INTEGRATED ECOSYSTEM MANAGEMENT PLAN

NORTH PENTECOST

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Sverige

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Table of Contents

List of figures

List of tables

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
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

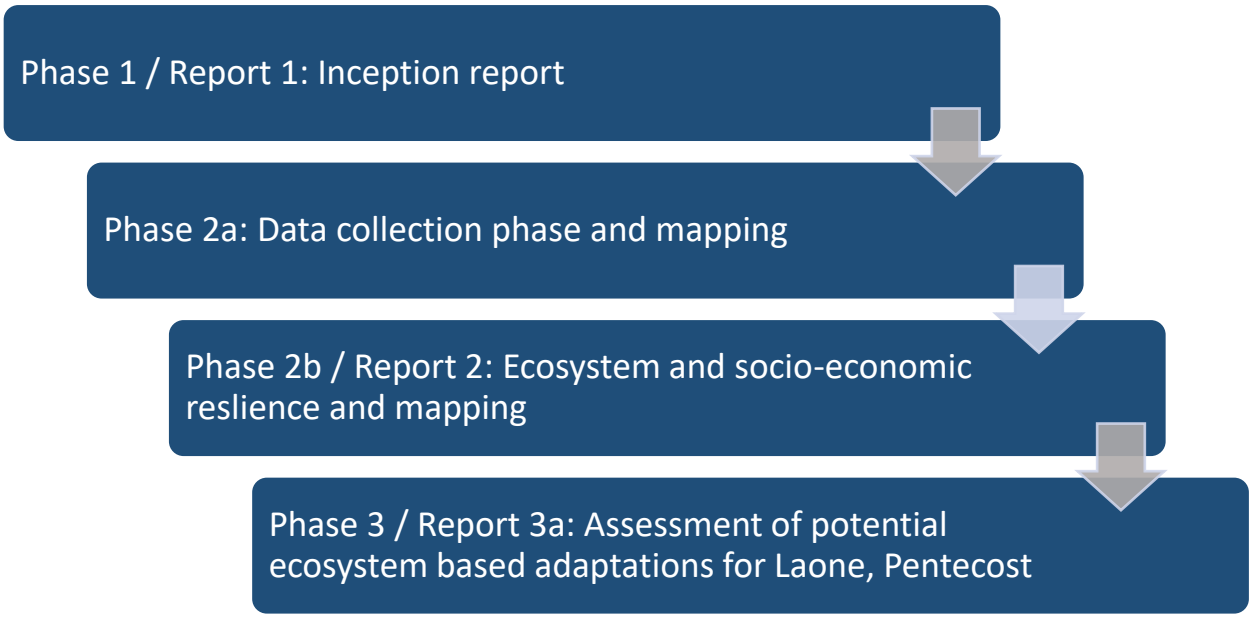
The objective of an Integrated Ecosystem Management Planning (IEMP) process is to generate a robust planning baseline to inform the identification of ecosystem-based adaptation (EbA) options for strengthening the socio-ecological resilience of communities to the impacts of climate change and other direct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

1. Synthesis of data and lines of evidence for North Pentecost extracted from the main report.
2. Detailed options assessments specific to North Pentecost.
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 islands of Pentecost and 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. The species and ecosystems of inland and coastal areas are coming under pressure due to the concentrations of human settlement and infrastructure they support, particularly in North Pentecost. 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 ESRAM 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 intervention. 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 ESRAM 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 ACTIVITES

3.1 PLANNING

3.1.1 Field trip 1

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.

3.1.2 Second field trip

A second field trip took place in July2025. The purpose of this trip was to present interim findings (survey results, EbA options, and EbA recommendations) and seek initial feedback on the EbA recommendations before finalisation of the IEMP component on the BIEM project. A summary report from this field trip is in Appendix C.

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.

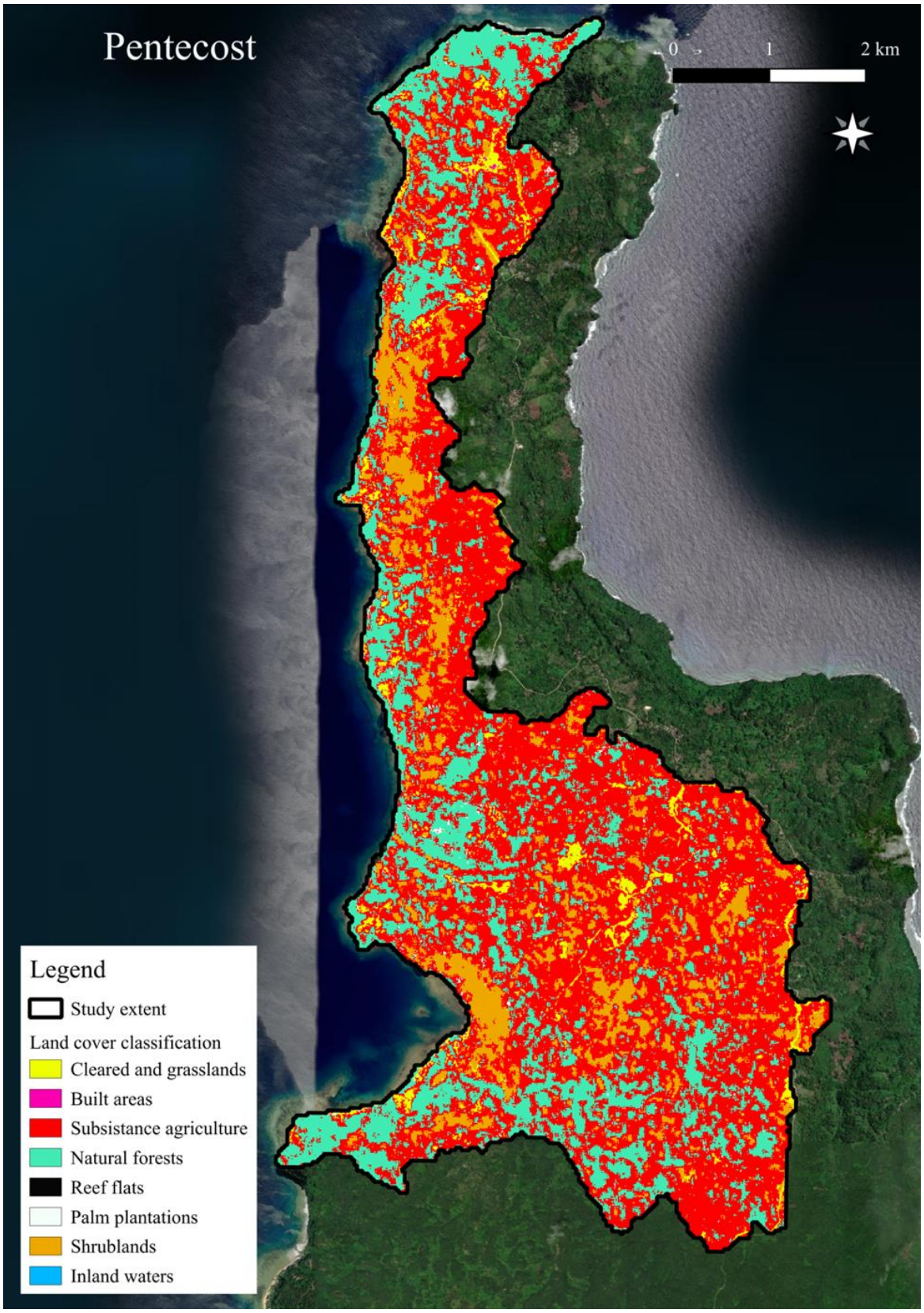
Consistent with the UN's System of Environmental Economic Accounting - Ecosystem Accounting (SEEA-EA) (UN, 2021), in our project sites we include the human-modified land-uses of 'subsistence gardens' and 'plantation forests' as ecosystem assets; as residual values, beyond human labour and capital input, 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 maps for North Pentecost are reproduced in Figure 2.

Figure 2: Area of interest for the North Pentecost community, Pentecost.



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. 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 North Pentecost in Pentecost is reported in Table 1. Subsistence gardens land use takes-up an estimated ~60% of all terrestrial land, with tropical forest and shrublands accounting for most of the remaining.

