu's lack of economic independence, high community dependence on subsistence agriculture, and its inaccessible location. This can also be exacerbated by volcanic and tectonic risks. Severe weather can damage critical infrastructure (roads, airports, ports) and community assets (boats, houses, community buildings).
8. Heat stress is expected to increase as the proportion of hot days increases the frequency of heatwaves, resulting in a greater number of people at risk of heat-related medical conditions and potentially risks to animal (domesticated and wild animals) and even plant health. This can result in loss of life (particularly of vulnerable people such as infants and the elderly) but also in loss of livelihoods, subsistence foods, socioeconomic output, and reduced labour productivity.
9. A warming climate can lead to the spread of vector borne diseases to higher latitudes directly impacting health but also labour productivity (Filho et al., 2019).

4.2 ECOSYSTEMS – LAND USE TYPES AND VALUATIONS

This section outlines the methodology for estimating the total ecosystem service value (TESV) provided by the ecosystems in the four areas of interest. TESV refers to the monetary value of the ecosystem services provided by ecosystems to human society and are estimated as valuations of *flows* of services, in monetary units per area per time period – most often $/hectare/year, rather than in terms of *stocks* of natural capital, which would be measured simply as a dollar asset value. These services can include provisioning services such as food and water, regulating services such as climate regulation and waste treatment, cultural services such as recreation and spiritual values, and supporting services such as soil formation and nutrient cycling.

There are four steps to providing a TESV:

1. Determining land-use and land-cover classifications in the area of study;
2. Generating land-use and land-cover maps and extent estimates (and if possible, ecosystem integrity);
3. Estimating economic valuations;
4. Bringing extent values and ecosystem service valuations together.

4.2.1 Determining land-use and land-cover classifications

Terrestrial ecosystems can be identified and mapped using various criteria, from a practical perspective (and in a Melanesia context) they have been defined here according to the major vegetation types that have been recognised by biodiversity and forest surveys. However, the pattern of land cover and land use remains complex and dynamic in Vanuatu, with transition between forest, rotational gardens, and forest regrowth. Thousands of years of shifting cultivation and secondary regrowth has left only the remotest areas and steepest terrain completely unmodified.

Whilst numerous possible classifications are available for ecosystem asset types, in preparation for the economic valuation of ecosystem services component of our study we adopted a simplified classification scheme that could be detected through the training of machine learning

tools using the library of support vector machines (libsvm) classification through Google Earth Engine. Cleaned Sentinel-2 satellite imagery dating from 2020 - 2022 was used as the input dataset and trained using locally identified land classifications. Further desktop validation was performed using Maxar high resolution imagery to ensure accuracy.

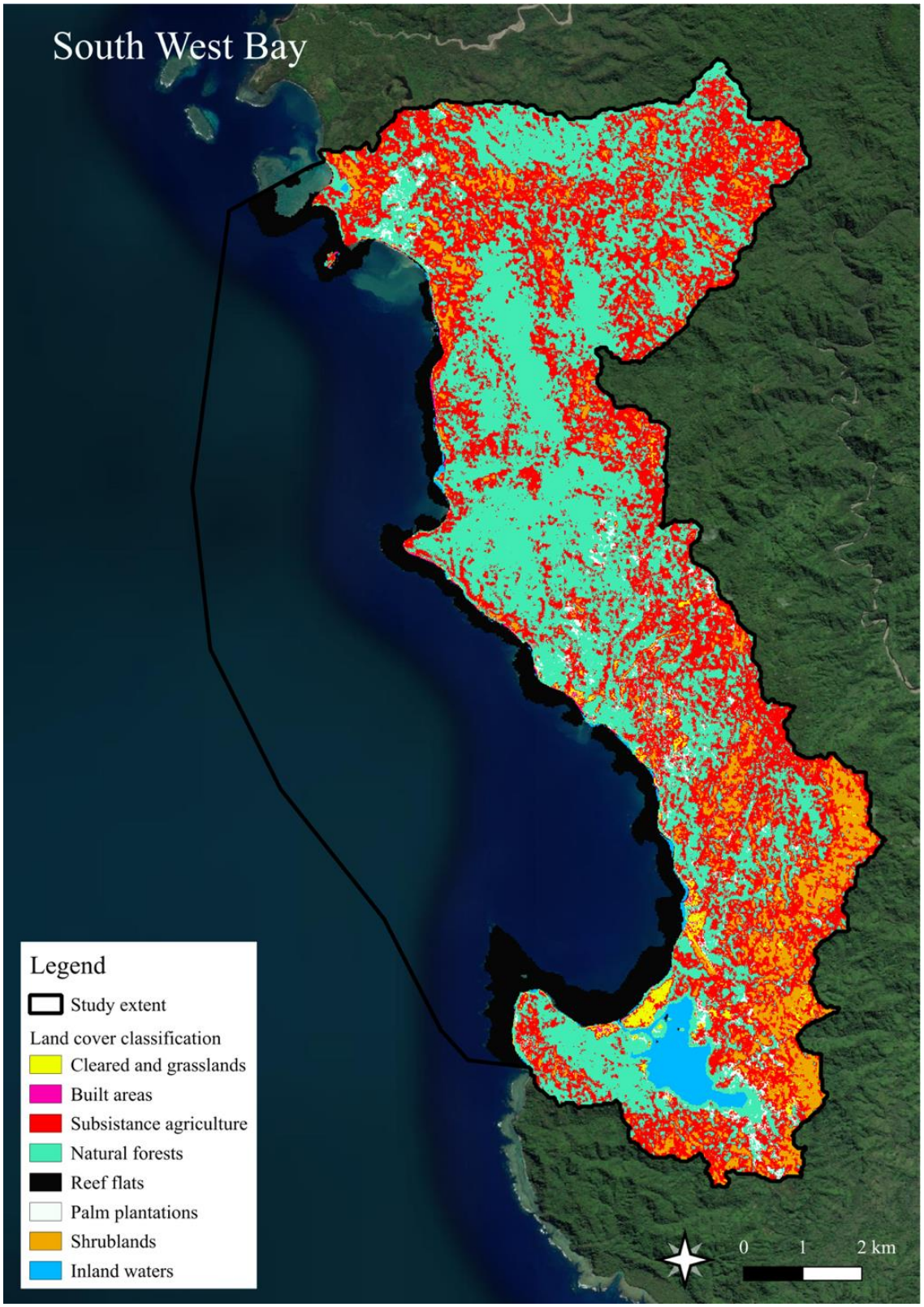
Consistent with the UN's System of Environmental Economic Accounting - Ecosystem Accounting (SEEA-EA) (UN, 2021), in our project sites we include the human-modified land-uses of 'subsistence gardens' and 'plantation forests' as ecosystem assets; as residual values, beyond human labour and capital input, are provided by nature in the delivery of the final ecosystem service (Boyd & Banzhaf, 2007).

A comprehensive qualitative description of these vegetation types and agricultural practices is provided in Mackey, et al. (2017, pp. 6–10). In addition, we identified the marine categories of coral reefs (UNEP/WCMC, 2017). We determined not to map sea-grass beds – despite datasets being available – as sea grass beds tend to be relatively ephemeral.

4.2.2 Ecosystem location and extent

Ecosystem location and extent data were generated from satellite data from Google Earth Engine based on the spatial extent data of the areas of interest provided by SPREP. The land cover map for South West Bay, Malekula is reproduced in Figure 2.

Figure 2: Land cover and ecosystem type for South West Bay area of interest.



4.2.3 Valuation of ecosystem services

The SEEA-EA framework allows for the benefits from ecosystem services to be valued in economic, or monetary terms. Economic valuation provides a way of enabling common measures of value between different ecosystem goods and services with other elements of well-being traded in markets. This allows trade-offs and benefits to be more effectively assessed. Not all ecosystem services lend themselves well to economic valuation. Whilst fisheries (a provisioning service) readily lends itself to valuation, specific local cultural spiritual ecosystem services (a cultural service) does not.

Box 1: The use and misuse of economic valuation of ecosystem services

The use of economic valuation of ecosystem services in monetary units needs to be undertaken with an understanding of the nuance of what is trying to be achieved – particularly to avoid its *misuse*. Valuation has a series of interlinked purposes (Buckwell & Morgan, 2022):

1) **Decision-making:** by assigning monetary values to ecosystem services, policymakers, governments, and businesses can better understand the trade-offs involved in land-use decisions, resource management, and environmental policies. This information helps decision-makers prioritize conservation efforts and sustainable development projects.
2) This can directly feed into **social cost-benefit analysis** - economic valuation allows for the comparison of the social and environmental costs and benefits associated with different land-use options or environmental management strategies. It helps identify the most cost-effective approaches for achieving environmental goals or maximising societal welfare.
3) **Measuring non-market environmental benefits** - Traditional economic indicators often fail to account for the environmental benefits provided by ecosystems. Valuing ecosystem services in monetary terms allows these benefits to be integrated into economic decision-making processes, leading to more sustainable outcomes.
4) **Raising awareness or political support -** Expressing the value of ecosystem services in monetary terms can help raise awareness among the public, businesses, and policymakers about the importance of preserving natural capital and biodiversity by enabling comparisons of benefits provided by different forms of capital. It highlights the economic significance of ecosystems and the potential costs of their degradation or loss.
5) **Facilitating market-based mechanisms -** Economic valuation can support the development of market-based instruments such as payments for ecosystem services programs, where beneficiaries compensate providers for the maintenance or enhancement of specific ecosystem services. These mechanisms create financial incentives for conservation and sustainable management practices.

In a concrete example, the ecosystem service value of a forest can be assessed in terms of its contribution towards the value of commercially logged timber by taking a very narrow view of its economic value – its direct commercial use. Alternatively, the ecosystem service value of forest can be assessed using a wider range of values (particularly indirect use and non-use values) from a wider range of ecosystem services, for example, including its economic contribution towards climate stability, freshwater regulation, and erosion control. This has been dubbed the 'basket of benefits' approach (Morgan et al., 2021).

Economic valuation of ecosystem services in monetary terms is *not* about 'packaging up' nature for sale to the highest bidder!

The team used a Total Economic Valuation (TEV) framework (see Figure 4, in the Inception Report). The TEV framework ensured that both obvious values (e.g., direct use values, such as the production of cash crops) and non-use values (e.g., existence values such as those surrounding unique ecosystems) were incorporated as much as practicable. This provided us with an estimate of the total ecosystem service value (TESV).

When seeking to estimate the monetary benefits of ecosystem services, several possible valuation techniques can be used depending on data and resource constraints. In this project, market-based methods were used to estimate use values (food and water consumption, for example) where relevant data were available. Benefit transfer was used to estimate non-use values. Benefit transfer is a method of estimating the value of a change in an environmental good or service at a (target) site using information from an existing study (or studies) conducted at another (source) site.

4.2.4 Estimating TESV

Estimating TESV requires making judgments as to what constitutes intermediate and final ecosystem services—those that are directly "enjoyed, consumed, or used to yield human well-being" (Boyd & Banzhaf, 2007, p. 619). If both intermediate and final ecosystem service values are totalised, contributions are double counted. For example, pollination services are intermediate inputs into the final food production value provided by agriculture, forests, and plantations. Therefore, the value of pollination services is embedded in the provisioning ecosystem service value for food.

Our benefit transfer valuation method identified and used specific valuation estimates with decreasing relevance from the project sites. Therefore, it first examined studies from:

1. Pentecost and/or Malekula (Pascal & Bulu, 2013);
2. Vanuatu (Buckwell, Fleming, Smart, et al., 2020);
3. Melanesia (Anderson, 2006);
4. Pacific / filtered global databases (Taye et al., 2021; van der Ploeg & de Groot, 2010).

The specifics of the methods are provided in Buckwell et al. (2020, pp. 338-339). From this range of sources, the team estimated an ecosystem coefficient value based on the median values from the filtered list of appropriate benefit transfer values. This is reported in Table 1. Total ecosystem service value estimates. The TESV for South West Bay is reported in Table 1. Subsistence gardens land use takes-up an estimated ~40% of all terrestrial land, with a significant extent of tropical forest and shrublands accounting for most of the remaining (~54%). South West Bay is the only area of interest that has any significant freshwater waterbodies.

Table 1: Total ecosystem service value for South West Bay, Malekula (2022 US$/yr/ha).

Ecosystem Type	Coastal Coral Reef	Tropical Forest + Shrublands	Grassland	Freshwater Waterbodies	Subsistence Gardens	Plantation Cropping
Extent (ha)	758	4,272	103	176	3,212	154
Proportion of land habitat type (%)		53.8	1.3	2.2	40.5	1.9
PROVISIONING						
Food	52,638	32,441	4,338	4,012	26,046,545	9,331
Water supply		991,775	15,351	263,069		
Raw materials / energy	822	157,572	779	191		
Genetic resources		27,807				
Ornamental resources		245,627				
Medicinal resources	2,467					
REGULATING						
Air quality regulation		2,122,584	11,680			
Climate regulation	175,185	597,846	34,706	11,463		
Moderation of disturbance	154,623	222,454				
Water flow regulation		4,634				
Waste treatment	2,467					
Erosion prevention		509,791				
Soil fertility maintenance		69,517	28,365	191		
Pollination		199,282				
Biological control	247					
CULTURAL ECOSYSTEM SERVICES						
Aesthetic	2,467					
Cognitive	1,645					
Inspiration	82					
Spiritual	822					
Recreational	288,685	74,151	556	75,845		
Total (US$)	682,153	5,255,482	95,774	354,770	26,046,545	9,331
Total (Vatu)	81,176,207	625,402,358	11,397,106	42,217,630	3,099,538,855	1,110,389

4.2.5 Specific value of subsistence farming

Subsistence gardens are of particular importance to the livelihoods of the people of Vanuatu – almost all households (between 86% and 96% from our household survey, see below) produce at least some of their own food. Table 2 reports the per capita potential economic value of subsistence gardens for South West Bay based on the estimated population of the areas of interest from Vanuatu census data and population densities (City Population, 2006; Vanuatu National Statistics Office, 2020).

Box 2: Value of subsistence gardens

Of particular note is the estimate for the economic value of subsistence gardens from Anderson (2006). Anderson's study was based on several communities in Papua New Guinea (PNG) and used a market-price replacement method to provide a per hectare per year value. The estimate is based on the equivalent cost of purchasing the grown food at a local market. The basket of food on which Anderson's estimate is based (staple crops) is broadly similar to the staples grown in Vanuatu. The study accepts that the estimates provided take a narrow view of the sustenance provided from subsistence gardens and ignores additional economic value that may be attributed to "risk management concerns of food security and social security, nor the important but less tangible values of social cohesion and cultural reproduction" (2006, p. 141). Nevertheless, the surprisingly high value estimate provided is contrasted, perhaps provocatively so, with the relatively low prices customary land achieves when it is transacted for alternative commercial uses. Anderson's value is a per hectare value based on exchange values (economic value is based on quantity X price) and is therefore compliant with the SEEA-EA principles; nonetheless, as it contributes a significant proportion to TESV, it needs to be treated with some caution and seen more as a *potential* value of subsistence gardens. The value provided by Anderson is significantly inflated from its original 2016 values due to relatively high price inflation in PNG in the subsequent years but is also moderated by a significant loss of value of the PNG Kina against the US dollar.

Table 2: Value of subsistence gardens to areas of interest.

	Area (km2)	Density (people/km2)	Population Estimate	Value of Subsistence Gardens ($US/yr and Vatu)	Per Capita Value of Food Gardens ($US/yr)
South West Bay, Malekula	79.3	5.653	449	US$ 26,046,545 VUV 3,099,538,855	US$ 58,068 VUV 6,910,092

CHAPTER 5: ADAPTATION PRIORITIES AND OPTIONS

5.1 DEFINING ECOSYSTEM-BASED ADAPTATION

Climate change adaptation can be defined broadly as adjustments to social-ecological systems in response to actual or expected climatic changes that ease any adverse effects or take advantage of new opportunities (Adger et al., 2005; Betzold, 2015; IPCC Part A, 2014). By adapting management of natural resources and socio-economic and ecological systems to climate changes, communities can reduce risks and lessen potential future damages that might otherwise occur (Leary, 1999). However, it is important to acknowledge the different vulnerability and capacity of many individuals have "to adapt to climate change and how this varies according to their age, sex, gender, education, social status, wealth and access to other strategic resources (e.g., information, finance, land, etc.)". It is also important to recognise that there is "a high degree of diversity between and within groups, making some people more vulnerable, and some more adaptable, than others" (SPC, 2015, p. 1). In addition, ecological systems also operate at different vulnerabilities according to their condition, scale, and impacts from outside the system under consideration.

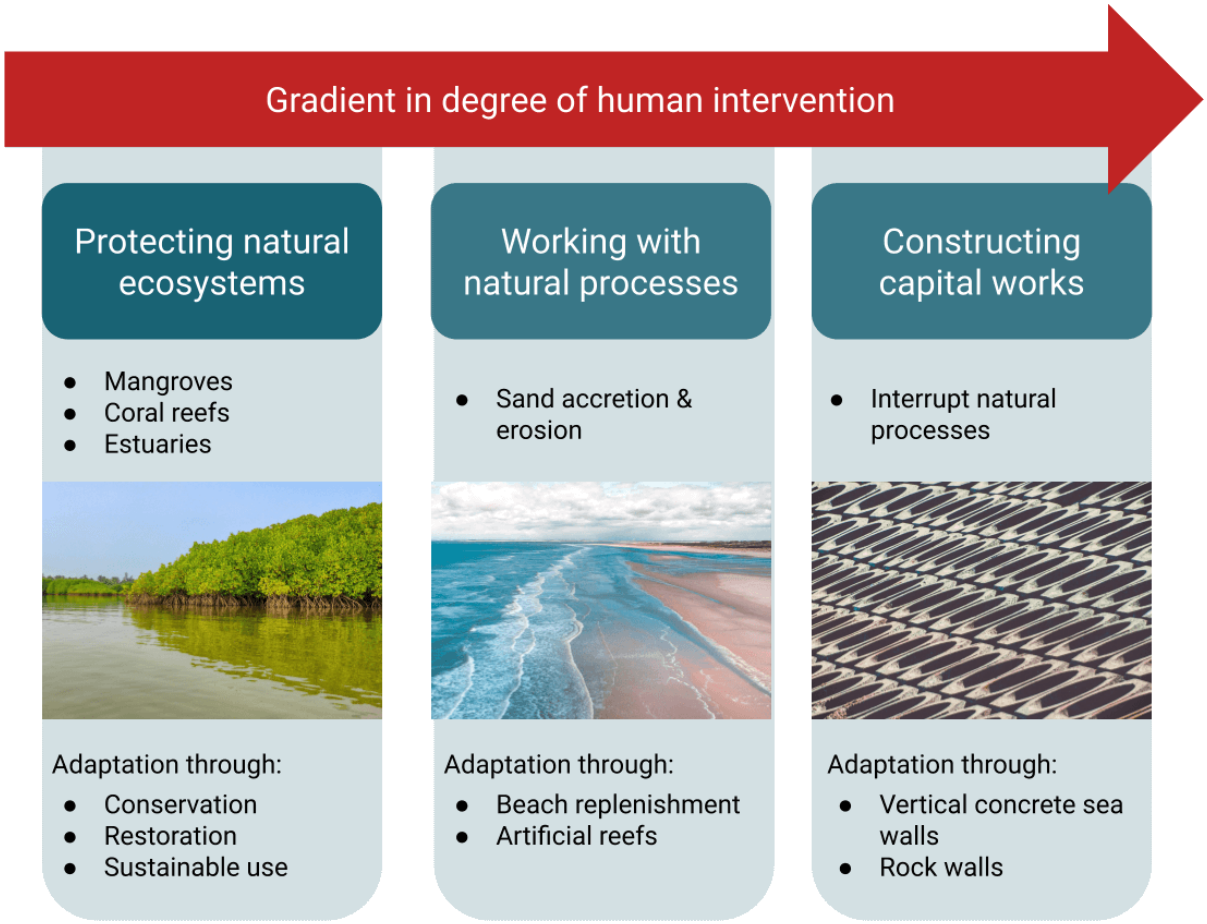
EbA links habitat conservation and active, adaptive management with broader social and economic development strategies that assist communities to adapt to trends and shocks associated with climate change and, in parallel, to improve social and economic well-being. EbA interventions are not rigidly defined but can be best understood in terms of their position on a continuum from 'hard', infrastructure-based interventions to those that solely deploy ecosystems in adaptation (see examples for coastal zone presented in Figure 3). In this sense, EbAs work *with* nature and natural processes (even when containing some hard components) and therefore provide the support and space to assist species to adapt to changing conditions in ways that are beneficial to human society. EbA is often closely tied with community-based adaptation, which is focused on a community scale and ensures that adaptation efforts are integrated with local development goals and community well-being and resilience (Nalau et al., 2018). Therefore, EbA is an *approach*, rather than a prescribed set of solutions.

