KIWA INITIATIVE
PEBACC+ Pacific Ecosystem-based Adaptation to Climate Change Plus
SPREP
Project co-funded by FFEM
GRIFFITH UNIVERSITY

JULY 2025

Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) - FULL REPORT

South Malaita & Maramasike Passage
Solomon Islands

IN PARTNERSHIP WITH: Pacific Community Communauté du Pacifique, SPREP, IUCN

THIS INITIATIVE IS FUNDED BY: European Union, AFD, in partnership with Canada, Australian Aid, New Zealand Foreign Affairs & Trade Aid Programme

Ecosystem and socio-economic resilience analysis and
mapping (ESRAM): South Malaita & Maramasike Passage,
Solomon Islands. Apia, Samoa: SPREP, 2025.

vi, 108p. 29 cm.

ISBN: 978-982-04-1403-7 (ecopy)

1. Economic development – Social aspects – Solomon Islands.
2. Ecosystems management – Solomon Islands.
3. Environmental assessment – Solomon Islands.
I. Pacific Regional Environment Programme
(SPREP). II. Title.

574.5095953

This report is produced by Griffith University for the Secretariat of the Pacific Regional Environment Programme (SPREP). It reports on an Ecosystems and Socio-economic Resilience Analysis and Mapping (ESRAM) exercise to assess and prioritise climate change-related ecosystem-based adaptations for three communities in southern Malaita Province.

Authors and field staff: Andrew Buckwell, Mark Ariki, and Annie Dan (independent consultant) (Griffith University, unless stated).

This report was also produced with the assistance and good offices of SPREP and the Solomon Islands Ministry of Environment, Climate Change, Disaster Management and Meteorology.

Citation:
Buckwell, A., Ariki, M., and Dan, A. (2025) *Ecosystems and Socio-economic Resilience Analysis and Mapping (ESRAM) for three communities of southern Malaita Province* for the Secretariat of the Pacific Regional Environment Programme (SPREP), Apia, Samoa.

Cover art: Stuart Chape

Key project partners:

Secretariat of the Pacific Regional Environment Programme
(SPREP)
PO Box 240
Apia, Samoa
sprep@sprep.org

www.sprep.org

Our vision: The Pacific environment, sustaining our livelihoods and natural heritage in harmony with our cultures.

As part of SPREP's commitment to the environment, this item is printed on paper made from 100% recycled post-consumer waste.

Table of contents

List of tables

List of figures

1 Purpose of this report

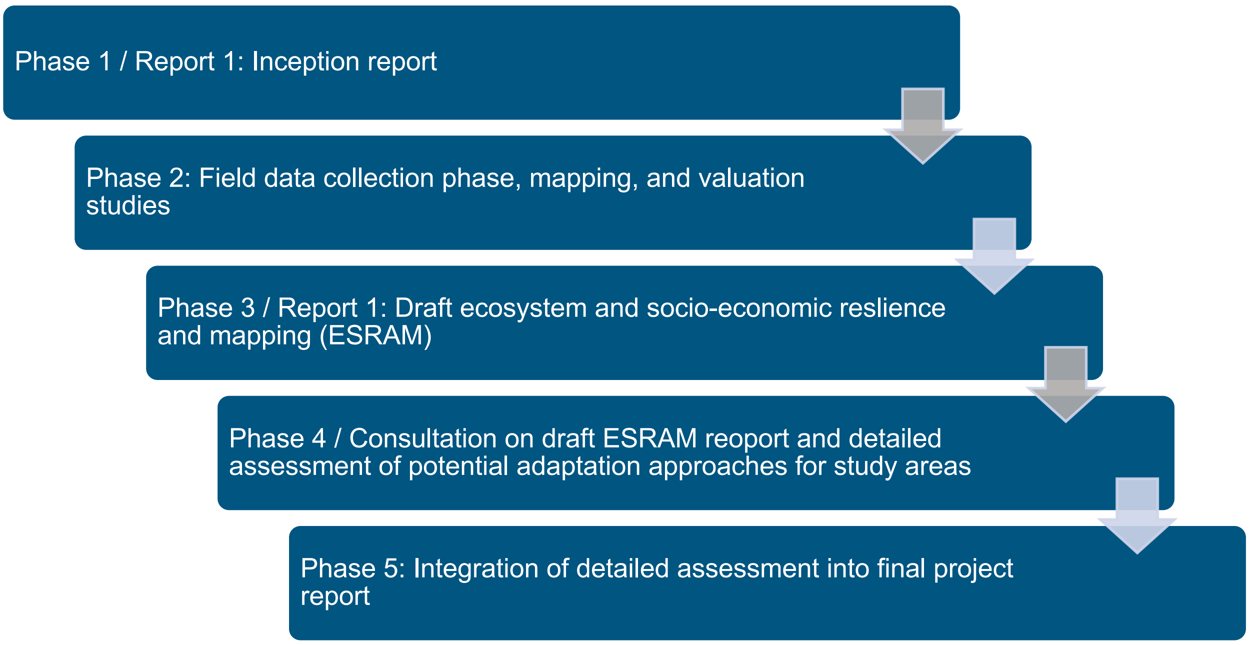
This report presents an Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) process for three communities in South Malaita – Eliote, Ori Ore, and Tapa'atewa. The purpose of an ESRAM is to generate a robust planning baseline to inform the identification of ecosystem-based adaptation (EbA) options for strengthening the socio-ecological resilience of communities to the impacts of climate change, environmental pressures, and other direct anthropogenic impacts. This report provides a comprehensive view of desktop- and field-based research activities that contribute towards a final ESRAM report.

As such this report provides:

1. an overview of approaches and methods for data identification and data collection;
2. a synthesis of data and lines of evidence for each community, including climate risks, ecosystem mapping, ecosystem service valuation, and socio-economic data collected in the field;
3. feedback from community validation sessions; and
4. assessment of and recommendations for a series of EbA options for the three communities.

This report comprises Phases 1 through to 5 of our overall ESRAM approach (Figure 1).

Figure 1: Locating current report



Data sources

Our overall approach between linking our data sources to making recommendations for potential EbA projects appropriate for each community is set out in Figure 2. We will draw on five lines of evidence for making high-level EbA recommendations. Further detailed assessments will be made before final EbA recommendations are made.

Figure 2: Summary lines of inquiry informing our ESRAM and document location

Line of enquiry	Evidence provided
Literature review (Section 2)	• Determinants of effective ecosystem-based adaptation
Climate risk data (Section 3)	• Current climate change related risks (at regional scale only) • Future climate risks
Ecosystem service mapping & valuation (Section 4)	• Land cover extent and location of different habitats • Economic valuation of ecosystem services
Community data (Sections 9 & 12)	• Community asset inventory • Community transect • Community feedback sessions
Individual surveying using Q-method (Sections 9 & 10)	• Q-methodology survey based on a series of statements encompassing livelihoods, conservation, climate risks, natural resource management, waste, sanitation, and health
Community validation sessions	• Ranking exercises and consideration of project priorities

2 Background

2.1 Overview of risks to Pacific islands communities

The communities of Pacific Island nations have a long history of resilience and adaptation to environmental variability (Barnett, 2011), including climate change, yet their rural communities face a range of chronic threats to the sustainable management of their natural resources. These threats are exacerbated by a contemporary rapid climate warming and new climate-related risks, such as increased incidence of extreme weather events, sea level rise, inundation, erosion, and ocean acidification (Kossin et al., 2020; Pachauri et al., 2014; Turley and Gattuso, 2012). In addition, increasing pressures on natural resources from population growth (in most instances), tourism development (in some instances), falling agricultural productivity from household gardens, and over-harvested fisheries are being magnified and compounded by these climate-related impacts (Faivre et al., 2022; Fleming, 2007; Mackey et al., 2017).

Most of the region's population's food is produced on a small scale, household basis or harvested from the sea (Anderson, Thilsted, and Schwarz, 2013). The Solomon Islands is typical of this regional pattern. In more remote areas, away from markets and transport networks, virtually *all* food consumed is grown by households. This food is grown in household gardens that are tended to by members of the household. Often, gardens are part of a complex agroforestry system of shifting cultivation that includes fallow periods and forest regrowth. Household livelihoods and human well-being are 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 the capacity to respond to severe weather events (Carpenter et al., 2006; MEA, 2003; Savage, McIver, and Schubert, 2019). Where transport links are better, and to an extent, this includes the project areas in South Malaita, some surplus produce is traded locally and into more distant markets in Honiara. In addition, increasing amounts of processed foods, such as imported rice, noodles, and canned meat is being consumed in such communities, purchased with cash earnings and remittances (Buckwell et al., 2024).

Compounding anthropogenic and natural resource pressures, in the Solomon Islands, non-climate change related risks, such as seismic and volcanic activity, further increase sudden-onset disruptions in ecosystem service delivery. Social changes, economic development, and demographic pressures also play their part. The population of Solomon Islands is growing and on the move (Solomon Islands Government, 2019).

These threats not only present risk to communities. Biodiversity is also under growing pressure from the interplay between climate change risks and human impacts from their growing footprint (**population X consumption X technology**). The species and ecosystems of inland and coastal areas are under particular pressure due to the concentrations of human settlement and infrastructure they support. In response, governments are acting to adapt to climate change so that people avoid or minimise the harm from a rapidly changing climate. Care needs to be taken to ensure the kinds of adaptation actions being taken do not cause even more loss and degradation of natural environments. For example, in response to rising sea levels and storm surges, governments 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 and Ware, 2018). 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 the harvesting of its natural resources.

2.2 Adaptation to climate change

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, Arnell, and Tompkins, 2005; Betzold, 2015; IPCC, 2023). 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.

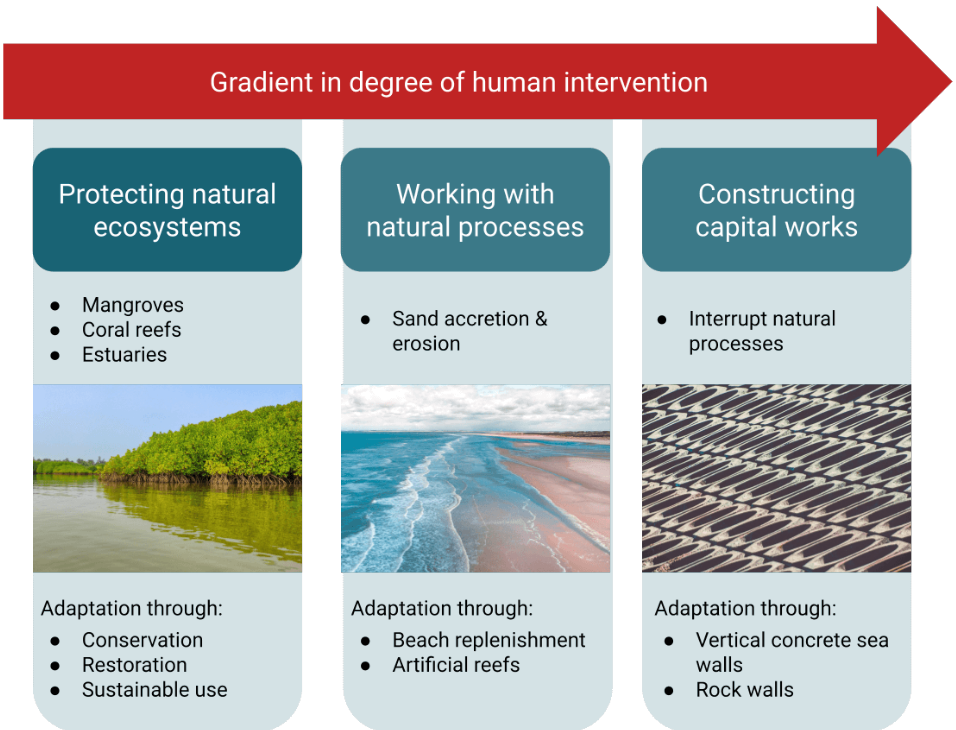
2.2.1 Ecosystem-based adaptation

Nature-based solutions (NbS) present a spectrum of options that deploy nature capital and ecosystems to achieve human wellbeing outcomes, nature conservation, and sustainable development (IUCN, 2020). Where NbS are used in service of adaptation, they are known as ecosystem-based adaptations, or EbA. 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, 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’, engineered, or capacity- and institutional components) and therefore provide the support and space to assist species and ecosystems to adapt to changing conditions in ways that are beneficial to human society. EbAs can also take the form of approaches that reduce pressure on natural systems to enable them function and potentially migrate. Therefore, EbA is an approach, rather than a prescribed set of solutions. EbA approaches need to consider different aspects of climate and environmental risk alongside other community needs.

Figure 3: A spectrum of adaptation options available

Example given for adaptations in the coastal zone) from interventions that maintain or build ecosystem integrity through to pure engineering solutions.



EbA is often closely tied with the concept of **community-based adaptation**, which is more focused on a community scale and ensures that adaptation efforts are integrated with local development goals and community well-being and resilience, therefore taking a place- and sector-based approach, focussing on economic/lifestyle mainstays, such as fishing or eco-tourism (Dumaru, 2010; Failler et al., 2015; Hafezi et al., 2018). A criteria of the IUCN's Global Standard for Nature-Based Solutions is consideration of scale, not only to the biophysical or geographic perspective but also to the influence of economic systems, policy frameworks and the importance of cultural perspectives (IUCN, 2020).

2.2.2 Criteria for qualification of ecosystem-based adaption

Figure 4 is drawn from the Friends of Ecosystem-Based Adaptation (FEBA, 2018) and describes the foundational qualities and criteria that tend to qualify interventions as EbAs. These criteria are generally consistent with the IUCN's Global Standard for Nature-based Solutions (IUCN, 2020), but are focussed specifically on EbA and include standards that include use of traditional knowledge, making them relevant to the Pacific context. These criteria 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.

Through our entire ESRAM process, we continually test our assumptions against these criteria. In some instances, these criteria are addressed directly (for example, in out detailed assessment process in Section 10), but in all instances they guide our logical process from background, through data collection, to final assessment. We will refer to these links throughout the document.

The challenge of transformational adaptation

Transformative adaptation presents greater challenges to the EbA approach, which broadly aims to increase the resilience of communities to climate change by enabling resistance to hazards and the capacity to recover and regenerate following significant perturbations, and therefore keep communities in place (Panda, 2018). Five key issues arise in the context of Solomon Islands:

1. **The identification, level, distribution, and management of the costs**; for example, many more transformational adaptations demand significant investment today (e.g., the transformation of subsistence agriculture to new levels of agricultural productivity), but many of the benefits will not accruing to many years into the future. Whilst communities can be patient, benefits accrual needs to be sufficiently timely to maintain support for EbA approaches over pursuing extractive industries with (apparent) shorter payback timeframes (Buckwell, Ware, et al., 2020).
2. **The definition of, the potential for, and need to avoid *maladaptation*** – activities that add to environmental risk, such as over-extraction of natural resources or the introduction of excess artificial inputs (e.g. fertilizers) into intensified agriculture.
3. **Capacity demands and policy alignment** – aligning EbA projects with government policies and strategies across different scales (national / regional / island / community) and across different sectors (fisheries, forestry, agriculture, and environment.
4. **The means to adapt** – including the facilitation of access to international funds and multi-year funded projects.
5. **The uncertainty in our climate futures and the downscaling of climate projections** to provide useful information to policy makers (Whetton et al., 2012).

Figure 4 Foundational qualities and criteria qualify ecosystem-based adaptations as effective

From: FEBA, 2018

Element A: EbA helps people adapt to climate change	**Criterion 1: Reduces social and environmental vulnerabilities**	1.1 - Use of climate information
		1.2 - Use of local and traditional knowledge
		1.3 - Taking into account findings of vulnerability assessment
		1.4 - Vulnerability reduction at the appropriate scale
	Criterion 2: Generates societal benefits in the context of climate change adaptation	2.1 - Quality and quantity of societal benefits compared to other adaptation options
		2.2 - Timescale of societal benefits demonstrated
		2.3 - Economic feasibility and advantages compared to other adaptation options
		2.4 - Number of beneficiaries
		2.5 - Distribution of benefits
Element B: EbA makes active use of biodiversity and ecosystem services	**Criterion 3: Restores, maintains, or improves ecosystem help**	3.1 - Appropriate scale of management
		3.2 - Prioritisation of key ecosystem services within management
		3.3 - Monitoring of ecosystem services health and stability
		3.4 - Protection and management area coverage / diversification of land use
		3.5 - Level of co-management (government, communities, private sector)
Element C: EbA is part of an overall adaptation strategy	**Criterion 4: Is supported by policies at multiple levels**	4.1 - Compatibility with policy and legal frameworks and policy support
		4.2 - Multi-actor and multi-sector engagement (communities, civil society, private sector)

2.3 ESRAMs and EbA

Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) is an evolving methodology originally developed for the Pacific Ecosystem-based Adaptation to Climate Change (PEBACC) project and designed and implemented by Secretariat of the Pacific Regional Environment Programme (SPREP). An ESRAM aims to generate baseline data for developing and implementing EbA and resilience projects in Pacific region.

Our approach to this project is consistent with the SPREP methodology and is demonstrated in Figure 5. The overall objective is to generate a robust planning baseline that can inform the identification of EbA approaches and project options for strengthening the socio-ecological resilience of communities to climate change and anthropogenic environmental risks. ESRAM findings feed into a process to plan, assess, and design fully costed EbA options.

Previous ESRAM studies have been conducted in the Solomon Islands, including:

1) ***Solomon Islands Ecosystem and Socio-Economic Resilience Analysis and Mapping (ESRAM), Volume 1: Introduction and national assessment.)*** (BMT WBM & SPREP, 2018a)
2) ***Solomon Islands Ecosystem and Socio-Economic Resilience Analysis and Mapping (ESRAM), Volume 2: Wagina Island*** (Choiseul Province). (BMT WBM & SPREP, 2018b)
3) ***Solomon Islands Ecosystem and Socio-Economic Resilience Analysis and Mapping (ESRAM), Volume 3: Honiara***. (BMT WBM & SPREP, 2018c)
4) **Ecosystem and Socio-Economic Resilience Analysis and Mapping for Tandai Ward (Guadalcanal), East Rennell (Rennell-Bellona Province), Wairaha Catchment (Malaita Province), and Nendo Island (Temoto Province)**. (Griffith University, 2024)

Each study differed in scale and budget. To inform this report we draw on the ESRAM national assessment (BMT WBM & SPREP, 2018a) and in particular on the suggested high-level adaptation options presented in Table 8-1 (p. 108). This table sets out adaptation and resilience options (not directly EbA options, though all options presented directly support NbS and EbA) in three sectors: (i) freshwater; (ii) coastal and marine; and (iii) terrestrial.