Table 1: Total ecosystem service value for North Pentecost (US$/yr/ha).

Ecosystem Type	Coastal Coral Reef	Tropical Forest + Shrublands	Grassland	Freshwater Waterbodies	Subsistence Gardens	Plantation Cropping
Extent (ha)	462	1074	111	3	1750	17
Proportion of terrestrial habitat type (%)		36.3	0.2	0.1	59.1	0.6
Provisioning						
Food	32,052	8,154	4,695	62	14,186,081	1,013
Water supply		249,266	16,613	4,033		
Raw materials / energy	501	39,603	843	3		
Genetic resources		6,989				
Ornamental resources		61,734				
Medicinal resources	1,502					
Regulating						
Air quality regulation		533,477	12,640			
Climate regulation	106,673	150,259	37,559	176		
Moderation of disturbance	94,152	55,910				
Water flow regulation		1,165				
Waste treatment	1,502					
Erosion prevention		128,128				
Soil fertility maintenance		17,472	30,697			
Pollination		50,086				
Biological control	150					
Cultural ecosystem services						
Aesthetic	1,502					
Cognitive	1,002					
Inspiration	50					
Spiritual	501					
Recreational	175,784	18,637	602	1,163		
Total (US$)	415,372	1,320,879	103,648	5,436	14,186,081	1,013
Total (Vatu)	49,429,268	157,184,601	12,334,112	646,884	1,688,143,639	120,547

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.

4.2.4.1 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 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).

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

	Area (km2)	Density (people/km2)	Population estimate	Value of Subsistence Gardens ($UD/yr and Vatu)	Per Capita Value of Food Gardens ($US/yr and Vatu)
North Pentecost	29.6	74.61	2209	US$ 14,186,081 VUV 1,688,143,639	US$ 6,422 VUV 764,218

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.

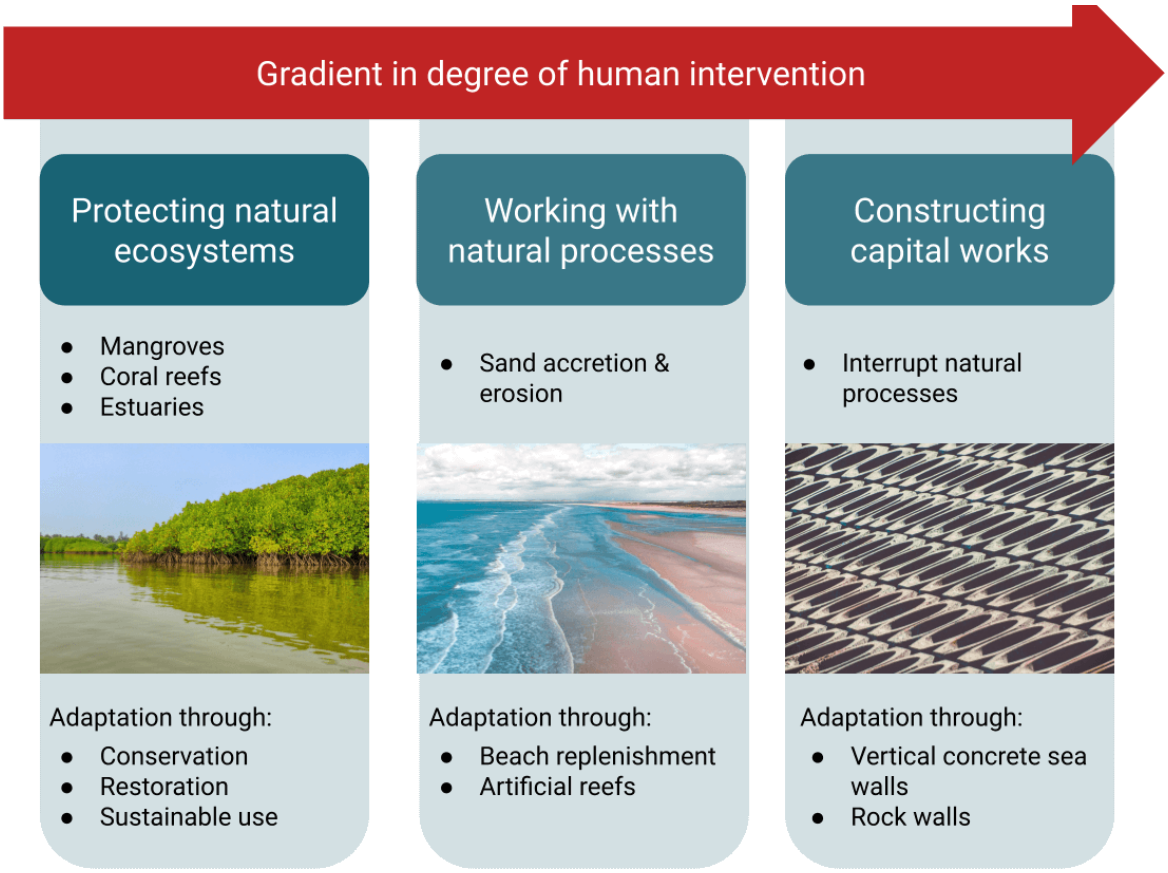
EbA links habitat conservation and active, adaptive management with broader social and economic development strategies that assist communities to adapt to trends and shocks associated with climate change and, in parallel, to improve social and economic well-being. EbA interventions are not rigidly defined 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 North Pentecost – 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 adapt to 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 IEMP 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 North Pentecost (Table 3).

Table 3: Key risks and features and potential EbA projects for North Pentecost as drawn from the lines of evidence described in Figure 5.

Sector	Local Attributes	Climate and Other Risks	Potential EbA Projects
Agriculture and livestock	• Gardens have a high degree of diversity and households communicated a relatively low risk of threats to food production. • Plots are generally larger than other communities. • A key priority identified was a lack of mulch and fertilisers for gardens. • Relatively low use of livestock (at least compared to Malekula) reported in the survey. (However, the go-along survey information does not reflect this, nor does it contradict it.)	• Long term reductions in productivity and/or changes to the growing conditions of key staples. • Increased temperatures reducing moisture content of soil. • Severe storm weather and/or extended droughts risking crop failure.	• Agricultural extension services should focus on agroforestry, animal husbandry and introduction of soil and water sensitive cropping (mulching) and more drought resistance crops. (High priority)
Water supply and sanitation	• Community has no freshwater courses, therefore drinking and irrigation water is collected in rainwater tanks. Most households collect rainwater in tanks of some description (79%). This is a key	• Changing rainfall seasonality and intensity also poses a water security risk. • Extended droughts risking water security.	• Water security is a key risk. With few or no water sources, projects should focus on accessible rainfall capture for drinking water. Given the low

	risk – a lack of rain, particularly given climate warming, was provided as a key concern. 45% of people reported that rainwater tanks provide a reliable source. • Solid waste is likely to increase over the medium term. If waste is continued to be buried locally, in (likely) poorly engineered pits, risks of deterioration and leakage due to increased severe weather is high. • Only a small proportion of houses are reported as optimal for rainwater capture (only ~24% have steel / breezeblock roofs).	• Severe storm weather causing damage to water infrastructure (tanks, gutters etc.).	proportion of private houses that have optimal roofs for rainwater capture, greater capture and improved distribution will likely need to be communal in nature. (High priority) • 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. (Medium priority)
Forest conservation	• Only 36% of land area is forested. • Deforestation ranked as 4th most important environmental risk in household survey.	• Increased temperatures reducing moisture content of forests, potentially making rainforest fire prone.	• Investment in forest conservation for sustainable resource management, particularly to secure materials for building and medicinal plants and to maintain reasonable fallow periods to enable soil regeneration. (High priority) • Investment in training of community -based fire-fighting capabilities. (Medium priority)
Fisheries and marine conservation	• Fishing remained important, but less so than on Malekula. A high proportion of fishing already takes place in deep water. • High level of sales of produce and fish and engagement in local markets, suggesting growing future threats to fish stocks.	• Increase ocean temperature extremes causing extended periods of coral bleaching, risking reef collapse. • Over-harvesting of fish causing collapse of key fisheries (particularly inshore reef fisheries).	• Deep water fishing already seems to be a response to resource management. Fish attracting devices (FADs) could be useful adaptation. Assess access to deep water fishing for GEDSI populations. (Medium priority)