Place- and sector-based (economic/lifestyle mainstays, such as fishing or tourism) EbA approaches need to consider different aspects of climate and environmental risk alongside other community needs. More transformative adaptation presents even greater challenges but is also burdened with definitional ambiguity (Panda, 2018). Three key issues arise in the context of Vanuatu:

1. The identification, level, distribution, and management of the costs, for example, many transformational adaptations will demand significant costs today (e.g., the complete evacuation of an island due to volcanic activity) with many benefits not accruing to many years into the future (and many costs – like loss of access to spiritual lands - may also accrue).
2. The definition of, the potential for, and need to avoid maladaptation (activities that add to environmental risk, such as over extraction of natural resource inputs into intensified agriculture), especially as knowledge and risks change through time.

3. The human knowledge and capacity demands that this level of adaptation present; and the role of government in this adaptation (e.g., logistics, provision of funding, financing, research).

Figure 3: A spectrum of adaptation options available (example given for the coastal zone) from interventions that maintain or build ecosystem integrity through to pure engineering solutions.



5.2 EbA AND SUSTAINABLE DEVELOPMENT

EbA approaches to adaptation projects in rural Pacific communities can take a range of forms and must lay at the intersection of socio-economic development pathways, biodiversity conservation, and climate change adaptation. At a very high level – and particularly for the communities at South West Bay – the importance of socio-economic development is noticeable. This is evidenced through the relative importance of cash-generating activities to household livelihoods, the wide diversity of crops that are grown and sold, the comparatively large size of the garden plots, and people's aspirations to learn more about running small businesses (for local benefit).

A socio-ecological systems approach is also required, embedding household and community well-being within a complex system that interacts with the range of socio-economic and ecological systems and sub-systems (Sahin et al. 2021). For example, the expansion of animal husbandry (hens and eggs) reduces pressure on the harvesting of wild fish for protein from local reefs, which, in turn, may increase the integrity of coral reef systems, protecting future fish

stocks and – in the even longer term – maintaining coastal protection through reducing wave energy through the accrual of coral cover. Other EbA *approaches* may also achieve the same objectives, such as increasing the capacity of a community to harvest fish protein away from local reefs in deeper water, which would demand investment in more robust watercraft, the skills, diesel supplies, and technicians to maintain the fleet, and training and financial support of a broader range of fishers, including members of socially vulnerable groups, than presently exists.

This food sub-system interacts with other sub-systems. For example, through protecting fish stocks and coral cover, and perhaps through the introduction of managed marine protected areas, the community can provide future opportunities for tourism businesses that are attracted by high integrity coral reefs and alternative and diverse livelihood opportunities. It is worth noting that tourists also generally demand higher protein diets. However, tourism businesses are only enabled though other infrastructure investments, such as access roads, communications, safe drinking water, sanitation, electricity, and pleasant accommodation options.

Conceptualising socio-ecological systems is necessarily complex and must find a balance between explicit local reflection and complexity and conceptual usefulness. Here, the team draws on two conceptualisations from studies in Vanuatu: that provided by Buckwell et al. (2020) for Port Resolution in Tanna and that by Sahin et al. (2021), which explores local, regional and country-level outcomes of EbA interventions. Importantly, both conceptualisations determine end points as household and community well-being that supports community resilience to external shocks. Buckwell et al.'s socio-ecological system is reproduced below, Sahin et al.'s is summarised.

5.2.1 Gender equity

Climate change-related risks are not equally shared by everyone in Pacific communities. In addition, the benefits of EbA are not automatically shared equitably and the aspirations of different members of the community are commonly divergent (Buckwell, Fleming, Muurmans, et al., 2020). Women, particularly poorer, rural women, experience greater vulnerability to climate change impacts than men, due to complex, intersectional drivers, including semi-formal community power dynamics, socially and culturally constructed discourse on the role of women in the family and society, and formal risks of land alienation and access to economic resources (Bendlin, 2014; Djoudi & Brockhaus, 2011). In addition, integrating broader socially inclusive perspectives generated by a consideration of GEDSI needs into climate change and development priorities is vital for addressing underlying social inequalities between, and the intersections of, women, men, girls and boys, the gender-diverse, people with a disability, the elderly, youth and children. Only then will climate change planning embrace the full gamut of diversity in local communities and address the concomitant issues arising from GEDSI and climate change.

Furthermore, gender is not only a driver of differential vulnerability to climate change but should also play a role in determining appropriate adaptations, as the needs and priorities of women and non-binary people are likely to be different to those of men, or the community as a whole (Bryan et al., 2015). Notwithstanding, women's roles and leadership in adaptation, in families, in communities, and in formal representative structures, are recognised as being a necessary condition for fostering resilience (Aipira et al., 2017). This is demonstrated empirically, where women's empowerment is linked to adaptation to change and improved social and economic outcomes for themselves and for communities as a whole (Bowman et al., 2009; Kassie et al., 2020).

5.2.2 Alignment with Vanuatu government strategy

The government of Vanuatu has articulated its climate adaptation policies and national development strategies in a range of documents, including the *National Sustainable Development Plan 2017-2030* (Republic of Vanuatu, 2016), *Vanuatu Climate Change & Disaster Risk Reduction Policy 2017-2030*, and in the operations of the Ministry of Climate Change (Hallwright & Handmer, 2021). These plans and strategies also lean on the *Framework for Resilient Development in the Pacific 2017-2030*, the *Sendai Framework on Disaster Risk Reduction 2015-2030,* and the *Pacific Gender and Climate Change Toolkit 2015*. Together, this posits that Vanuatu is well-progressed on implementing the conceptual integration of disaster risk management and climate change adaptation and through sustainable development will conserve key ecosystem assets, such as food gardens, forests, coral reefs, and freshwater assets as being essential to the livelihoods of the Ni-Vanuatu (Betzold, 2015, 2016).

As such, EbA as an adaptation is broadly supported in policy, however, it is essential that local implementation is reflective of community vulnerabilities, needs, and aspirations. Having a strategy and a plan is no guarantee of appropriate and timely action in implementation of adaptations at local level in more remote communities. Partnership between the international organisation sector, the national government, the provincial government, local communities, and specialist implementation NGOs will be essential.

5.2.3 Criteria for qualification of ecosystem-based adaption

Figure 3 is drawn from FEBA (2018) and describes the foundational qualities and criteria that qualify interventions as EbAs. It sets a series of standards against which EbA intervention should be considered, for them to both meet the criteria for EbA but also to fulfil broad social and economic objectives.

Figure 4: What foundational qualities and criteria qualify interventions as effective ecosystem-based adaptation.

Foundation	Qualification Criteria	Standards
EbA helps people climate change	Reduces social & environmental vulnerabilities	1. Use of climate information 2. Use of local traditional knowledge 3. Adaptations take into account findings of vulnerability assessment 4. Vulnerability reduction at the appropriate scale
	Generates societal benefits in the content of climate change adaptation	1. Quantity and quality of societal benefits compared to other adaptation options 2. Timescale of societal benefits is demonstrated 3. Economic feasibility and advantages compared to other adaptation options 4. Maximising the number of beneficiaries 5. Equitable distribution of benefits

EbA makes active use of biodiversity and ecosystem services	Restores, maintains, or improves ecosystem health	1. Appropriate scale of management 2. Prioritisation of key ecosystem services within management
EbA is part of an overall adaptation strategy	Is supported by policies at multiple levels	1. Compatibility with policy and legal frameworks and policy support 2. Multi-actor and multi-sector engagement (communities, civil society, private sector)
	Supports equitable governance and enhances capacities	1. Accountability and group representation 2. Consideration of gender balance and empowerment 3. State of Indigenous and local knowledge and institutions 4. Long-term capacity to ensure sustainable governance

5.3 METHODOLOGY FOR DETERMINING EbA OPTIONS

To enable the project to present early options to the community, the team developed very high-level EbA concept proposals before the field trip, so they could be confirmed or amended in the field trip. The team's methodology is described for proposing appropriate EbA options for each of the communities. There are five lines of evidence, shown in Figure 4.

Figure 5: Lines of inquiry informing ecosystem-based adaptations.

Line of Enquiry	Evidence Provided
Literature	• Determinants of effective ecosystem-based adaptation • Government policy
Household survey	• Household resource use • Current household livelihoods • Perceived socio-economic and environmental risks • Household aspirations and preferences for the future
Go-along survey	• Community assets • Current community projects
Ecosystem service valuation	• Land cover extent and location of different habitats • Economic valuation of ecosystem services
Climate risk data	• Current climate change related risks (at regional scale only) • Future climate risks

The team brings these five lines of inquiry together taking a sectoral approach, examining climate and socio-economic risks across (i) agriculture, (ii) water supply and sanitation, (iii) forestry, (iv) fisheries and marine conservation, and (v) infrastructure, society, and economy. From these risks the team determined key priorities, distilled down to five. These priorities were then linked to EbAs from a list of options, shown in Table 3.

When assessing data from the household survey, the team leant heavily on *comparisons* between the communities rather than the individual data points themselves. This is, in part, due to the likely low levels of data integrity (given the method of data collection), particularly in relation to technically specific questions. We, therefore, assume that mis-reporting rates are relatively stable and that where one community has stated a particular level of concern over a particular issue, it is not the datapoint *per se* that is important but how that data point compares to other communities. For example, if the average plot is size is reported to be 4,000 m^2 in Community A and 5,000 m^2 in Community B, we maintain a relative level of scepticism about the specific values but maintain that, *in general*, plots sizes are larger in Community B.

CHAPTER 6: COMMUNITY EbA PRIORITIES

This section details the final output of this component of the ESRAM process. The team highlighted the highest priority EbA measures for the four areas of interest. By considering the unique ecological, social, and economic context of each community, the section provides a tailored- and community-data led and socially inclusive approach to prioritising EbA measures that will support the resilience and well-being and livelihoods of the communities.

Taking account of both locally specific and general pressures, risks, and opportunities, the team recommends the following EbA projects for South West Bay, Malekula (Table 3).

Table 3: Key risks and features and potential EbA projects for South West Bay, Malekula as drawn from the lines of evidence described in Figure 5.

Sector	Local Attributes	Climate and Other Risks	Potential EbA Projects
Agriculture and livestock	• Garden plots were on the smaller side and crops showed the greatest level of crop diversity for Malekula. • Livestock management was at a relatively high level. • 92% of households reported difficulties in growing crops related to floods and storms. There was no sense of limits on agricultural expansion or of need for improved agricultural inputs, nor were people concerned about access to markets. • Concern over lack of rain that limits crop growth was the lowest in the sample.	• Increased temperatures reducing moisture content of soil. • Severe storm weather and/or extended droughts risking crop failure. • Coastal erosion, flooding, and sea level rise has potential to impact low-laying garden areas.	• Agricultural extension services should focus on agroforestry and introduction of soil and water sensitive cropping (mulching), potential irrigation, and more drought resistance crops.
Water supply and sanitation	• Water sources are relatively diverse, particularly in the southern areas, with significant amounts taken from rivers and lakes.	• Changing rainfall seasonality and intensity also poses a water security risk. • Extended droughts risking water security.	• Improved sanitation facilities, such as water-efficient and composting toilets (dry sanitation technology toilets) (Kinrade et al., 2014).

	• Very few flush toilets are available in the community, encouraging a high reliance on bush toilets. Sanitation was highly ranked as an infrastructure issue. • Households generate a reasonable amount of non-compostable waste, which is mostly burned and buried in backyards.	• Severe storm weather causing damage to water infrastructure (tanks, gutters etc.). • Potential for water quality issues resulting from lack of good sanitation.	• Tourism-related opportunities may arise in the eco-tourism sector, entailing protection of habitats and ecosystems. This would also entail investments in water supply and waste and sanitation systems.
Forest conservation	• The area retains a high proportion of forest to gardens. Deforestation was a mild concern for households.	• Increased temperatures reducing moisture content of forests, potentially making rainforest fire prone. • Forest loss is increasing across Vanuatu. Approximately 75% of this is due to agriculture (Vanuatu Government, N.D.). • Forests across Vanuatu are also become more degraded, 60% of this due to anthropogenic impacts (Vanuatu Government, N.D.).	• Forest conservation in key upper catchment areas to maintain water quality and quantity in both rivers and lakes. • Investment in training of community -based fire-fighting capabilities.
Fisheries and marine conservation	• Fishing is not quite as important as it is to other Malekula communities. However, the freshwater sources for food are very important. • Most marine resources are collected on local reefs and freshwater sources, with little harvested from deeper water. 4 households list owning a boat.	• Increase ocean temperature extremes causing extended periods of coral bleaching, risking reef collapse. • Freshwater water quality is highly contingent on degradation of the sanitation systems. • Over-harvesting of fish causing collapse of key fisheries (particularly inshore reef fisheries).	• Little fishing done in deeper water; therefore focus should be on taking pressure off reef fisheries through in-shore fisheries development, such as in-shore FADs. • More pro-activity marine resource management, such as development of MPAs
Infrastructure and economy	• Education levels are the lowest and the resident age levels are highest, suggesting that young adults are staying in the villages. • When considering future aspirations, this community showed some modest interest in small business-type enterprise (including tourism) though this is based off the lowest baseline in the sample. • Homes are relatively secure, and many made of breezeblock.	• Increase prevalence of more extreme weather, such as cyclones will impact an already very concerned community.	• Natural disaster management and capacity building about how to respond to natural disasters. • Economic specialisation can bring benefits and investment into local services to increase resilience. Modest project investment in supporting small business needs to be balanced from an equity perspective to ensure benefits are not captured by first movers.

	• Better health care and disaster management preparedness and safety were listed as important gaps. • Covid has impacted communities by making fishing and hunting more difficult and more work for both men and women. • Very few local shopping and social services and poor transport links.		• Financial capacity building for members of socially vulnerable groups should be included.

Key data gaps

Despite being able to draw on four important data sources (household survey, go-along survey, ecosystem assessment, climate risk assessment) we note there are important data missing:

1. Due to the requirements of the capacity-building aspects of this project (specifically the recruitment of local community enumerators) our survey had to rely heavily on quantitative data points for virtually all aspects of the household survey. Whilst this has proved useful in estimating certain, factual aspects of household and community attributes it also has meant that attitudinal questions (e.g., *what are the key environmental risks?*) needed to be based on a pre-prepared list rather than open-ended questioning. This also prevented the capture of richer qualitative data (e.g., *why are these key environmental risks?*).
2. Ecosystem asset inventories and TESV estimates are useful in and of themselves in assessing the status of assets at a point in time. However, time series data on relative changes in, for example, land cover between forest-subsistence gardens-other land uses, provide more useful information on trends in ecosystem asset inventories.
3. Ecosystem condition data, particularly for coral reef and forest habitats, was not available.
4. Downscaled climate risk data to at least island level would provide more accurate community- and climate-risk assessments, and for specific GEDSI and climate change data to be collected and relevant risk assessments made, and will likely be required before, for example, detailed implementation of any farming extension services.

CHAPTER 7: DETAILED ASSESSMENT METHODOLOGY

For the next phase of the project, the team proposes a detailed assessment of the alternative adaptation options from Table 3 for key social assets and ecosystem services (e.g., drinking water provision) on the islands. This will involve the following steps:

1. Identify an appropriate assessment methodology or methodologies;
2. Prioritise options using a combination of economic valuation of costs and benefits and MCA; and
3. Make recommendations on a stakeholder engagement strategy and implementation plan.

7.1 COSTS OF NO ACTION

Vanuatu is facing growing pressure to take action to address the impacts of climate change, particularly in rural areas where a significant portion of the population lives. Failure to take any actions in adapting to the effects of climate change will result in significant social, environmental, and economic costs, including increased poverty and food insecurity, loss of infrastructure and homes, decreased access to basic services such as education and healthcare, and potentially negative impacts on members of socially vulnerable groups.

Social Costs:

- Increased poverty and food insecurity: Climate change is projected to lead to decreased agricultural productivity, resulting in food shortages, increased poverty, and potential damage to people with a disability. This will have a disproportionate impact on rural communities, which are heavily reliant on agriculture for their livelihoods.
- Loss of homes and displacement: Rising sea levels, increasing frequency and intensity of natural disasters, and erosion of coastal areas will result in the loss of homes and displacement of communities, with potential deadly impacts on people with a disability and the elderly.
- Decreased access to basic services: Climate change impacts, such as increased frequency of natural disasters, will disrupt access to essential services such as education, healthcare, and clean water, with potential significant future impacts on youth and children.

Environmental Costs:

- Loss of species and critical habitats due to climate change threats: Rising sea levels, increasing frequency and intensity of natural disasters, and erosion of coastal areas will change the structure and functioning of terrestrial and marine ecosystems.
- Loss or change in species composition in forest and coral reef environments can alter food webs and modify the degree to which ecosystems can be self-sustaining (and provisioning to people in terms of food and cultural benefits).

- Loss of the physical benefits of intact coral reefs and rainforests will have impacts on ecosystem stability, habitat maintenance and creation and the abundance and distribution of species.
- Damaged and degraded ecosystems are more prone to invasion by exotic species, which can further imperil native biodiversity and the values attached to natural systems and species.

Economic Costs:

Decreased agricultural productivity: Changes in temperature, precipitation, and other climatic conditions will have a negative impact on the agricultural sector, resulting in decreased crop yields and a decline in export revenue.

Loss of infrastructure and property: Climate change will lead to the destruction of infrastructure and property, incurring high costs for repair and reconstruction.

Decreased tourism revenue: The tourism sector will be negatively impacted by increased frequency of natural disasters and decreased access to key tourist destinations due to climate change impacts.

The impacts of climate change on Vanuatu's environment, economy and society are clear, and inaction will result in significant costs. It is imperative that the National and Provincial governments act now to address the impacts of climate change and implement socially inclusive adaptation measures to protect the country's economy and citizens. Implementing adaptation measures now will be less expensive than waiting and dealing with the consequences of inaction later.

7.2 TYPES OF ASSESSMENT

There are multiple methods of assessment available, the use of which is dependent on the complexity of the project, the multiple values that are at stake and the quality of data that is available (financial, economic, and biophysical).