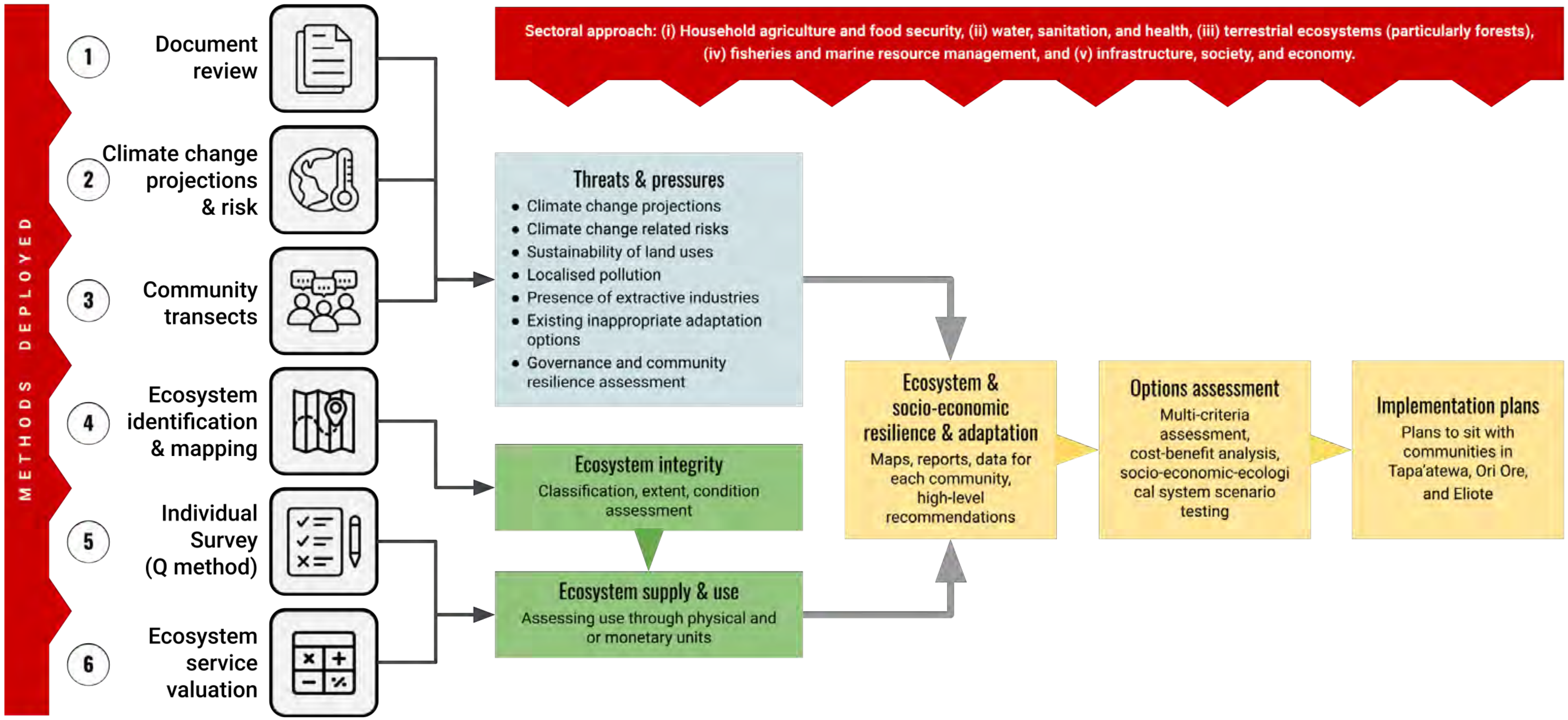
Our ESRAM study brings together six lines of inquiry, examining climate and socio-economic risks across five sectors: (i) household agriculture and food security, (ii) water, sanitation, and health, (iii) terrestrial ecosystems (particularly forests), (iv) fisheries and marine resource management, and (v) infrastructure, society, and economy.

2.4 Alignment with Solomon Island Integrated Vulnerability Assessment (SIIVA)

Solomon Islands Ministry of Environment, Climate Change, Disaster Management and Meteorology (in conjunction with University of South Pacific) has developed the Solomon Island Integrated Vulnerability Assessment (SIIVA) tool as a key instrument to identify and prepare the country to the risks posed by climate change and disaster, as well as adapt to these threats, on a sector-by-sector approach. The tool also recognises that both climate and non-climate change vulnerabilities need to be addressed to increase resilience.

In many ways, SIIVA is very aligned with ESRAM and adopts similar methods for community engagement and mapping of ecosystems and threats. However, ESRAM maintains its very specific focus on prioritising EbA and EbA approaches to adaptation and building resilience.

Figure 5: Our approach to the ESRAM methodology



2.5 Socio-ecological systems framework

EbA approaches to adaptation projects in rural Pacific communities can take a range of forms but must lay at the intersection of socio-economic development pathways, biodiversity conservation, and climate change adaptation. A socio-ecological systems approach is also required, embedding household and community wellbeing within a complex system that interacts with the range of socio-economic and ecological systems and sub-systems (Buckwell et al., 2024; Sahin et al., 2021).

For example, the implementation of a marine protected area, with additional restrictions, to secure the sustainability of the fish catch, or to improve the potential tourism values of the reef, may require a reduction in the wild fish catch from a local reef. This, in turn, means local demand for protein needs to be obtained from other sources. Without appropriate complementary interventions this might increase the take of other wild terrestrial animals or reduce the nutrition of people within the community who lack access to cash to buy alternative foods. These complementary interventions might include programmes to increase update of poultry management or 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.

Conceptualising socio-ecological systems is necessarily complex and must find a balance between explicit local reflection and complexity and conceptual usefulness. In this series of studies, the team draws on three experiences and conceptualisations from studies in Solomon Islands and Vanuatu: those provided by Buckwell et al. for East Rennell (2024) and Port Resolution in Tanna (2020) and that by Sahin et al. (2021), which explored local, regional and country-level outcomes of EbA interventions.

Importantly, all conceptualisations determine end points as household and community well-being that supports community resilience to external shocks. In particular, the socio-ecological systems thinking informed our Q methodology statement concourse (see Section 7), which enabled us to consider a full range of concerns, relationships, and aspiration within the communities in each of the study areas.

2.6 Gender and social inclusion

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. 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 and Brockhaus, 2011). Furthermore, gender is not only a driver of different vulnerability to climate change but also should play a role in determining appropriate adaptations, as the needs and priorities of women are likely to different to men, or the community as a whole (Bryan, Kritjanson, and Ringler, 2015). Notwithstanding, womens' roles and leadership in adaptation, in the families, in communities, and in formal representative structures, is recognised as being necessary condition for fostering resilience (Aipira, Kidd, and Morioka, 2017). This is constantly demonstrated empirically, where womens' 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).

Solomon Islands is traditionally considered a male dominated and remains a largely patriarchal society, with men occupying positions of decision making in both formal representative democratic structures (the national parliament, for example) and at local, community level, where customary application of kastom lore can disadvantage women and the rights women do have – in using kastom natural resources – can be ignored.

Gender roles and the gendered division of labour continue to be sharply demarcated in Solomon Islands. Solomon Islands is a patriarchal society—men have greater access to important resources as well as greater institutional access to power and privilege (Dyer, 2017). Notwithstanding, women are increasingly participating in the formal economic sphere in Solomon Islands and play key roles in domestic and household decision making and in local management of natural resources. Nearly 30% of all businesses and approximately 20% of small and medium-sized enterprises in Solomon Islands are operated by women (Solomon et al., 2009).

However, gender consistently explains relationships of power, access to resources, vulnerability and resilience and is therefore a key category for analysis (Anderson, 2009, p. 3) and is therefore a vital element in assessing the climate adaptation literature and in designing community-based adaptation (CBA) and climate change adaptation (CCA) projects.

Throughout all of our observations we were careful to target the inclusion of women and women's perspectives. Our key data was collected from an individualised survey method (Q-methodology), which can ensure that women's voices are definitively collected.

2.7 International context

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 in Solomon Islands to simultaneously deal with climate change-induced risks and progress towards the **2030 Agenda for Sustainable Development** and the goals set out in the *Convention on Biological Diversity*.

The government of the Solomon Islands has also made greenhouse gas mitigation and adaptation commitments to the international community through the United Nations Framework Convention on Climate Change (UNFCCC) in its **Nationally Determined Contribution** (NDC) statement 2021 (Solomon Islands Government, 2021). The NDC statement commits the Solomon Islands to a range of actions relevant to an ESRAM including:

- Strengthen capacity for and raising awareness of activities relating to the Warsaw Framework for REDD+ [1] and Article 6 of the Paris Agreement to implement carbon projects.
- Ensuring engagement with carbon projects directly benefits resource owners.
- Supporting communities in sustainable forest management practices, including monitoring, reporting, and verification.
- Integrate gender considerations in planning of climate actions.
- Reviewing and revising the National Adaptation Programme of Action (NAPA).
- Develop a coordinated and geo-referenced national information system covering livelihood assets – natural, human, financial, social, and physical capital – that can be used to identify sensitivities to climate change, adaptive capacity, and natural resource and environmental management.

2.8 Study locations

2.8.1 Maramasike Passage and South Malaita

The locations for our ESRAM studies are shown in Figure 6 on South Malaita and the Maramasike Passage. The Maramasike Passage is a 45km channel that separates the two main islands of Malaita Province. On

[1] Reduced Emissions from Deforestation and Degradation +.

the north side is Malaita proper and to the south is South Malaita Island (also known as Maramasike). The wider northern entrance of the passage leads to Raroi Su'u Lagoon, a sheltered bay, which contains scattered coral reefs, islands and mangrove forests. The southern entrance is significantly narrower and deeper flanked by steeper banks. In places, the passage is less than 400 m wide and only about 4 m deep. The regional centre of Afio is stationed at the southern end. Afio has deep water port facilities, with regular ferry services, is proximate to the region’s airfield that has a regular air service, and hosts regular markets and Provincial government offices. South Malaita’s landcover predominantly comprises of heavily modified secondary forest, tropical primary forest, household subsistence gardens, and commercially logged concessions (Figure 7 and Figure 8). Since the 1980s the Solomon Islands has experienced a rapid expansion of export-orientated native forest logging (Porter and Allen, 2015). The largely permissive regulatory environment has resulted in forests suffering from poor logging practices and over-exploitation and there is deep community suspicion that the harvesting of their natural resources is not delivering the promised benefits (Kabutaulaka, 2005; Katovai, Edwards, and Laurance, 2015)

There is no formal mineral mining in South Malaita. The region’s agricultural systems are typical of Solomon Islands and the wider Pacific, with a system of shifting cultivation, and abandonment for a fallow period of secondary forest regrowth. Trees and other wild plants are exploited for food, building materials, and kastom medicines, and tree and palm species, particularly coconut, are used in local plantations. Areas where there is reasonable road access has broadened the accessibility of new cultivation areas for communities. The majority of households likely achieve their nutritional needs within the parameters of what they need but even though households have adequate access to food, there is a significant need to improve their nutritional needs, even if they consume the average amount of the required food groups (Bird et al., 2023). Raising pigs is also a traditional practice in Malaita. They are used for traditional practices, including payment as compensation, bride price, gifts and feasts (Allen et al., 2006).

Figure 6: Location of project areas in South Malaita, Malaita Province, Solomon Islands

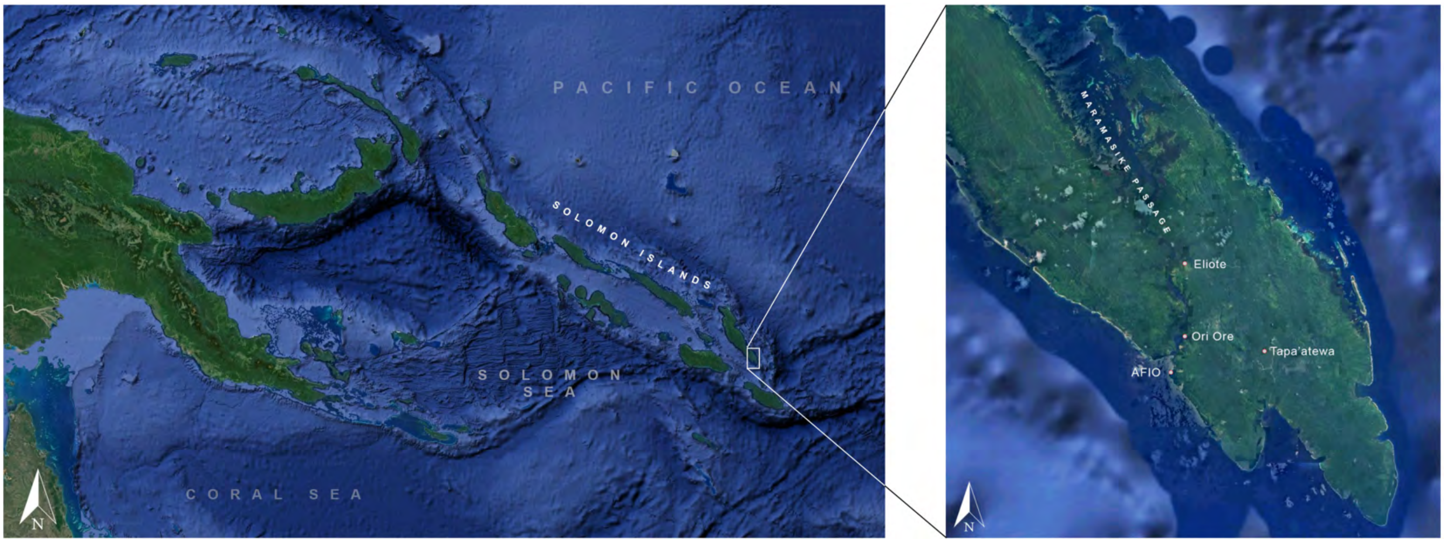


Figure 7: Land cover in South Malaita

Land cover in South Malaita is dominated by weedy secondary forest regrowth and remnant rainforest trees and patches of primary forest

Figure 8: Road incursion in South Malaita

Road incursion (supported by commercial logging) is enabling forest edge drying, weedy species incursion, but also cultivation and access to markets

Generally, cash income levels are low for the rural people of Malaita (Solomon Islands Government, 2009, 2019). The main sources are copra, cocoa and fresh food marketed locally or in Honiara (Allen et al., 2006). However, for many people, the only way to find sufficient income to pay fees for high school children is for the husband or the entire family to migrate elsewhere for wage employment, or to sell produce or services in Honiara. Like most Melanesians who invoke concepts of kastom, on becoming Westernised, they reflect on practices that may be lost or abandoned (Keesing, 1982).

Administratively, South Malaita comprises three local government wards, with a total population of 16,146 (Solomon Islands Government, 2019) (Table 1):

Table 1: Population and population change for three wards of South Malaita.

Ward	Population (2019)	Area (km^2)	Density (people per km^2)	Population change (2009-2019)
Rarosu’u	6,049	171.1	35.35	+1.9%
Aba-Asimeuru	5,929	110.6	53.60	+1.9%
Asimae	4,168	163.5	25.49	+3.2%
Total	16,146	445.2	36.27	

2.8.2 *Tapa’atewa and the Tapa’atewa catchment*

The Tapa’atewa river catchment is in the central highlands of South Malaita and drains southwards, with the village centred at -9.59085, 161.47262. The village itself is on a ridge above the river at around 180m elevation (Figure 9 and Figure 10). There are approximately 35 households and a population of 125 to 180 people. The area is currently and has been historically subject to significant commercial logging activities and subsequent disturbance of forest cover in terms of logging and road incursion around the community and across the wider catchment.

Downstream of Tapa’atewa, outside the customary lands is a relatively enclosed embayment, containing coral reefs and sea grass beds, which is the home for a number of small coastal communities, who likely engaging the harvesting of marine resources. Siltation from logged catchments is likely to have significant impacts on the water quality of this embayment, impacting coral growth and water quality.

Being in an area of commercial logging, roads servicing Tapa’atewa are in relatively good condition. There is reasonable access to a weekly marketplace on Maramasike Passage at Matangasi Port, which also has a jetty that is serviceable at low and high tide (at -9.590, 161.406). Local produce, in particular, betelnut, but also other food vegetables is sold here. There is no direct road access to the main port at Afio, however, Afio is just a short boat ride away.

Figure 9: Tapa'atewa environs

Image credit: Google Earth

Figure 10: Tapa'atewa community

Photo credit: Stuart Chape

2.8.3 Eliote and Ori Ore

Eliote (Figure 11) lays midway along the Maramasike Passage on higher ground at the end of a spring fed narrow tidal inlet behind a mangrove forest. There are approximately 69 households and a population of around 400 people. The village is not connected to the area by any road and access by boat is restricted to high (and near-high) tide only. At lower tides the access channel is much diminished in depth and is not navigable by boats or canoes. The community lays on higher ground, well above the high-water mark (5-6m above) on a narrow ridge extending towards the channel. It is surrounded by estuarine mangrove forest on three sides.

Ori Ore is a small settlement towards the southern end of the Maramasike Passage (Figure 12). There are approximately 19 households and a population of around 35 people in the village itself and a further ~125 who live in houses along the passage and away in Honiara and overseas, in Australia. Parts of the village is low laying, spreading up the hill well above the high-water mark. The village is serviced by a lighted jetty that is serviceable at both low and high tides (these is a key advantage).

Figure 11: Eliote and environs

Photo credit: Stuart Chape.

Figure 12: Ori Ore and environs

Photo credit: Stuart Chape.

2.9 Commercial logging activity in South Malaita

South Malaita has been subject to significant historic and continuing commercial logging beyond that proximate to Tapa'atewa. By way of examples, Figures 13 and 14, from the north of South Malaita (in catchments that drain into the confines of Maramasike Passage) show the significant impact of both the direct deforestation and the impact of the infrastructure that supports logging activity, including road incursion and the construction of shipping terminals. Figure 13 is imagery of the area prior to commercial activity (the date is unknown as Apple Maps do not publish timestamps for their map tiles). Figure 14 is more recent imagery from Google Earth (most likely 2024). Note, also, that the catchment drains into areas where coral reefs are present. Figure 15 is an example from the highlands area near Tapa'atewa showing the significant footprint and generally destructive nature of commercial logging.

Figure 13: A portion of northern South Malaita from undated Apple Maps aerial imagery

Figure 14: A portion of northern South Malaita from recent Google Earth aerial imagery

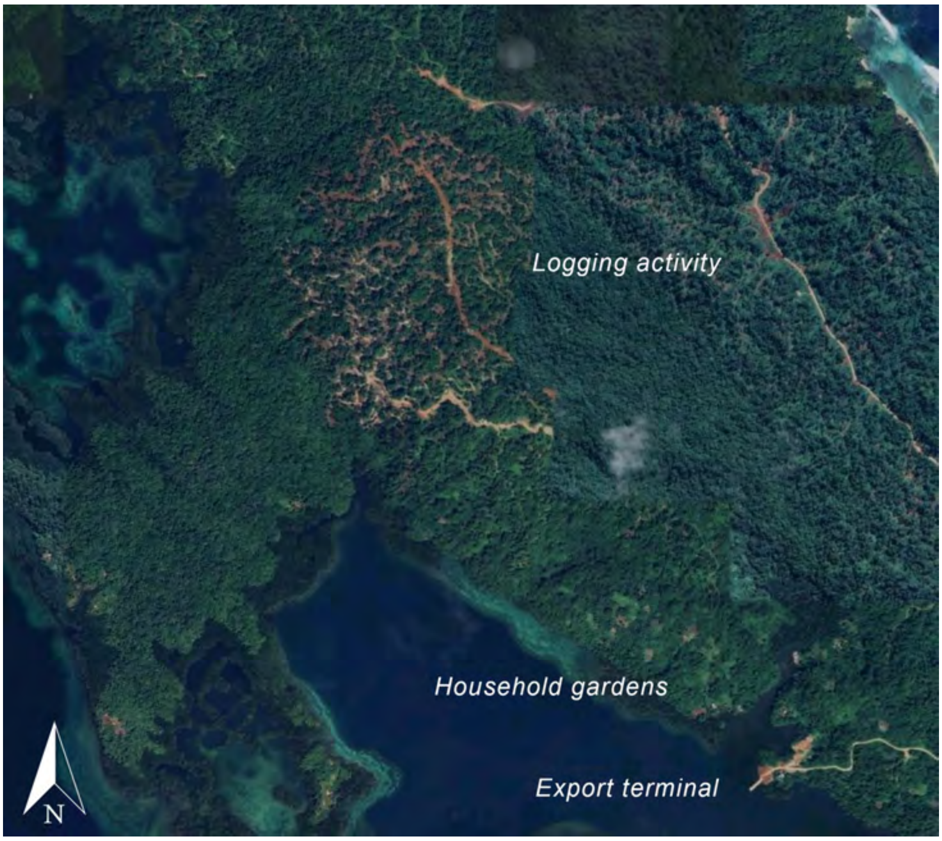


Figure 15: Commercial logging activity

Commercial logging activity in the South Malaita Highlands, near Tapa'atewa. Photo credit: Stuart Chape.