	• 8 recorded fibreglass boats individually owned in the community.		
Infrastructure and economy	• Community interest in developing small business and sales of goods and services, such as food, cooked foods, and handicrafts. • Access to markets was listed as a concern and there is a desire to increase the quantity of trade in food and handicrafts. • Area appears to have reasonable shopping, financial, civil, and social services, with good access to the region. • Relatively higher interest shown towards tourism-related activities.	• Over-harvesting of fish for tourist consumption causing collapse of key fisheries (particularly inshore reef fisheries). • Increasing severe weather disruptions can make the tourism sector unreliable and subject to interruption.	• Economic specialisation can bring benefits and investment into local services to increase resilience. Project investments in supporting small business needs to be balanced from an equity perspective to ensure benefits are not captured by first movers. (Medium priority) • Financial capacity building for members of socially vulnerable groups should be included. (Medium priority)

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 North Pentecost. 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	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

GEDSI sensitivity			

* 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>Notes on Costs and Feasibility</th></tr>
<tr><td>Fish attracting devices</td><td>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 consisting of 10 x offshore FADs and 6 x inshore FADs is US$ 97,855.
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 $40,184).
• Using this data and benefits from Sharp (in terms of market value of fish catch) and a 10% discount rate (as recommended by Buckwell et al. (2020)) we calculated a NPV of such a scheme over 25 years in 2022 values as US$ 561,694, at a benefit cost ratio of 2.31.
• 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$ 879,198 at a benefit cost ratio of 2.30.
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)</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 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).
Total investment for implementation of 46.2 hectares of MPA (10% of total) + community ranger program over 5 years: US$ 402,964
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>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></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$ –312,050 and a benefit cost ratio of 0.18.
Over a 25-year period, at 5% discount rate we estimate a NPV of the project of
US$ –371,767 and a benefit cost ratio of 0.24.

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)</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).
Total investment for implementation of a 107.4 hectares forest CCA (10%) + community ranger program over 5 years: US$ 557,543
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$ 364,465 and a benefit cost ratio of 1.58.
Over a 25-year period, at 5% discount rate we estimate a NPV of the project of
US$ 757,099 and a benefit cost ratio of 1.97.

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>
</table>

<table>
<tr><td>Combined MPA and forest conservation area with community ranger program</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 a 50 hectares forest CCA + community ranger program over 5 years: US$ 921,329
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>
• Over a 25-year period, at 10% discount rate, we estimate a NPV of the project of US$ 206,850 and a benefit cost ratio of 2.01.
• Over a 25-year period, at 5% discount rate, we estimate a NPV of the project of US$ 649,903 and a benefit cost ratio of 1.72.
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</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 two demonstration plots and associated support over 5 years is US$ 714,877.
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 two demonstration plots, specialist advice, equipment, vehicle, nursery and logistical and management costs during implementation phase.</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$ 11,391,532 and a benefit cost ratio of 15.1.
• Over a 25-year period, at 5% discount rate, we estimate a NPV of the project of US$ 25,424,553 and a benefit cost ratio of 28.8.</td></tr>
</table>

Combined MPA, forest conservation, community ranger, and community garden extension program	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: 1. community garden agricultural extension program, relevant specialists, improved poultry management and distribution, the set-up of a plant nursery and management and logistical costs. 2. MPA as a formal CCA. 3. forest CCA. 4. community ranger program that jointly supports the CCAs. 5. Shared logistical and management support across the entire program of works. Total investment for implementation for two demonstration plots and associated support over 5 years is US$ 1,544,143. The economic benefits were estimated to be: • Over a 25-year period, at 10% discount rate, we estimate a NPV of the project of US$ 3,129,872 and a benefit cost ratio of 3.5. • Over a 25-year period, at 5% discount rate, we estimate a NPV of the project of US$ 12,410,443 and a benefit cost ratio of 9.7.
Water tank investment program	Based on data from Kouwenhoven & Cheatham (2006) and from the household survey (in terms of proportion of households that don't currently utilise rainwater tanks and the appropriateness of private rooftop capture) we estimate the North Pentecost community would benefit from the installation of four additional community-sized tanks (27,500 litre tanks) to maintain resilience, given the prevalence of inappropriate domestic roofing materials (evidenced by the household survey). Given that only 45% of the household survey respondents stated that the current water tank supply is reliable, we recommend doubling the requirement to eight community-sized tanks if sufficient capture surfaces can be secured. Cost of installation (including pipes, guttering): US$ 357,857. No cost benefit analysis was undertaken therefore we do not have a NPV estimate.
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 NORTH PENTECOST

9.1 HEADLINE RESULTS

The output from our MCA for North Pentecost, 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		Water tank scheme	
Rank			1		5		8		3		2		4		6		7	
Total score			865		530		305		685		765		559		475		470	
		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	5	100	-5	-100	5	100	10	200	10	200	2	40	2	40
Costs of inaction	Economic	5	10	50	5	25	5	25	5	25	5	25	2	10	5	25	10	50
	Social	5	5	25	5	25	5	25	5	25	5	25	2	10	2	10	10	50
	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	2	30
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. First, we adjusted the discount rate within any cost benefit analysis down from 10% to 5% (Table 7). Second, we removed the project NPV from the MCA and proportionally adjusted the weightings of all other criteria accordingly (Table 8).

Table 7: Sensitivity analysis of MCA using a discount rate of 5%.

Project		Rank	Score
A	Demonstration plots, extension officer + plant nursery	1	865
B	Forest CCA + community ranger program	5	530
C	MPA + community ranger program	8	305
D	B + C	2	785
E	A + B + C	3	765
F	Fish attracting devices	4	559
G	Micro-financing initiative	6	485
H	Water tank scheme	7	470

Table 8: 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	7	506.25
D	B + C	2	731.25
E	A + B + C	3	706.25
F	Fish attracting devices	8	448.75
G	Micro-financing initiative	4	543.75
H	Water tank scheme	5	537.50

A comparison table, showing rankings from Tables 6, 7, and 8 is reported in Table 9. 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 water scheme scored relatively lowly. In the case of the water tank scheme, we are cognisant of the fact that no non-provisioning benefits were provided to account for the economic value of greater water security 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 9: 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	8
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	Water tank scheme	480	470	537.50	496	7

CHAPTER 10: DISCUSSION ON IMPLEMENTATION

10.1 INCLUSIVE ENGAGEMENT

Inclusive engagement of the North Pentecost 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 Pacifika 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 FUNDING ENVELOPES

The MCA reported above presents a prioritisation list for adaptation projects for North Pentecost. 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 10 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 10: 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					A+B+C
3				B+C	
4		Fish attracting devices			
5				Forest CCA + community ranger program (B)	
6	Micro-financing initiative				
7			Water tank scheme		
8			MPA + community ranger program (C)		

10.3 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.

10.4 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.

10.5 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 North Pentecost 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 FOREST HABITS

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.

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).

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.

A range of financing sources are outlined in the DRAFT Vanuatu National REDD+ Strategy (Vanuatu Government, N.D.)

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).

Potential budget limitations

REDD+ (and PES) projects demand capacity investments that support the development, marketing, and (potential) sale of sustainable forest and non-timber forest products (e.g. tourism or sustainable forest products). Alternative livelihood development opportunities (tourism and the conservation economy) also demand commitments to infrastructure development from government, regardless of any support within the communities, which might not be forthcoming due to fiscal constraints shackling the government, which natural resource extraction and export were supposed to alleviate.

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A range of financing sources are outlined in the DRAFT *Vanuatu National REDD+ Strategy* (Vanuatu Government, N.D.)

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).

11.2 AGRICULTURAL EXTENSION, AGRO-FORESTRY, AND POULTRY MANAGEMENT

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, such as food production from household gardens and agro-forestry. (Weber, 2012, p. 84). 96% of households in North Pentecost undertake some form of subsistence food production, agro-forestry, and animal husbandry.