A. Cost-benefit analysis

CBA is a systematic approach used to evaluate the potential gains and losses of a decision, project, or action. It involves quantifying both the financial and non-financial advantages and disadvantages, allowing for comparison and informed decision-making. By weighing the costs against the anticipated benefits, this analysis provides a framework for determining whether a course of action is worthwhile. It aids in maximizing value and efficiency by identifying options that yield the greatest net positive outcome and helping individuals, businesses, and governments allocate resources effectively while considering the broader impact of their choices.

For example, Buckwell et al. (2020) used CBA to assess the return on investment from a range of EbA projects on the island of Tanna. Specifically, this was a *social* CBA, which used ecosystem service valuation estimates and modelled biophysical changes to determine a dollar value for the value of the assessment projects and a cost-benefit ratio to determine the return on investment.

Although some marketed benefits were used (specifically tourism values for coral reef and forest conservation, and the value of subsistence gardens), there was extensive use of non-market values and avoided cost values for many ecosystem services derived from changes in land use and land cover. Specifically, this study derived NPVs (Net Present Values) for:

1. Implementation of a broad ranging agricultural extension program, including extension officers, a network of demonstration garden plots, and a supporting tree nursery at an island scale (Tanna). The island scale was further refined to generate sub-island implementation costs in Sahin et al. (2021).
2. Implementation of CCAs for both forests and coastal coral reefs.

A CBA has also been conducted for fish attracting devices (FADs) in the Pacific by Sharp (2011). However, in this study, only financial costs and direct (provisioning) values assessment were included. Nevertheless, this study provided a useful datapoint for a NPV of a program of FADs.

B. Cost-effectiveness analysis

Where costs maybe be transparent and benefits less easy to quantify, cost-effectiveness analysis (CEA) is most appropriate. CEA determines the least costly approach for achieving defined biophysical or sociological objectives. This method does not evaluate whether a measure is justified (e.g., by generating a return on investment). CEA is applied in assessing adaptation options in areas where adaptation benefits are difficult to express in monetary terms, such as human health, security (e.g., water security), and ecosystem services. The option that achieves the desired outcome is determined to be the most cost-effective.

For example, the UNFCCC (2011) apply CEA to assess Kouwenhoven & Cheatham's (2006) work that assessed pilot projects to achieve community and household water security through water harvesting in the Cook Islands, Samoa, Fiji, and Vanuatu. The study assessed dam construction, desalination, rainwater harvesting (tanks) and watershed protection methods. In consultation with the community, rainwater tanks were deemed to be the most cost-effective. The UNFCCC report estimated water security can be achieved at a cost of around US$ 1,000 per household, which installs a 2,000-litre household tank with guttering for channelling and two communal tanks for approximately US$ 63,500 (2006 values). Foster et al. (2021) conclude that private rainwater tanks outperform communal rainwater tanks irrespective of whether communal tanks were managed by a community-based committee. The findings support the notion that in some circumstances private property rights can help avert resource depletion, and that household self-supply can deliver a more reliable water supply than community-based management.

Installation of small scale (private) water tanks is dependent on a range of local factors, such as appropriately sized and sited impermeable surface for rainwater capture. Installation costs are highly dependent on transport and labour costs. Nonetheless, distributed systems provide greater redundancy in failure (from lack of maintenance, maintenance capacity, and training in use) and can be emptied and safely stored in times of severe weather.

C. Multi-criteria assessment

Given the range of implementation considerations, we have chosen to apply a hybrid approach to potential EbA assessment, combining elements of CBA with MCA, a broader assessment methodology. MCA is a decision-making approach that evaluates various alternatives using multiple criteria or factors. It considers diverse dimensions such as economic, environmental, social, and technical aspects to provide both a holistic and pragmatic view. By assigning weights to criteria, it quantifies their relative importance, aiding in comparing options objectively. This method helps stakeholders make informed choices by systematically analysing trade-offs and synergies among different criteria, fostering well-rounded and balanced decision outcomes.

MCA accepts that several criteria are required to estimate effective options, especially in the context of EbA. MCA is useful because it can incorporate both quantitative and qualitative

considerations and can assess across a suite of criteria. Both aspects are extremely important for EbA. The approach allows assessment of different adaptation options against multiple criteria, each of which is given a weighting (most often assigned through community engagement activities, or surveying). The overall score is obtained using the weighting and the option with the highest score is selected by stakeholders.

This method is useful when exact economic valuation data is not available or where the monetised ecosystem service costs and benefits (provisioning, regulating, cultural) are hard to quantify, or where many criteria (in addition to monetary benefit and effectiveness) need to be assessed in parallel (UNFCCC, 2011).

Further, MCA enables greater transparency to the assessment (avoiding the 'black box effect' of CBA) and provides opportunities for feedback from the client and efficient re-assessment of options based on client preferences.

The steps we take in our MCA are follows:

1. Criteria identification: Clearly define the problem you're trying to solve and identify the relevant criteria that need to be considered. These criteria should be measurable, relevant, and reflective of the objectives and values of the decision-maker.
2. Criteria weighting: Assign relative weights to each criterion to reflect their relative importance in the decision-making process. The weights are determined (mostly) subjectively through discussions, or surveys.
3. Alternative evaluation: Evaluate each alternative against each criterion. This can involve gathering data, conducting research, and quantifying how well each alternative performs with respect to each criterion.
4. Normalisation: Normalise the data to ensure that the criteria are measured on the same scale. This might involve converting raw scores into a standardised format, such as percentages or scores out of 10.
5. Scorings: Assign scores or values to each alternative for each criterion. Apply the criteria weights to the normalised scores to calculate weighted scores for each alternative-criterion combination.
6. Aggregation: Sum up the weighted scores for each alternative to get an overall score for each alternative. This reflects its performance across all criteria, considering their relative importance.
7. Sensitivity analysis: Test the robustness of the results by varying the weights of the criteria or changing the evaluation scores to see how sensitive the final rankings are to changes in these inputs.
8. Ranking and decision: Rank the alternatives based on their aggregated scores. The alternative with the highest score is often considered the most favourable choice. However, the decision-maker may also consider other factors, such as budget constraints or risk tolerance.
9. Iteration: Depending on the complexity of the decision and feedback received, you might need to iterate through the process, revisiting criteria weights or evaluating additional alternatives.

7.3 HYBRID APPROACH

In this instance we take a hybrid approach, where we include a NPV estimate of a project's value (based on cost-benefit analysis) as one of the weighted criteria in a broader MCA process.

NPV is a financial metric used to evaluate the profitability of an investment or project over time. It considers the time value of money, recognising that a dollar today is worth more than a dollar in the future due to factors like inflation and opportunity cost. NPV is calculated by subtracting the initial investment cost from the present value of expected future cash flows. If the resulting NPV is positive, the project is considered financially viable and likely to generate value. A negative NPV suggests that the project may not be worthwhile. NPV aids decision-making by helping investors compare potential returns to the cost of capital and assess the risk associated with an investment. It provides a quantitative basis for choosing between different projects or investments, aiming to maximise value and make informed financial choices.

CHAPTER 8: MULTI-CRITERIA ASSESSMENT PARAMETERS

8.1 CRITERIA IDENTIFICATION AND WEIGHTING

Table 4 presents and describes the eight criteria for assessment in the MCA for options evaluation for South West Bay. It also states the weighting given to each criterion and the thresholds for defining the scores given. The weighting system was developed amongst the authors of this report and in consultation with the client (SPREP) and represents a best estimate.

Table 4: Criteria and attribute scoring.

Criterion	Description	Sub-Criteria	Weighting (totals 100)	Attributes and Scores for Attributes
Project NPV[Õ]	The value of present value benefits minus the present value costs over a 25-year period. A positive NPV indicates, from an economic perspective, a project should proceed. A negative NPV indicates the project does not return a value and should not proceed.		20	High (> $500,000): 10 Medium ($50,001 - $499,999): 5 Low (< $50,000): 2 Neutral ($0): 0 Negative: -5 Not able to be estimated: 2
Costs of inaction	Failure to take any actions in adapting to the effects of climate change will result in significant environmental, social, and economic costs. These can be a combination of financial (monetary) costs and economic costs.	Economic costs For example: Lost agricultural productivity, crop yields and a decline in household income. Replacement costs of rebuilding damaged infrastructure and property. Decreased tourism revenue from increased frequency of natural disasters and decreased access to key tourist destinations due to climate change.	4	Nil: 0 Low: 2 Medium: 5 High: 10

		Social costs For example: Increased poverty and food insecurity. Community displacement – non-economic loss and damage. Decreased access to basic services, clean water and sanitation.	4	Nil: 10 Low: 5 Medium: 2 High: 0
		Environmental costs For example: Loss of ecosystem services that result from continued climate change.	4	Nil: 10 Low: 5 Medium: 2 High: 0
Interconnected ecosystem service co-benefits	A qualitative assessment of the ecosystem co-benefits that would accrue from implementation of EbA intervention.		15	High: 10 Medium: 5 Low: 1 None: 0
Scalability	A qualitative assessment of how scalable the EbA project can be. This metric is a combination of both the size the project can scale to and whether the project requires on-going investment to scale, or whether it can scale through knowledge diffusion.		15	Whole island, knowledge diffusion: 10 Whole island, through project: 6 Community only, through project: 3 Household only, through project: 1 None: 0
Technological appropriateness	Appropriateness to local context in terms of community capabilities and maintenance capacities.		10	Yes: 10 Potentially: 5 No: 0 Unknown: 0
Effectiveness over time	Consideration of how long the EbA option will be effective, e.g., will it only provide a short-term benefit that may require further action or an upgrade in the future.		9	Long term: 10 Medium term: 5 Short term: 2 No impact: 0
Impacts on economic distribution and GEDSI sensitivity	Does the EbA intervention promote a more equitable distribution of wealth / income? Does the EbA intervention promote greater gender, equity, disability, and sexuality inclusion?		15	Yes, actively promotes inclusivity: 10 No impact: 5 Detrimental: -1

* A note on project investment cost

We have not included project costs as this is an implementation, or feasibility, issue. That is, projects will be considered feasible to implement if the quantum of finance is available. If it is not available, the project, regardless of its apparent priority in the MCA, cannot be implemented. This issue will be further addressed in Section 11.

8.2 PROJECT DATA SOURCES

Table 5 presents available sources for estimations of our NPV estimates for the five-year project implementation costs.

Table 5: Data sources for net present value estimations and project investment data.

<table>
<tr><th>Ecosystem-based Adaptation</th><th colspan="2">Notes on Costs and Feasibility</th></tr>
<tr><td>Fish attracting devices</td><td colspan="2">Data is drawn from a report by Sharp (2011) on the benefits of FADs in the Pacific. Sharp draws upon costs defined in a report by SPC (2005) for a community-level implementation of a series of offshore and inshore FADs, and maintenance and replacement of those.
A five-year implementation costs and project parameters (in 2011 New Zealand dollar values) on an appropriate multi-community level package of FADs (South West Bay population ~449) consisting of 5 x inshore FADs is US$ 21,662.
On-going costs included in the cost benefit analysis are for maintenance (every 2 years at US$ 40,184) and replacement (every 6 years at $40,184).
• Using this data and benefits from Sharp (in terms of market value of fish catch) and a 10% discount rate (as recommended by Buckwell et al. (2020)) we calculated a NPV of such a scheme over 25 years in 2022 values as US$ 23,155, at a benefit cost ratio of 5.0.
• Using this data and benefits from Sharp (in terms of market value of fish catch) and a 5% discount rate (as recommended by Buckwell et al. (2020)) we calculated a NPV of such a scheme over 25 years in 2022 values as US$ 37,840 at a benefit cost ratio of 4.8.
Sharp qualifies a range of market and non-market ecosystem service benefits, which also informs this MCA, in terms of the ecosystem service co-benefits.</td></tr>
<tr><td>Marine protected areas (with an associated community ranger program) (C)</td><td colspan="2">Data is drawn from Buckwell et al. (2020) who costed out a range of project parameters and estimated both non-market and market costs and benefits from the implementation of a Marine Protected Area (MPA). The project costs included the relevant biodiversity assessments and other technical assistance and the costs associated with a management committee and the implementation of a community ranger program (2 rangers plus 1 coordinator).
Total investment for implementation of 75.8 hectares of MPA (10% of total) + community ranger program for a MPA, including required plans, audits, mapping, bylaws, and equipment, over 5 years: US$ 395,269.
In the CBA, over a 25-year period, we include the following market and non-market costs and benefits:</td></tr>
<tr><td></td><td>Costs</td><td>Benefits</td></tr>
<tr><td></td><td>MPA implementation costs.
Community ranger implementation costs.
Ongoing committee management.
10-year periodic review of MPA.</td><td>Increase in tourism values for MPA at 2% per year.
Maintenance of coastal protection values of reef.
Improved value of fishing on the reef
Salaries of community rangers for first five years.
Social value of community ranger training for first five years.</td></tr>
</table>

<table>
<tr><td></td><td>

Over a 25-year period, at 10% discount rate we estimate a NPV of the project of US$ –320,090 and a benefit cost ratio of 0.27.
Over a 25-year period, at 5% discount rate we estimate a NPV of the project of US$ –392,225 and a benefit cost ratio of 0.34.

We propose that without a community ranger program none of the benefits of a MPA would accrue due to lack of enforcement therefore the NPV of any such program would be moot.
</td></tr>
<tr><td>Forest conservation area (with community ranger program) (B)</td><td>
Data is drawn from Buckwell et al. (2020) who costed out a range of project parameters and estimated both non-market and market costs and benefits from the implementation of a forest CCA. The project costs included the relevant biodiversity assessments and other technical assistance, as well as the costs associated with a management committee and the implementation of a community ranger program (2 rangers for the South West Bay area).
Total investment (future value) for implementation of a 427 hectares forest CCA (10% of South West Bay’s forests completed over 5 years) + community ranger program (2 rangers and 1 coordinator) and required plans, audits, mapping, bylaws, equipment, and regeneration saplings (for 427 hectares), over 5 years: US$ 527,367.
In the CBA, over a 25-year period, we include the following market and non-market costs and benefits:
<table>
<tr><th>Costs</th><th>Benefits</th></tr>
<tr><td>Implementation costs
Community ranger implementation costs.
Ongoing committee management.
10-year periodic review.</td><td>Maintenance of full suite of market and non-market values of forest at current values (i.e., no further degradation).
Salaries of community rangers for first five years.
Social value of community ranger training for first five years.</td></tr>
</table>

Over a 25-year period, at 10% discount rate, we estimate a NPV of the project of US$ 2,661,840 and a benefit cost ratio of 4.97.
Over a 25-year period, at 5% discount rate we estimate a NPV of the project of US$ 4,563,797 and a benefit cost ratio of 6.46.

We propose that without a community ranger program none of the benefits of a MPA would accrue due to lack of enforcement, therefore the NPV of any such program would be moot.
</td></tr>
<tr><td>Combined MPA and forest conservation area with community ranger program (B+C)</td><td>
Data is drawn from Buckwell et al. (2020) who costed out a range of project parameters and estimated both non-market and market costs and benefits from the implementation of a formal MPA, a forest CCA and implementation of a community ranger program.
The project costs included the relevant biodiversity assessments and other technical assistance and the costs associated with a management committee and the implementation of a community ranger program (4 rangers). Additional savings were found by combining functions of the management committees to operate across all the conservation efforts. Total investment for implementation of:

427 hectares (10% of South West Bay’s forests completed over 5 years) forest CCA and required plans, audits, mapping, bylaws, equipment, and regeneration saplings.
75.8 hectares (10% of South West Bay’s reefs) for a MPA, including required plans, audits, mapping, bylaws, and equipment.
community ranger program over 5 years (4 rangers plus 1 coordinator)
shared committee resources totals US$ 568,039

In the CBA, over a 25 year period, we include the following market and non-market costs and benefits:
<table>
<tr><th>Costs</th><th>Benefits</th></tr>
<tr><td>As defined above for formal MPA and forest CCA.</td><td>As defined above for formal MPA and forest CCA.</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td></td><td>

Over a 25-year period, at 10% discount rate, we estimate a NPV of the project of US$ 2,341,750 and a benefit cost ratio of 2.41.
Over a 25-year period, at 5% discount rate, we estimate a NPV of the project of US$ 4,171,572 and a benefit cost ratio of 3.21.

We propose that without a community ranger program none of the benefits of a MPA would accrue due to lack of enforcement, therefore the NPV of any such program would be moot.
</td></tr>
<tr><td>Community garden extension program and nursey (A)</td><td>
Data is drawn from Buckwell et al. (2020) who costed out a range of project parameters and estimated both non-market and market costs and benefits from the implementation of a community garden agricultural extension program, relevant specialists, improved poultry management and distribution, the set-up of a plant nursery and management and logistical costs.
Total investment for implementation for one demonstration plot, one nursery, and associated support over 5 years is US$ 883,544.
In cost benefit analysis, over a 25-year period, we include the following market and non-market costs and benefits:
<table>
<tr><th>Costs</th><th>Benefits</th></tr>
<tr><td>Establishment of one demonstration plots, specialist advice, equipment, vehicle, nursery and logistical and management costs during implementation phase.
Establishment of a nursery and support staff.</td><td>50% improvement in garden productivity over 25 years (eventually for all households in the community, taking account of population changes and technology diffusion).
Ceasing and reversal of deforestation (and maintenance of spared forest ecosystem service values).</td></tr>
</table>

Over a 25-year period, at 10% discount rate, we estimate a NPV of the project of US$ 64,948,230 and a benefit cost ratio of 96.4.
Over a 25-year period, at 5% discount rate, we estimate a NPV of the project of US$ 141,030,472 and a benefit cost ratio of 183.8.

</td></tr>
<tr><td>Combined MPA, forest conservation, community ranger, and community garden extension program (A+B+C)</td><td>
Data is drawn from Buckwell et al. (2020) who costed out a range of project parameters and estimated both non-market and market costs and benefits from a the implementation of a:

community garden agricultural extension program, relevant specialists, improved poultry management and distribution, the set-up of a plant nursery and management and logistical costs.
MPA as a formal CCA.
forest CCA.
community ranger program that jointly supports the CCAs.

</td></tr>
<tr><td>Toilets and sanitation project</td><td>
Data is drawn from Kinrade et al. (2014) and who costed installation of water efficient composting toilets and Gerber et al. (2011) who estimated avoided costs of improved sanitation in terms of hospital treatments and avoided lost wages.
The proposed project took a conservative estimate of every household requiring a composting toilet (only 2 households in South West Bay claimed to have a functioning toilet in the house). The program would install 22 toilets each year, achieving 100% coverage after 5 years. Kinrade (2014) recommends that systems would require replacement after 15 years.
The investment over 5 years would total $750,503.
<table>
<tr><th>Costs</th><th>Benefits</th></tr>
<tr><td>Per unit installation costs (accounting for growth in households) (Kinrade et al., 2014, p. 47)
Replacement costs after 15 years (as recommended in Kinrade, 2014)</td><td>Avoided costs of both hospital admissions and walk-in patients (Gerber et al., 2011, pp. 61-63).
Avoided costs of lost work days due to illness and death (Gerber et al., 2011, pp. 61-63).</td></tr>
</table>
</td></tr>
</table>

	The economic benefits were estimated to be: • Over a 25-year period, at 10% discount rate, we estimate a NPV of US$ –621,288 and a benefit cost ratio of 0.16. • Over a 25-year period, at 5% discount rate, we estimate a NPV of US$ –846,874 and a benefit cost ratio of 0.19.
Micro-financing initiative	For information on the implementation costs of Micro-financing Initiatives (MFIs), we draw on reports by Hunt et al. (2015) and Henkel (2006). MFI costs include the establishment of regulatory frameworks, raising capital, and administrative costs. From the perspective of benefits, these are depended on the extent of the 'pro-poor' focus of the MFI scheme, which can perform less well. From a development perspective, MFIs should achieve a self-sufficiency to endure. Commercial Vanuatu banks already offer micro-financing opportunities (e.g., Vanuatu National Bank; VNB) so much of the broader establishment costs are already sunk. In this instance, project costs would be more associated with outreach and community engagement functions of existing financial institutions. Other programs have also established MFIs, e.g. the Vanuatu Women's Development Scheme (VANWODS) in 1999 (McGuire, 2000), which continues its outreach and operations today (see https://www.facebook.com/people/Vanwods-Microfinance-Inc/100075646886617/). Costs and benefits for further outreach are not available in the published literature. Therefore, no NPV value is established. Notwithstanding, Henckel (2006) concludes MFI schemes in Vanuatu by the VNB have been successful.