Serving logging in central South Malaita, again on the Maramasike Passage, we encountered the logging terminal shown in Figure 16 (at –9.5304, 161.3985, which appeared to export both round logs and cut timbers, as evidenced by planks also stored there. This suggests the presence of a saw mill. The timber industry services and maintains a number of roads on the island, which are in relatively good condition and are freely used by members of the community.

Figure 16: Logging terminal in Maramasike Passage

Commercial operations have established terminals along Maramasike Passage. This terminal site is towards the south of the passage, near Ore Ori at -9.5304, 161.3985. Note the barge and tug ready for loading. Photo credit: Stuart Chape.

3 Climate impacts on Solomon Islands and Malaita Province

As tropical developing island nation, the Solomon Islands has particular vulnerabilities and exposures to the current and future impacts of climate change. This section highlights country-level data, projections, and general climate risk assessments only. Downscaled climate data and projections are not available. Specific risks to the socio-ecological systems of the study areas are detailed in Sections 5, 6, and 7.

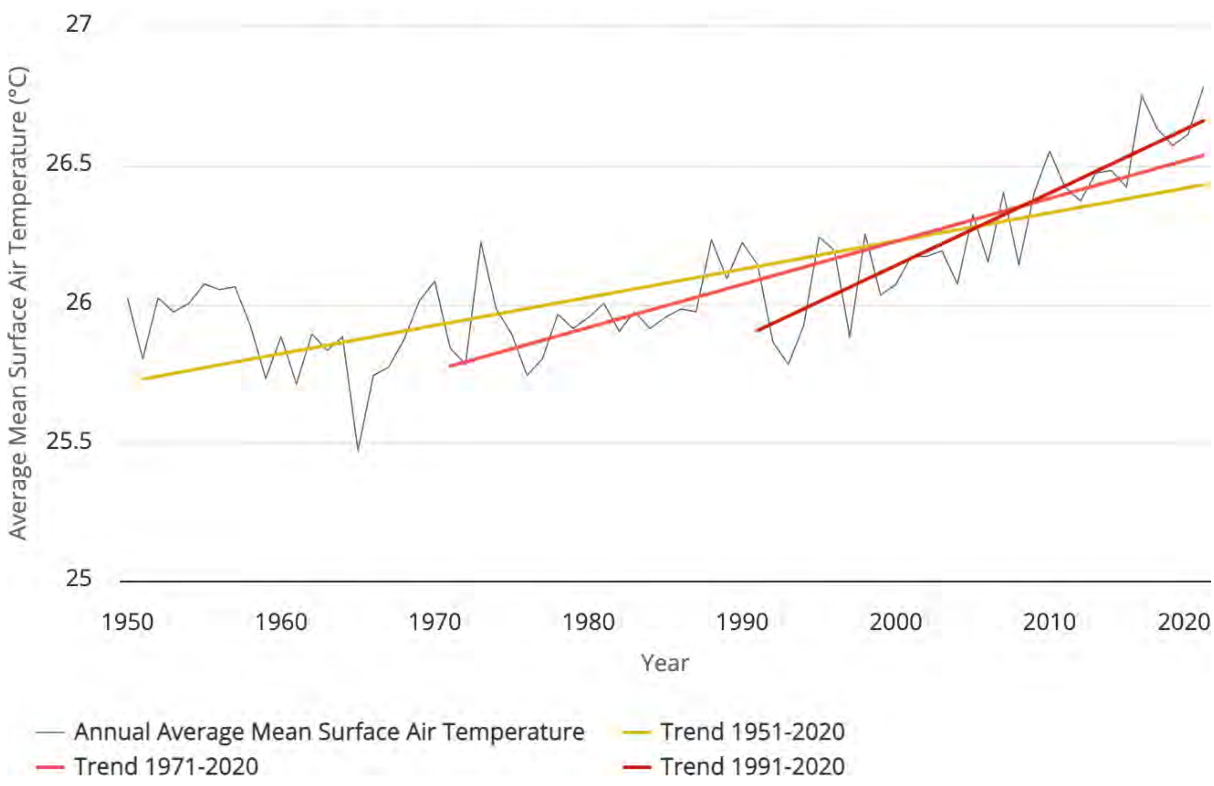
3.1 Overview

Year to year the climate of the Solomon Islands is influenced by interconnected, large-scale climate phenomenon, such as the El Niño–Southern Oscillation (ENSO), which alters inter-annual rainfall patterns, temperatures, and wave direction. However, due to its location near the equator, the Solomon Islands experiences a relatively stable climate (distribution of mean weather) with average temperatures between 24.5°C and 26.5°C year-round. Average monthly rainfall is also relatively consistent, ranging from 150–350 millimetres (mm), and usually peaking between January and March.

Notwithstanding, historical climate data point to increases in average temperature between 1962–2012 at a rate of around 0.14–0.17°C per decade (Figure 17). And rates of warming appear to have accelerated since about 1990, with the Berkeley Earth Dataset suggesting temperatures in 2015–2017 have reached around 0.8°C above the long term average (Climate Change Knowledge Portal, 2023; World Bank Group, 2021).

Figure 17: Solomon Islands average mean surface air temperature annual trends

This included significance of trend per decade for 1951-2020 showing accelerating increases. Data from Climate Change Knowledge Portal, 2023



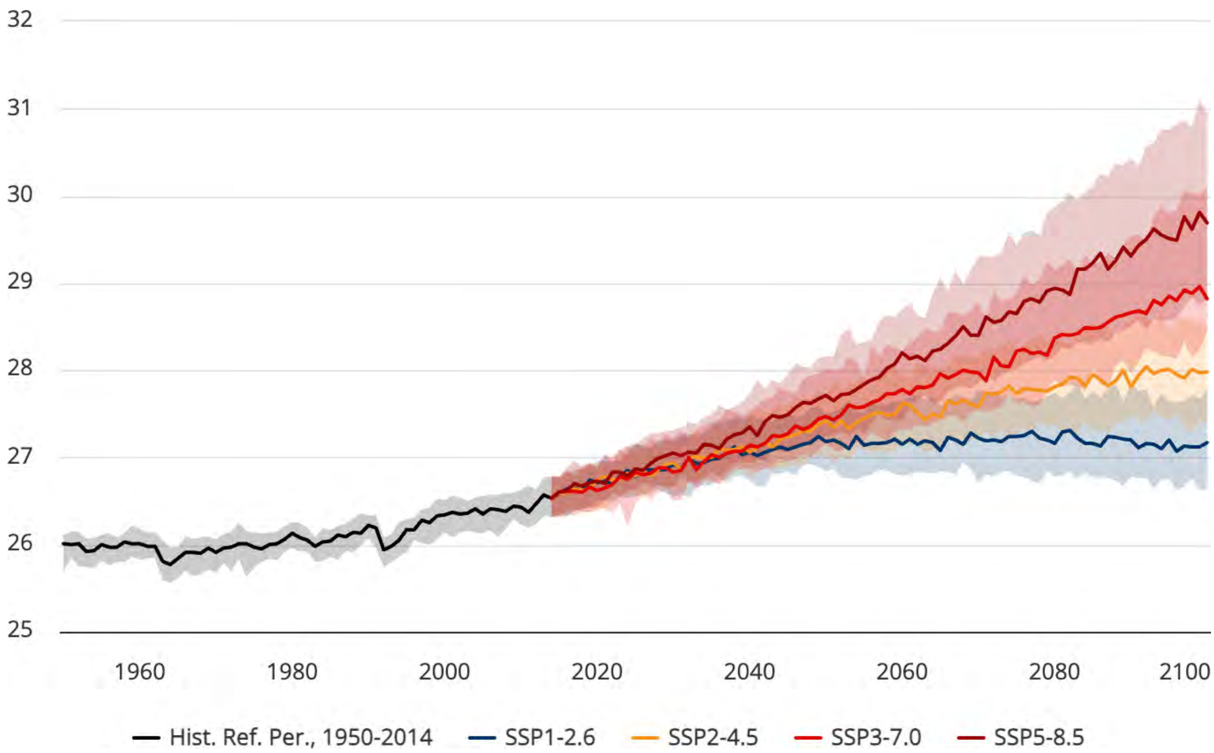
3.2 Projected future climate changes

Projections for the Solomon Islands in the Representative Concentration Pathways [2, 3] (RCPs) suggest that temperatures will rise between 0.7°C (0.4°C -1.2°C) in the high mitigation scenario (RCP 2.6) and 2.8°C (2°C - 4°C) in the low emissions scenario (RCP 8.5) by 2090 (Figure 18). Climate change is likely to be below the global average in the Solomon Islands with the difference reflected in the moderating effect of large amounts of nearby ocean cover. However, ocean cover is known to distort model simulations, and the current iteration of global models does not have the spatial accuracy to reliably capture climate processes over small island states, these projections should be approached with caution (World Bank Group, 2021).

There is some evidence that annual precipitation will increase slightly, however, there is uncertainty around future changes, as models disagree, particularly around the future impacts of ENSO. A warmer atmosphere is likely to lead to an increase in the frequency and intensity of extreme rainfall events.

Figure 18: Solomon Islands multi-model ensemble projected mean temperature to 2100 under a range of Representative Concentration Pathways

Data from: Climate Change Knowledge Portal, 2023



3.3 Further climate change impacts

3.3.1 Sea level rise

The IPCC's 6th Assessment Report (AR6) (IPCC, 2023) concludes that global sea level rise is accelerating and is projected to continue to do so in the future. The report states that sea levels have risen by about 20 cm since the late 19th century and are currently rising at a rate of about 3.6 mm per year. This rate is

[2] Since the International Panel on Climate Change's (IPCC) sixth assessment report (AR6) projected future changes to climate and impacts on society are now modelled through 'Shared Socioeconomic Pathways' (SSPs). SSPs have not replaced RCPs. The two ways of looking at projected future changes both remain valid and active. However, whilst RCPs focussed on carbon dioxide concentration ('radiative forcing') pathways, SSPs are meant to provide a more comprehensive framework that includes the interactions between social, economic, and environmental factors.

[3] There are four Representative Concentration Pathways: RCP2.6, RCP4.5, RCP6.0, and RCP8.5. They represent four plausible futures, based on the rate of emissions reduction achieved at the global level and are defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100.

expected to increase to 4-9 mm per year under RCP2.6 and 10-20 mm per year under RCP8.5 by the end of the century.

The report also states that sea level rise will continue for centuries beyond 2100, even if greenhouse gas emissions are reduced. This is because the oceans have a large thermal inertia, meaning that they take a long time to warm up and cool down. As a result, sea levels will continue to rise even after global warming has been stabilized.

The Solomon Islands are in an area that has experienced above average rates of sea-level rise in recent decades [4]. Estimates show a rise of ~8–10 mm/year between 1993 and 2010 (World Bank Group, 2021). Note this is relative sea level rise which is a net combination of increases in sea surface levels and any uplift / recession that specific parts of tectonically active areas experience (Faivre et al., 2022). In addition, localised sea level rise is impacted by regional cyclical phenomena, in particular ENSO. Global mean sea-level rise is estimated in the range of 0.44–0.74 meters (m) by the end of the 21st century according to the IPCC's Sixth Assessment Report (IPCC, 2023). Such increases are a significant threat to low lying coastal areas in the Solomons.

3.3.2 Tropical cyclones and extreme weather

Tropical cyclones have historically impacted the Solomon Islands and its exclusive economic zone at a rate of around 21 cyclones per decade, with around a quarter categorises as Category 3 and above (World Bank Group, 2021). Cyclones frequency is influenced by the ENSO cyclone. Figure 19 shows recent tracks of tropical cyclones over Malaita between 1982 and 2022 (BOM, 2023). The general projection is for a decrease in cyclone formation frequency through to 2100 by between 6%–35%. However, there is also evidence that the intensity of cyclones may increase. Any uncertainty is based on the future of ENSO cycles, which is not very well understood (BOM & CSIRO, 2014).

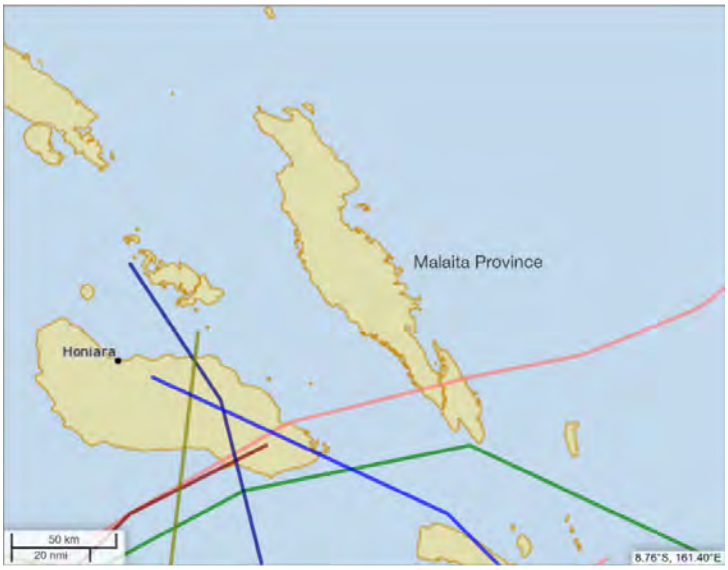


Figure 19: Cyclone tracks across Malaita Province between 1982-2022 (BOM, 2023)

[4] According to the Solomon Island's Second National Communication to the UNFCCC.

3.4 Downscaled climate impacts and impacts on ecosystems

Downscaled climate projections, for example, at an island or provincial level are not available.

Downscaled sea level rise projections are also subject to considerable uncertainty, particularly in tectonically active regions, such as the Solomon Islands and Melanesia, as a whole. Whilst the Solomon Islands lays in a region where sea levels have been rising relatively quickly, different islands are still subject to local uplifting and recession, meaning that *net* sea level rise is the key metric for determining local sea level rises. For example, when investigating local erosion in Port Resolution (Tanna, in Vanuatu) Faivre et al. (2022) determined that the area was subject to tectonic uplift (net sea level recession) and that local erosion is likely caused by other climate factors, including shifts in dominant wave patterns causing erosion in new places.

With lack of downscaled climate impacts and significant uncertainty in assessing localised net sea level rise, we cannot disaggregate climate change-driven environmental changes from other localised anthropogenic impacts, such as natural resource management, population growth. Therefore, assessments of the impacts of climate change and sea level rise are covered in the comprehensive ecosystem risk assessments in Sections 5, 6, and 7.

4 Ecosystem mapping and economic valuation approach

This section describes our approach to our ecosystem mapping and ecosystem service valuation.

4.1 Ecosystem mapping

Terrestrial ecosystems can be identified and mapped using various criteria, from a practical perspective (and in a Melanesian 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 the Solomon Islands, with transition between forest, rotational subsistence gardens, and secondary forest regrowth. Thousands of years of shifting cultivation and regrowth has left only the remotest areas and steepest terrain completely unmodified – it has been suggested that disturbed and logged forest will take more than 50 years to recover (Katovai, Edwards, and Laurance, 2015; Katovai et al., 2021). Nonetheless, South Malaita and the Solomons Islands, generally, still contains very significant tracts of primary forest.

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 existing global datasets and the training of machine learning tools using the library of support vector machines (libsvm) classification through Google Earth Engine. We used 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 the accuracy of the outputs.

Further global datasets we used included:

1. Tree cover loss data was extracted from Global Forest Watch (Global Forest Watch, 2024).
2. Coral reef data we used extracted extent data from the Allen Coral Atlas (Allen Coral Atlas, 2024).
3. Mangrove extent and loss data we used extracted date from Global Mangrove Watch (Bunting et al., 2022; Global Mangrove Watch, 2024).
4. Sea grass likely extent is data extracted from Allen Coral Atlas (Allen Coral Atlas, 2024)

Consistent with the UN's System of Environmental Economic Accounting Ecosystem Accounting (SEEA-EA) (UN Statistical Division, 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 and Banzhaf, 2007).

4.2 Ecosystem services

Our ecosystem service classification is a modified version of that used by the SEEA-EA (UN Statistical Division, 2021) to best fit the range of datasets for which we can determine economic valuations, which were majority provided by the Ecosystem Services Valuation Database (Brander et al., 2024) and the original ecosystem services database constructed by de Groot et al. (2012) for The Economics of Environment and Biodiversity (TEEB) and then as extracted by Buckwell et al. (2020).These classifications are not entirely consistent. Table 2 provides a comparison between the SEEA-EA and the ecosystem services classification used by TEEB and used here, alongside a generalised description of each ecosystem service.

Table 2: Comparison of ecosystem services classification from SEEA EA and TEEB.

Domain	Ecosystem service from SEEA-EA	Mapped to ecosystem service based on TEEB	Description
Provisioning	Biomass - crops Biomass - Grazed biomass Biomass – Livestock Biomass - Aquaculture Biomass -Wild fish and wild animals	Food Ornamental resources Medicinal resources	Contributions of nature to the production of cultivated food, wild harvested food (including food for domesticated animals) and contributions to medicine.
	Biomass – Wood	Raw materials / energy	Contribution of nature to biomass for building and construction and for burning fuels.
	Genetic material	Genetic resources	Development of new animal and plant breeds; gene synthesis; and product development.
	Water supply	Water supply	The combined ecosystem contributions of all parts of water flow regulation and filtration to human consumption.
Regulating	Global climate regulation	Climate regulation	Carbon sequestering and storage services.
	Rainfall pattern	-	
	Local climate regulation	-	
	Air filtration	Air quality regulation	Filtering of air-borne pollutants through the deposition, uptake, fixing and storage.
	Soil quality regulation	Soil fertility maintenance	Decomposition of organic and inorganic materials and to the fertility of soils.
	Soil and sediment retention	Erosion control	Stabilisation services that mitigate against soil washing away and landslips.
	Solid waste remediation	Waste regulation	Transformation of organic or inorganic substances that mitigates their harmful effects.
	Water purification	Water supply (see above)	
	Water flow regulation	Water flow regulation	Regulation of river flows and groundwater and lake water tables derived from the ability of ecosystem to store and release water, including both a baseline flow and peak flow mitigation.
	Flood control	Moderation of disturbance	Vegetation that mitigates both flooding rivers and coastal protection services from protecting against wave energy.
	Noise attenuation	-	
	Pollination	Pollination	Contributions of wild pollinators to the fertilization of crops.
	Biological control	Biological control	Pest species control from natural, not human functions.
	Nursery and population & habitat maintenance	-	
Cultural	Recreation related	Recreation	Characteristics and qualities of ecosystems that enable all people's use through direct experiential interactions.
	Visual amenity	Aesthetic	

	Education, scientific & research	Cognitive	Ecosystem contributions resulting from characteristics and qualities of ecosystems that enable people to use the environment through intellectual interactions with the environment.
	Spiritual, artistic & symbolic	Spiritual Inspiration Existence value	Contributions from the characteristics and qualities of ecosystems that are recognised by people for their cultural, historical, aesthetic, sacred or religious significance.