Poultry management

Some baseline studies have been completed (for example see Jansen et al., 2009). In this study, most surveyed farmers thought chickens were easy to care for, provide food for the family and was a good cash income enterprise. Some farmers were interested in keeping local chickens but found it difficult to obtain the birds.

There are organisations in the Pacific already devoted to improved management of poultry, including *Russell Parker's Kai Kokorako Perma-Poultry* [1] and the *Happy Chickens Project* from the Kyeema Foundation in Fiji [2].

Knowledge system retention

Knowledge retention and innovation are important considerations. As populations have become more mobile and economies more diverse, many young people are no longer involved in agriculture and traditional knowledge may not get passed on. Hundreds of years of carefully accumulated knowledge and the naturally adaptive character of Pacific food production system risks being lost. In addition, new knowledge and new crops and varieties from outside assistance are important. This can be achieved through recruitment of agricultural extension officers to run education programs, including the use of demonstration farms – to 'teach by showing and doing'. As farmers make decisions based on uncertain benefits and uncertain costs, demonstration farms can provide a level of assurance to support individual farmers' innovation, reducing exposure to risk of failure, hunger, loss of income or indebtedness. Demonstration farms can improve the confidence of farmers in taking up new techniques by seeing the evidence themselves.

[1] See https://www.poultryhub.org/all-about-poultry/village-poultry-in-south-africa/chicken-keeping-for-pacific-island-communities

[2] See https://kyeemafoundation.org/explore-our-work/fiji/happy-chickens-project/

Coordination

Agricultural extension, particularly in more rural areas, are best administered, or at least coordinated through subnational agencies, rather than central government. This way, delivery of advisory services can be more responsive to the needs of communities and has been shown to be delivered at lower costs. Capacity, financial resources, skills, and coordination issues commonly constrain the ability to realise economic. One specific way to address this is to build networks between semi-formalised groups and decentralised local government institutions, where the role of extension agents is equally about facilitation and knowledge and network brokering as it is information provision. This 'pluralistic model' should also seek to engage private sector partners (The University of the Sunshine Coast, 2016).

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 North Pentecost 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 North Pentecost 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: North Pentecost 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	16,023	3%
North Pentecost	203	North Pentecost	6,745	6%

Sections A and B household membership and demographics

Household membership

The average household size in North Pentecost was 4.3, slightly lower than the average across all communities. 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		
North Pentecost	47	203	82	91	0	4.3	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.

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

	Total Where Age Stated	<18	18-35	36-45	46-60	>60	Visual Representation
North Pentecost	203	43	21	17	10	10	

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 Table A4.

- All communities reported lower educational standards than what is reported in the 2020 Vanuatu Household Census for rural households (Vanuatu National Statistics Office, 2020). Whilst our data should not challenge the census data, it is still useful for cross-community comparison for identifying specific priorities.
- North Pentecost's educational levels were generally better than average across the whole sample, particularly so for primary education (57%).
- University education was rare. 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		
North Pentecost	57	24	1	4	1	0
Average from sample	51	21	1	5	3	1

Section C: Household livelihoods

Key findings from all household livelihood questions:

Nearly everyone in North Pentecost undertakes some subsistence activity, growing food and preparing gardens is most important. Collecting and catching marine resources is moderately and jointly important to growing food.

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 A5 reports the answer to the overarching yes/no question and Table A6 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 A5: Proportion (%) of households stating they undertake subsistence activities.

	North Pentecost
Yes	96
No	4

Table A6: Types of subsistence activities undertaken by household members (percent of household members undertaking this activity).

	North Pentecost
Preparing land for food gardens	43
Growing food	62
Fishing	40
Collecting shellfish / marine resources	40
Hunting wildlife	20
Collecting plants	26

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

Survey respondents were asked to describe their cash-earning activities. Table A7 reports the proportion of people in each household who undertake an activity from the list of activities presented in the survey. In North Pentecost, 87% of households reported earning some cash income. Earnings are mostly from sale of produce and marine resources and cooked food. Compared to the remainder of the respondents across Vanuatu, there is a lower proportion of people engaged in wage-earning activities.

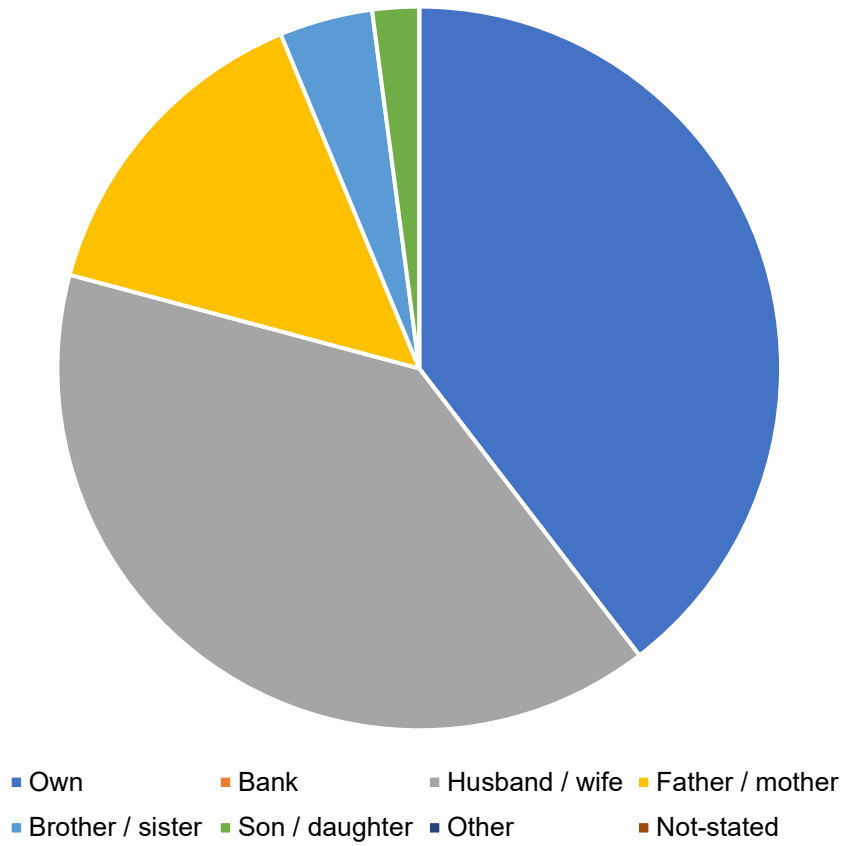
Table A7: Proportion of people (%) undertaking some form of cash-generating activity, by community.

	North Pentecost
2020 Vanuatu Household Census	24.5
Selling grown food / animal products	39
Selling fish / marine products	34
Selling cooked food	29
Selling forest materials	22
Tourism accommodation / restaurant	1
Selling handicrafts	14
Education / health	2
Work for wages	17
Casual labouring	12

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. 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 (North Pentecost).



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

North Pentecost has a high proportion of housing constructed solely from plant materials (45%). Table A8 reports the full results.

Table A8: Composition of main house and roof. Percent of respondents reporting main house's construction materials by community.