*The NPVs have also been adjusted in to 2022 US dollar values using World Bank deflator data (World Bank, 2023).

CHAPTER 9: MULTI-CRITERIA ASSESSMENT RESULTS FOR SW BAY

9.1 HEADLINE RESULTS

The output from our MCA for South West, based on the household survey data, the go-along survey, and the valuations from the CBA are reported in Table 6. The highest three ranked EbA projects were: (1) implementation of demonstration plots, agricultural extension and plant nursery; (2) the agricultural extension program combined with a formal MPA and a forest CCA; and (3) a combination of forest CCA and formal MPA.

Table 6: Headline results of multi-criteria assessment based on a baseline discount rate of 10%.

			Demonstration Plots, Extension Officer + Plant Nursery (A)		Forest CCA + Community Ranger Program (B)		MPA + Community Ranger Program (C)		B + C		A + B + C		Fish Attracting Devices		Micro-Financing Initiative		Composting Toilets	
Rank			1		4		7		2		3		6		5		8	
Total score			865		630		305		785		765		399		475		250	
		Weight	*Score*	*Weighted Score*	*Score*	*Weighted Score*	*Score*	*Weighted Score*	*Score*	*Weighted Score*	*Score*	*Weighted Score*	*Score*	*Weighted Score*	*Score*	*Weighted Score*	*Score*	*Weighted Score*
Project NPV		20	10	200	10	200	-5	-100	10	200	10	200	2	40	2	40	-5	-100
Costs of inaction	Economic	5	10	50	5	25	5	25	5	25	5	25	2	10	5	25	5	25
	Social	5	5	25	5	25	5	25	5	25	5	25	2	10	2	10	5	25
	Environmental	5	10	50	10	50	5	25	10	50	10	50	5	25	0	0	2	10
Eco-system co-benefits		15	10	150	10	150	10	150	10	150	10	150	5	75	0	0	2	30
Effectiveness over time		8	10	80	5	40	5	40	5	40	10	80	5	40	10	80	5	40
scalability		15	10	150	2	30	2	30	5	75	5	75	5	75	10	150	0	0
Technological appropriateness		10	10	100	5	50	5	50	10	100	10	100	10	100	5	50	10	100
GEDSI and other distributional impacts		12	5	60	5	60	5	60	10	120	5	60	2	24	10	120	10	120

9.2 SENSITIVITY ANALYSES

We performed two sensitivity analyses. Firstly, we adjusted the discount rate within any cost benefit analysis down from 10% to 5%. There was no change to any values, so this is not reported. Secondly, we removed the project NPV from the MCA and proportionally adjusted the weightings of all other criteria accordingly (Table 7).

Table 7: Sensitivity analysis based on removing the NPV of the project.

Project		Rank	Score
A	Demonstration plots, extension officer + plant nursery	1	831.25
B	Forest CCA + community ranger program	5	537.50
C	MPA + community ranger program	6	506.25
D	B + C	2	731.25
E	A + B + C	3	706.25
F	Fish attracting devices	7	448.75
G	Micro-financing initiative	4	543.75
H	Water tank scheme	8	437.50

A comparison table, showing rankings from Tables 6 and 7, and the sensitivity analysis at r=5% is reported in Table 8. In each instance, the demonstration plot, agricultural extension officer, and plant nursey scored the highest (and so had the highest mean score) whilst the combined program, which included the agricultural extension program) ranked second.

The cost savings available to a combination of the joint conservation program (forest and marine) enabled this program to be ranked third, with a particularly high score when the discount rate was set at 5% (representing a high value given to future benefits). The MPA alone and the composting toilet scheme scored relatively lowly. In the case of the composting toilet scheme, we are cognisant of the fact that no regulating ecosystem service benefits were provided to account for the economic value of improved water quality on freshwater fisheries into the future.

Methods to determine this are not based upon the market values of the current system of water capture and distribution (e.g., what would be the cost of replacing such a system) but the value of the well-being and security that people feel knowing their water is secure. Such methods can only be determined through non-market survey methods (e.g., contingent valuation) for which there is no available baseline data. We recognise this could make the case for water tanks stronger.

Table 8: Comparison of options in sensitivity analysis.

Project		Base Case MCA	r=5%	Removal of NPV	Mean Score	Rank
A	Demonstration plots, extension officer + plant nursery	865	865	831.25	854	1
B	Forest CCA + community ranger program	530	530	537.50	533	4
C	MPA + community ranger program	305	305	506.25	372	7
D	B + C	685	785	731.25	734	3

E	A + B + C	765	765	706.25	745	2
F	Fish attracting devices	569	559	448.75	526	5
G	Micro-financing initiative	485	485	543.75	505	6
H	Composting toilets	250	250	437.50	313	8

CHAPTER 10: DISCUSSION ON IMPLEMENTATION

10.1 INCLUSIVE ENGAGEMENT

Inclusive engagement of the South West Bay community during project implementation will best ensure as many people as possible are provided the opportunity to participate in the planning, implementation, and monitoring of a project that will impact their community. This includes people of all ages, genders, abilities, socioeconomic backgrounds, and cultural identities. This engagement should adhere to the following principles:

1. Culturally appropriate: Planning activities should be designed in a way that is culturally appropriate for Pasifika communities and include techniques that are tried and tested.
2. Meaningful participation: Community members should have the opportunity to make decision into the project's design, implementation, and monitoring.
3. Transparency and accountability: Each project's goals, objectives, and potential risks and impacts needs to be clearly articulated. Decision makers should also be accountable to the community for their decisions and actions.
4. Capacity building: Both engagement and implementation activities should be designed to build the capacity of the community to further participate in the project. This may include providing training on the project's technical or maintenance requirements, or supporting the community to develop its own governance structures.

10.2 COMMUNITY ENGAGEMENT ON WASH ISSUES

Experiences document in Lal (2006) show that implementation of composting toilets demands significant focus on a, multi-pronged and sequenced program of community engagement, which includes:

- education programs that highlight the merits of using composting toilets over other options (including business as usual). This education campaign can describe the economic, social, and environmental benefits of composting, particularly on local drinking water quality and water efficiency; and
- encouragement of acceptance of composting toilets as being representative of improvements in service provision. (Despite the obvious benefits of composting toilets they have been viewed as inferior, or a step backwards, to flushing toilets from those people who have access to them.)

10.3 FUNDING ENVELOPES

The MCA reported above presents a prioritisation list for adaptation projects for South West Bay. This list does not include implementation costs. As implementation costs are likely to be external (grants, government funding etc.) they act as an independent factor, or a feasibility

filter. For example, a project that returns a considerable net present value will not be feasible if the capital costs remain too high. Table 9 puts the prioritised projects in the context of funding envelopes and therefore provides a realistic framework for decision making.

Working from the top left (no regrets / very low cost and high ranking), projects should be considered according to the funding available. For example, if less than $100,000 is available, FADs should be considered the priority option (on the proviso that the community is a coastal community).

Table 9: Ranking of adaptation projects by funding requirement.

Rank	No regrets / very low $0-$1,000	Low $1,001-$100,000	Medium $100,001-$500,000	High $500,000-$1,000,000	Very high >$1,000,000
1				Demonstration plots, extension officer + plant nursery (A)	
2				B + C	
3					A+B+C
4				Forest CCA + community ranger program (B)	
5	Micro-financing initiative				
6		FADs			
7			MPA + community ranger program (C)		
8			Composting toilets		

10.4 PROJECT INTEGRATION AND CAPACITY BUILDING

As already alluded to, project integration can bring efficiency and effectiveness advantages to implementation, for example, the multi-tasking of conservation committees and co-ordination between use of resources, technology, equipment, skills, experience, and connections into project sites to lay foundations for on-going relationships with communities.

Notwithstanding this, project integration can also come with risks. Failure of coordination can mean all projects are put at risk and longer-term investments in capacity building, with considerable up-front investment in that capacity can come at the expensive of more immediate action. Whilst project implementation is commonly criticised for being too short sighted – often leaving communities with only best intentions, attempting projects that have significant complexity (and even greater complexity through integration) can put project outcomes at risk if capacity is low. This applies to even relatively simple interventions, like the installation of rainwater tanks, especially if training, tools and plans are not co-developed and owned by community members.

10.5 POLICY ALIGNMENT

The Vanuatu *Environmental Management and Conservation Act 2002* allows for establishment of Community Conservation Areas (CCA) – the key conservation tool in Vanuatu legislation. To be formalized, a CCA must be registered with one of the appropriate Vanuatu government departments. Creating the CCA must follow an established procedure, which allows for community consultation, biodiversity audits, community approval of a management plan, notification of neighbouring communities and support from both the island Council of Chiefs and the provincial government. CCAs may be of any size, marine or terrestrial, privately-, community- or cooperatively-owned and managed, and can support local practices by allowing for the sustainable harvesting of resources, such as fish, timber and non-timber forest products.

10.6 MONITORING AND EVALUATION

A monitoring and evaluation (M&E) schedule should be designed ensure the EbA projects fulfill stated ambitions and to assess their effectiveness in reducing vulnerability and building resilience to climate change. The M&E process should be participatory, involve local communities and stakeholders, and should assess that the project:

1. continues to be relevant to the specific needs of Vanuatu and the EbA projects being implemented;
2. is effective in collecting and analysing data to assess the progress and effectiveness of EbA projects;
3. is efficient in terms of time and resources;
4. is provide timely information to decision-makers so that they can make necessary adjustments to EbA projects; and
5. distributes the benefits in a relatively equal manner.

In addition, the robustness of the M&E process and resources committed to it should match the complexity of the projects considered.

CHAPTER 11: IEMP OUTCOMES

The vulnerability of social and ecological systems to intensifying human activities, both locally and in extended supply chains as access to wider markets, in sectors such as agriculture and fishing (and potentially, in the future, logging and mining) is increasing. Climate change and continuing carbon emissions are likely to increase this vulnerability, as weather patterns warm and potentially alter rainfall and forest moisture patters, meaning adaptive capacity, for which Pacific nations are notably renowned, needs to also increase. The population of South West Bay area is also increasing. Communities in Vanuatu depend heavily and directly on the health of ecosystems (including the complex shifting cultivation and forest management system) for their food and their livelihoods and potentially, their economic development, through accessing export markets for produce. In addition, in the short term, tourism development (made possible by relatively good mobile access) is likely to be niche and cater for those seeking environments that are closer to nature.

11.1 ROBUST NATURAL FOREST HABITATS

A robust forest and forest community managed conservation network is vital for the on-going resilience of all aspects of Vanuatu communities. The country's *Vision 2030* (Vanuatu Government, 2016) highlights the social, environmental and economic benefits of forest ecosystems as a key means for Vanuatu to achieve resilient, inclusive green growth. Establishment of formal protected areas, such as that promoted through this project increases the institutional robustness and sustainability of any protected area network.

In addition to the inclusion of more forest under active and local management for sustainable harvesting, there are significant benefits from retaining primary forest adjacent to subsistence gardens and integrated with agro-forestry. For example, forests provide sustainable fuel-wood sources and non-timber forest products, improve soil stability and fertility, and subsistence garden forest cover through agro-forestry provides shade and microclimatic buffering from extreme weather events (Harrison et al., 2016).

If the extent and connectivity of remnant primary forests falls below critical thresholds, these co-benefits will diminish, and further downward pressure is placed on subsistence garden productivity. Assisting communities with the protection of forest areas as an EbA, implemented through protected area status can thus reduce the risk of climate change impacts.

Funding sources for forest conservation projects are becoming more diversified over time, expanding beyond straightforward government funding sources. Philanthropic demand for conservation (or activities that are pro-forestation) and the global demand for carbon sequestration are two important areas, which are discussed more here.

Payment for ecosystem services and REDD+

Payment for ecosystem services (PES) schemes describes one of a suite of policy mechanisms put forward to support forest conservation *and* to provide for more equitable social and economic outcomes. First considered in the 1990s, PES schemes now generate between US $36 and 42 billion in global annual transactions (Pagiola, 2008; Salzman et al., 2018). PES schemes compensate communities for pursuing sustainable forest management practices, such as instituting protected area status, reducing extractive forest uses, such as commercial logging, and reducing the loss of forest for agriculture. PES-compatible activities

generate positive environmental externalities through ecosystem services, which benefit local communities (e.g. soil stability, water quality), regional communities (e.g. shared catchments), and the global community (through reduced greenhouse gas emissions) (Engel et al., 2008; Morgan et al., 2021).

PES implementation is diverse and non-prescriptive but has been increasingly used to reduce carbon emissions through REDD (Reduced Emissions from Deforestation and Degradation) – a global initiative to provide compensation for communities to support sustainable management of forests (UN-REDD, 2016). REDD uses performance-based contracts, based on agreed activities, which support forest livelihoods and retention and/or sequestration of forest carbon (Angelsen, 2009). Later, the addition of the '+' (to make REDD+) flagged the inclusion of conservation, sustainable management of forests, and enhancement of forest carbon stocks to focus the scheme more on equity rather than strict resource allocative efficiency (Pagiola et al., 2005). The capital for most nascent REDD+ programs has been provided by international multilateral development funds. Once a REDD+ program is operating benefit transfer can take multiple forms (Garcia et al., 2021). Compensation can be made in cash, or in kind, for example, for schools and medical facilities, or as funding to health and education services, and to individuals, households, or community organisations.

Mobilisation for REDD+ finance

Sustainable resource mobilisation for forest conservation will likely be best achieved through exploration of such mechanisms that valourize forest conservation. Thus, the contemporary drive by the Vanuatu government towards protected area status is most likely to be both supported and effective if it is linked to alternative, non-extractive, or limited-extraction livelihood opportunities – the '+' in REDD+. Supporting opportunities include development of non-timber forest products (Pandey et al., 2016), eco-tourism (Munch-Petersen, 2011), agro-ecological tourism (Addinsall et al., 2015). Localised REDD+ / PES projects can form part a larger nationwide or regionwide programmes of work.

REDD+ schemes remain novel, sometimes costly, institutionally complex and demand-led (Porras et al., 2013), which can limit participation due to high transaction costs, the requirement for settled land tenure, and the fact that opportunities tend not motivated by communities themselves. Successful REDD+ projects require an understanding of any specific proximate drivers of deforestation (e.g. commercial forestry or agricultural incursion). Further, schemes can lack governance standards and legitimacy by failing to reflect stakeholder's perspectives and priorities, particularly those of local communities (Wallbott et al., 2019). Therefore, they demand a high degree of co-design to reflect community expectations and ensure livelihood opportunities align with donor demands for enhancement of carbon stocks (Bush et al., 2021).

REDD+ readiness

REDD+ readiness refers to the efforts undertaken to develop the capacities needed to demonstrate and implement REDD+, and meet UNFCCC REDD+ requirements. REDD+ readiness support is provided to developing countries through bilateral and multilateral initiatives, including the UN-REDD Programme. Readiness activities include both financial and technical support on REDD+ related areas of work including governance, stakeholder engagement, developing a REDD+ national strategy/action plan, designing a safeguards information system, and developing a forest emission reference level and a national forest monitoring system. For more information see the REDD+ Factsheet: https://www.un-redd.org/sites/default/files/2021-10/Fact%20Sheet%201-%20About%20REDD3.pdf

REDD+ readiness began in Vanuatu in 2007 with the establishment of the Vanuatu Carbon Credits Project. Since then, funded by external grants, Vanuatu has become a participant country of the World Bank's Forest Carbon Partnership Facility and Vanuatu's REDD+ Readiness Preparation Proposal has been developed and accepted by the Facility Participants Committee, enabling Vanuatu to access funds from the Readiness Fund. Responsibility for coordination of REDD+ activities lay with the National REDD+ unit in the Vanuatu Department of Forestry, with the Project Management Unit (PMU) in the Department of Climate Change responsible for managing funds.

The readiness status of REDD+ in Vanuatu is summarised in the DRAFT *Vanuatu National REDD+ Strategy* (Vanuatu Government, N.D.) at https://static1.squarespace.com/static/58d6cc1e17bffcffb801edde/t/62d9c78ffd068b11aee550ba/1658439573552/Vanuatu-National-REDD-Strategy_Final-Draft.pdf

The vision set out in the strategy is to "safeguard and restore forest landscapes, facilitate climate- and forest-friendly production of goods and services, build resilience in forest-based communities, and support additional livelihood opportunities from sustainable forest management for the benefit of current and future generations" (Vanuatu Government, N.D., p. 10).

Potential budget limitations

REDD+ projects also demand infrastructure investments that support the development, marketing, and sale of such products (e.g. tourism or sustainable forest products). Both alternative livelihood development opportunities (tourism and the conservation economy) demand commitments to infrastructure development from government, regardless of the continued support with the communities. Potentially they will remain unfulfilled due to fiscal constraints shackling the government, which natural resource extraction and export were supposed to alleviate. Greenfield development of both sectors is complex and requires a long lead time, suggesting that the immediate demands of livelihoods generation, such as food and water security remain more pressing (Buckwell et al., 2024).

Resilient farming systems

One of the higher return policy interventions for improving rural well-being and resilience is stimulating innovation in the sectors from which the rural poor derive their livelihoods (Weber, 2012, p. 84). Nearly all households undertake some form of subsistence food production and animal husbandry. A robust, resilient, evolving, and forewarned farming system is imperative to South West Bay for:

- Local food security during change climates and through natural disasters, ensuring the community has a reliable supply of a variety of foods but also systems in place to recover quickly or store reserves if harvesting is interrupted.
- Nutrition: Local agriculture can help to improve nutrition by providing access to a variety of nutritious foods, such as fruits, vegetables, and meats.
- Economic development: Agriculture can be a major economic driver. A robust farming system can help to create jobs, generate income, and boost exports. Experimentation in new, export-orientated niche products (coffee, cocoa) can generate income but come at a risk to producing farmers, in terms of marketing investments and forgone effort towards foods that directly support their own and their community's livelihoods.

Though small-scale demonstration plots have been trialled in Vanuatu, reportedly with some success (Clarke et al., 2019), adoption of modified gardening techniques is likely to face many of the same barriers, which have been documented elsewhere, such as aversion to

taking new risks, due to the potential for shocks causing crop failure and loss of livelihood, lack of new inputs and education, and conformity affects (Clifton & Wharton, 1971; Dercon & Christiaensen, 2011).