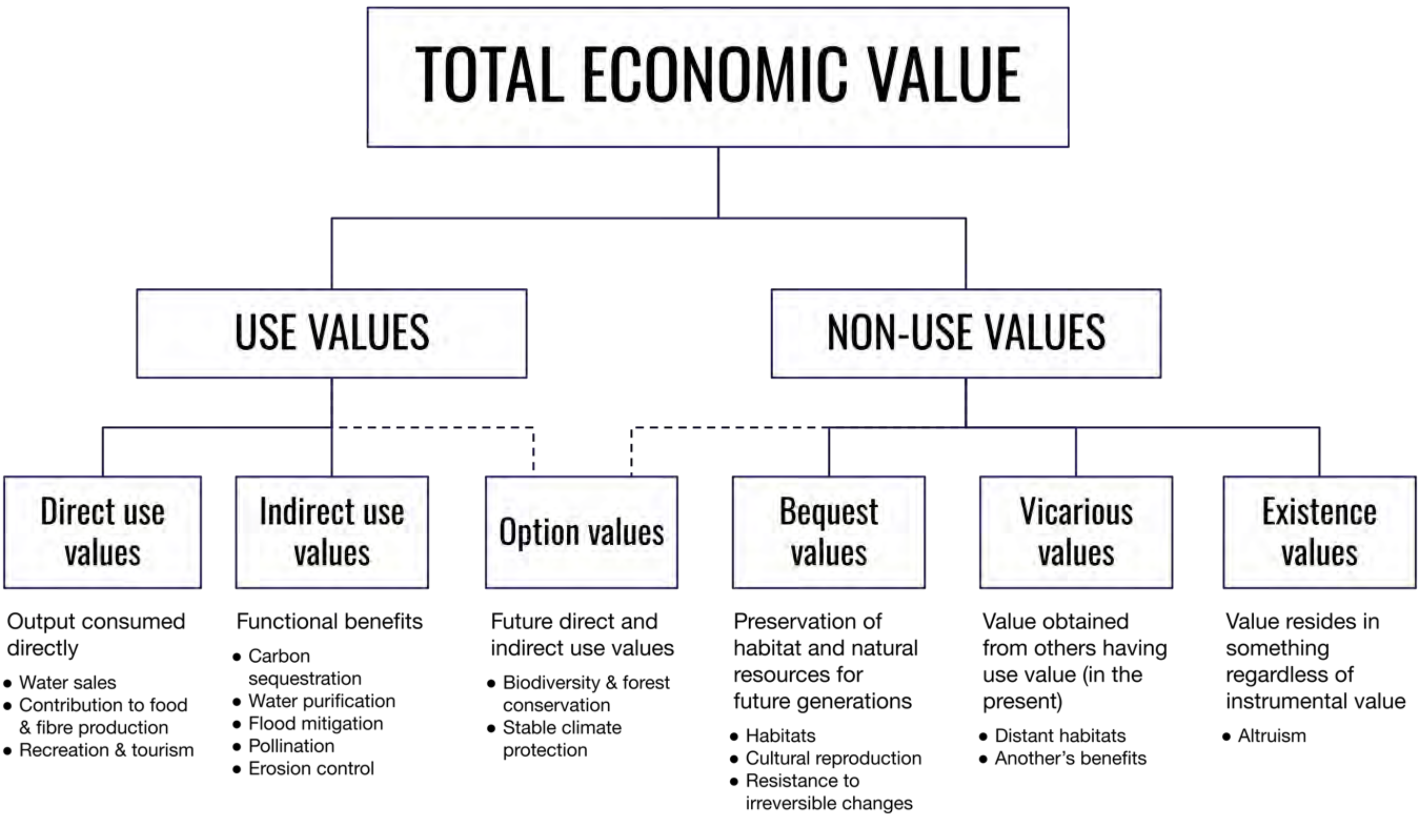
4.3 Ecosystem service valuation

The SEEA-EA framework (UN Statistical Division, 2021) 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 to enable trade-offs and benefits to be more effectively assessed. Not all ecosystem services lend themselves well to economic valuation for specific local cultural reasons (for example, some spiritual services).

4.3.1 Total economic value

The team used a Total Economic Valuation (TEV) framework (Figure 20) (Buckwell and Morgan, 2022). 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 total ecosystem service value (TESV) (Gashaw et al., 2018).

Figure 19: Total economic value framework



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 and Morgan, 2022):

1) **Decision-making** – Helping policymakers, governments, and businesses to better understand and prioritise the trade-offs involved in land-use decisions, resource management, and environmental policies, particularly using social cost benefit and cost effectiveness analysis.
2) **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.
3) **Raising awareness or political support –** To help build support from the public, businesses, and policymakers about the importance of preserving natural capital and biodiversity by enabling comparisons traditional, and more familiar, economic measures, such as GDP.
4) **Facilitating market-based mechanisms –** To support the development of market-based instruments for the protection of natural capital, such as payments for ecosystem services programs (where beneficiaries compensate providers for the maintenance or enhancement of specific ecosystem services).

By way of 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!

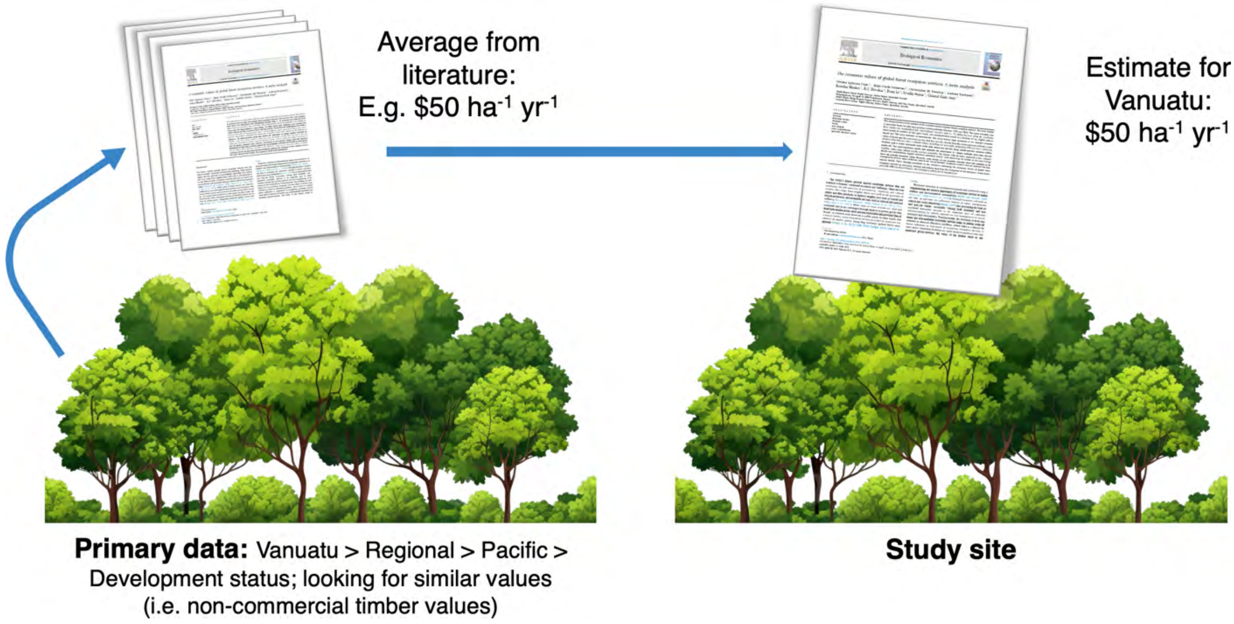
4.3.2 Benefit transfer

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. This approach is useful when a primary study for the target site is not possible due to time and/or budget constraints (see Figure 21).

The team drew estimates from a range of sources, including databases from Brander et al. (2024), Taye et al. (2021) and van der Ploeg & de Groot (2012) filtered in accordance with those deployed in assessing TESV for Vanuatu and Tanna by Buckwell et al. (2020). Buckwell's study could only find a single data point for the value of subsistence farming that would be appropriate for the Solomon Islands – that by Anderson (2006) for communities in Papua New Guinea – and this remains the case today.

While the authors recognised this as a potential weakness in their study, geographic and cultural similarities suggest it could be an effective substitute.

Figure 20: Benefit transfer method



Benefit transfer method

Our benefit transfer for value estimates took the following hierarchy of value estimates:

1) Estimates from Pacific islands from the Ecosystem Services Valuation Database (Brander et al., 2024).
2) Estimates from appropriate value estimates (low income countries) from the TEEB Valuation Database (de Groot et al., 2012) as extracted by Buckwell et al. (2020).
3) Specific valuation from Anderson (2006) for the value of subsistence agriculture (from Papua New Guinea)

Where multiple values were extracted from the datasets, the median value of all datapoints was calculated. At each step, where gaps in individual ecosystem service valuations for the range of habitat types were not filled, they were filled by the next step. In all instances, only per hectare, per year estimates were used. All valuation methods were considered. Value estimates were normalised to 2022 US dollars estimates using GDP deflator values from World Bank datasets (World Bank, 2023) and the 12 month mean exchange rates between currencies.

4.3.3 Residual method

We also used the residual method, which quantifies the value attributable to non-priced inputs to agricultural production (Young, 2010). For example, plantation cropping demands a combination of human and natural inputs to provide the final ecosystem service (food). Human inputs (labour, fuel) generally have clear exchange values already priced into the cost of production. The residual method subtracts the costs of human inputs from the gross revenue obtained from agricultural production and then assigns the resulting margin as the return attributable to relevant nonmarket, unpriced inputs. We used the residual method to estimate a per hectare value per year value for plantation agriculture from Buckwell et al. (2020).

4.3.4 Economic value estimate coefficients

From this range of sources, the team estimated an ecosystem coefficient based on the median values from the filtered list of appropriate benefit transfer values. This is reported in Table 3. To provide the TESV for each of the region's ecosystems we multiply the coefficient value by the mapped extent (in hectares). This are reported in Sections 5, 6, and 7.

Box 2: The economic value of subsistence agriculture

Of particular note is the estimate for the economic value of subsistence agriculture 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 applied for a typical household of 2 adults and 4-5 children and can be applied on both a per hectare basis, or a per household basis.

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 agriculture. The value provided by Anderson is significantly inflated from its original 2016 values due to relatively high price inflation in PNG in the subsequent years but is also moderated by a significant loss of value of the PNG Kina against the US dollar.

Table 3: Ecosystem service valuation coefficients (2022 US$ per hectares per year)

Ecosystem service	Coral reef	Mangrove forests	Sea grass	Grasslands	Primary forest	Secondary forest	Plantation	Subsistence agriculture	Freshwater water bodies
Provisioning									
Food	69	693	26	42	8	8	61	8,108	23
Water supply				150	232	232			1,494
Raw materials / energy	1.0	215		8	37	37			1
Genetic resources					7	7			
Ornamental resources					57	57			
Medicinal resources	3	3							
Regulating services									
Air quality regulation		236		114	497	497			
Climate regulation	231	483	56	338	140	140			65
Moderation of disturbance	204	990			52	52			
Water flow regulation					1	1			
Erosion prevention		102			119	119			
Soil fertility maintenance		224		277	16	16			1
Waste									
Pollination					47	47			
Biological control	0.3								
Cultural services									
Aesthetic	3								
Cognitive	2								
Inspiration									
Spiritual	1								
Recreation	381	982		5	1,190	1,190			431
Existence value									

4.3.5 Establishing final ecosystem service valuations

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 and 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.

Ecosystem accounting reconciles inputs and outputs so that the value of final services is the sum of value–added through intermediate components. In general, regulating ecosystem services are intermediate services to final benefits enjoyed locally and therefore not totalled in a TESV (though nevertheless present useful information for decision-making). The exceptions to this are (a) air quality regulation (an end in itself); (b) erosion control and moderation of disturbance (b) climate regulation, which, although it provides a measure of an intermediate service (a stable climate) that contributes to local food production, for example, it also provides a final service to global society as a public good or a private good if emissions reductions are converted into a carbon permit; and (c) the moderation of disturbance functions of coral reefs and mangroves, providing coastal protection.

5 Marine ecosystems and ecosystem services assessment

This section describes the application of our mapping and economic valuation approach, detailed in Section 4, to the marine ecosystems associate with the communities of Eliote and Ori Ore and to the Maramasike Passage and South Malaita, in general. We set out our assessment in terms of the key ecosystem service assets that provide use and non-use value to these communities. For each ecosystem asset we set out its extent, location, and its economic valuation, and then we set out the key risks to the ecosystem asset.

5.1 Sea grass

Seagrass beds are crucial ecosystems for habitat for marine life, in particular, marine life nurseries for fish, they stabilize sediments. Sea grass beds also improve water quality and sequester carbon, thus supporting biodiversity and mitigating climate change (McKenzie et al., 2021). Their role in mitigating climate change is also being increasingly recognised in projects that support blue carbon.

Assessing the species distribution is beyond the scope of this project.

5.1.1 Sea grass ecosystems and ecosystem service valuation

We used Allen Coral Atlas to estimate sea grass extent (Allen Coral Atlas, 2024). It should be noted that sea grass beds are naturally relatively ephemeral, therefore, Figure 22 shows the likely *maximum extent* of *potential* sea grass beds in the Maramasike Passage. This extent is estimated to be **1,960 ha**. Data points for ecosystem service economic values were available for food and for climate regulation (i.e. carbon storage). (Note that, similar to mangrove forests, significantly more carbon is stored in the sea grass ‘soil’ – the substrate below the surface of the water – and is therefore relatively permanent.) Figure 23 reports the total ecosystem service values for sea grass beds.

Figure 21: Maximum extent of sea grass beds

The maximum likely extent of sea grass beds in the Maramasike Passage. Note the sea grass beds are relatively ephemeral and subject to year-to-year variability. Data source: Allen Coral Atlas.

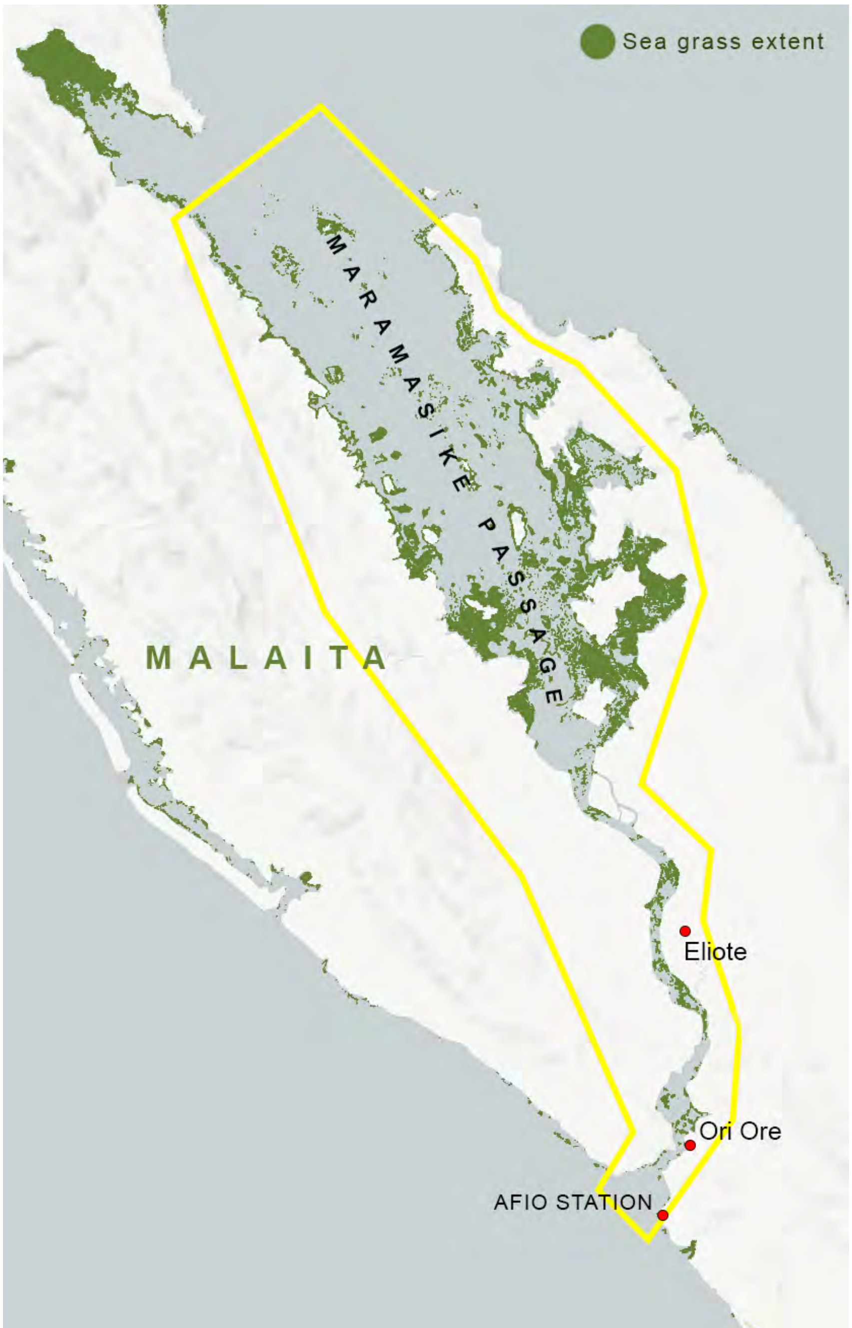
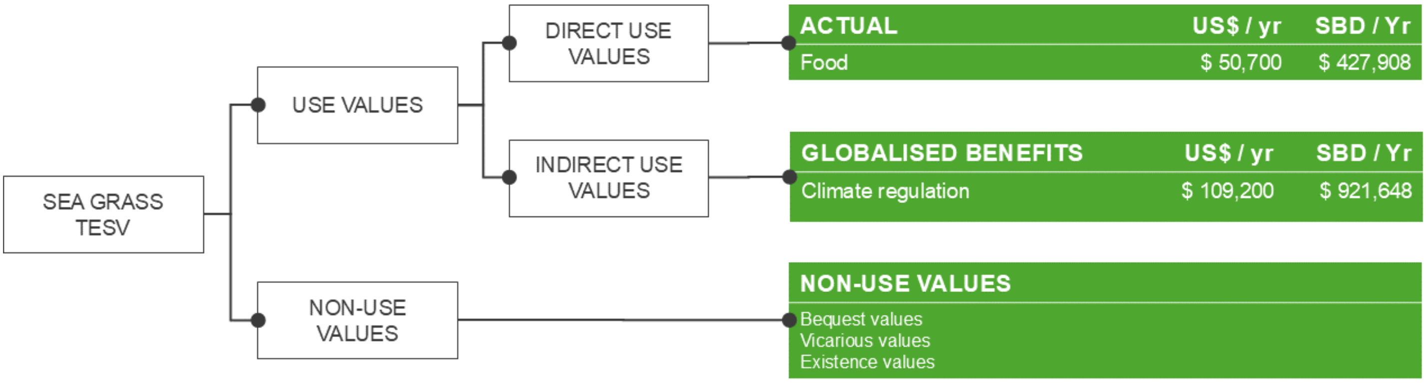


Figure 22: Total ecosystem service values for sea grass beds in Maramasike Passage



5.1.2 Threats to seagrass ecosystems

Seagrass beds in the Maramasike Passage face a number of threats, including: coastal development (for example, commercial logging facilities), which cause habitat destruction and sedimentation that blocks sunlight. (The Maramasike Passage hosts at least two commercial logging facilities); nutrient runoff from sewage from poor sanitation, which causes algal blooms; rising sea temperatures that stresses seagrass beds and leads to increased susceptibility to disease; rising sea levels that can block light; ocean acidification that can affect the growth and structural integrity of seagrass; destructive fishing methods and poor boating practices that can physically damage beds; and increased storm activity that can reduce recovery periods. Notwithstanding these threats, seagrass beds in the Pacific are considered to be in generally good condition (McKenzie et al., 2021), but given the limitations of the budget for this study, this could not be confirmed for the Maramasike Passage.