	North Pentecost	
	House	Roof
No answer	2	21
Plant materials / timber only	45	53
Plant materials / timber, Brick / breeze block only	36	2
Brick / breeze block only	13	11
Metal	9	13

Section D: Agriculture

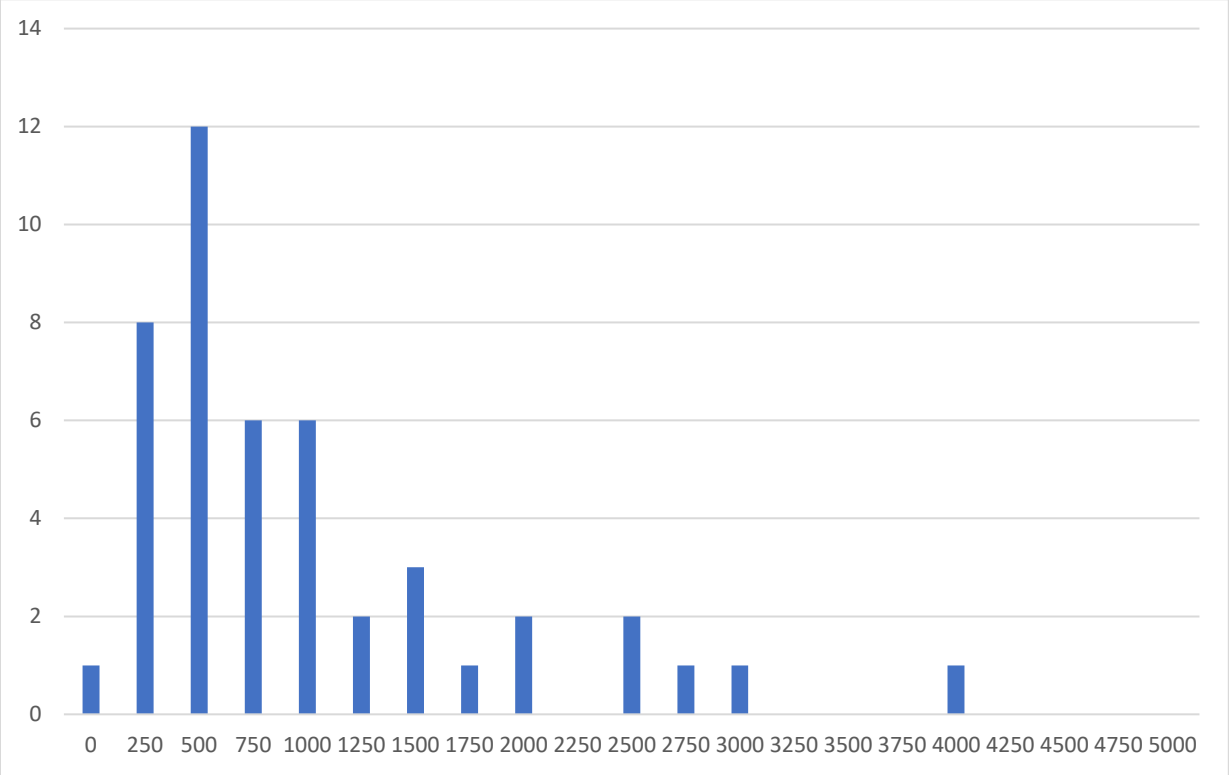
The next series of questions asked respondents about their agricultural practices, in particular about the land utilised, crops grown and livestock management and belief-based questions on respondents' perception of limitations and risks in their agricultural practices.

The distribution of plot size in North Pentecost was slightly larger than other communities surveyed. The diversity of crops was the greatest, with 16 listed. 81% of all households stated they sold some of their grown food. Around a third (the lowest) of households stated they face problems that limit how much food they grow. The main reasons given were storms and cyclones and not enough rain. Livestock management rates were lower than on Malekula, with less than half of households stating they owned poultry, and approximately 1-in-3 stating they ate chicken or eggs regularly. Around 1-in-5 households listed 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 histogram distributions of gardens under production for North Pentecost.

Figure A2: Distribution of total garden plot size under household management for North Pentecost (m2).



D.1.2. Most important crops

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%). Whilst this list should not be seen as definite (and would have been influenced by the numerators), it is still likely that the greater diversity of crops reported for North Pentecost (Pentecost) than other communities reflects a greater diversity grown in this community. Table A9 reports the full spectrum of crops listed.

A very high proportion (~81%) of households in North Pentecost (Pentecost) are selling surplus produce when compared to all the communities in the wider survey.

Table A9: Commonly grown crops for each community. Percent of households listing item.

Crop	Total
Taro	85
Kava	22
Manioc	73
Banana	78
Yam	75
Fijian taro	16
Kumula	32
Wild yam	8
Cabbage	53
Water melon	2
Cucumber	5
Sugar Cane	1
Corn	7
Paw paw	0
Beans	1
Ginger	1
Pineapple	1
Pumpkin	3
Water taro	3
Range of crops listed	18

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

Table A10 reports results of an overarching question on whether households are experiencing any issues with growing food. The results show that households in North Pentecost reported fewer issues growing food than those experienced across all ESRAM reports.

Table A10: Proportion (%) of households reporting issues with growing food.

	North Pentecost	All
Yes	68	84
No	32	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 A11.

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 and slightly fewer in North Pentecost). 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. Concerns were generally higher in Wiawi than elsewhere (e.g., twice that of North Pentecost). Our data cannot determine why this is the case, however, this is identified as a key priority to address in considering adaptation options.

Table A11: Proportion (%) of all households reporting specific issues with growing food.

Issue	North Pentecost	Total
Not enough rain	43	56
Flood	6	53
Storms and cyclones	53	69
Volcanos, earthquakes	17	24
Can't get food to market	23	42
No seed stock	28	37
No fertilizers / mulch	43	39
Not enough tools	38	42
No labourers	32	39
No where to make my garden bigger	30	33
Cannot get to my land	4	21
Can't access banking	23	21

D.2.1. Number and use of livestock

We asked respondents about their livestock management. These data are reported in Table A12.

Table A12: Livestock management on Pentecost (total households, n=47).

	Produce/ Own	Eat Regularly	Buy It	Sell It	Would you like eat more
Poultry meat	44	38	25	30	36
Eggs	25	37	24	13	31
Pigs	22	27	19	12	23
Cattle	7	15	12	4	14
Milk	3	11	11	2	12
Goat	0	1	1	0	6
Goat milk	0	0	0	0	5

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 North Pentecost, common forest and grassland harvesting were important, with more than 9 in 10 collecting some harvest. The most important items were bamboo, bananas, coconut products, medicinal plants, fruits, and nuts. Table A13 reports the mean score provided by respondents, which has been normalised to generate a score between 0 and 100 for ease of comparison.

Table A13: Importance of forest and grassland produce (total households).

Item	North Pentecost	All
Wild animal food	62	61
Bamboo	91	92
Banana	90	90
Coconut products	89	89
Rattan	80	56
Medicinal plants	87	84
Cultivated fruits	84	81
Wild fruits	85	80
Nuts	84	81
Bush meat	67	70
Mushrooms	43	48
Average for all	78	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 A14 reports these data disaggregated by community. 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 A14: Water resource use, reliability, and accessibility for North Pentecost. Proportion (%) of households stating this option.

	Drinking/ Cooking	Washing	Washing of Clothes	Watering Plants	Is this source reliable	Is this source accessible
Public taps	19	21	19	9	15	15
Private well	11	15	15	6	9	11
Natural spring	6	11	11	0	4	4
River / lake	2	4	4	0	0	0
Rainwater tank	79	74	74	60	45	49
Piped	0	0	0	0	2	2
Bottled	11	6	6	4	2	4
Trucked-in	0	0	0	0	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.

In North Pentecost, 89% of households are producing *some* non-compostable waste. The amount of waste produced is below the average for other communities in the survey. This waste is disposed of mainly by burying and burning in backyards and in community waste pits. There are no community recycling opportunities.

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 A15.

Table A15: How much waste is produced by households each week (% stating option).

	North Pentecost	All
None	11	16
Less than 1 bag	60	43
2 to 5 bags	13	17
More than 5 bags	11	16
Other	6	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. Only one household in North Pentecost used a community recycling scheme but we are not aware of such a scheme operating here. The full results for North Pentecost are reported in Table A16.

Table A16: What does your household do with your non-compostable waste. Proportion (%) of households that stated an option by community.

	North Pentecost	Total
We re-use all waste	12	21
Backyard pit	50	60
Burn in backyard	60	65
Community waste pit	52	36
Ocean/waterway	7	10
Community recycling centre	2	17
Authorised collection	2	7
Other	10	6

Question F.2.1. Accessibility of toilet facilities

We asked North Pentecost 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 Tables A17.

Flushing toilets remain relatively rare across all communities. Only 8.5% of households on Pentecost have one in their home. 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. Of the 20 households on Pentecost that gave no answer to having a toilet at their house, only one answered that they had access to a flushing toilet in the community. The remainder stated they had access to a bush toilet as a default.

Table A17: Access to toilet facilities for North Pentecost. Proportion (%) of households selecting option (all households stated at least one option).