11.2 IMPROVED SANITATION TO IMPROVE SURFACE AND GROUND WATER QUALITY

Environmentally, composting toilets eliminate the need for septic tanks and sewage treatment, preventing water contamination and promoting groundwater protection. Moreover, they produce nutrient-rich compost for agricultural use, reducing reliance on external fertilizers. Health-wise, composting toilets reduce the risk of waterborne diseases and improve sanitation practices, fostering a healthier environment. They also minimize odour and pest problems, enhancing the overall living experience.

Economically, composting toilets reduce dependency on external infrastructure and maintenance costs, making them a cost-effective solution. The generated compost can also serve as a valuable resource for agricultural production, boosting local livelihoods. Socially, composting toilets promote community participation in sanitation initiatives, fostering a sense of ownership and responsibility for public health. They also align with sustainable development goals, contributing to a cleaner, healthier, and more resilient Vanuatu.

Notwithstanding, implementation of composting toilets presents a number of barriers, detailed by Lal et al. (2006):

> *"Trials with compost toilets in Tuvalu and elsewhere in the Pacific, such as Kiribati, have demonstrated that although such a system is technologically feasible, locals are reluctant to embrace them for social reasons. The main obstacles include the "newness" of the technology, personal attitudes and preferences. Some have argued that the flush toilet system took almost 20 years to be accepted. The rate of adoption no doubt increased once flush toilets took on a prestige value and were found to offer convenience, comfort and privacy, and once the toilets became incorporated in the house. The use of compost toilets is seen as a step backwards, particularly because the early designs placed the toilets outside the house. Although later compost toilet designs incorporate these as an integral part of a home, they are likely to be slow to gain acceptance, even if they were to offer health as well as economic benefits. Another reason for limited social acceptability could be the concerns about human health effects, particularly from handling composted material."* (Lal et al., 2006, p. 3)

11.3 ENHANCED FISHERIES MANAGEMENT AND MARINE PROTECTION

As with forests, the marine protected areas (MPAs) are also vital to maintaining the functions of coastal coral reefs. Implementation and effective management of MPAs can increase fish diversity and biomass (or at least arrest declines), particularly as they mature, when they can measurably increase local food security (Mascia et al., 2010). Where mixed zoning includes at least some no-take zones, this increases biomass and take zones can benefit from spill-over (Lester et al., 2009). MPAs do not necessarily increase coral cover but can arrest its (often) continued demise in proximity to human settlement (Agardy et al., 2011). The presence of MPAs has been shown to increase tourism in Vanuatu (Pascal et al., 2015) and there is a strong link between biological success and social success (legitimacy) (Christie,

2004). This is likely to benefit South West Bay due to the presence already of small-scale tourism.

Implementation of FADs, in conjunction with MPAs, will likely support a healthy local fish catch and reduce pressure on coastal coral reefs. Fish has a long history in Pacific diets. It is nutritious and high in protein, omega-3 fatty acids, and other essential nutrients. Continued substitution of fish by less nutritious foods (made available by increasing trades in imported, low nutrition foodstuffs) may impact the nutritional status of people in the community. FADs can help also boost economic activity for the local area by increasing the catch of fish, which can be sold locally or exported off the island. FADs also create and support jobs in the fishing seafood processing industries, and in fishing tourism. Notwithstanding, a rigorous maintenance schedule is required that, while best delivered through local capacity building and delivery, is at risk of neglect from its common property status or local lack of boats or fuel to keep the schedule.

11.4 RESIDUAL RISKS

Understanding the distributional impacts of the proposed projects is essential to understanding the impact of a project, not just its outputs and outcomes (Asian Development, 2007). No quantitative poverty impact analysis (PIA) has been undertaken to disaggregate which stakeholder groups would likely benefit most from the projects. It cannot be explicitly stated the projects, as proposed, are explicitly pro-poor. However, a number of demographic attributes of South West Bay and Vanuatu in general suggest that we can make at least a qualified judgement that the demonstration plots project, in particular, can benefit indiscriminately and would have positive distributional impacts. Vanuatu's rural communities remain relatively homogenous and tribally based. Tribal affiliation provides entitlements to shelter and customary rights to farming land and forest and marine resources; hence there is no land-owning class that overtly benefits from improved productivity.

Nevertheless, this optimism needs to be tempered by the understanding poorer farmers often benefit less from extension programmes due to their propensity to farm smaller plots, be more risk averse, and be less likely to engage in such programmes. Provided outreach associated with the programme is carefully designed – perhaps even specifically targeting households that are typically hard to reach, or individuals who are marginalized – the impact on poverty reduction should be high. Notwithstanding, a more detailed, quantified PIA, would provide a valuable adjunct to this report.

APPENDIX A: South West Bay Household Survey

Household survey results

The household survey focused on the resources and livelihoods of households. The survey was paper-based, and questions were tick box answers to maximise data integrity by minimising the potential for mistakes by choosing more than once answer, particularly given the limitations of using locally recruited, inexperienced enumerators. The survey had the following sections:

1. About the respondent – who is completing the survey.
2. Household structure – characteristics of the household, who else lives there, gender/age/disability.
3. Subsistence and livelihoods assessment – subsistence, cash incomes and household ownership and materials.
4. Agriculture, gardens, non-garden products – garden size, location, produce grown, livestock, problems with production, forest use.
5. Water resources – water sources, reliability.
6. Sanitation – sanitation and waste.
7. Reef and marine resources – where, what and when marine resources are harvested.
8. Household development – impact of environmental change, impact of Covid-19, emergency management planning, household opportunities.
9. Governance – involvement in community decision making.

Margin of error

Table A1 reports the margin of errors at 90% confidence for the household survey samples, based on population estimates for the smallest available population units (statistical division in the Vanuatu census). These margins of error should be kept in mind when considering survey results.

Table A1: Margin of errors for household survey.

Sample Description	Sample Size (household members)	Statistical Area(s)	Population (from census)	Margin of Error
Full sample	683	North Pentecost, North West Malekula, South West Malekula	16,023	3%
South West Bay, Malekula	197	South West Malekula	3,775	6%

Sections A and B: Household demographics

Household membership

The average household size in South West Bay was 4.0, which is lower than the average across all communities. Full results are reported in Table A2.

Table A2: Household surveys and structure of households.

	Household Surveys	Total People in Households	Total by Gender			Average Occupancy	Median Occupancy
			M	F	Non Binary		
South West Bay, Malekula	49	197	83	83	0	4.0	4
Total	153	683	360	243	0	4.5	4

Question B.2.2. Age group of household members

Table A3 reports the proportion of people in each age range for household members reported in the household survey. South West Bay has a moderate age profile, very similar to Wiawi.

Table A3: Proportion (%) of household members by age group.

	Total Where Age Stated	<18	18-35	36-45	46-60	>60	Visual representation
South West Bay, Malekula	172	30	34	19	12	6	

Question B.2.3. Education attainment level

We asked about educational attainment and report the results for all four communities (including the survey respondent). The full results are reported in Tables A4 (by community) and A5 (by gender).

All communities reported lower educational standards than what is reported in the 2020 Vanuatu Household Census for rural households, South West Bay, quite significantly (Vanuatu National Statistics Office, 2020). This may be attributed to respondent under-reporting. Whilst our data should not challenge the census data, it is still useful for cross-community comparison for identifying specific priorities.

South West Bay's educational levels were considerably lower than the average across the whole sample, with completion of primary education at 37%.

University education was rare. We also broke this data down for men and women across all communities. This is reported in Table A5. Generally, men had a slightly higher standard across all levels of attainment, but the differences were quite small.

Table A4: Educational attainment by community (Percent sample stating level of achievement and average percent across communities).

	Finished Primary School	Finished Secondary School	Finished University	Post-School Training	Other Qualification	Don't Know
Rural population from 2020 census	66	31	1	2		
South West Bay, Malekula	37	18	1	2	2	2
Average from sample	51	21	1	5	3	1

Table A5: Educational attainment by gender (Percent stating level of achievement and average percent across communities).

	Finished 1° School	Finished 2° School	Finished University	Post-School Training	Other Qualification	Don't Know
Male	56	28	1	6	6	1
Female	46	26	1	4	2	1

Section C: Household livelihoods

Key findings from all household livelihood questions:

In South West Bay, growing food is important but fishing not quite so (but still ~40%). Hunting wildlife is not important.

C.1.1. Subsistence activities

We asked the survey respondent to state whether anyone in the household undertook any subsistence activities and which members of the household carries out what types of subsistence activities.

Table A6 reports the answer to the overarching yes/no question and Table A7 reports the follow-up question, broken down by community and island. Unsurprisingly, a very high proportion of households undertook *at least one* form of agricultural activity for household consumption (subsistence). These figures are somewhat higher than what is stated in the 2022 Vanuatu National Agriculture Census Preliminary Report (2022), which reports that 74.5% of households are involved in subsistence agriculture. This lower figure is likely to be skewed by the growing urban population and no regional breakdown is currently available. Note that this is significantly down on the 2009 census figure of 98% for the country as-a-whole (Vanuatu National Statistics, 2009).

Table A6: Proportion (%) of households stating they undertake subsistence activities.

	South West Bay	All Malekula
Yes	88	87
No	12	13

Table A7: Types of subsistence activities undertaken by household members (percent of household members undertaking this activity).

	South West Bay
Preparing land for food gardens	25
Growing food	50
Fishing	39
Collecting shellfish / marine resources	37
Hunting wildlife	6
Collecting plants	27

We also broke subsistence activities down by gender (male/female/non-binary) for all the communities together. This is reported in Table A8. In general, there was a reasonable degree of shared contributions to these activities, with males reported to undertake more preparation of land for food gardens and hunting wildlife.

Table A8: Subsistence activities (all communities). Percent of household members and percent of men and women undertaking each subsistence activity (male: n=290, female: n=343).

	Preparing Land for Food Gardens	Growing Food	Fishing	Collecting Shellfish/ Marine Life	Hunting Wildlife	Collecting Plants
Male	62	54	49	35	34	34
Female	57	49	44	32	20	20

Question C.2.1. Do any members of the households earn cash?

Survey respondents were asked to describe their cash-earning activities. Table A9 reports the responses to the overarching question about earning cash and Table A10 reports the proportion of people in each household who undertake an activity from the list of activities presented in the survey. Also reported in Table A10 for comparison is the proportion of people aged over 15 earning cash as reported in the 2020 Vanuatu Household Survey (Vanuatu National Statistics Office, 2020).

More than three quarters of South West Bay households report some income, mostly from working for wages and selling grown food.

Table A9: Proportion (%) of households undertaking some cash-earning activities.

	South West Bay	All Malekula
Yes	78	78
No	12	22

Table A10: Proportion of people (%) undertaking some form of cash-generating activity, by community.

	South West Bay
2020 Vanuatu Household Census	30.1
Selling grown food / animal products	22
Selling fish / marine products	12
Selling cooked food	12
Selling forest materials	15
Tourism accommodation / restaurant	1
Selling handicrafts	9
Education / health	2
Work for wages	23
Casual labouring	13

The analysis also broke down cash-earning activities by gender across all communities. This is reported in Table A11. There is a fair degree of similarity between women and men in terms of earning additional cash in aggregate, with the only significant difference being in jobs for wages, including other casual work and education and health in which men predominate, and in selling cooked food and handicrafts in which women predominate. 1 in 4 men and 1-in-5 women declared some cash income.

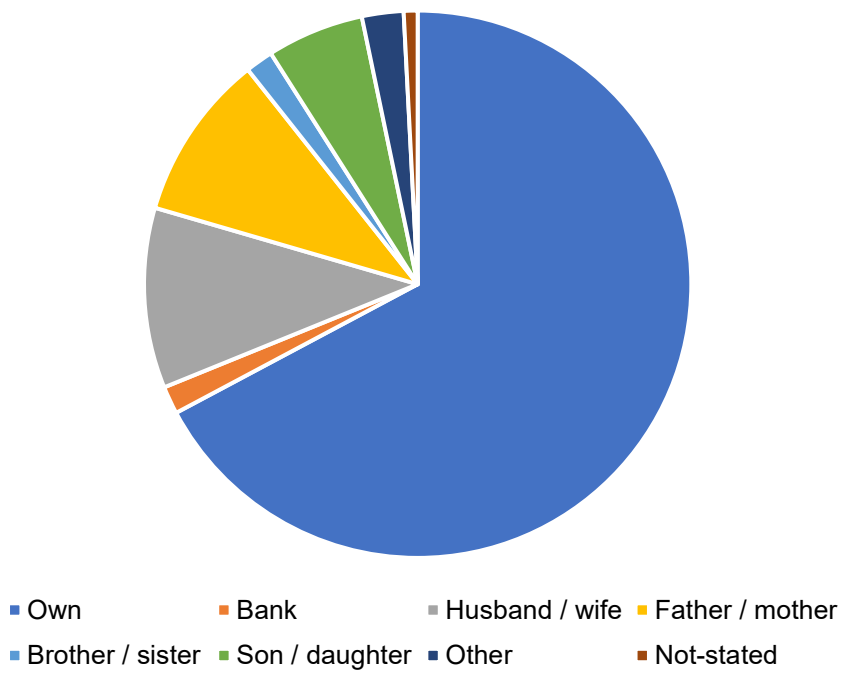
Table A11: Cash earning activities (all communities). Proportion (%) of men and women undertaking each activity (male: 290, female: 343).

	Male	Female
Selling grown food / animal products	37	36
Selling fish / marine products	32	31
Selling cooked foods	26	29
Selling forest materials	17	17
Tourism accommodation/ restaurant	5	4
Selling handicrafts	11	14
Education / health	9	6
Work for wages	25	19
Casual labouring	19	13

Question C.3.1. Who owns the house you live in?

Respondents reported on the ownership status of their main dwelling. This is reported in Figure A1, categorised by island. In the vast majority of cases the respondent's house is owned by them, or their spouse. It is likely the differences between the two islands, in terms of the answer 'own' and 'husband / wife' is down to the interpretation of the enumerators. In each case, the total between 'own' and 'husband / wife' is approximately 75%. Virtually no houses were mortgaged / owned by the bank.

Figure A1: Who owns the house you live in Malekula.



Question C.3.2. What is the house made of?

Table A12 reports the full results.

Table A12: Composition of main house and roof. Percent of respondents reporting main house's construction materials by community.

	South West Bay	
	House	Roof
No answer	27	12
Plant materials / timber only	27	78
Plant materials / timber, Brick / breeze block only	24	8
Brick / breeze block only	22	0
Metal	0	2

Section D: Agriculture

The next series of questions asked respondents about their agricultural practices, in particular about the land utilised, crops grown and livestock management and belief-based questions on respondents' perception of limitations and risks in their agricultural practices.

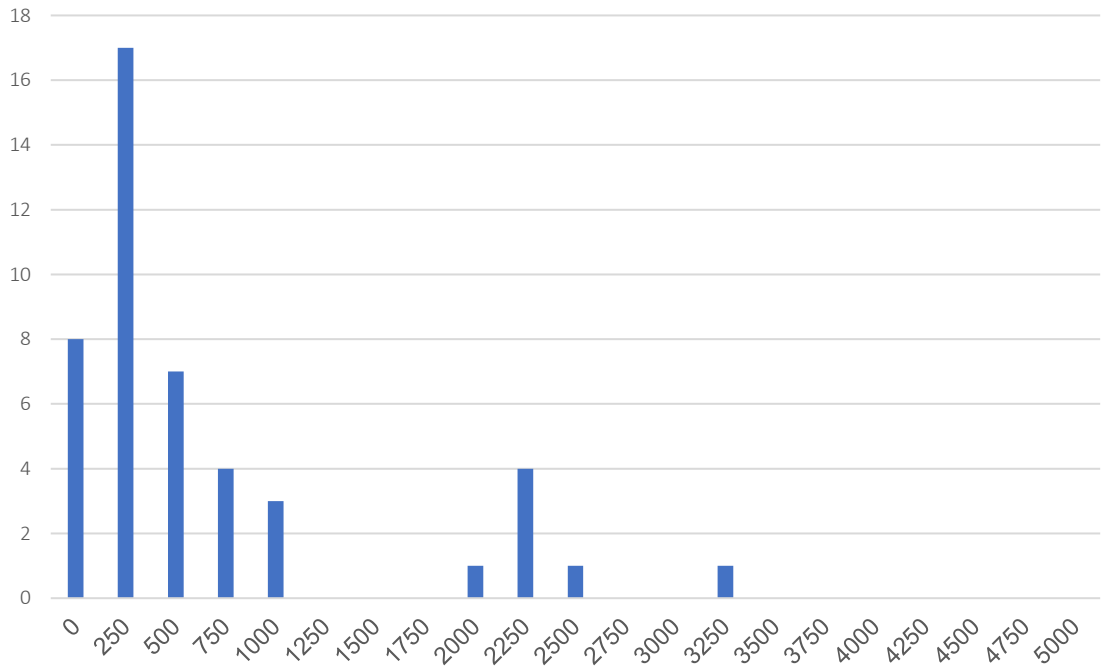
Key findings from all agriculture questions:

The distribution of plot size in South West Bay was smaller than other communities. The diversity of crops was the largest for Malekula, with 12 listed. 43% of households sold some of their produce. Nearly all households stated they face problems that limit how much food they grow. The main reasons were floods, cyclones, not enough rain and problems getting food to markets. Livestock management rates were much higher than on Pentecost, with 60-65% eating chicken and eggs regularly and around 4-in-10 households listing they managed pigs.

Question D.1.1. Garden plot extent, ownership, changes

Respondents were asked to list the garden plots under their management and describe their size and tenure. This datapoint involved the respondent reporting the approximate length and width of each block, as opposed to 'pacing out' each area. The enumerator then calculated the area under management. The upper ranges reported were very large. One respondent reported managing 300,000 m^2 (30 hectares) and another 150,000 m^2. We have no independent verification of the veracity of this data and omitted it from the following figures. Figure A2 shows a histogram distribution of gardens in South West Bay.

Figure A2: Distribution of total garden plot size under household management for South West Bay, Malekula (outliers removed: 3).



D.1.2. Most important crops grown

Households were asked to list a maximum of eight of the most important crops grown, state whether they produced surpluses, and what they did with any surplus. The proportion of households listing Vanuatu staples in all communities was relatively similar between all

communities and both islands – taro (85%), manioc (73%), banana (78%), and yam (75%). Table A13 reports the full spectrum of crops listed.

Table A13: Commonly grown crops for each community. Percent of households listing item.

	South West Bay	All Malekula	Total
Taro	96	84	85
Kava	0	13	22
Manioc	63	61	73
Banana	76	78	78
Yam	57	68	75
Fijian taro	0	0	16
Kumula	41	26	32
Wild yam	6	3	8
Cabbage	59	44	53
Water melon	0	0	2
Cucumber	2	1	5
Sugar Cane	2	1	1
Corn	6	3	7
Paw paw	0	0	0
Beans	0	0	1
Ginger	0	0	1
Pineapple	0	0	1
Pumpkin	2	5	3
Water taro	6	4	3
Range of crops listed	12	13	18

Table A14 reports the total number of households reporting the sale of at least one line of produce. A very high proportion (~80%) of households in South West Bay (Malekula) are selling surplus produce when compared to all the communities in Malekula.

Table A14: Proportion (%) of households that sell some of their grown produce.

	South West Bay	All Malekula
Sale	43	44
No sale	57	56

D.1.3. Do you face any problems that limit how much food you can grow?

Table A15 reports results of an overarching question on whether households are experiencing any issues with growing food. The results show nearly all households in Malekula reported some issues (and continued to report them in D.1.4.).