5.2 Coral reefs

Coral reefs are crucial for the communities of Maramasike Passage by supporting fisheries that provide food and livelihoods, and the potential for attracting tourists and therefore boosting income from tourism-related activities, such as diving and snorkelling. Additionally, coral reefs act as natural barriers to wave energy, protecting coastlines from erosion and storm damage, thus reducing costs associated with coastal protection and damage to infrastructure and houses, particularly during cyclones and extreme weather. The Maramasike Passage has coral reefs through most of its length, but in particular, in the wider, northern lagoon area, close to Eliote’s access channel to the Passage.

5.2.1 Coral reef ecosystems and ecosystem service valuation

We used Allen Coral Atlas (2024) to estimate coral reef location extent. The ecological condition of coral reefs is strongly related to ecosystem service generation, particularly that for food (fisheries) and the potential tourism. Ecological integrity is very dependent on proximity to human settlement and is highly sensitive to sediment exports from deforested catchments (Brewer et al., 2013; Cinner et al., 2013), fishing effort (particularly the harvesting of herbivorous fish), and coastal development (particularly from the impacts of poorly treated sewerage).

The coral reefs around Afio (at the southern end of the Maramasike Passage) were observed to be highly impacted and therefore in very poor condition, in terms of coral cover and subsequent fish life. Therefore, these reefs are unlikely to support a healthy fishery and will provide no potential tourism value. In the long term, severely degraded coral reefs will eventually lose their coastal protection values. At the northern end of the passage, deforested catchments drain into the lagoon and likely have a measurable impact on coral reef ecosystem integrity, again reducing the potential for tourism and fisheries. Other than the generalised ecological assessment provided here, this report does not contain any detailed assessment of the condition of coral reefs through the Maramasike Passage.

The extent of coral reef habitat extent and location for the Maramasike Passage is shown in Figure 24, which shows the Benthic Map layer with the Coral/Algae extent isolated for measurement. Coral reef/algae extent is **1,484 ha**.

Figure 25 reports the total actual and potential ecosystem service values for the coral reefs of the Maramasike Passage, notwithstanding assessments of ecological integrity.

Figure 23: Coral reef extent in the Maramasike Passage

Data source: Allen Coral Atlas.

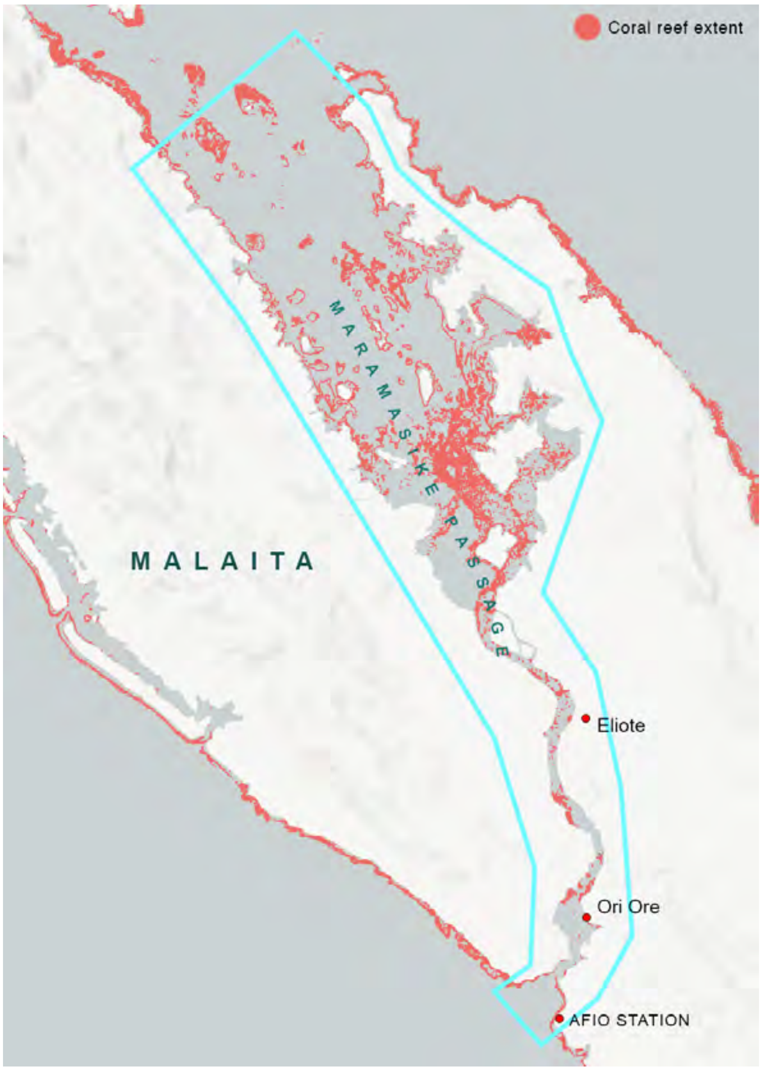
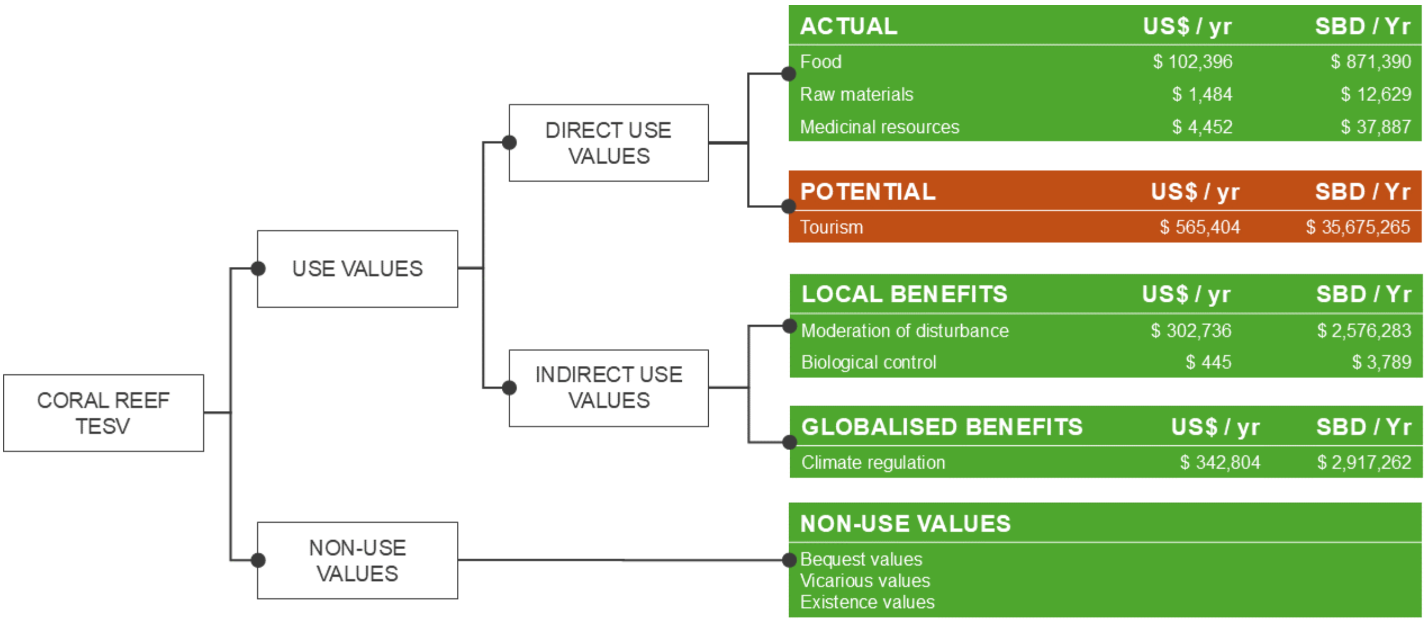


Figure 24: Actual and potential total ecosystem service value of coral reefs in the Maramasike Passage



5.2.2 Threats to coral reef ecosystems

Threats to the coral reefs of the Maramasike Passage are manifold and manifest.

Land based pollution and human settlement

It is widely accepted that there is a negative relationship between coral reef ecosystem condition and proximity to human populations, socio-economic development, population densities, and the mix of economic activities, largely as a result of land-based pollution exports (Mackey et al., 2017). The reefs of the Maramasike Passage will also be impacted by sediment run-off from broadscale commercial logging, which can dramatically increases turbidity restricting light and slows new coral recruitment on reef substrate (Brown et al., 2017) [5].

Figure 26 shows this threatening process in action, with sediment clear being noticeable in the river (to the right of the photo) and in the Maramasike Passage in the top centre. Figures 27 and 28 show average annual water turbidity in the Maramasike Passage for the year 2020 (Figure 27), which was a relatively wet year and 2023 (Figure 28), for which there is no rainfall data available from the Australian BOM [6]. Note also that this northern end of the passage has been subject to significant commercial logging.

[5] For methods associated with turbidity calculations, see: https://allencoralatlas.org/methods/#turbidity

[6] See http://www.bom.gov.au/cgi-bin/climate/pccsp/site_data.cgi?download=%2Fweb01%2Fncc%2Fwww%2Fpccsp%2FSLB_000003_Rain.csv&ts_period=monthly&data_source=raw&variable=Rain&period=annual&s_yr=2018&e_yr=2023&ave_yr=0&unit=A&nat_id=SLB&station=000003

Figure 25: Evidence of sediment export

Evidence of sediment being exported into Maramasike Passage from heavily logged catchments. This example is from the terminal at -9.5304, 161.3985 near Ore Ori. Note also the sediment-laden river to the right of the photo. Photo credit: Stuart Chape.

Over-harvesting of wild fish and marine life

Over-exploitation of herbivorous reef fish stocks also represents risks to coral reefs, particularly during re-growth phases after short-term perturbations, where algal growth is in directly competition with new coral recruitment (Brodie and Waterhouse, 2012). There are also links between loss of apex predators and general reef fish diversity (Cheal et al., 2010). In addition, McCook (1999) and Olds et al. (2014) argue that reefs can maintain resilience to external perturbations (e.g. bleaching) where healthy populations of herbivorous fish are present. Therefore, maintaining wild reef fish catch well below maximum sustainable yields is a key to reducing threats of coral reef degradation. In addition, where wild take is for profit (rather than solely subsistence), access to market is another measure that can predict reef condition (Brewer et al., 2013). As a result, the production of Pacific coastal fisheries from coral reefs is expected to decline by up to 50% by the end of the century (Bell et al., 2016).

Climate change

Climate change is projected to have significant impacts on marine environments. Increased frequency of coral bleaching and ocean acidification may progressively degrade reefs leading to decreased coastal protection (greater risk from extreme weather events to coastal communities) and to diminished fish catch (Duvat and Pillet, 2017; Hoegh-Guldberg et al., 2007; Pittock, 2010; Turley and Gattuso, 2012)

The production of coastal fisheries from coral reefs is expected to decline by up to 50% by the end of the century (Bell et al., 2016). Moreover, climate change is expected to increase damage to reefs from more severe physical damage to reefs, while greater sediment and nutrient runoff from heavier rainfall would damage coral reefs more frequently, particularly in study areas that have significant rivers, such as Guadalcanal and Malaita (Bell et al., 2016). Combined, this is a cause of phase shifts from hard coral cover to algal cover, which globally increase by around 20% since 2010 (UNEP, 2024).

The complex interplay between these factors is beyond the scope of this report, but it will suffice to say that coral cover in the Maramasike Passage will likely become under very significant increasing pressure current climate trends and activities continue.

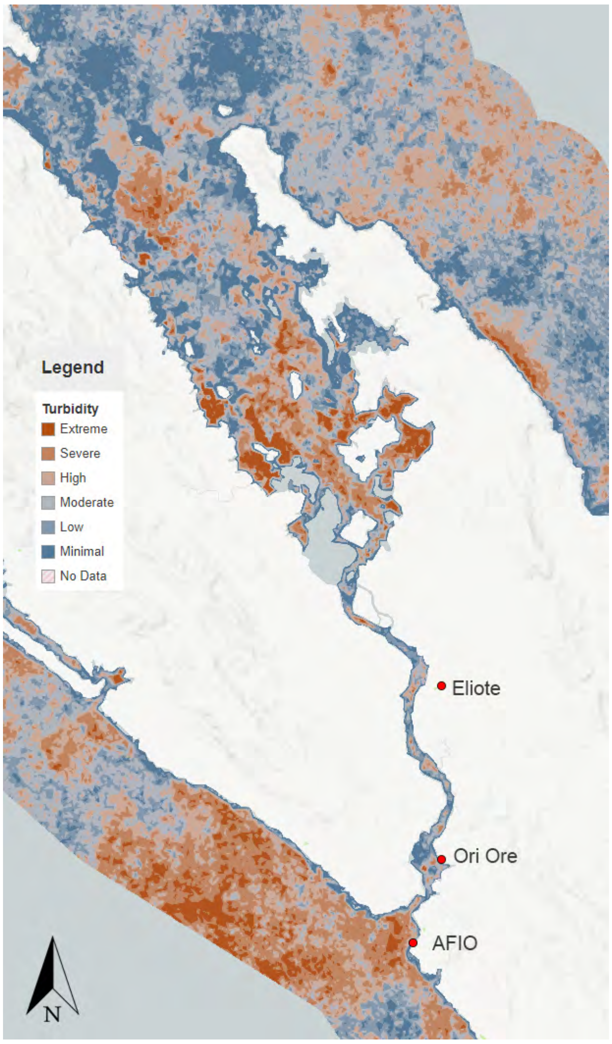


Figure 26: Turbidity in the Maramasike Passage (average annual turbidity for 2020) (Allen Coral Atlas, 2024).

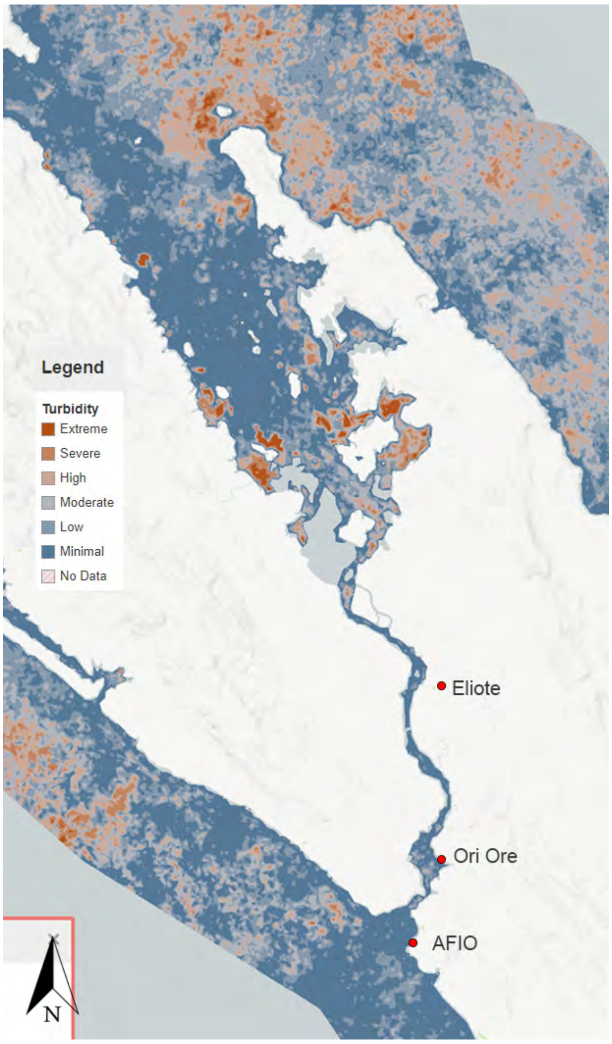


Figure 27: Turbidity in the Maramasike Passage (average annual turbidity for 2023) (Allen Coral Atlas, 2024).

6 Inter-tidal ecosystems and ecosystem services assessment

This section describes the application of our mapping and economic valuation approach, detailed in Section 4, to the inter-tidal zone ecosystems associate with the communities of Eliote, and Ori Ore and to the Maramasike Passage and South Malaita, in general. We set out our assessment in terms of the key ecosystem service assets that provide use and non-use value to these communities. For each ecosystem asset we set out its extent, location, and its economic valuation, and then we set out the key risks to the ecosystem asset.

6.1 Mangrove forests

Mangrove forests typically occupy lowland estuaries and river mouths where there is sufficient freshwater supply. Mangrove forests are vital for ecosystem services, offering coastal protection from storms and erosion, which safeguards properties and reduces repair costs. They also support fisheries and tourism, providing significant economic benefits to local communities through resources and sustainable livelihoods. For example, in many countries between 50–80 % of commercial and subsistence fish species spend some part of their life cycle in mangrove forests where there is detritus, food, and shelter. This is invaluable to the ongoing productivity of coastal waters (Veitayaki et al., 2017). Mangroves also protect the shorelines and defend the settlements and infrastructure behind, and are harvested for timber and non-timber products, such as firewood (sometimes charcoal) and traditional medicines.

Mangrove forests are very significant sinks for carbon, in both the above ground biomass and in the soils (Giri et al., 2011; Jakovac et al., 2020). This is recognised in the growing recognition of the importance of 'blue carbon' to the planet's climate stability and the role that mangrove forests may play in global carbon markets (Adame et al., 2018). Mangrove forests' role as carbon sinks applies as both a *flow* of carbon sequestration into new biomass and soil and as a permanent store of carbon. The Maramasike Passage hosts a large component of the Solomon Islands' mangrove forest inventory. Assessing the species present was beyond the budget and scope for this project.