Type of Toilet	In House	Access To
Bush toilet	51	49
Flush toilet	9	2
Other	6	0
No answer	43	40
Accessible to vulnerable people		
Accessible	38	26

Not stated	28	

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:

Less than half of households surveyed in North Pentecost collected marine resources in the last week. This was collected in a wide range of locations, including local reefs (77%), other reefs (41%), and in the deep water (55%). Of households that harvested marine and freshwater resources, men were engaged 100% of the time, women 45% of the time. 73% of households harvest sufficient resources to give away to extended family and 73% sold or traded. Nearly half expressed a desire to harvest more resources. Trading / selling is mostly the domain of women (59%) over men (41%).

G.1.2. Collecting marine resources in the last week

First, we asked an overarching, yes/no question, which is reported in Table A18.

Table A18: Proportion (%) of households undertaking some collection of marine resources in the last week.

	North Pentecost	All
Yes	47	63
No	53	37

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

Table A19 reports results of those households that caught or collected marine resources. This question provides insight into local environmental pressures. Local reefs were the most important locations for fishing, though a fair proportion (55% for North Pentecost) stated they also caught fish in deep water. There is currently a program of government support for FADs, but the research team was not made aware of any program in the four communities. Thus, any recommendations will be adapted once this information is learned.

Table A19: Where do households collect marine resources, North Pentecost. Percent of households stating they undertake some collection (n=22).

	Fish	River Plants	Shellfish	Sea Weed
Local reef	77	5	36	9
Another reef	41	0	32	5
Deep water	55	0	9	0
River / lake	5	0	0	0
Mangrove	0	0	0	0

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

Respondents were asked *who* caught or collected marine resources. This is reported in Table A20. Although more men than women tended to be engaged in these activities, labour was generally shared.

Table A20: Who caught or collected the marine resources, Pentecost. Percent by gender undertaking collection of resources (n=22).

	Fish	River Plants	Shellfish	Sea Weed
Men	100	0	50	5
Women	45	0	36	5
Children	23	0	9	9
Non-binary	5*	0	5*	5
* Note that no-non-binary people were listed in the household survey				

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 Tables A21. A surprising number of households harvesting marine resources sold or traded those resources: 72% for North Pentecost. The proportion of households harvesting marine resources in North Pentecost was lower (less than half other communities on Malekula, from other ESRAM studies) suggesting a reasonable level of labour specialisation in trading marine resources. Although not a direct proxy for shortages (determining over-harvesting would have been difficult given the circumstances of the survey), between 40 and 50 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.

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 11: What do households do with marine resources in North Pentecost. Percent of households that undertake some collection undertaking each activity (n=22).

	Fish	River plants	Shellfish	Sea Weed
Household use	86	18	55	5
Given to extended family / clan	73	14	50	5
Sold / traded	73	14	50	9
Is there a shortage / require more	45	5	27	5

Section H: Household development

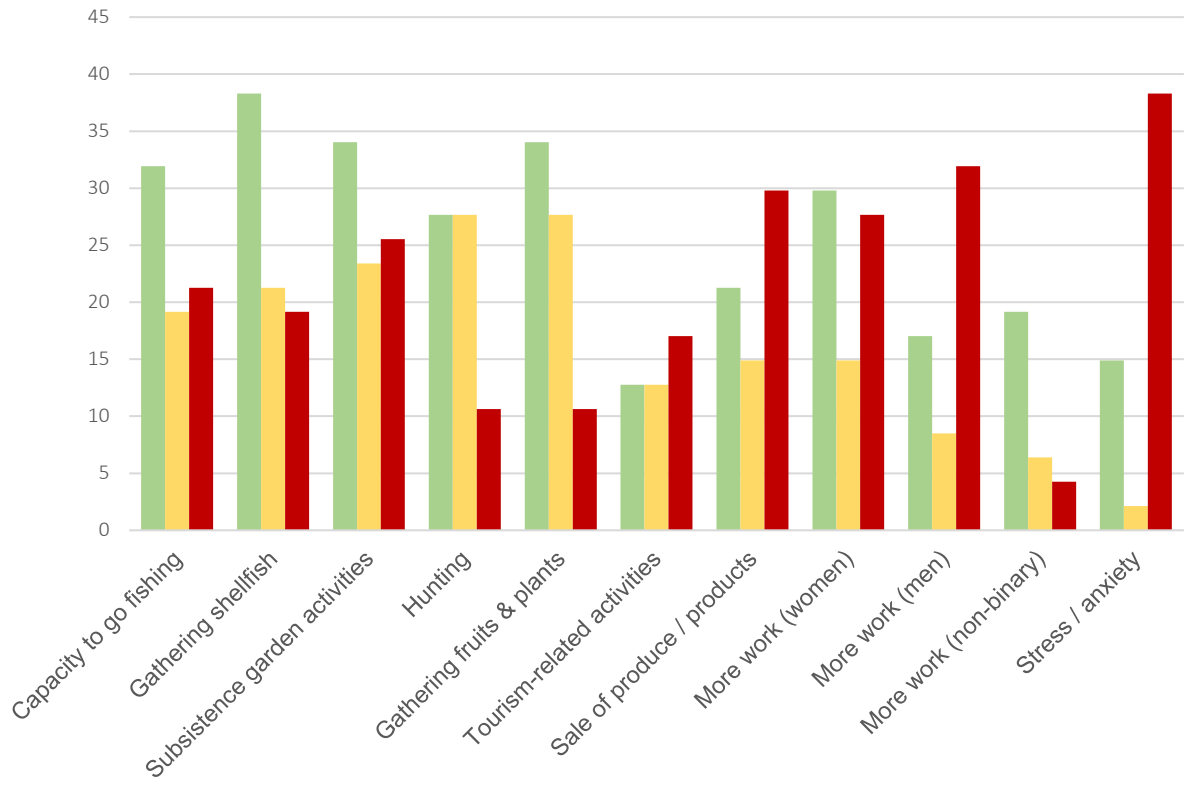
Section H concentrated on household aspirations, concerns, and likely planned actions for the future.

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 for North Pentecost.

Figure A3: What activities has the Covid-19 pandemic changed for your household (North Pentecost).

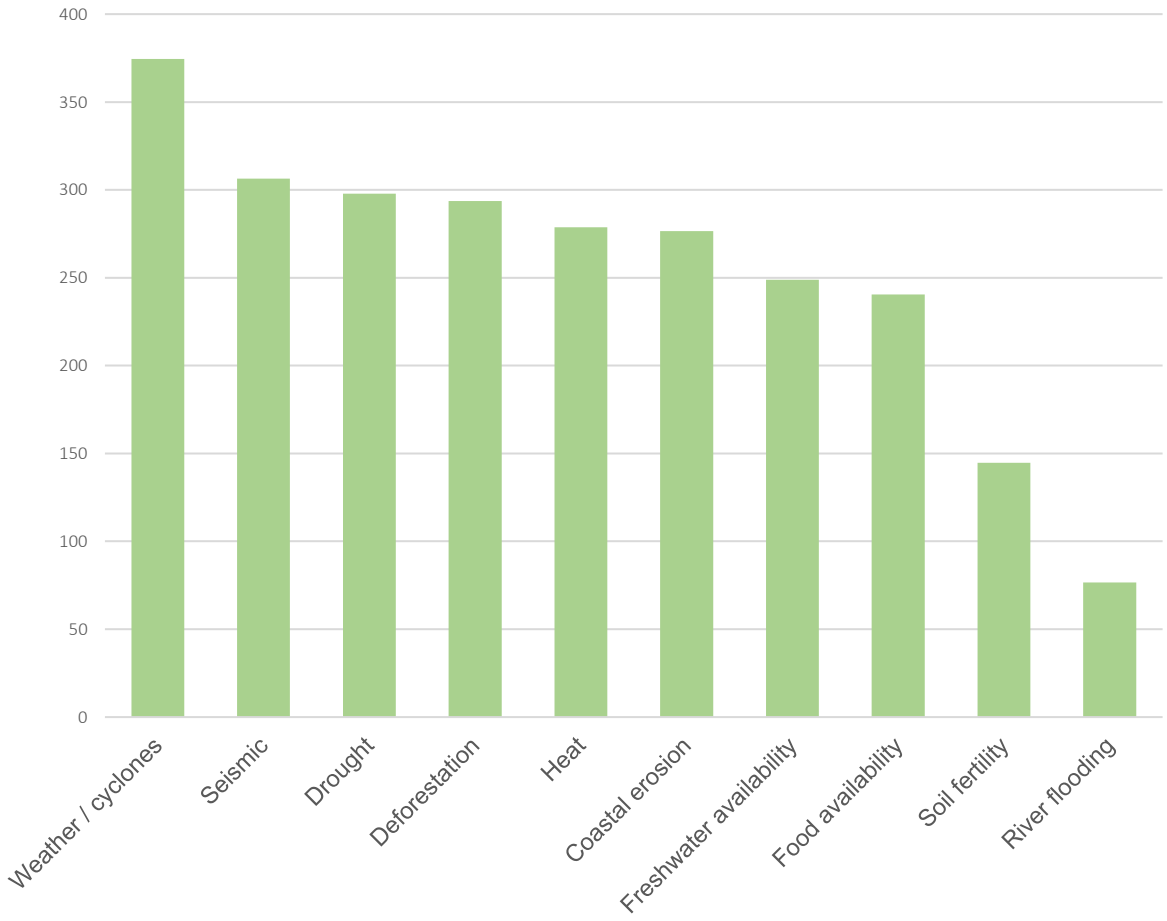
Percent of household respondents selecting measure. Key: less: n; no impact: n; more: n.