Table A15: Proportion (%) of households reporting issues with growing food.

	South West Bay	All Malekula	All sites
Yes	94	92	84
No	6	8	16

D.1.4. What are the main problems you encounter that limit your food growing?

The team asked those respondents who experience issues with growing food to rank one or more of those issues from a list. Upon feedback from the data collection team, it was clear the intent of the ranking was too complex to effectively collect robust data so, as a result, we totalled the number of respondents who selected the issue, regardless of ranking. This is reported in Table A16.

The data shows respondents are overwhelmingly concerned about weather and climatic issues associated with extreme weather events – both too much rain and too little. Almost all agriculture in these communities rely solely on being rainfed, with little or no irrigation, hence the weather and climate are big drivers of uncertainty in the immediate future for food security.

As a result, respondents pointed significantly towards a lack of seed stock, not enough tools, and no fertilizers (~40% of Malekula households). Many of these issues can be alleviated through agricultural extension programmes (Buckwell, Ware, et al., 2020), which should be designed to also target the requirements of women and members of socially disadvantaged groups.

Table A16: Proportion (%) of all households reporting specific issues with growing food.

	South West Bay	All Malekula	All sites
Not enough rain	53	61	56
Flood	84	74	53
Storms and cyclones	76	76	69
Volcanos, earthquakes	14	27	24
Can't get food to market	37	50	42
No seed stock	22	41	37
No fertilizers / mulch	16	38	39
Not enough tools	24	43	42
No labourers	14	42	39
No where to make my garden bigger	29	34	33
Cannot get to my land	16	28	21
Can't access banking	24	40	21

D.2.1. Number and use of livestock

We asked respondents about their livestock management. These data are reported in Table A17 for all of Malekula.

Table A17: Livestock management in Malekula (n=106).

	Produce/ Own	Eat Regularly	Buy It	Sell It	Would you like eat more
Poultry meat	63	64	36	52	53
Eggs	47	59	29	28	46
Pigs	39	33	21	23	33
Cattle	37	50	44	26	37
Milk	7	7	4	3	5
Goat	3	8	4	0	5
Goat milk	0	1	0	0	1

D.3.1. How important are the forest and grassland resources?

We asked respondents to state on a scale of 1 to 3 (0 = *no answer*, 1 = *not very important*, 2 = important, and 3 = *very important*) how important forest and grassland communal resources were to them.

For South West Bay, common forest and grassland harvesting were important, with 90% collecting some harvest. The most important items were bamboo, coconut products, bananas, medicinal plants, fruits, and nuts.

Table A18 reports the mean score provided by respondents, which has been normalised to generate a score between 0 and 100 for ease of comparison. Forest and grasslands are generally equally important between the four locations and the two islands. Bamboo products, banana, and coconut food products are particularly important. Specifically noteworthy is the importance of medicinal plant collection, which had an 84% score in the whole sample (and equally important in all locations).

Table A18: Importance of forest and grassland produce (total households).

	South West Bay	All Malekula	All sites
Wild animal food	62	60	61
Bamboo	90	93	92
Banana	89	91	90
Coconut products	88	89	89
Rattan	27	45	56
Medicinal plants	80	83	84
Cultivated fruits	80	79	81
Wild fruits	75	77	80
Nuts	81	80	81
Bush meat	75	72	70
Mushrooms	55	51	48
Average for all	73	75	76

Section E: Water resources

This section asked respondents about their access to water resources for drinking, irrigation, and general domestic use.

Question E.1.1. Water sources and reliability

Table A19 reports the proportion of households that reported they accessed the following water sources, aggregated for all households in the survey. Table A20 reports these data disaggregated for South West Bay. We also asked a question around who collected the water from the range of sources. However, this question was poorly attended. As the limited data provided showed this task was generally evenly shared between men and women (not children) it is not reported here.

Table A19: Water resource use, reliability, and accessibility for all communities. Proportion (%) of households stating this option.

	Drinking / cooking	Washing	Washing clothes	Watering plants	Is this source reliable	Is this source accessible
Public well/tap	42	42	41	39	27	27
Private well	11	11	10	7	5	4
Natural spring	15	18	14	7	7	6
River / lake	33	39	37	27	19	22
Rainwater tank	52	39	38	32	21	30
Piped	59	56	54	53	36	42
Bottled	20	8	8	9	3	7
Trucked in	2	1	1	1	0	0

Table 20: Water resource use, reliability, and accessibility for South West Bay, Malekula. Proportion (%) of households stating this option.

	Drinking/ Cooking	Washing	Washing Clothes	Watering Plants	Reliable	Accessible
Public well/ tap	73	76	76	80	35	39
Private well	12	14	14	10	2	2
Natural spring	16	22	20	12	8	6
River/ lake	59	69	67	45	27	33
Rainwater tank	57	37	35	33	12	31
Piped	80	73	73	71	20	51
Bottled	35	16	16	20	4	12
Trucked in	0	2	2	2	0	0

Section F: Waste management and sanitation

This section asked households about access to sanitation services, including waste management facilities, toilets and washing facilities.

Key findings from all waste and sanitation questions

In South West Bay, 84% of households are producing *some* non-compostable waste. The amount of waste produced is around average for all the communities surveyed. Most is disposed of in backyard pits or burned in the backyard. Few (<10%) households stated waste is disposed of at community recycling centres or authorised collections.

Question F.1.1. How much non-compostable waste does your household produce?

The quantity of non-compostable waste generated in each household is reported in Table A21.

Table A21: How much waste is produced by households each week (% stating option).

	South West Bay	All Sites
None	14	16
Less than 1 bag	31	43
2 to 5 bags	20	17
More than 5 bags	18	16
Other	16	8

F.1.2. How do you dispose of your non-compostable waste?

Nearly all non-compostable waste is disposed of through burial and burning, though some households claim to re-use all their waste. However, this is likely not a longer-term strategy. Unsurprisingly, recycling opportunities remain limited, though are more prevalent on Malekula. How non-compostable waste is disposed of is reported in full in Table A22.

Table A22: What does your household do with your non-compostable waste. Proportion (%) of households that stated an option by community.

	South West Bay	All sites
We re-use all waste	26	21
Backyard pit	51	60
Burn in backyard	69	65
Community waste pit	21	36
Ocean/waterway	8	10
Community recycling centre	10	17
Authorised collection	8	7
Other	8	6

Question F.2.1. Accessibility of toilet facilities

The team asked households to describe the sanitary facilities that they had available and accessible to them. Respondents could select multiple entries, so results are presented as total number of households selecting this option. This is reported in Table A23.

Flushing toilets remain relatively rare across all communities. Only 13.3% on Malekula have flushing toilets and only 2% of households in South West Bay had a flushing toilet at their house. Accessibility to vulnerable people (pregnant, elderly, or people with a disability) was quite mixed. It is possible this question was too complex, or demanded too much detail, however, it is likely accessibility could be an issue and exclusion from sanitation facilities could be the subject of specific study. For Malekula, of the 11 households that gave no answer to this question, again only one answered they had access to a flushing toilet.

Table A23: Access to toilet facilities for Malekula. Proportion (%) of households selecting option (all households stated at least one option).

Type of Toilet	South West Bay		All Malekula	
	At House	Access To	At House	Access To
Bush toilet	78	43	73	38
Flush toilet	2	2	13	5
Other	10	2	8	1
No answer	8	53	10	58
ACCESSIBLE TO VULNERABLE PEOPLE				
Accessible	41	29	38	25
Not stated	51	16	57	19

Section G: Use of marine resources

This section asked households about their regular (in the last week) use of marine resources, what they collected, who collected them, from where were they collected and what was done with any surplus.

Key findings from all marine resource questions:

Three quarters of households surveyed in South West Bay (78%, the highest) collected marine resources in the last week. In South West Bay, 82% of these households harvested marine resources used the local reef to catch fish and there was little use of the deep water and other reefs. Freshwater locations were also important, used by 42% of households for fish and river plants (32%). A very high proportion of households (63%) harvested marine shellfish on local reefs. Of households that harvested marine and freshwater resources, men were engaged 86% of the time, women 61% of the time and children 59%. 64% of households harvest sufficient resources to given away to extended family and 45% sold or traded. Trading / selling is mostly the domain of men (42%) over women (18%) and children (20%). 40% expressed a desire to harvest more resources. (This is across all Malekula communities.)

G.1.2. Collecting marine resources in the last week

First, we asked an overarching, yes/no question, which is reported in Table A24.

Table A24: Proportion (%) of households undertaking some collection of marine resources in the last week.

	South West Bay	All Malekula	All Sites
Yes	78	70	63
No	22	30	37

G.1.2. Where are marine resources caught or collected?

Of those households that caught or collected marine resources, Tables A25 report *where* they did this. This question provides insight into local environmental pressures. Local reefs

were the most important locations for fishing, though a fair proportion (34% for Malekula respectively) stated they also caught fish in deep water, and freshwater rivers and lakes were important for households on Malekula.

Table A25: Where do households collect marine resources, South West Bay, Malekula. Percent of households stating they undertake some collection (n=38).

	Fish	River Plants	Shellfish	Sea Weed
Local reef	82	13	63	11
Another reef	8	5	13	8
Deep water	13	0	0	3
River / lake	42	32	11	5
Mangrove	0	3	0	0

G.1.2. Who caught the marine resources caught or collected

Respondents were asked *who* caught or collected marine resources. This is reported in Table A26. Although more men than women tended to be engaged in these activities, labour was generally shared. A large proportion of children were engaged in fishing on Malekula (59%).

Table A26: Who caught or collected the marine resources, Malekula. Percent by gender undertaking collection of resources (n=74).

	Fish	River Plants	Shellfish	Sea Weed
Men	86	32	47	7
Women	61	15	43	5
Children	59	8	24	3
Non-binary	12*	1	3	0
* Note that no-non-binary people were listed in the household survey, so this figure is likely erroneous.				

G.1.4. What is done with the harvested marine resources?

Respondents were asked *what they did* with the caught or collected marine resources; this is reported in Table A27. A surprising number of households harvesting marine resources sold or traded those resources: 45% for Malekula. Although not a direct proxy for shortages (determining over-harvesting would have been difficult given the circumstances of the survey), 41% percent of households responded positively to *"Is there a shortage or would you like more?"* suggesting that a fair proportion of households are experiencing some bio-physical constraints on marine resource harvesting, specifically for fish.

No specific questions were asked of use of larger marine species, such as dugongs and turtles, which are commonly used in in community festivities.

Table A27: What do households do with marine resources on Malekula. Percent of households that undertake some collection undertaking each activity (n=74).

	Fish	River Plants	Shellfish	Sea weed
Household use	89	32	50	8
Given to extended family / clan	64	26	39	0
Sold / traded	45	11	16	3
Is there a shortage / require more	41	14	23	0

G.1.5. If sold, who sells the harvested marine resources?

We asked households that stated they sold collected marine resources who was responsible for that activity. These results are reported in Table A28.

Table A28: If sold, who sells the harvested marine resources. Percent selected of those households that stated it sold some marine resources.

	Malekula	All sites
Men	42	42
Women	18	27
Non-binary	1	1
Children	20	17

Section H: Household development

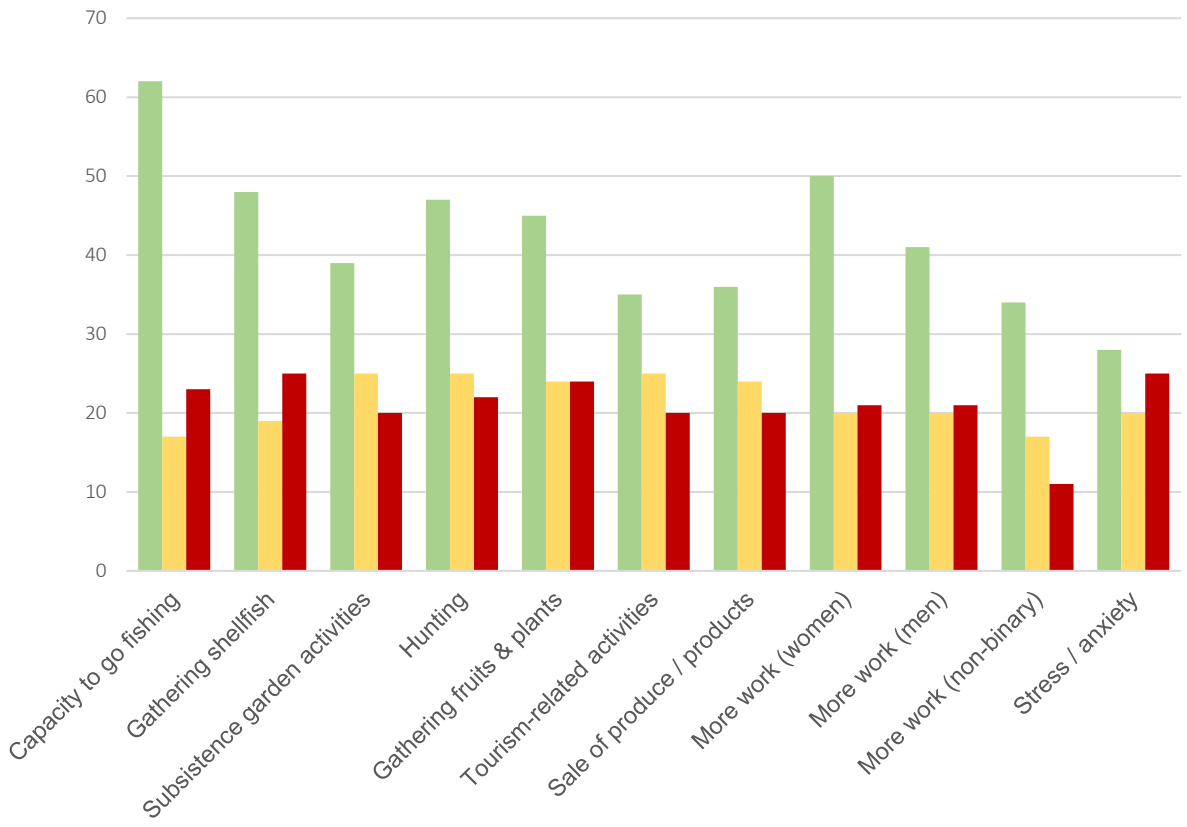
Section H concentrated on household aspirations, concerns, and likely planned actions for the future.

H.1.1. Has the Covid-19 pandemic changed your household activities?

From a list of pre-determined likely issues, we asked respondents what impact the Covid-19 pandemic had been on them and anyone in their household. This is reported in Figure A3.

Figure A3: Has Covid-19 changed anything (Malekula).

Percent of household respondents selecting measure. Key: less: n; no impact: n; more: n.



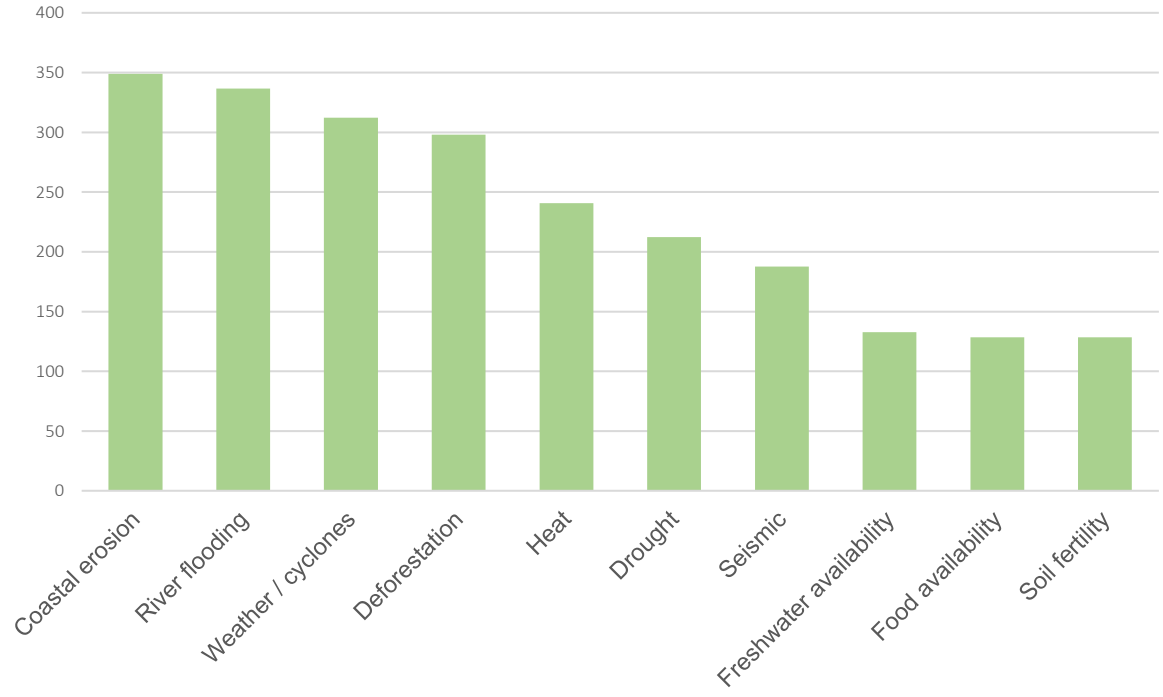
Question H.2.1. Concern about environmental challenges key findings

The most pressing environmental challenges for South West Bay were coastal erosion, river flooding, the impact of extreme weather (cyclones) and deforestation. Least pressing was soil fertility and food availability.

Women were generally more concerned with environmental challenges than men, particularly food and freshwater availability (which was generally considered only of minor importance).

These full results are reported in Figure A4.

Figure 6: Level of concern for environmental challenges, South West, Malekula.



Environmental concern by gender

We also broke down this data by gender (for the whole sample). Equating no answer to a value of zero and then subsequently scores of 1, 2, 5, and 10 we calculated the average score given to each environmental risk. This is reported in Table A29. In general, women were more concerned about environmental risks than men and were so for all available answers. Women were considerably more concerned about food and freshwater availability (perhaps related to traditional domestic tasks and the health of children, the elderly and disabled) and coastal erosion, seismic activity, and deforestation.

Table A29: Level of concern about environmental risks by gender.