6.2 Mangrove ecosystems and ecosystem service valuation

Mangrove extent along the Maramasike Passage is significant – there was an estimated **4,269 Hectares** (Ha) of mangrove forest in 2020, spreading along **184.21 km** of coastline (see Figure 29) (Global Mangrove Watch, 2024). Carbon storage in these mangroves forests (above and below ground) is estimated to be between **478,213 tonnes (t) and 2,000,351 t** in total, based on an estimates from Meng et al. (2021) [7]. This between **1,755,043 t and 7,341,288 t CO_2-equivalent** [8]. At current European Union Emissions Trading Scheme spot prices (US$ 74), this has a potential storage value of between **US$ 129,873,190 and US$ 543,255,309**. Whilst carbon projects are based on risks to the carbon sink, it could potentially be demonstrated that the mangroves of Maramasike Passage are at low term risk of loss, removal, or degradation.

Total ecosystem service economic value of the mangrove forests of Maramasike Passage is reported in Figure 30. This shows both actual benefits (the harvesting of food, for example) and potential benefits (potential for tourism development or sale of carbon credits). It also shows the economic benefits captured locally and those captured at a global scale.

[7] Meng et al. estimate that mangrove forests have an above ground carbon (AGC) total of between 12 t/ha and 150.2 t/ha and below ground carbon (BGC) total of BGC = (AGC x 1.58) + 81.06.
[8] Each tonne of carbon biomass represents around 3.17 tonnes of carbon dioxide.

Figure 28: Location and extent of mangrove forest in the Maramasike Passage

Date source: Global Mangrove Watch, 2024.

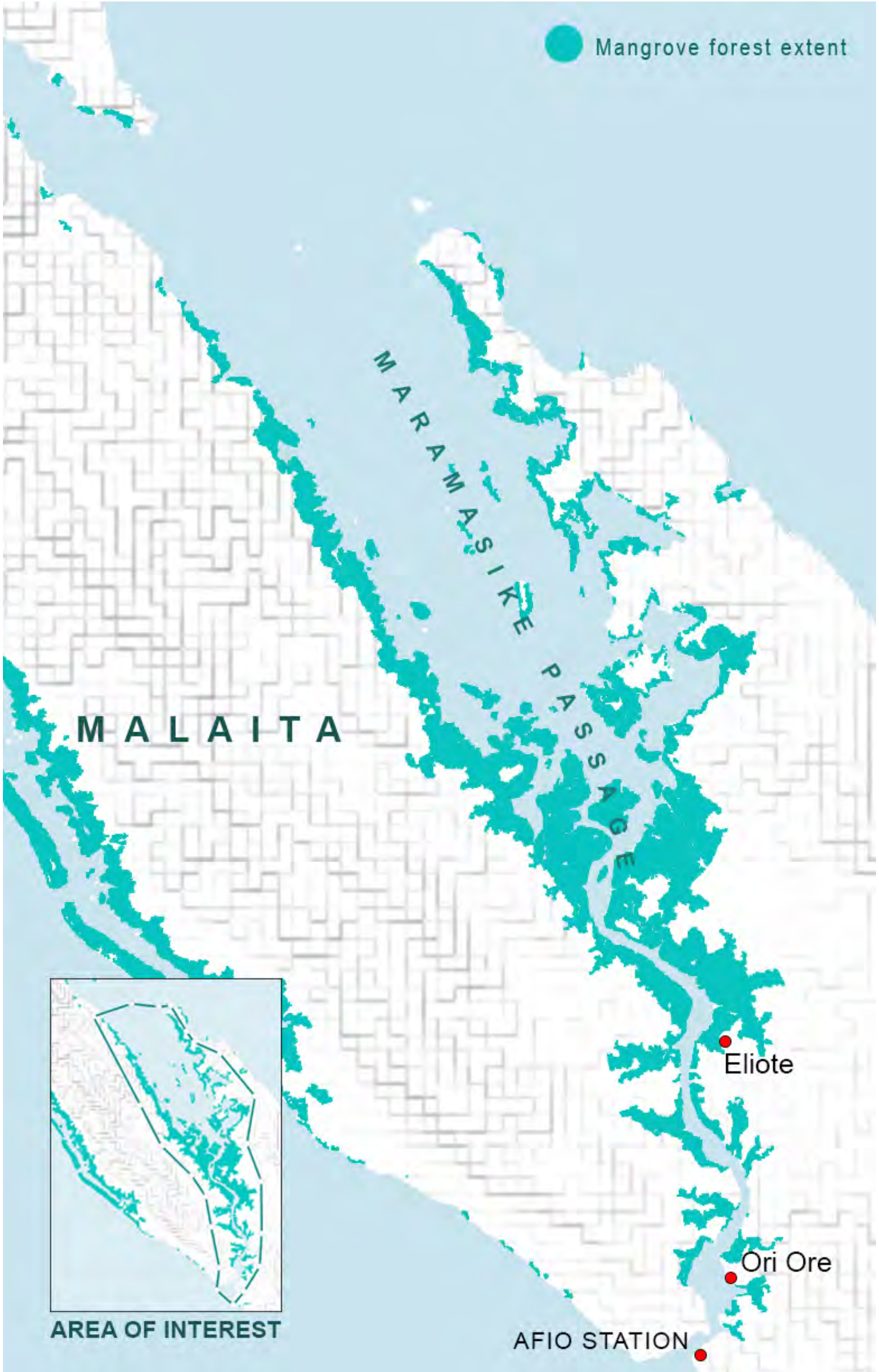
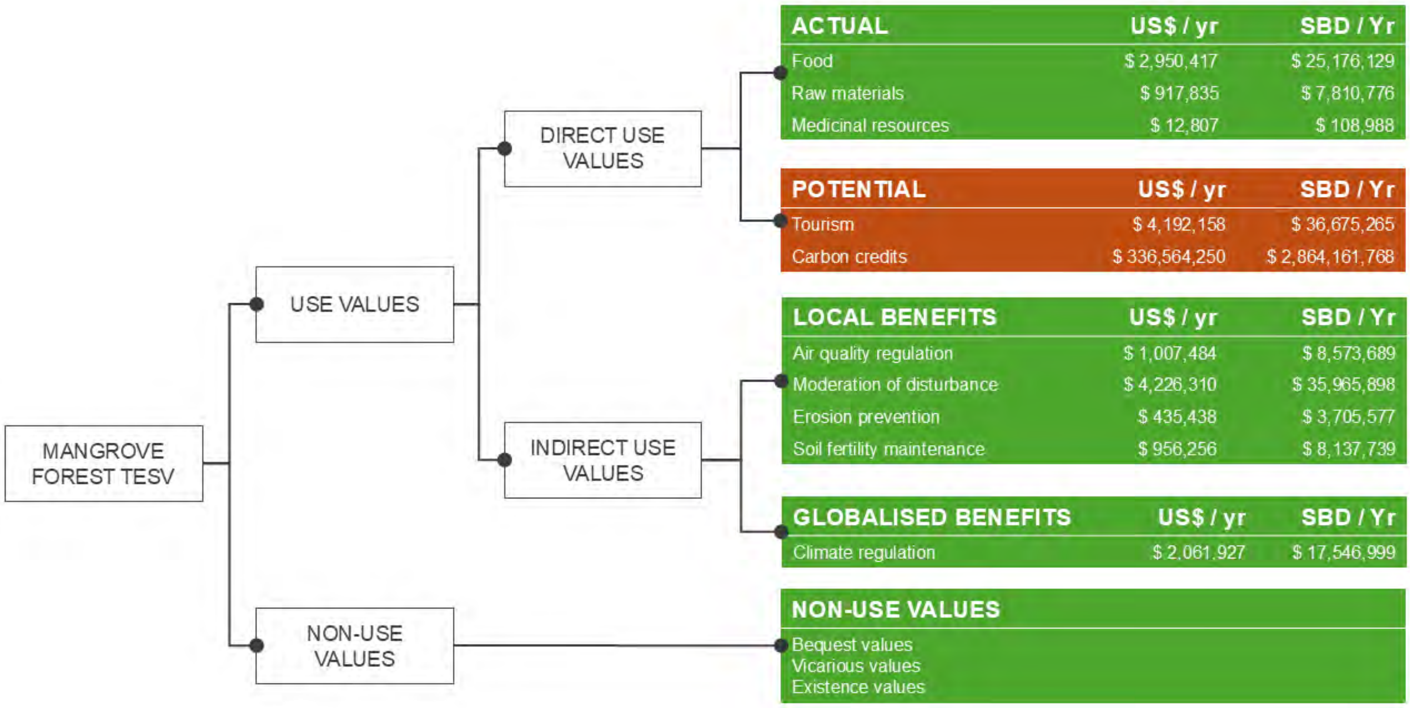


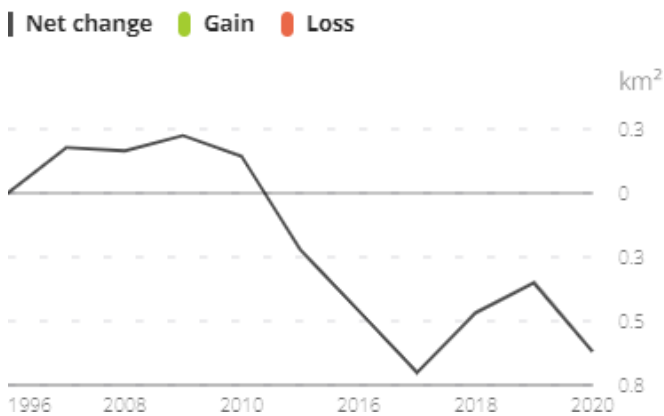
Figure 29: Total ecosystem service economic value of mangrove forests in the Maramasike Passage



6.3 Threats to mangrove ecosystems

Data from Global Mangrove Watch estimates that there is regional mangrove loss in Maramasike Passage of 0.62 km^2 between 1996 and 2020, representing a 1.4% loss (Figure 31). This modest loss was reflected in the data from the community transects (see Section 8) that report only limited incursions into mangrove forest for the cutting for firewood or loss to agriculture. There are some logging terminals that are the cause of localised losses of mangroves, however, these tend to be situated on shorelines that are not dominated by mangroves and nursery habitat functions of mangrove forests can be impacted by sediment flows emanating from logging activities (Hamilton et al., 2017). Currently, mangrove forests in the Solomon Island have not been subject to the intense threats that are apparent in South East Asia (including Indonesia) that include development pressures and aquaculture (Friess et al., 2019; Goldberg et al., 2020).

Figure 30: Net change (km^2) in mangrove forest extent in the Maramasike Passage (1996 to 2020) (Global Mangrove Watch, 2024)



Notwithstanding existing, but limited, anthropogenic threatening processes, there are future threats to the mangrove forests of the Maramasike Passage related to climate change. Increase temperatures are associated with mangrove dieback (observed by Duke et al., 2017 in Australia), rapid increases in sea levels can impact the location of mangroves (for example, they may require room to migrate), and changes in rainfall patterns may affect the availability of freshwater.

7 Terrestrial ecosystems and ecosystem services assessment

This section describes the application of our mapping and economic valuation approach, detailed in Section 4, to the inter-tidal zone ecosystems associate with the communities of Tapa'atewa, Eliote, and Ori Ore and to the Maramasike Passage and South Malaita, in general. We set out our assessment in terms of the key ecosystem service assets that provide use and non-use value to these communities. For each ecosystem asset we set out its extent, location, and its economic valuation, and then we set out the key risks to the ecosystem asset.

7.1 Tropical forest ecosystem extent and valuation

The vegetated landscape of South Malaita is highly modified from centuries of cultivation and agroforestry, and in more recent years, significant levels of commercial logging causing residual forest degradation. As a result, the landscape is predominantly secondary forest regrowth and cultivated areas with a patchwork of taller, remnant primary forest species. Unfortunately, aerial imagery available for South Malaita is not comprehensively high resolution and there are no complete records of imagery without some degree of cloud obscured areas. The most cloud-free coverage is Sentinel-2 imagery from 5th August 2021. Our estimates land use / land cover estimates from this imagery are in Table 4.

Table 4: Land use / land cover estimates for South Malaita

Land cover / land use	Hectares	Proportion of land cover	Normalised to account for cloud cover	Normalised proportion of land cover
Cloud obscured areas	5,979	14.0	0	0.0
Subsistence agriculture, grasslands and cleared	7,276	17.0	8,459	19.8
Built areas	156	0.4	181	0.4
Regrowth forest	19,719	46.1	22,925	53.6
Natural forests	7,479	17.5	8,695	20.3
Plantation areas (coconut and palm areas)	718	1.7	834	2.0
(Mangroves)	(1,424)	(3.3)	(1,655)	(3.9)
Total	42,750		42,750	0.0

Given the significant areas of cloud obscured areas that are now know to be logged not displayed and not identified in global datasets, such as Global Forest Watch (2024). For example, Figure 32 shows low resolution imagery around the community of Tapa'atewa. By comparing it with imagery available from Apple Maps (Figure 33) it is clear that the logging activity is relatively recent, yet the logged area is not displayed in the low-resolution section in the bottom right of Figure 32. Figure 33 shows further evidence of the discontinuities in the aerial imagery for South Malaita, whereby roads cut through by commercial logging companies are not shown in contiguous tiles, suggesting areas of commercial logging are likely more widespread that apparent.

Figure 34 shows the best estimate of the location and extent of primary and secondary forest for South Malaita. Figure 35 reports the total actual and potential ecosystem service values for primary and secondary forests in South Malaita.

Figure 31: Tapa’atewa from Google Earth, showing recent commercial logging activity and demonstrating the limitations of low-resolution imagery over South Malaita

Figure 32: Tapa'atewa using undated tiles sourced from Apple Maps

Figure 33: Discontinuities in aerial coverage of logging roads near Tapa'atewa suggesting aerial imagery does not reflect the reality (Google Earth).

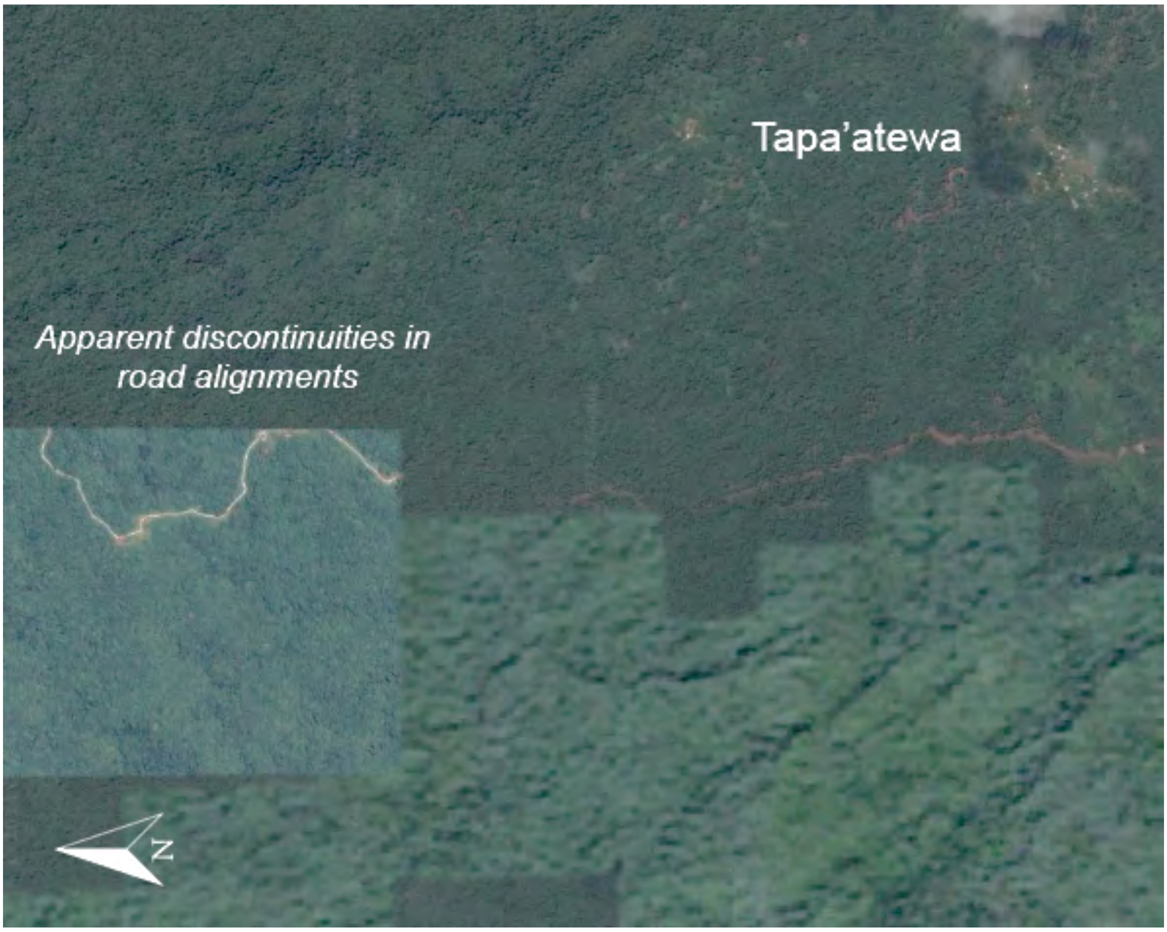


Figure 34: Location and extent of key land cover / land use types for South Malaita