Question H.2.1. Concern about environmental challenges key findings

The most pressing environmental challenges for North Pentecost were the impact of extreme weather (cyclones), seismic activity, drought, and deforestation. Least pressing was river flooding and soil fertility. 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 A4: Level of concern for environmental challenges, North Pentecost.



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 A22. 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.

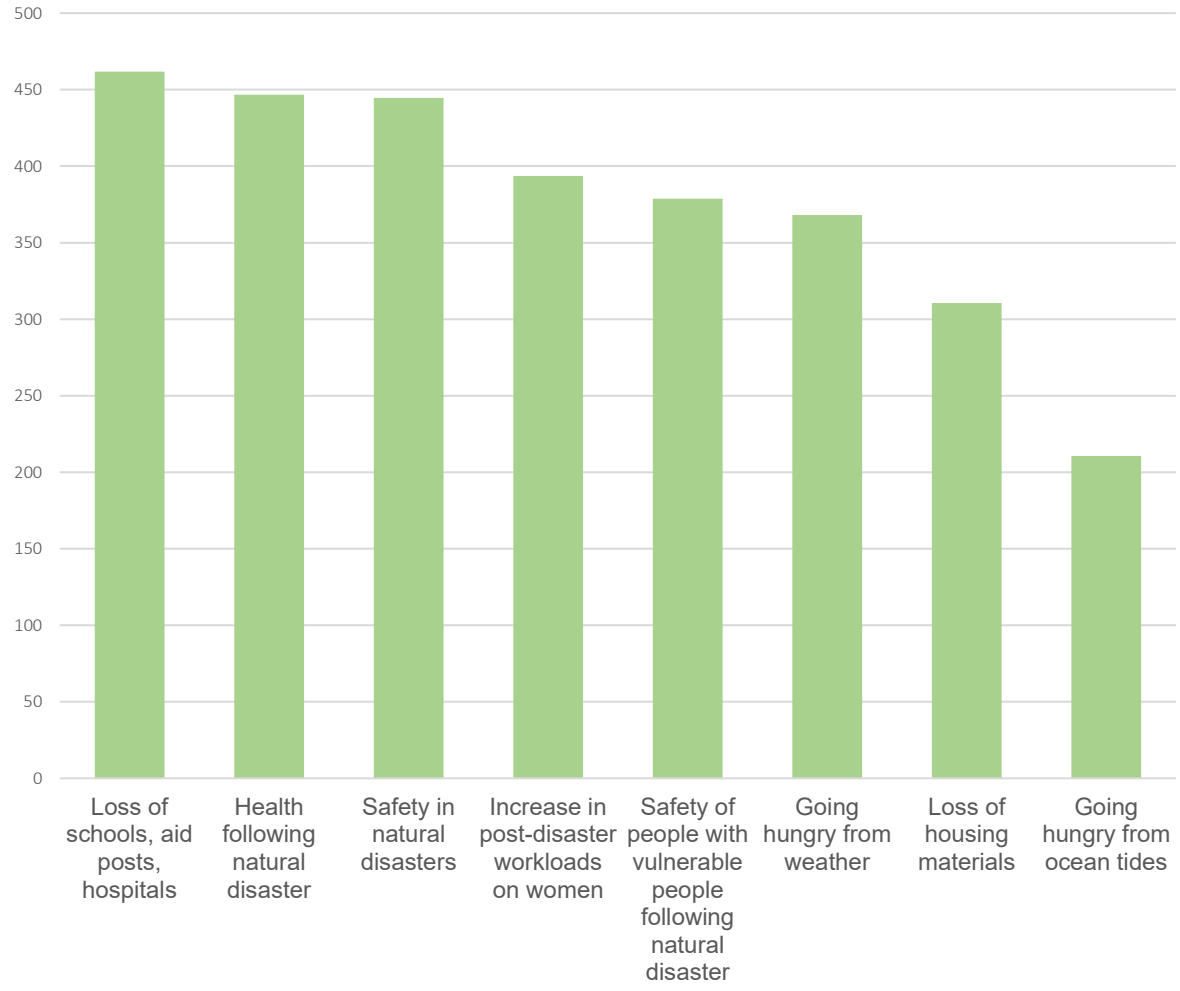
Table A22: Level of concern about environmental risks by gender.

	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

The most pressing of the socio-economic challenges presented to respondents in North Pentecost were loss of schools, hospitals and health and safety impacts because of natural disasters. Going hungry and loss of housing materials was least important. These full results are reported in Figure A5.

Figure A5: Relative concern about potential socio-economic problems for North Pentecost. 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 A23. Women show a greater level of concern across all and every indicator, except for going hungry because of sea level rise. Women were considerably more concerned about hunger and issues around natural disasters.

Table A23: 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 A24.

- Looking to the future, the following opportunities were important for improving a household's happiness and security in North Pentecost: improving farming practices, more equal share of household chores, making and selling food, handicrafts, and clothes, and more livestock (though a large portion of households *also* did not see more livestock as important). Running a small business was of interest to a reasonable cohort. Tourism opportunities (guiding, restaurants, accommodation) were not so important, suggesting that the preference for business opportunities was focussed on local services.
- 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 A24: What activities might be important you going forward for Pentecost (0 – no answer; 1 to 5 is in terms of relative importance).

	0	1	2	3	4	5
Tour guiding	30	6	23	15	4	21
Running a restaurant	30	6	17	15	19	13
Running tourist accommodation	30	15	19	13	6	17
Working in tourist accommodation	30	23	17	13	11	6
Running a small business	28	15	2	15	30	11
Obtaining banking literacy	34	4	4	15	21	21
Education to get employment	34	6	6	13	19	21
Catch more fish out to sea	32	4	13	15	13	23
Making and selling handicrafts	30	2	0	11	15	43
Making and selling food	11	6	4	2	30	47
Making and selling clothes	32	6	2	6	13	40
More livestock	40	4	6	2	9	38
Improving my farming practices	17	4	6	2	17	53
More equal share of household chores	15	4	4	2	26	49

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 A25.

Table 12: 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

The final substantive enquiry was into household 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, see Section 7.7 on data gaps) 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 A26 can provide a reasonable, generalised picture of community preferences and priorities.

The most important services and infrastructure priorities for respondents in North Pentecost were better health care and schools, improved sanitation, and better access roads. The least important was more livestock. Four issues relating directly to women were also ranked lowly, but this may be an artefact of these issues being specifically important for less the 39% of the respondents who were female. Preferences between men and women were relatively equal, including amongst issues related specifically to women.

Table A26: Mean importance and ranking of services and infrastructure to households in North Pentecost (scores ranked 1 to 5).