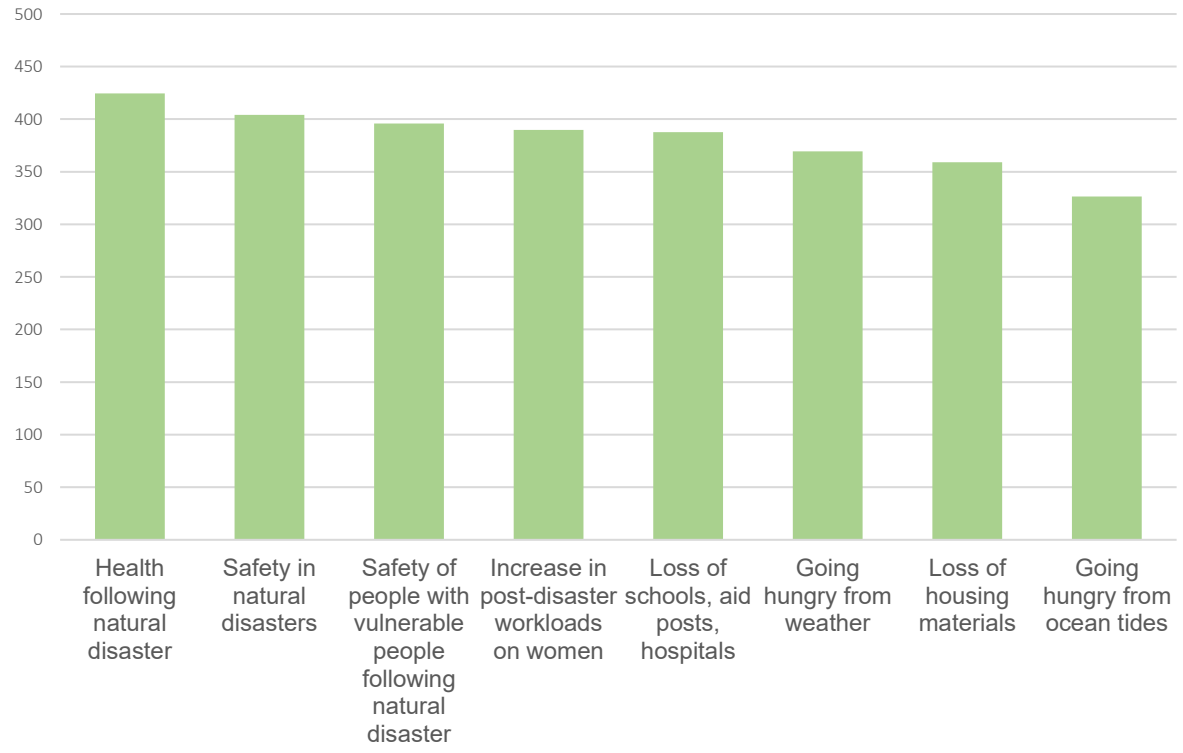
	Women	Men	Proportional value (women to men)
Drought	3.0	2.3	1.28
Heat	3.0	2.4	1.28
Food availability	2.3	1.5	1.58
Freshwater	2.1	1.6	1.32
Soil fertility	1.6	1.5	1.12
Weather/ cyclones	4.1	3.5	1.18
River flooding	2.7	2.7	1.00
Coastal erosion	4.0	3.0	1.33
Seismic	3.2	2.4	1.33
Deforestation	3.5	2.7	1.28
Average	3.0	2.3	1.28

Question H.2.2. Concern about socio-economic challenges key findings

Pressing issues for South West Bay were health and safety during and after natural disasters, particularly of vulnerable people. Going hungry from coastal inundation and loss of housing materials were of least concern. Women were generally more concerned than men, across all issues bar one (coastal inundation's impact on food production). They were more worried about going hungry as a result of extreme weather, the safety of vulnerable people during natural disasters and the post-disaster workloads for women.

These full results are reported in Figure A5.

Figure A5: Relative concern about potential socio-economic problems for South West Bay, Malekula. Scale is an index of average scores in accordance with the scale described above.



H.2.2. Socio-economic concern by gender

We also disaggregated the data by gender (for the whole sample). Equating no answer to a value of zero and then subsequently scores of 1, 2, 5, and 10 to 'not very worried', 'a little worried', 'very worried', and 'this would be catastrophic', respectively, the average scores given to each environmental risk is reported in Table A30. Women show a greater level of concern across all and every indicator, except for going hungry because of sea level rise.

Table A30: Socio-economic concern by gender.

	Women	Men	Proportional value (women to men)
Going hungry from weather	4.1	3.2	1.29
Going hungry from ocean tides	2.9	2.9	0.99
Loss of housing materials	3.7	3.2	1.14
Safety in natural disasters	4.7	4.0	1.17
Health after natural disaster	5.0	4.2	1.20
Safety of vulnerable people after natural disaster	4.8	3.8	1.26
Loss of schools, aid posts, hospitals	4.9	4.0	1.23
Increase in post-disaster workloads on women	4.7	3.7	1.26
Average	4.1	3.2	1.29

Future household opportunities

The final substantive questions asked respondents to score a series of statements on future potential livelihood opportunities in terms of how important they may be in the future. The full results are reported in Table A31.

Looking to the future, the following opportunities were important for improving a household's happiness and security in Wiawi: a more equal share of household chores, improving farming practice, making and selling food and handicrafts with a small business. Tourist accommodation and guiding were considered moderately important – the only community where this was the case. This may be linked to turtle conservation opportunities where tourists assist in nesting surveys. These preferences were generally equally shared between men and women.

Across several options, the general shape of the preferences was in a U-shape; that is many options were either quite important or not important at all. There were few options were there was a range of preferences. This suggests that when implementing projects such as EbAs, certain options may meet the demands of a sub-section of the community, but they need to be implemented in a way that if one group receives a benefit, another must not lose out, so they are not negatively impacted. Such equality of benefit is essential to retain the social cohesion of smaller-scale, rural communities.

Question H.4.1. Looking to the future, how important might the following activities be for improving your household's happiness and security?

Table A31: South West Bay – plans for the future.

	0	1	2	3	4	5
Tour guiding	2	31	10	20	10	27
Running a restaurant	20	33	12	12	10	12
Running tourist accommodation	4	35	6	14	8	33
Working in tourist accommodation	16	35	6	14	10	18
Running a small business	16	12	4	22	14	31
Obtaining banking literacy	16	14	6	18	16	29
Education to get employment	2	31	10	16	12	29
Catch more fish out to sea	16	16	2	27	10	29
Making and selling handicrafts	4	29	6	22	8	31
Making and selling food	10	22	2	22	6	37
Making and selling clothes	16	29	6	16	16	16
More livestock	12	24	0	20	10	33
Improving my farming practices	8	6	2	18	22	43
More equal share of household chores	8	4	0	20	14	53

Plans for the future broken down by gender

The team also disaggregated the data by gender (for the whole sample). Equating no answer to a value of zero and then subsequently adding scores of 1, 2, 3, 4, and 5 the team calculated the average score given to each potential plan a household might have for the future. Propensity to see potential in future activities was relatively similar between genders, with women showing a greater propensity to make a living making and selling handicrafts, building livestock numbers, working in tourism accommodation and education and employment, whilst men considered catching more fish out to see, gaining financial literacy, and running tourism accommodation as more important. The full results are reported in Table A32.

Table A32: Plans for the future by gender.

	Women	Men	Proportional value (women to men)
Tour guiding	2.3	2.4	0.96
Running a restaurant	2.1	2.0	1.01
Running tourist accommodation	2.2	2.5	0.86
Working in tourist accommodation	2.2	2.1	1.05
Running a small business	2.9	2.8	1.03
Obtaining banking literacy	2.7	3.1	0.88
Education & employment	3.0	2.8	1.05
Catch more fish out to sea	2.4	2.9	0.82
Making & selling handicrafts	3.2	2.9	1.07
Making & selling food	3.2	3.3	0.98
Making & selling clothes	2.7	2.5	1.07
More livestock	2.9	2.7	1.09
Improving farming practices	3.5	3.7	0.94
More equal share of chores	3.8	3.7	1.04

Question H.4.2. How important will these services and infrastructure be to improving the lives of the people in your household - key findings

Households were asked about their aspirations and plans for the future. Whilst the list of options was not exhaustive (as we had to maintain the principle of no hand-written answers) it was relatively comprehensive (20 options). Respondents were asked to score each option (from 1 to 5) in order of importance. We accept that simple 'popularity' is only a part of understanding what EbA activities should be prioritised – particularly with respect to the priorities that impact some members of the community and not others (viz gender-based priorities) but the rankings reported in Table A33 provides a reasonable, generalised picture of community preferences and priorities.

- The most important services and infrastructure priorities for respondents in South West Bay was better health care, more information about disaster risk management, improved access to markets, and better schools. Least important was coastal protection from erosion, identity cards and bank accounts for women and the vulnerable to get disaster support, and capacity building for women's participation in managing community facilities.
- Across Malekula, as a whole, the most important elements were better access roads, financial training for women and the vulnerable after natural disasters, support for women and the vulnerable to get insurance policies after a disaster, and better menstrual hygiene education and services. Least important was conservation projects, coastal protection from erosion, and more livestock.
- Preferences between men and women were relatively equal, including amongst issues related specifically to women.

Table A33: Mean importance and ranking of services and infrastructure to households in South West Bay, Malekula (scores ranked 1 to 5).

Rank	Activity	Average score
1	Better health care	4.59
2	Information about disaster risk management	4.55
3	Better access to markets	4.53
4	Better schools	4.51
5	Improved sanitation	4.50
6	Improved water sources	4.49
6	Better access roads	4.49
8	Better menstrual hygiene education and services	4.43
8	Emergency and disaster management plans for women and the vulnerable	4.43
10	More jobs / labouring	4.41
10	More livestock	4.41
12	Training for women and the vulnerable to help escape in disasters	4.39
13	Ensuring women can make decisions about disaster management evacuation centres	4.37
13	Financial training for women and the vulnerable after natural disasters	4.37
15	Conservation projects	4.35
16	Disaster management plans for women and the vulnerable after natural disasters	4.33
17	Support for women and the vulnerable to get insurance policies after a disaster	4.31
18	Capacity building for women's participation in managing community facilities	4.27
19	Identity cards and bank accounts for women and the vulnerable to get disaster support	4.22
20	Coastal protection from erosion	4.20

Importance of services and infrastructure by gender

We also looked at the importance of services and infrastructure by gender (Table A34). Women generally ranked the importance of services and infrastructure more highly, though concern was relatively evenly shared. The largest discrepancy was support for conservation projects (more important for men), and concern for building women's capacity to participate in managing community facilities (more important for men, surprisingly).

Table 7: Importance of services and infrastructure by gender.

	Women	Men	Proportional value (women to men)
Conservation projects	3.7	4.0	0.92
Better health care	4.4	4.3	1.03
Improved water sources	4.2	4.0	1.03
Improved sanitation	4.1	4.1	1.00
Better menstrual hygiene education & services	4.0	4.1	0.96
Better schools	4.4	4.3	1.01
More jobs / labouring	4.1	4.1	1.01
More livestock	3.6	3.6	1.00
Better access roads	4.3	4.2	1.02
Better access to markets	4.2	4.0	1.04
Coastal protection from erosion	3.9	3.6	1.07
Information on disaster risk management	4.1	4.0	1.02
Emergency and disaster management plans for women and vulnerable people	4.0	3.9	1.02
Ensuring women can make decisions about disaster management evacuation centres	3.9	3.9	0.98
Capacity building for women's participation in managing community facilities	3.7	4.0	0.92
Training for women & vulnerable people in disasters	4.4	4.3	1.03
Disaster management plans for women & vulnerable people	4.2	4.0	1.03
Financial training for women & vulnerable people	4.1	4.1	1.00
Identity cards and bank accounts for women & vulnerable people	4.0	4.1	0.96
Emergency and disaster management plans for women and vulnerable people	4.4	4.3	1.01

APPENDIX B: South West Bay Go-along survey results

Go-along surveys, sometimes called 'transect walks', are a qualitative data collection method that act as a supplement to maps and spatial data layers on electronic maps, such as land use and land cover. They operate like a roving interview style, using space and experience to prompt important discussion. They are an excellent tool for creating a record of environmental, social, and economic conditions, such as those arising in the natural, built, and experienced environments. They also provide community members to provide context-relevant information that should be used to inform decision making.

Key findings

While all communities were aware that forest and marine resources are getting scarcer and they generally support conservation, there remains a need to enhance awareness of conservation efforts to ensure that such efforts do not affect people's daily and normal livelihood activities, such as fishing. Awareness could include:

- what trees you can or cannot cut and for what reason;
- what marine resources can or cannot be caught and why (e.g., the parrot fish that clean coral and produces sand);
- managing sand digging; and
- managing forest clearance for gardening so there is no or very limited soil runoff to the sea, which can damage the reefs.

Other findings

Conservation and resource management

- A good number of interviewees are not aware that there are conservation efforts already in their areas (i.e., the SUMAs). Others do not know the conservation boundaries. The are some community leaders who see the importance of conservation areas and are keen to see more implementations and assistance on potential projects identified in the SUMAs process, but others are not clear about what their conservation plans should be working to achieve.
- Some people feel there is a risk of being cut-off from the resources as there are no management systems put in place, or effectively communicated. This affects their normal livelihood activities.
- Only individuals with boats can go outside the "no-go fishing boundary zone" to fish, which can be exclusionary to the majority, and may impact some vulnerable people such as widows and/or the elderly.
- While some communities depend on up-hill streams as their main water source, others harvest rainwater.
- In some communities, the landowners feel that only they have the right to cut down hardwood trees on their land to build bungalows, even when their land is in the

conservation area. Again, this is because no conservation management system has been effectively put in place.

- In some communities there are two forms of conservation: One implemented by the government and one by community leaders. The ones implemented by community leaders are seasonal and have certain times of the year where the taboo is lifted for a few days.

Food and markets

Food market prices are high, and for some, this has now become their main source of income. Markets *for* food are also inconsistent. Communities are depending more on processed foods from shops, especially canned meat, which is likely to have a medium to longer term deleterious impact on health.

Infrastructure

Transport services in most areas are very expensive due to high fuel prices.

Natural hazards

Signs of sea level rise are evident in most areas. There are reports that in some cases sea levels have risen by to up to 2 metres in the last 6-8 years. Whilst this claim might seem to require substantiation, it has been found in some areas of Vanuatu where land is subsiding. Experienced sea level rise is a combination of a rise in ocean levels and subsidence (Faivre et al., 2022).

Social and economic

- There are several micro businesses in the communities such as fishing boats, shops, land transport.
- Youth population is low. (Note this is somewhat contradicted by the household data.)
- There are a few home improvements due to seasonal work.
- Most houses and bungalow are rundown. The two main causes are Covid-19 and cyclones.
- Some communities have a very poor or zero telecommunications network.
- No communities have mains electricity and use solar-powered appliances only.
- The frequency of reported disability is very low in most communities visited.
- Some communities have self-funded projects such as solar streetlights and public toilets.

Summary of community assets

Table B1 reports a community asset ‘stocktake’ undertaken during the go-along survey.

Table B1: Community assets at South West Bay, Malekula.

Asset	Quantity	Notes
Schools	2	1 French school and 1 English school
Churches	1	Catholic
Poultry farms		One fenced. Nearly every household has free range hens
Cattle farms	4	Not fenced
Piggery		Almost every household has pig pens
Tilapia pond	nil	
Docks	3	For copra and cocoa
Shops	8	Mini stores bring in stock from Santo
Cooperative	nil	
Fiberglass boats	4	Own by individuals
Water source	2	Sourced from streams by DoWR and ADRA
Power source		Solar power in nearly every household
Access to Area		By boat, road, and plane
Aid post	1	
Police post	nil	
Women's Centre	nil	
Community halls		In every community. Built from forest materials
Bank	nil	
Money Transfer	nil	
Post office	nil	
Satellite TV rental office	nil	
Market Houses	nil	
Air strip	nil	
Telecommunications Network		Average for both Digicel & Vodafone

RERENCES

Addinsall, C., Glencross, K., Scherrer, P., Weiler, B., & Nichols, D. (2015). Agroecology and Sustainable Rural Livelihoods: A Conceptual Framework to Guide Development Projects in the Pacific Islands. *Agroecology and Sustainable Food Systems*, *39*(6), 691-723. https://doi.org/10.1080/21683565.2015.1017785

Adger, W. N., Arnell, N. W., & Tompkins, E. L. (2005). Successful adaptation to climate change across scales. *Global Environmental Change*, *15*(2), 77-86. https://doi.org/10.1016/j.gloenvcha.2004.12.005

Agardy, T., Di Sciara, G. N., & Christie, P. (2011). Mind the gap: Addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Marine Policy*, *35*(2), 226-232.

Aipira, C., Kidd, A., & Morioka, K. (2017). Climate Change Adaptation in Pacific Countries: Fostering Resilience Through Gender Equality. In L. Filho (Ed.). Springer.

Amos, J. (2007). *Vanuatu Fishery Resource Profiles*. https://www.sprep.org/att/publication/000557_IWP_PTR49.pdf

Anderson, T. (2006). On the economic value of customary land in Papua New Guinea. *Pacific Economic Bulletin*, *21*(1), 138-152. https://openresearch-repository.anu.edu.au/bitstream/1885/157842/1/211_economic value.pdf

Andrade, Á., Córdoba, R., Dave, R., Girot, P., Herrera-F, B., Munroe, R., Oglethorpe, J., Paaby, P., Pramova, E., Watson, J., & Vengara, W. (2011). *Draft principles and guidelines for integrating ecosystem-based approaches to adaptation in project and policy design: A discussion document*.

Angelsen, A. (2009). *Realising REDD+: National strategy and policy options* (A. Angelsen, M. Brockhaus, M. Kanninen, E. Sills, W. D. Sunderlin, & S. Wertz-Kanounnoikoff, Eds.). Center for International Forestry Research.

Asian Development, B. (2007). *Poverty Impact Analysis: Selected Tools and Applications*. https://www.adb.org/sites/default/files/publication/27972/poverty-impact-analysis.pdf

Barnett, J. (2011). Dangerous climate change in the Pacific Islands: Food production and food security. *Regional Environmental Change*, *11*(1), 229-237. https://doi.org/10.1007/s10113-010-0160-2

Bendlin, L. (2014). Women's human rights in a changing climate: highlighting the distributive effects of climate policies. *Cambridge Review of International Affairs*, *27*(4), 680-698. https://doi.org/10.1080/09557571.2014.960507

Betzold, C. (2015). Adapting to climate change in small island developing states. *Climatic Change*, *133*(3), 481-489. https://doi.org/10.1007/s10584-015-1408-0

Betzold, C. (2016). Aid and Adaptation to Climate Change in Pacific Island Countries. *SSRN Electronic Journal*(July). https://doi.org/10.2139/ssrn.2815307

Bowman, C., Cutura, J., Ellis, A., & Manuel, C. (2009). *Women in Vanuatu: Analyzing Challenges to Economic Participation. Directions in Development*. https://openknowledge.worldbank.org/bitstream/handle/10986/2624/484580PUB0Wome101Official0Use0Only1.pdf?sequence=1&isAllowed=y

Boyd, J., & Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, *63*(2), 616-626.

Bryan, E., Kritjanson, P., & Ringler, C. (2015). Why paying attention to gender matters for Climate Change adaptation. In.

Buckwell, A., Fleming, C., Muurmans, M., Smart, J. C. R., Ware, D., & Mackey, B. (2020). Revealing the dominant discourses of stakeholders towards natural resource

management in Port Resolution, Vanuatu, using Q-method. *Ecological Economics*, *177*, 106781-106781. https://doi.org/10.1016/j.ecolecon.2020.106781

Buckwell, A., Fleming, C., Smart, J., Ware, D., & Mackey, B. (2020). Challenges and sensitivities in assessing total ecosystem service values: Lessons from Vanuatu for the Pacific. *Journal of Environment and Development*, *29*(3), 329-365. https://doi.org/10.1177/1070496520937033

Buckwell, A., & Morgan, E. (2022). Chapter 3 Ecosystem services and natural capital: Application to sustainable finance. In C. Timothy & S. Tapan (Eds.), *De Gruyter Handbook of Sustainable Development and Finance* (pp. 41-70). De Gruyter. https://doi.org/doi:10.1515/9783110733488-003

Buckwell, A., Ware, D., Fleming, C., Smart, J. C. R., Mackey, B., Nalau, J., & Dan, A. (2020). Social benefit cost analysis of ecosystem-based climate change adaptations: a community-level case study in Tanna Island, Vanuatu. *Climate and Development*, *12*(6), 495-510. https://doi.org/10.1080/17565529.2019.1642179

Bush, G., Kitts, N., Fleming, C., & Taye, F. (2021, 2020). Assessing preferences for direct versus indirect compensation in imperfect markets; an empirical test of the substitutability of cash for goods in an avoided deforestation scheme in the Democratic Republic of Congo. Perth, Australia.