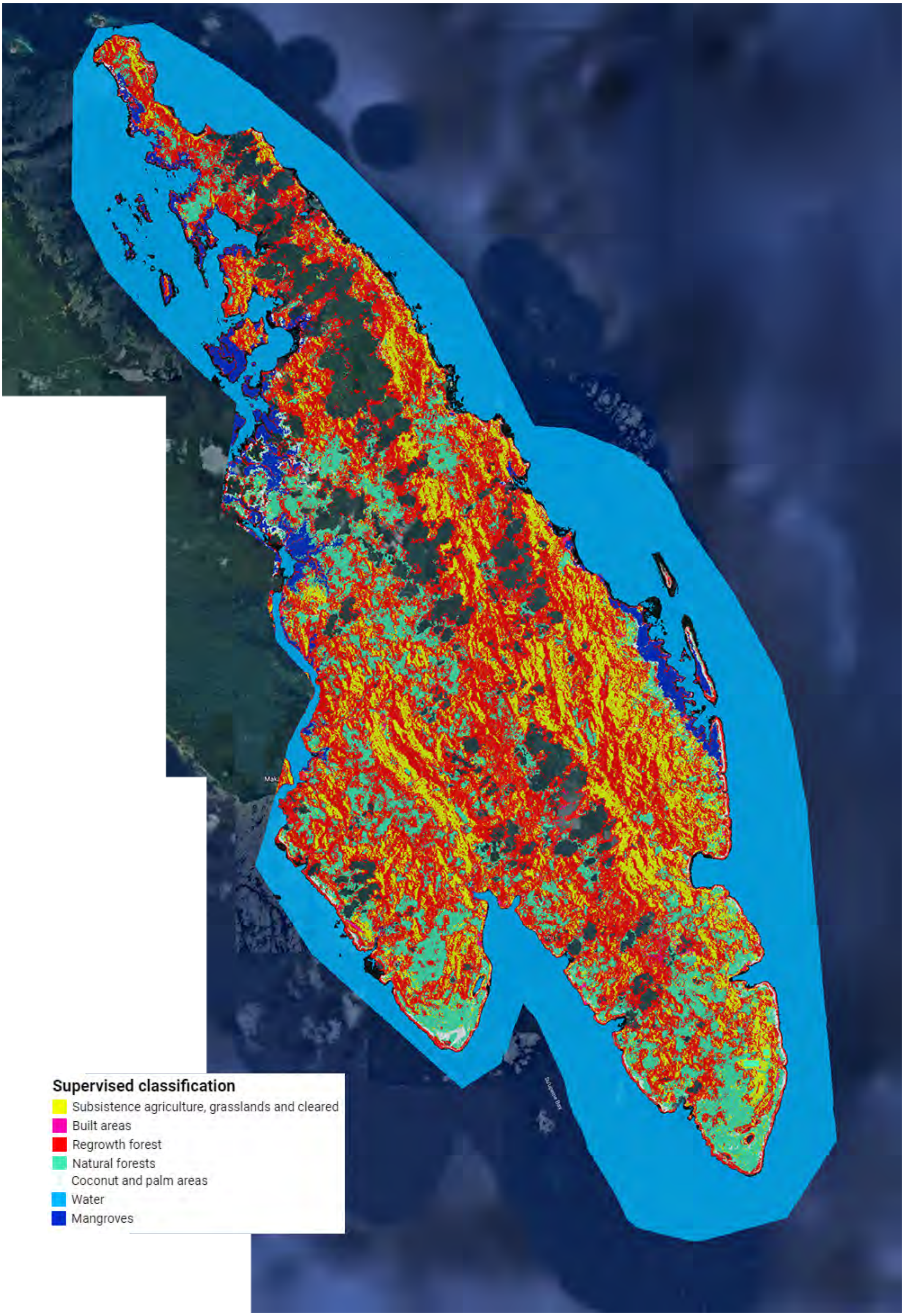
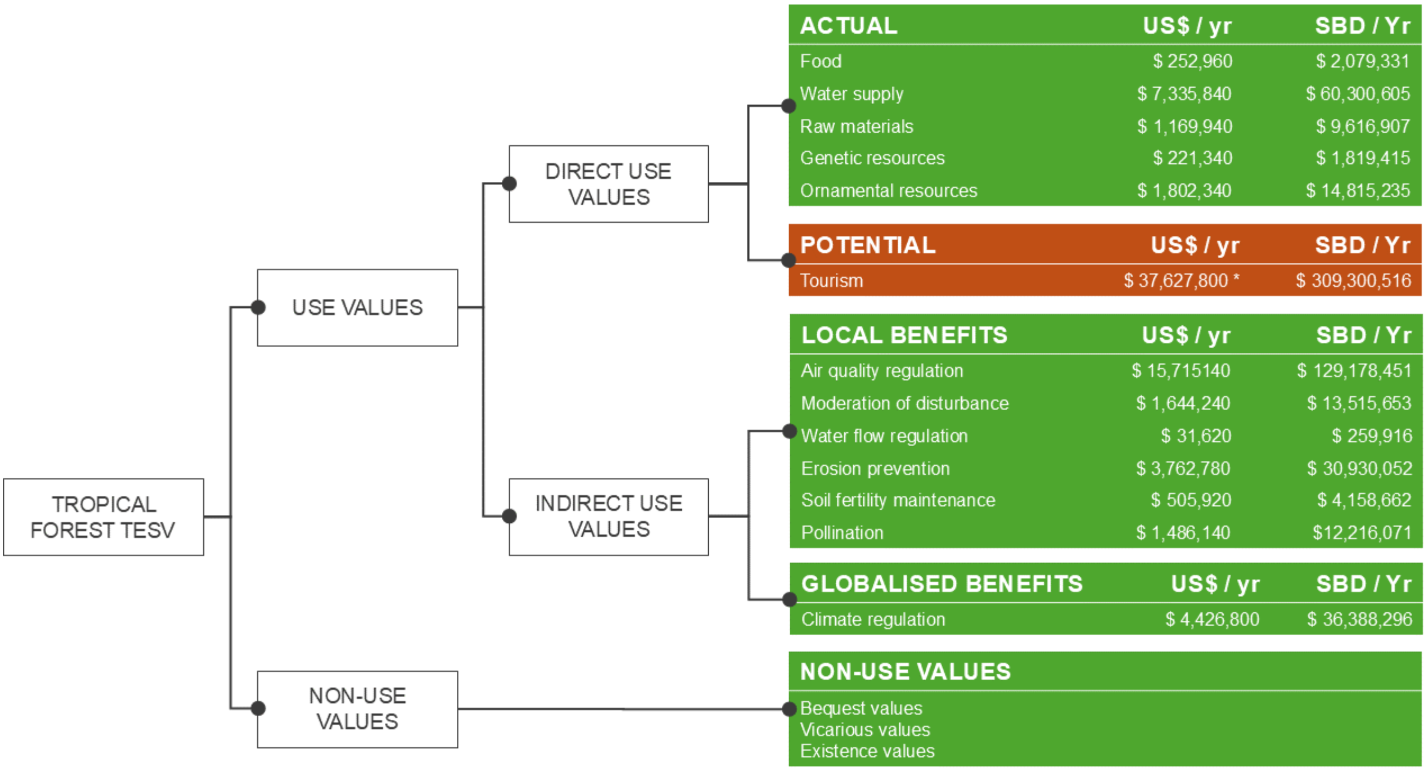


Figure 35: Actual and potential total ecosystem service value of tropical forests in South Malaita

Note this for both primary forest and secondary forest.



7.1.1 Threats to forest ecosystems

The key threats to forest ecosystems in South Malaita are incursion of both commercial logging and subsistence agriculture into forested areas, which are both direct (from deforestation) and indirect. Indirect impacts include the drying of forests as a result of primary forest loss on the margins and as a result of road incursion (Kleinschroth et al., 2019). Whilst we used a supervised generated dataset for this report (see Section 4 for methodology), for forest change we refer to Global Forest Watch (2024) time series data, which provides an indicative estimate for net forest loss in South Malaita.

From 2001 to 2023 South Malaita lost 2,720 ha of tree cover (at 30% canopy cover), which is the equivalent of 6.4% (Global Forest Watch, 2024) (Figure 37). Between 2002 and 2023 South Malaita lost 1,710 ha of humid primary forest, making up 64% of its total tree cover loss in that period (Figures 36 to 28). This is the equivalent of 5.8% since 2002. The checked line indicates that 94.2% of all humid primary forest remains, however, this remains difficult to reconcile with our supervised dataset, which points to significant areas of secondary forest regrowth.

In addition to direct anthropogenic pressures, such as commercial logging and incursion of cultivated areas, climate change also represents threatening processes. Increases in temperatures and changes in rainfall patterns will likely have impacts on the nature and humidity of the forest, which will impact on the capacity of the forest to generate ecosystem services, such as carbon sequestration, water flow regulation, and erosion control (Rogers et al., 2022).

Higher temperatures and prolonged periods of low rainfall and high heat will likely cause a drying of the forest. Given the already relatively degraded status of the South Malaita's forests this will include greater drying through the disturbed forest fringes resulting in potentially greater risks from wild fires and invasive species incursion.

Figure 36: Tree cover loss in South Malaita between 2001 and 2023 2023

Data: Global Forest Watch, 2024.

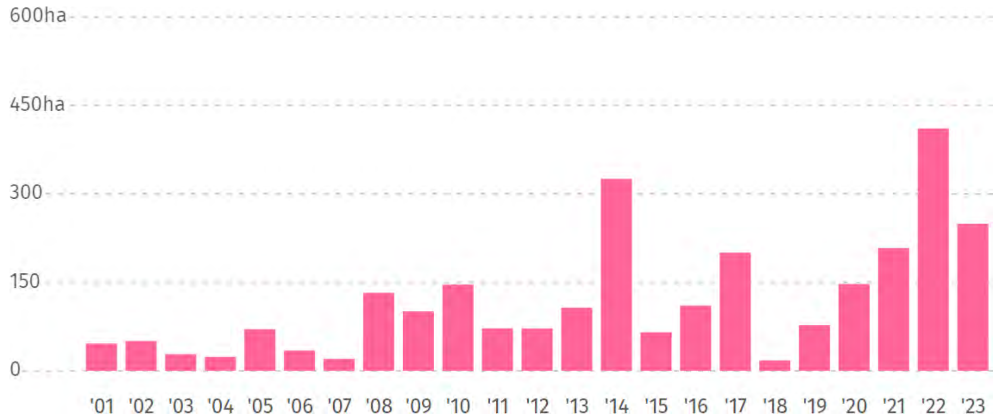


Figure 37: Primary forest loss in South Malaita from 2002 to 2023

Data: Global Forest Watch, 2024.

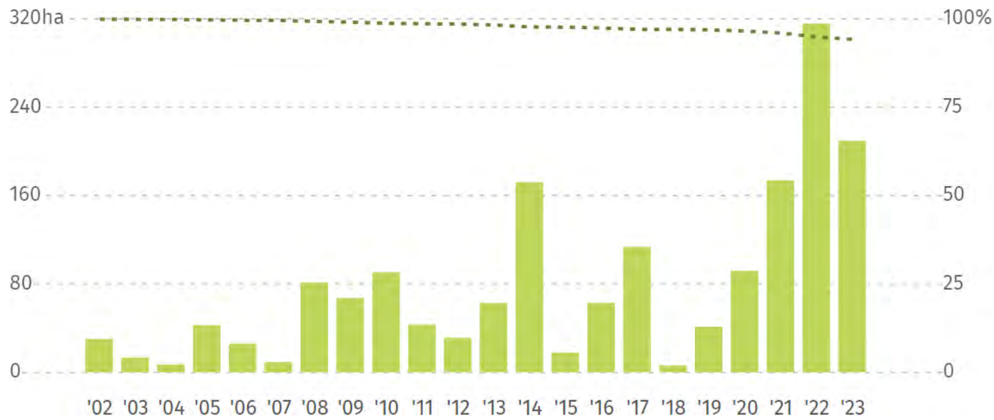


Figure 38: Forest loss between 2001 and 2020 for South Malaita. Yellow pixels show early forest loss (from 2001) and red pixels show most recent forest loss (to 2020). Forest loss is related to both incursion from commercial logging and from expansion of subsistence gardens.

7.2 Subsistence agriculture

Household subsistence agriculture holds significant importance for the people of South Malaita and the Pacific region. Nearly all households perform some form of cultivation for domestic consumption with some generating surpluses for cash exchange where there is access to markets and many households typically source 80% of their nutritional and nourishment needs from their own labours (Anderson, Thilsted, and Schwarz, 2013; Anderson, 2006). This sector is crucial for ensuring food security and provides a steady supply of nutritious foods, in lieu of relying on processed, imported goods, for which supply chains can be interrupted and prices rapidly vary (Anderson, Thilsted, and Schwarz, 2013). This is particularly important in more remote areas where access to markets for alternatives is limited.

In addition, household cultivation is deeply embedded in the cultural practices of the Solomon Islands and is a traditional skill passed through generations, involving methods and crop varieties that are specific to their heritage. Maintaining these gardens helps preserve cultural identity and kastom practices. In times of economic hardship or natural disasters, subsistence agriculture act as a buffer, providing a reliable source of food when external supplies may be disrupted.

Cultivated areas are typically managed in a shifting cultivation-fallow cycle, where secondary forest regrowth reestablishes the soil and helps maintain soil fertility and biodiversity. Cultivated gardens are commonly combined with agroforestry practices and the maintenance of key fruit and nut bearing trees. Livestock, including hens and pigs and wild harvested food and produce form further parts of the household food production system (Mackey et al., 2017).

These gardens also promote environmental sustainability by encouraging the use of traditional agricultural practices that are often more ecologically sound than using artificial fertilisers and pesticides. These practices can help maintain water quality in catchments and in receiving lagoons, where high nutrient loads can further damage coral reef ecosystems (Wolff et al., 2018).

7.2.1 Extent of subsistence agriculture and economic valuation

In this context, of a highly modified landscape of subsistence agriculture, secondary forest regrowth and patchy undisturbed primary forests, we consider subsistence agriculture as a key land use, or ecosystem type, consistent with the SEEA Ecosystem Accounting framework (UN Statistical Division, 2021). The key (and only) ecosystem service generated is food, which is valued at **US$ 8,108 ha^{-1} yr^{-1}** (which can also be assumed to be a per household value – see Box 2).

The extent and location of subsistence agriculture gardens in show in Table 5 and Figure 35 (both above). Our estimate for the value contribution of subsistence agriculture in South Malaita is between **US$ 32,737,901 and US$ 68,585,572 per year** (SBD 271,724,578 – SBD 569,260,248). The range is defined on whether we used a per household calculation (lower value) or a per hectare calculation (see Box 2). The median value is **US$ 50,661,736** (SBD 420,492,413) For the individual communities we can only estimate using a per household calculation as we don't have the accurate extent estimates (in hectares) for each community. These estimates are reported in Table 5.

Table 5: Value of subsistence agriculture to project sites

Based on values derived from per household value estimates.

	Households	Population	People / household	Value of subsistence agriculture (per household estimate) (US$)
South Malaita	4,038*	16,146†	4.0*	32,737,901
Eliote	69	400	1.8	47,003
Ori Ore	19	35	1.8	14,936
Tapa'atewa	35	152	4.3	35,328
(Mean)			(4.0*)	

* Calculated estimated value.

† Sourced value from Solomon Islands census.

7.2.2 Threats to subsistence agriculture

Key environmental pressures and threats to subsistence agriculture derive from localised pressures and from global climate change. The productivity of this subsistence system and integrity of the adjoining tropical forests are at the centre of a complex web of interdependencies that have an impact on overall village community resilience, within which climate change is a significant factor (Figure 39) (Buckwell, Ware, et al., 2020). These interconnections will be explored further during the detailed options assessment phase of the project. in scenario testing.

Chronic pressures, such as population change, which is increasing across each of the three local governance wards in South Malaita, increase the pressure on the existing cultivated areas, which encourages both the shortening of fallow periods (the time for secondary forest regrowth, which replenishes the soil) and the further incursion into forested areas at the margins. Access to markets, which for South Malaita and the Maramasike Passage includes markets at Afio and at Matangasi (at -9.5909, 161.4061) provide further outlets for surplus, which also increases pressure on cultivated areas. However, current regular sale of produce and food out of South Malaita and into Honiara mostly consist of betelnut.

The pest species, Giant African Snail (*Achtatina fulica*), is suspected to be present around Afio (Kiddle, Stronge, and Pennary, 2017). It is believed the snail will present a very threat to fruits and vegetables grown by households, as it has around Honiara. Control measures (using an introduced flatworm) is known to have impacts on other snail species. However, our data collection reveal no reported concern for this species.

Climate change will likely have significant negative impacts on agricultural output in Solomon Islands due to both changes in temperature (almost certain) and potential changes in rainfall variability (Rosegrant et al., 2015). For example, crop yields of staples, such as taro, are projected to diminish over time due to increased heat and its impacts on soils, perhaps demanding increased inputs, such as artificial fertilisers to make up the gap (Figure 40). Further significant risk arises from changes in river catchment health that may result from a combination of heighten temperatures and prolonged periods of low rainfall and high heat, that impacts flow rates of water in streams and rivers. South Malaita is a relatively small island, with similarly small catchments. No flow periods during extreme conditions will likely be challenging for communities.

Given agriculture's significant role in both employment, GDP, and livelihoods, adverse climate change-driven impacts on the agriculture sector maintaining "business-as-usual" in the agriculture sector demands costly long-term actions. In addition to local food consumption, cash crops are also vulnerable to climate change, in particular, extreme weather events that can have significant impact on crops, such as coconut, bananas, breadfruit, and cacao (Bell et al., 2016).

Projections for growing season length out to 2100, under all RCPs, present a grim picture but is nevertheless still subject to significant social, economic, and environmental uncertainty. (Note that in Figure 40, by definition, the growing season cannot be >365.25 days).

Figure 39: Factors influencing the productivity and sustainability of village subsistence farming systems.

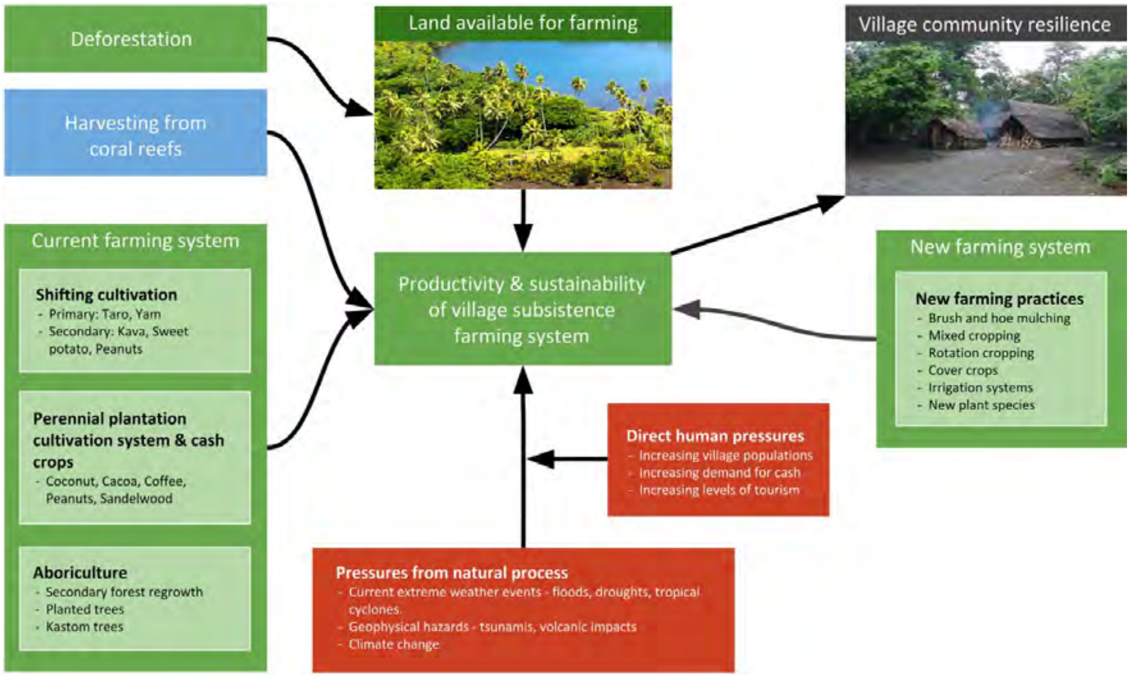
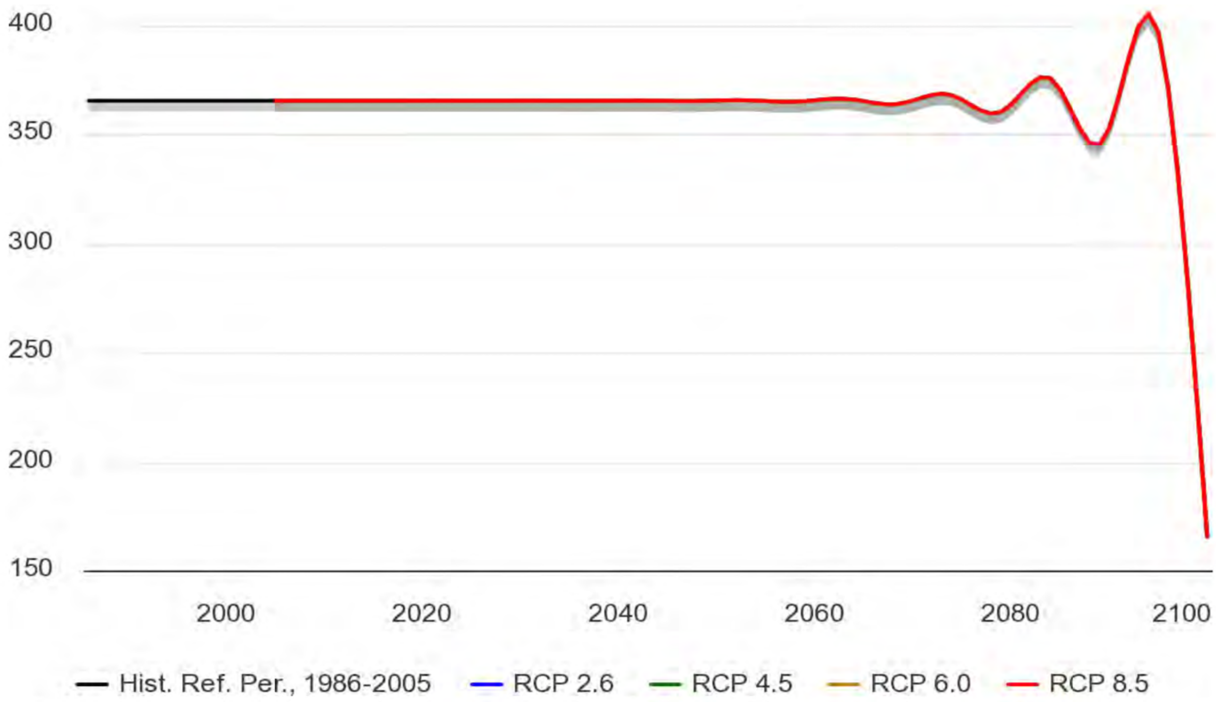