Rank	Activity	Average Score
1	Better health care	4.32
2	Better schools	4.23
3	Improved sanitation	4.10
4	Better access roads	4.06
5	More jobs / labouring	3.97
6	Improved water sources	3.84
6	Better access to markets	3.81
8	Conservation projects	3.77
8	Financial training for women and the vulnerable after natural disasters	3.77
10	Coastal protection from erosion	3.74
10	Better menstrual hygiene education and services	3.71
12	Identity cards and bank accounts for women and the vulnerable to get disaster support	3.68
13	Support for women and the vulnerable to get insurance policies after a disaster	3.65
13	Information about disaster risk management	3.61
15	Emergency and disaster management plans for women and the vulnerable	3.52
16	Disaster management plans for women and the vulnerable after natural disasters	3.48
17	Training for women and the vulnerable to help escape in disasters	3.45
18	Ensuring women can make decisions about disaster management evacuation centres	3.32
19	Capacity building for women's participation in managing community facilities	3.29
20	More livestock	2.77

Importance of services and infrastructure by gender

We also looked at the importance of services and infrastructure by gender (Table A27) across the whole sample. 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 A27: 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: North Pentecost 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.
- As part of its conservation project, **North Pentecost** is examining how to make its marine CCAs into a tourist attraction site (despite generally low support in the community), to generate income to help with its management. Continued pursuit of marine CCAs must ensure that local decision making takes steps to ensure greater inclusion and communication of decisions that might impact community resource use restrictions.
- The **North Pentecost** community has a custom ceremony that manages land fertility and forest conservation in a 4-year cycle. Changes are being implemented to allow communities to have access to resources for up to 3 months to crop to sustain their livelihood while the rest of the area is within a ban.

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).
- Most communities live along the coastline, but communities such as North Pentecost have migrated inland onto higher, steeper terrain.

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 North Pentecost.

Asset	Quantity	Notes
Schools	2	1 French school & 1 English school
Churches	1	Anglican, in almost all villages
Poultry farm		Virtually every household has free range chickens
Cattle farm	4	Not fenced
Piggery		Almost every household has pig pens
Tilapia Pond	nil	
Docks		Kava stored at home
Shops	>30	Bring in supplies from Santo, 1 big shopping centre
Cooperative		
Fiberglass boats	8	Own by individuals
Water source		Every household collects rain water as there are no rivers or stream in the area. There are also rain water harvest facilities in a few communities
Power source		Solar power in every household. Solar street lights are self-funded by community
Access to Area		By boat, road, and plane
Police post	1	Vanuatu Police Force
Aidpost		
Women's Centre	1	Vanuatu Women's Centre branch
Community halls		In every community. Built from forest materials
Bank	1	National Bank branch
Money Transfer	1	Western Union agent
Post office	1	Vanuatu post branch
Satellite TV rental office	1	CANAL SAT
Market Houses	2	Selling mainly cooked food and handicrafts
Air strip	1	Closed at time of survey
Telecommunications Network		Very good for both Digicel & Vodafone

APPENDIX C: Field trip report – North Pentecost

Dates: 16th – 25th July

Vatunmalanvanua Area Council. Area Covered: Five main communities of North Pentecost under the Vatunmalanvanua Area Council (including North Pentecost)

Purpose of the Field Trip

This field trip to North Pentecost, which took place from the 16th to the 25th of July 2025, was organized as part of our commitment to transparency, community engagement, and sustainability. The purpose was to report back on findings from the 2022 community-based survey conducted across five main communities under the Vatunmalanvanua Area Council. In addition to sharing findings, the trip served to raise awareness about environmental management, and to encourage local understanding and ownership of Nature-based Solutions (NbS) and community adaptation practices.

Methodology

The report back approach used was highly participatory. Upon arrival, a group of four previous enumerators from 2022 were re-engaged, alongside four new individuals who expressed interest in joining. These included two women married to the enumerators, an elderly man, and his daughter-in-law—all members of the community committee in Abatunbuliva. A training session was held on July 17th to build their understanding of the findings, the project's objectives, and the data collected in 2022. Given the limited infrastructure in the area, including

lack of projectors and consistent electricity (as most communities rely on solar power), a low-tech, discussion-based method was adopted.

Each participant was assigned a topic and was encouraged to present findings in their own local language. This method proved to be not only effective but also empowering for the team. It ensured that the information was shared in a way that was both culturally appropriate and easily understood by the broader community.

Community engagement and presentations

Each community visited received a detailed presentation from the trained local team. These sessions included a general introduction by the team leader, followed by sector-specific presentations conducted by the local team members. At the end of each session, a time was allocated for community feedback, questions, and discussion.

The team visited the communities of Antagurua (19 participants), Abatunbuliva (50 participants), Labaru (15 participants), Angoro (27 participants), and North Pentecost (11 participants). Chiefs and chairpersons from each of these communities welcomed the initiative, and certificates of appreciation were distributed during the gathering in Angoro.

Table 13: Location and attendance and feedback workshops

Community	Attendance	Key Figures Present
Antagurua	19	Chairman, mothers, and men
Abatunbuliva	50	Chief, community men and women
Labaru	15	Mostly women, few men, chairman present
Angoro	27	Chief Nathaniel Toa, Father Rex Toa, Martin Wilson (Nasuman rep.)
North Pentecost	11	Chairman Eden Lini, 10 men

Key outcomes and observations

The overall reception from the communities was overwhelmingly positive. A total of 122 adults attended the report back sessions, with many expressing gratitude for the return visit and for being informed about the findings. Community leaders and former government employees who were present during the sessions voiced their support for the recommendations and findings, noting the importance of sustainable environmental practices. Several communities expressed strong interest in forming NbS and adaptation committees to take local action based on the recommendations shared.

Community-led environmental practices

Across all communities, traditional conservation practices like 'Tambu Karen'—a method of communal gardening—remain strong. These practices involve setting aside forested areas for community farming, helping to limit land degradation by concentrating farming activity in one area. However, concerns were raised about the environmental risks, such as flooding or landslides, when such gardens are located above homes.

Communities reported existing or proposed plant nurseries in Nazaret, Herenhala, Ghamalmauwa, Ataftabanga, Labultamata, and Vulumanu. Forest conservation efforts were noted in Labaru, Batagorovanua, Atagurua, Harenhala, and Aviriana.

There were also practices to ban hunting of certain birds and prevent bushfires caused by garden waste burning.

Reflections from the Team

The field trip was also a learning experience for the team. Solomon Aru shared his appreciation for revitalizing traditional knowledge. Joce Dovo highlighted the economic value of growing and selling local produce instead of relying on imported goods. Anastasia Bague gained confidence in public speaking and saw the value of engaging in environmental work. Pauline Hango noted the declining quality of crops and developed a stronger interest in conservation. Silas and John Hango both emphasized the practicality of Nature-based Solutions, realizing that sustainable solutions can come from within the community.

Comments from Community Leaders and Participants

Leaders and elders across all five communities welcomed the report back sessions and expressed support for the findings. In Labaru and Angoro, the chiefs voiced strong support for environmental conservation. In Antagurua, the former PENAMA provincial president highlighted concerns about water access. Community members frequently asked whether the government would follow through with the recommendations. The team clarified that while the report has been submitted to the government, its implementation depends on government decisions.

Challenges

There were several logistical challenges, including difficulties in contacting the Area Administrator due to poor mobile network coverage. The region’s reliance on solar power also limited the use of presentation equipment such as projectors. Additionally, some certificates of appreciation could not be distributed because of name inconsistencies or absentee recipients.

Recommendations

It is recommended that community-based adaptation committees be formally established and supported in each of the five communities. There is also a need for ongoing follow-up visits and technical support to ensure the recommendations are acted upon. Finally, the remaining certificates should be corrected and distributed appropriately.

Team Composition

The team included both returning and new members. New members on this trip were Anastasie Bague, Solomon Aru, Pauline Hango, and Joice Dovo. Returning members from the 2022 survey team included Silas Dovo, John Hango, Howard Tabe, and Judah Sau.

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PEUMP
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SPREP
Secretariat of the Pacific Regional
Environment Programme