Carpenter, S., DeFries, R., Dietz, T., Mooney, H., Polasky, S., Reid, W. V., & Scholes, R. J. (2006). Millennium Ecosystem Assessment: Research needs. *science*, *314*(5797), 257-258. https://doi.org/10.1126/science.1131946

Christie, P. (2004, 2004). Marine protected areas as biological successes and social failures in Southeast Asia.

City Population. (2006). *Population of Vanuatu Administrative Divisions*. Retrieved 11/07/2023 from https://www.citypopulation.de/en/vanuatu/admin/

Clarke, T., McNamara, K., Clissold, R., & Nunn, P. (2019). Community-based adaptation to climate change: Lessons from Tanna Island, Vanuatu. *Island Studies Journal*, *14*(1), 59-80. https://doi.org/10.24043/isj.80

Clifton, R., & Wharton, J. (1971). Risk, uncertainty, and the subsistence farmer: Technological innovation and resistance to change in the context of survival. *Studies in Economic Anthropology. George Dalton (Ed). Washington, DC. American Anthropological Association*, 151-180.

Dercon, S., & Christiaensen, L. (2011). Consumption risk, technology adoption and poverty traps: Evidence from Ethiopia. *Journal of Development Economics*, *96*(2), 159-173.

Djoudi, H., & Brockhaus, M. (2011). Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. *International Forestry Review*, *13*(2), 123-135. https://doi.org/10.1505/146554811797406606

Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*, *65*(4), 663-674. https://doi.org/10.1016/j.ecolecon.2008.03.011

Faivre, G., Tomlinson, R., Ware, D., Shaeri, S., Hadwen, W., Buckwell, A., & Mackey, B. (2022). Effective coastal adaptation needs accurate hazard assessment: a case study in Port Resolution, Tanna Island Vanuatu. *Climatic Change*, *170*(1), 10. https://doi.org/10.1007/s10584-021-03304-9

FEBA. (2018). *Making Ecosystem-based Adaptation Effective*. https://www.iucn.org/sites/dev/files/feba_eba_qualification_and_quality_criteria_final_en.pdf

Filho, W. L., Scheday, S., Boenecke, J., Gogoi, A., Maharaj, A., & Korovou, S. (2019). Climate Change, Health and Mosquito-Borne Diseases: Trends and Implications to

the Pacific Region. *International Journal of Environmental Research and Public Health*, *16*(24), 5114. https://www.mdpi.com/1660-4601/16/24/5114

Fleming, E. (2007). Agricultural productivity change in Pacific island countries. *Pacific Economic Bulletin*, *22*(3), 32-47. http://hdl.handle.net/1885/157881

Foster, T., Rand, E. C., Kotra, K. K., Sami, E., & Willetts, J. (2021). Contending With Water Shortages in the Pacific: Performance of Private Rainwater Tanks Versus Communal Rainwater Tanks in Rural Vanuatu. *Water Resources Research*, *57*(11), e2021WR030350. https://doi.org/10.1029/2021WR030350

Garcia, B., Rimmer, L., Canal Vieira, L., & Mackey, B. (2021). REDD+ and forest protection on indigenous lands in the Amazon. *Review of European, Comparative & International Environmental Law*, *30*(2), 207-219. https://doi.org/10.1111/reel.12389

Gassner, P., Molisa, V., Westerveld, L., Macmillan-Lawler, M., Davey, K., Baker, E., Clark, M., Kaitu'u, J., Wendt, H., & Fernandes, L. (2019). *Marine Atlas. Maximizing Benefits for Vanuatu*. http://macbio-pacific.info/Resources/vanuatu-interactive-marine-atlas/

Gerber, F., Holland, P., & Lal, P. (2011). *Assessing the social and economic value of climate change adaptation in the pacific region- A case study on water quality, quantity and sanitation improvements as an adaptation to climate change, Tuvalu* (A background case study for IUCN's report, Climate Change Adaptation in the Pacific: Making Informed Choices, Issue. IUCN. https://gsd.spc.int/sopac/docs/nre/Water%20security%20Final.pdf

Hafezi, M., Giffin, A. L., Alipour, M., Sahin, O., & Stewart, R. A. (2020). Mapping long-term coral reef ecosystems regime shifts: A small island developing state case study. *Science of the total environment*, *716*, 137024-137024. https://doi.org/https://doi.org/10.1016/j.scitotenv.2020.137024

Hallwright, J., & Handmer, J. (2021). Progressing the integration of climate change adaptation and disaster risk management in Vanuatu and beyond. *Climate Risk Management*, *31*, 100269. https://doi.org/10.1016/j.crm.2020.100269

Harrison, S., Karim, S., Alauddin, M., & Harrison, R. (2016). The contribution of agroforestry to economic development in Fiji and Vanuatu. In *Promoting sustainable agriculture and agroforestry to replace unproductive land use in Fiji and Vanuatu* (pp. 9-18). Australian Centre for International Agricultural Research (ACIAR).

Henckel, T. (2006). *Vanuatu's economy: is the glass half empty or half full?* (Pacific Economic Bulletin, Issue. T. A. N. U. a. A. P. P. Crawford School of Public Policy. https://openresearch-repository.anu.edu.au/handle/1885/157830

Hickey, F. R. (2008). Nearshore fisheries and human development in Vanuatu and other parts of Melanesia. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, *24*(1), 9-18.

Hunt, K., Rokoua, C., Miller, C., Werekoro, P., & Sharma, P. (2015). *'Developing Fiji's Microfinance Sector: Some Policy Implications* (Griffith University–South Pacific Central Banks Joint Policy Research Working Paper No. 3, Issue. G. A. Institute. https://www.griffith.edu.au/__data/assets/pdf_file/0021/219324/JPRWP3-web.pdf

IPCC. (2022). *Climate Change 2022. Impacts, Adaptation and Vulnerability. Summary for Policymakers* (Working Group II contribution to the WGII Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Issue. I. P. o. C. Change. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_SummaryForPolicymakers.pdf

IPCC Part A. (2014). *Climate Change 2014: Impacts, Adaptations, and Vulnerability. Part A: Global and Sectoral Aspects.Intergovernmental Panel on Climate Change. Cambridge University Press, UK.*

Kassie, M., Fisher, M., Muricho, G., & Diiro, G. (2020). Women's empowerment boosts the gains in dietary diversity from agricultural technology adoption in rural Kenya. *Food Policy*, 101957-101957.

Kinrade, P., Arold, N., Pickering, P., Rooke, E., & Manfredo, J. (2014). *Pacific Adaptation (Costs and Benefits) Scenarios: Water Security in Tuvalu*. Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP). https://terranova.org.au/repository/paccsap-collection/pacific-adaptation-scenarios-costs-and-benefits-water-security-in-tuvalu-technical-report/cba-tuvalu-water-security-technical-report.pdf

Kossin, J. P., Knapp, K. R., Olander, T. L., & Velden, C. S. (2020). Global increase in major tropical cyclone exceedance probability over the past four decades. *Proceedings of the National Academy of Sciences*. https://doi.org/10.1073/pnas.1920849117

Kouwenhoven, P., & Cheatham, C. (2006). *Capacity Building to enable the Development of Adaptation Measures in Pacific Island Countries: Economic Assessment of Pilots*. S. f. t. P. R. E. Programme. https://library.sprep.org/sites/default/files/173.pdf

Lal, P., Saloa, K., & Uili, F. (2006). *Economics of liquid waste management in Funafuti, Tuvalu* (IWP-Pacific Technical Report (International Waters Project) no. 36, Issue. https://library.sprep.org/sites/default/files/000522_IWP_PTR36.pdf

Leary, N. A. (1999). A framework for benefit-cost analysis of adaptation to climate change and climate variability. *Mitigation and adaptation strategies for global change*, *4*(3-4), 307-318. https://doi.org/10.1023/A:1009667706027

Lester, S. E., Halpern, B. S., Grorud-Colvert, K., Lubchenco, J., Ruttenberg, B. I., Gaines, S. D., Airamé, S., & Warner, R. R. (2009). Biological effects within no-take marine reserves: A global synthesis. *Marine Ecology Progress Series*, *384*(1), 33-46.

Mackey, B., & Ware, D. (2018). Limits to capital works adaptation in the coastal zones and Islands: Lessons for the Pacific. In (pp. 301-323). Springer. https://doi.org/10.1007/978-3-319-64599-5_17

Mackey, B., Ware, D., Nalau, J., Buckwell, A., Smart, J., Fleming, C., Connolly, R., & Hallgren, W. (2017). *Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) and associated works at multiple scales in Vanuatu*. https://www.griffith.edu.au/__data/assets/pdf_file/0023/528080/vanuatu-ecosystem-socio-economic-resilience-analysis-mapping.pdf

Mascia, M. B., Claus, C. A., & Naidoo, R. (2010). Impacts of marine protected areas on fishing communities. *Conservation Biology*, *24*(5), 1424-1429.

McGuire, P. (2000). *Microfinance in Vanuatu: institutions and policy* (Pacific Economic Bulletin Update Papers, Issue. A. P. P. a. t. t. A. N. University.

MEA. (2005). *Ecosystems and Human Well-being: Current State and Trends*. Island Press.

Morgan, E., Buckwell, A., Guidi, C., Garcia, B., Rimmer, L., Cadman, T., & Mackey, B. (2021). The Basket of Benefits Approach: Capturing Multiple Forest Ecosystem Services for Just Benefit Sharing. *Ecosystem Services*, *55*, 101421. https://doi.org/10.1016/j.ecoser.2022.101421

Munang, R., Thiaw, I., Alverson, K., Mumba, M., Liu, J., & Rivington, M. (2013). Climate change and ecosystem-based adaptation: A new pragmatic approach to buffering climate change impacts. *Current Opinion in Environmental Sustainability*, *5*(1), 67-71. https://doi.org/10.1016/j.cosust.2012.12.001

Munch-Petersen, N. F. (2011). An Island Saved, At Least for Some Time? The Advent of Tourism to Rennell, Solomon Islands. In G. Baldacchino & D. Niles (Eds.), *Island Futures: Conservation and Development Across the Asia-Pacific Region* (pp. 169-175). Springer Japan. https://doi.org/10.1007/978-4-431-53989-6_13

Nalau, J., & Becken, S. (2018). *Ecosystem-based Adaptation to Climate Change: Review of Concept*. https://www.griffith.edu.au/__data/assets/pdf_file/0029/553475/Nalau-and-BeckenS_PGIFTreport_Final_2018.pdf

Nalau, J., Becken, S., & Mackey, B. (2018). Ecosystem-based Adaptation: A review of the constraints. *Environmental Science & Policy*, *89*, 357-364. https://doi.org/10.1016/j.envsci.2018.08.014

Pachauri, R., Allen, M., Barros, V., Broome, J., Cramer, W., Christ, R., Church, J., Clarke, L., Dahe, Q., & Dasgupta, P. (2014). *Climate change 2014: synthesis report. Contribution of Working Groups I, II and III to the fifth assessment report of the Intergovernmental Panel on Climate Change*. IPCC.

Pagiola, S. (2008). Payments for environmental services in Costa Rica. *Ecological Economics*, *65*(4), 712-724. https://doi.org/10.1016/j.ecolecon.2007.07.033

Pagiola, S., Arcenas, A., & Platais, G. (2005). Can Payments for Environmental Services Help Reduce Poverty? An Exploration of the Issues and the Evidence to Date from Latin America. *World development*, *33*(2), 237-253. https://doi.org/10.1016/j.worlddev.2004.07.011

Panda, A. (2018). Transformational adaptation of agricultural systems to climate change. *Wiley Interdisciplinary Reviews: Climate Change*, *9*(4), e520. https://doi.org/10.1002/wcc.520

Pandey, A. K., Tripathi, Y., & Kumar, A. (2016). Non timber forest products (NTFPs) for sustained livelihood: Challenges and strategies. *Research Journal of Forestry*, *10*(1), 1-7. https://doi.org/10.3923/rjf.2016.

Pascal, N., & Bulu, M. (2013). *Economic valuation of mangrove ecosystem services in Vanuatu: Case study of Crab Bay (Malekula Is.) and Eratap (Efate Is.)*. IUCN.

Pascal, N., Molisa, V., Wendt, H., Brander, L., Fernandes, L., Salcone, J., & Seidle, A. (2015). *Economic assessment and valuation of marine ecosystem services, Vanuatu. A report to the MACBIO Project* (MACBIO, Issue.

Porras, I., Barton, D., Miranda, M., & Chacón-Cascante, A. (2013). *Learning from 20 Years of Payments for Ecosystem Services in Costa Rica*.

Republic of Vanuatu. (2015). *Vanuatu Climate Change and Disaster Risk Reduction Policy 2016-2030*.

Republic of Vanuatu. (2016). *Vanuatu 2030: The People's Plan: National Sustainable Development Plan 2016 to 2030*. https://www.gov.vu/attachments/article/26/Vanuatu2030-EN-FINAL-sf.pdf

Republic of Vanuatu. (2018). *National Policy on Climate Change and Disaster-Induced Displacement*. https://www.iom.int/sites/default/files/press_release/file/iom-vanuatu-policy-climate-change-disaster-induced-displacement-2018.pdf

Ruddle, K., & Hickey, F. R. (2008). Accounting for the mismanagement of tropical nearshore fisheries. *Environment, Development and Sustainability*, *10*(5), 565-589.

Sahin, O., Hadwen, W., Buckwell, A., Fleming, C., Ware, D., Smart, J. C. R., Dan, A., & Mackey, B. (2021). Assessing how ecosystem-based adaptations to climate change influence community wellbeing: A Vanuatu cast study approach. *Regional Environmental Change*, *21*, 90. https://doi.org/10.1007/s10113-021-01809-8

Salzman, J., Bennett, G., Carroll, N., Goldstein, A., & Jenkins, M. (2018). The global status and trends of payments for ecosystem services. *Nature Sustainability*, *1*(3), 136-144.

Savage, A., McIver, L., & Schubert, L. (2019). Review: The nexus of climate change, food and nutrition security and diet-related non-communicable diseases in Pacific Island Countries and Territories. *Climate and Development*, 1-14 (In Press). https://doi.org/10.1080/17565529.2019.1605284

Sharp, M. (2011). *The benefits of fish aggregating devices in the Pacific*. SPC. https://spccfpstore1.blob.core.windows.net/digitallibrary-

docs/files/30/305687f90ea59b387db4a09bc4143eb8.pdf?sv=2015-12-11&sr=b&sig=pGaaFJJduJym7M11nt7GhJIBpNNg5YroI19iFdReaU8%3D&se=2024-01-23T23%3A51%3A18Z&sp=r&rscc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsct=application%2Fpdf&rscd=inline%3B%20filename%3D%22FishNews135_27_Sharp.pdf%22

SPC. (2005). *Research into more cost effective mooring systems for fish aggregating devices (FADs) in the Pacific region as a means to limit fishing pressure on inshore marine resources.* (Report to New Zealand under the Pacific Initiative for the Environment, Issue. S. o. t. P. Community. https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/f3/f329c039f1ed50439e103a3a291001fe.pdf

SPC. (2012). *The Pacific Gender & Climate Change Toolkit: Tools for Practitioners*. https://www.weadapt.org/sites/weadapt.org/files/2017/june/pacific_gender_toolkit_full_version.pdf

SPC. (2015). *The Pacific Gender & Climate Change Toolkit: Tools for Practitioners*. S. o. t. P. Commuity. https://www.pacificclimatechange.net/sites/default/files/documents/Pacific_gender_toolkit_full_version.pdf

Taye, F., Vinde Folkersen, M., Fleming, C., Buckwell, A., Mackey, B., Kc, D., Le, D., Hasan, S., & Saint Ange, C. (2021). The drivers of change in the economic value of global forest ecosystem services: A meta-analysis. *Ecological Economics*, *189*, 107145. https://doi.org/10.1016/j.ecolecon.2021.107145

Turley, C., & Gattuso, J.-P. (2012). Future biological and ecosystem impacts of ocean acidification and their socioeconomic-policy implications. *Current Opinion in Environmental Sustainability*, *4*(3), 278-286. https://doi.org/10.1016/j.cosust.2012.05.007

UN-REDD. (2016). *Towards a Common Understanding of REDD+ under the UNFCCC* (Technical Resources Series. No. 3, Issue. https://www.uncclearn.org/wp-content/uploads/library/redd_under_the_unfccc_hq.6_713128_1.pdf

UN. (2021). *System of Environmental-Economic Accounting - Ecosystem Accounting*. https://seea.un.org/ecosystem-accounting

UNEP/WCMC. (2017). *Global Distribution of Coral Reefs*. Retrieved 10/10 from http://data.unep.wcmc.org/datasets/1

UNFCCC. (2011). *Assessing the Costs and Benefits of Adaptation Options: An Overview of Approaches*.

van der Ploeg, S., & de Groot, R. (2010). *The TEEB Valuation Database–a searchable database of 1310 estimates of monetary values of ecosystem services*. Foundation for Sustainable Development.

Vanuatu Government. (2016). *Vanuatu 2030: The People's Plan: National Sustainable Development Plan 2016 to 2030*. https://www.gov.vu/attachments/article/26/Vanuatu2030-EN-FINAL-sf.pdf

Vanuatu Government. (2018). *Vanuatu National Biodiversity Strategy and Action Plan (NSAP) 2018 - 2030*.

Vanuatu Government. (N.D.). *[Draft] Vanuatu National REDD+ Strategy* Vanuatu Government. https://static1.squarespace.com/static/58d6cc1e17bffcffb801edde/t/62d9c78ffd068b11aee550ba/1658439573552/Vanuatu-National-REDD-Strategy_Final-Draft.pdf

Vanuatu National Statistics, O. (2009). National Population and Housing Census. In. Port Vila, Vanuatu.

Vanuatu National Statistics Office. (2009). *National Population and Housing Census*. https://vnso.gov.vu/index.php/census-and-surveys/census/censuses

Vanuatu National Statistics Office. (2020). *National Population and Housing Census*. Republic of Vanuatu. https://vnso.gov.vu/images/Pictures/Census/2020_census/Census_Volume_1/2020NPHC_Volume_1.pdf

Vanuatu National Statistics Office. (2022). *Vanuatu National Agriculture Census Preliminary Report*. https://vnso.gov.vu/index.php/en/census-and-surveys/census/national-population-and-housing-census/2022-vanuatu-national-agriculture-census

Wallbott, L., Siciliano, G., & Lederer, M. (2019). Beyond PES and REDD+: Costa Rica on the Way to Climate-Smart Landscape Management? *Ecology and Society*, *24*(1), art24-art24. https://doi.org/10.5751/ES-10476-240124

Weber, J. G. (2012). Social learning and technology adoption: The case of coffee pruning in Peru. *Agricultural Economics*, *43*(1), 73-84.

WHO & UNFCCC. (2020). *Health & Climate Change Country Profile Vanuatu*. https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/evidence-monitoring/country-profiles

World Bank. (2023). GDP deflator. In.

World Bank Group. (2021). *Climate Risk Profile - Vanuatu*. https://www.who.int/teams/environment-climate-change-and-health/climate-change-and-health/evidence-monitoring/country-profiles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PEUMP
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SPREP
Secretariat of the Pacific Regional
Environment Programme