Figure 40: Solomon Islands projected growing season length from multi-model ensemble to 2100

(Climate Change Knowledge Portal, 2023)

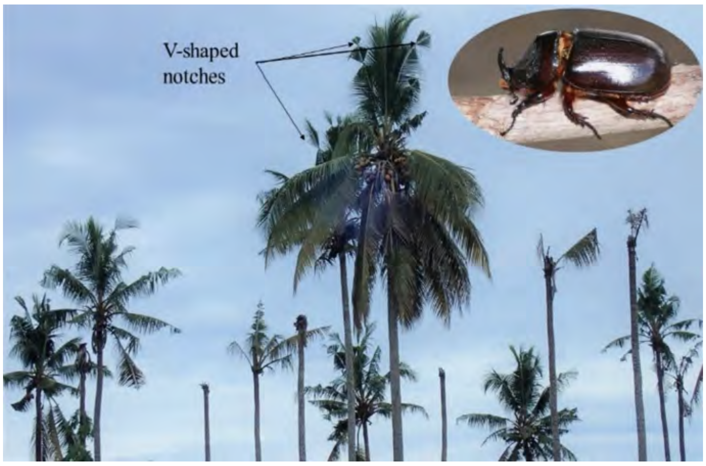


7.3 Plantation

Our aerial imagery detected 718 hectares classified as plantation (coconut/palms) that was relatively evenly spread around South Malaita so as to not be broadly visible in Figure 35 at print resolution. Therefore, ecosystem service value contribution of plantation is **US$ 43,798** (**SBD 363,523**).

Threats to South Malaita's plantation agriculture lay particularly with invasive species, namely the coconut rhinoceros beetle (*Oryctes rhinoceros*) (CRB), which has caused severe damage to coconut palms, threatens the food security and livelihoods, since its outbreak in the Solomon Islands (Marshall et al., 2023). and is now confirmed present in South Malaita. The impact of the CRB can be noticed through the characteristic pattern of damage caused to coconut palms (Figure 39). "Until a viable biological control agent is found [for CRB], it is important to contain the beetle and stop further spread through surveillance, sanitation, and enforcing strict local quarantines" (Paudel et al., 2021, p. 37). No specific mentions of CRB was made by any of the community members at any of the project sites.

Figure 39: Characteristic damage to coconut palms from the coconut rhinoceros beetle. (Source, Marshall et al., 2023)



8 Socio-economic data collection methods and approach

Overall, remote sensed and desktop data only will be able to capture limited dimensions of community vulnerability to environmental hazards and will not elicit ideas from the community to reduce its vulnerability. Both desktop and primary data are needed. This section highlights our primary data collections methods, which included both community-level and individual approaches that are both qualitative and quantitative in nature

8.1 Community transects and community inventories

To elicit community level data we undertook a participatory community appraisal based on a community 'transect walk' (Chakraborty, Tobin, and Montz, 2005). Transect walks are an excellent tool for creating a record of environmental conditions: those arising in the natural, built, and experienced environments. The walk can take 1-3 hours and are completed with members of the community who have sufficient local knowledge and technical skills to identify broad, community-level issues and propose high level solutions (Ahmed and Kelman, 2018). Key topics of the go along survey include, but are not limited to:

1. **Population and demographic changes** – How many households are in the community / what is the estimated population? What migration is occurring?
2. **Community assets** – including Nakamals, schools, medical centres, tourism enterprises and potential tourism opportunities.
3. **Defining the boundaries of the community** – Ascertain the boundaries of household gardens, community forest, communal forest and marine resources.
4. **Existing conservation areas and projects** – including a subjective assessment of the level of resourcing, management, and governance of existing community conservation efforts.
5. **Community hazards** – What are the key hazards faced by your community; extreme weather, fish stocks, tsunamis, volcanoes, earthquakes, droughts.
6. **Community exposures** – Are there dwellings or buildings that are particularly exposure to coastal hazards in your community?
7. **Community vulnerabilities** – Are there any people or households in your community who have reported, or are known to be more vulnerable to hazards than others; do they have anything in common?
8. **Water resources, sanitation, waste management, and sanitation vulnerabilities and risks**.

In addition, we also carried out a community asset inventory, which is a straightforward questionnaire aimed at documenting important community assets, such as infrastructure, communications, market access and social capital assets, such as community cooperatives, womens' groups, and church associations, which can be valuable vehicles for social change in the community.

8.2 Individual surveying using Q-methodology

A second line of enquiry was undertaken through an individual survey that used statement ranking (in terms of strength of agreement/disagreement) to generate two outputs: a straightforward assessment of statement importance across all sampled respondents in a community; and a dataset that can be applied to Q-methodology (hereafter, Q) (see below).

Q-methodology

Q is a hybrid quantitative and qualitative research technique based on the objective, statistical analysis of people's subjectivity – how they think and feel about the world around them (Brown, 1980; Stephenson, 1953). Q leans into discursive/contextual methods of knowledge generation that uphold both personal realities and shared experiences of the world suited to socio-ecological systems (such as Pacific communities) where the more complex a problem, the greater the number of plausible and coherent perspectives there likely is (Buckwell et al., 2023).

Q is a type of factor analysis that seeks correlations amongst consistent groups of respondents who share similar views of the world. These correlations reflect coherent mindsets, which are analogous to the structure of a discourse, with views formed from both external influences (acting on people) and also emergent of collective heuristics (people and power structures actively shaping people) (Dryzek, 1994). Q is not designed to lead to statistically generalisable results but rather to provide a detailed portrayal of the full scope of perspectives of a situation within a given community (Buckwell, Fleming, Muurmans, et al., 2020).

In practice, Q facilitates the placement of statements by respondents (the ‘P-set’) onto a grid with spaces ranked from ‘most salient’ to ‘least salient’ in response to primer question, in this instance, *what statements do you most agree with and which do you most disagree with* (Figures 40 and 41).

The Q-set is constructed from a potentially infinite number of perspectives, which is filtered down to a management number for study. Statistical techniques reduce the often-considerable variance into the fewest possible meaningful factors.

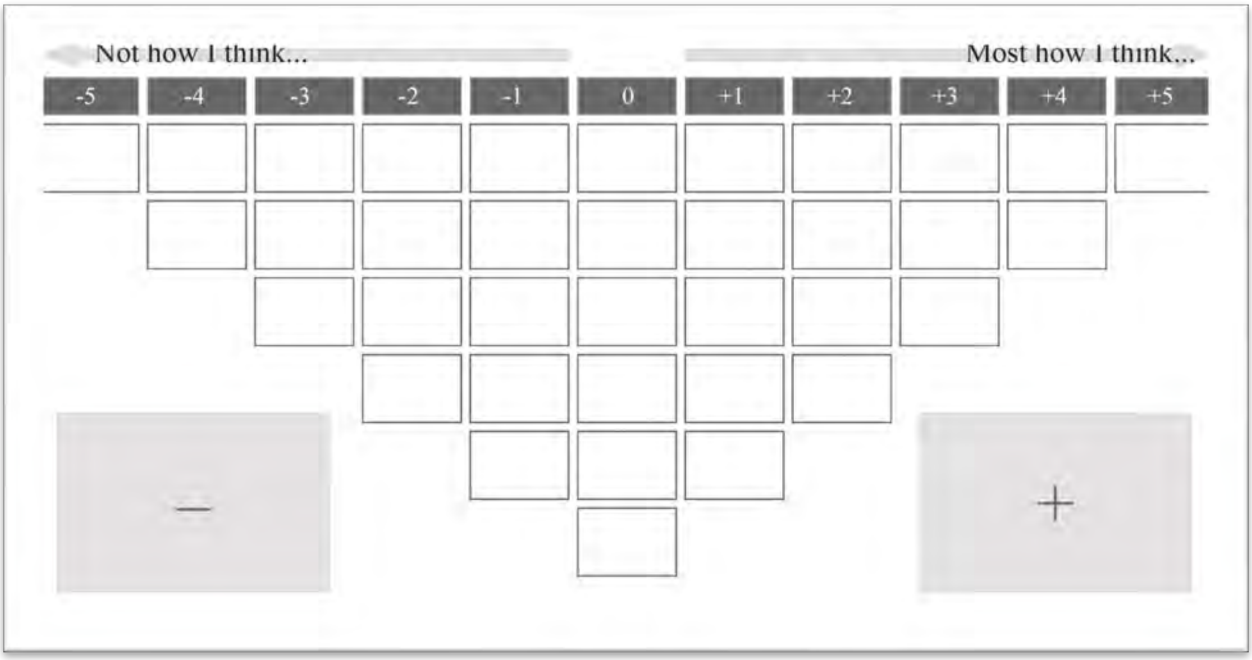
Our statement set was generated by taking a mixed methods approach, which included drawing prior author experiences in Melanesia and the Solomon Islands and expert elicitation. The statement set for this study was subsequently filtered down to 36 statements, which, from experience, provides a reasonable depth and breadth of statements but is not unwieldy for respondent sorting. We used a slightly different statement set for Tapa’atewa (a highland, forested community) that had one statement swapped out to the Q-set used for Eliote and Ori Ore, however, Q analysis allows for valid comparison across all respondents.

Figure 40: Respondent undertaking a Q-sort in Eliote

Participants were asked to rank statements on a quasi-normal distribution, with fewer statements at the most positively and negatively salient columns (our sorting grid is in Figure 42). This pattern has no statistical implications, but is a strategy used in Q to encourage participants to 'think harder' about what is most and least salient (Watts and Stenner, 2012).

During and after sorting, participants are asked to 'think out aloud' and explain their feelings about the statements, particularly the reasoning behind their placement of the most and least salient statements. This information, though not part of the statistical analysis, can enable further, subjective analysis, to be undertaken by the researcher, with greater confidence.

Figure 41: Sorting grid for our Q-methodology



8.2.1 Sampling

As Q is not designed to garner generalisable, population level results (for example, 50% of men align with factor 1) respondent recruitment can be done through strategic sampling rather than stratified sampling. It is more important that a wide range of viewpoints of respondents are sampled, rather than trying to capture as many responses as you can from stakeholders who are likely to have similar viewpoints. Therefore, we tried to seek a diversity of respondents, including all the demographic groups.

8.2.2 Statistical treatment

For statistical analysis we used KADE (Banasick, 2018), which automates many of the functions of Q, unless stated. Unless otherwise stated, our correlation matrix was subject to factor analysis using Horst Centroid, allowing the application to recommend the number of factors to extract, as recommended by Brown (1980). In each case, the factors were subjected to Varimax rotation – a technique that maximises the variance shared amongst responses (Akhtar-Danesh, Baumann, and Cordingley, 2008). Respondents were included in each rotated factor using the 'autoflag' feature at p-values of <0.05. Confounding sorts (respondents who load into more than one factor) and null sorts (respondents who do not load, or were flagged, into any factor) were set aside from further subjective analysis.

9 Field data findings

This section reports on our community transects, community asset inventories, and statement ranking findings for the three project sites: Tapa'atewa, Eliote, and Ori Ore.

9.1 Tapa'atewa

Data collection took place in Tapa'atewa took place on 24th July 2024. (Note that data collection at Tapa'atewa was interrupted by the death that morning of the paramount chief, which slightly limited the number of Q participants we could recruit.)

Tapa'atewa is a forested community in South Malaita's central highlands (Figures 42, 43, and 44). It is a community of between 125 and 180 people and sits atop a ridge above the southwards flowing Tapa'atewa river catchment, at approximately 200m of elevation. The terrain comprises steep valleys and ridges, and the elevated community is relatively exposed to high winds and heavy rainfall. The surrounding forest is generally highly degraded secondary regrowth (and fallow), agroforestry gardens, and cultivated gardens, with only small pockets of remnant primary forest patches and individual rainforest tree species. Commercial logging operations have historically been widespread, but at the time of the visit had been temporarily suspended due to a dispute over incursion of loggers into customary gardens. There is adequate road access (with relatively good quality roads) to local trading centres, which are maintained by the logging companies.

Figure 42: Tapa'atewa environs, showing clear evidence of recent commercial logging activity

Figure 43: Tapa'atewa village

9.1.1 Community transect

The community transect for Tapa’atewa is documented in Table 7.

Table 6: Community transect findings for Tapa’atewa community

Subject domain	Notes
Community demographics	• 25-38 households. • 125-180 population. • Migration in and the village is common, with people working in, going to school in, and migrating to Honiara (in particular). • New household formation is common from marriages. • There’s an increase in children, suggesting that population is either growing, or is at least stable (considering outward migration).
Community hazards	• Rainfall has recently been frequent and regular. In heavy rains the rivers and streams become laden with silt. • The village is commonly impacted by disruptive strong winds and wet weather. (The village is situated high on a ridge.) It was reported that one traditionally built house was destroyed by high winds. • The community is aware of logging activities and link it to poor water quality in watercourses, particularly during wet weather. When water sources are silted-up, community members must travel further to water sources that are known not get affected. • There have been no reported (major) landslips resulting from this, but the community is very aware of the potential for it. • It was reported that logging activities have incurred on areas that have used as household gardens. There is generally poor community engagement by and information provided about commercial logging activities. • Logging activities ceased in early 2024 due to a local dispute. (It was not disclosed what the dispute was about.) • Changes in overall climate (heat, wet, drought etc.) is not especially noticeable. • Earthquakes are rare and there has been no noted impacts. • There are no community plans for hazard management. It is not considered a priority,

Infrastructure	• The road network was mostly constructed by and services the logging industry. There was addition support from the Member of Parliament.
Pollution	• Community suffers from poor water quality after heavy rain. This is linked directly to nearby logging activity, which has now (reportedly) ceased, though the pollution events continue. There is currently no answer to this issue; the community instead just travels further to source non-polluted water.
Exposures & vulnerability	• There are many (more than half) solidly built houses with steel roofs that can provide amply shelter during a cyclone. The school and the church buildings can also provide shelter. • Community leaders are aware of actions to take during natural disaster preparation, response, and recovery.
Water resources and sanitation	• Most households get water for drinking and cooking from local piped in water source. Direct from rivers and streams is an alternative option. Recently, it has been relatively wet and so there are currently few pressing water supply issues. • Heavy rain impacts water quality but also can disrupt the local piped water (debris getting stuck and breaks in the pipe). • Some houses have a private water tanks.
Waste management	• An increasing amount of consumables is now purchased in non-biodegradable packaging. This prompted community action to encourage people to bury waste tins and plastic that people reluctantly followed. • Non-biodegradable waste is currently buried in informal household pits. There are no plans for any investments in alternative waste options.
Power sources	• Households use a combination of stand-alone 20W solar units, butane cans and collecting firewood. • Households mostly cook using firewood obtained from nearby forests. This source does not seem to be diminishing.
Conservation efforts	• There is a latent demand for forest conservation activities in the community. However, there is no current plans for, nor management committee to support any formal forest conservation efforts. • Tribal boundaries are relatively well-defined, which supports the possibility of conservation projects.
Gardens and farming	• The extent of the cultivated gardens is increasing. There is access to nearby markets (at Matangasi, on the waterfront on Maramasike Passage) for an outlet for surplus and wild-harvested betelnut. • Household plots are both nearby and far away from the village centre. • Fallow periods are getting shorter. Reported to be between 5 and 10 years. (This seems quite normal.) • There has been no recent agricultural extension programs but there are often new varieties and techniques being tried.
Tourism	• There is no tourism; no plans; nor any known activities for tourism. • Forest conservation *may* bring tourism opportunities.

Figure 44: Tapa'atewa. There is a mixture of traditionally built housing and housing built from concrete, timber, and steel roofs.

9.1.2 Community asset inventory

The community asset inventory for Tapa'atewa is reported in Table 8.

Table 7: Community asset inventory for Tapa'atewa

Item	Quantity / notes	Item	Quantity / notes
Schools	1 kindy to primary school	Police posts	Nearest at Afio
Churches	1 (SSEC)	Aid posts	Clinic at Afio
Poultry / hatchery	1 poultry farm that produces eggs	Womens' Centres	0
Cattle farms	0	Community Halls	1 (the chief's house)
Piggeries	1 pig farm	Banks	0
Other plantations	Kava, betelnut, cocoa, and commercial timber	Money transfers	0
Tilapia ponds	3 that has just been started	Post offices	0
Docks	0	Market houses	1 weekly marketplace at Matangasi
Shops	2 canteens / shops	Air strips	1 at Parasi
Cooperatives	0	Phone network	Adequate (1 carrier)
Boats	0		

9.1.3 Individual surveying

A ranked list of statements by average score for all respondents from Tapa'atewa (n=19) is reported in Table 8. No factor analysis is undertaken here (see Section 10).

The two most important issues across all respondents in Tapa'atewa were the need to develop a waste management strategy and the belief that implementing protected area status on forested areas will be an effective way of managing logging. An additional two statements that support forest conservation (S26 and S28) were also ranked highly; the former linking conservation to economic prosperity and the latter linking it to tourism opportunities. These concerns are validated in the community transect data (see Table 6 above). Further, in support of forest conservation, is the general belief that customary lands can be protected from further logging incursion as there is reasonable feeling of security of tenure over customary lands, which is often a barrier to successful implementation of protected area status. Two statements associated with the benefits of logging (the benefits from logging are shared fairly and mining and forestry offer enough benefits to make up for their environmental impact) were ranked 35th and 36th, suggesting there are generally poor support for renewed commercial logging. Backing this up was a general disagreement that the logging sector offers good jobs in support of livelihoods.

Table 8: Raw statement ranking for Tapa'atewa community members (no factor analysis applied)

Ref	Statement	Mean	Mean rank
S8	Our community needs better places to throw away non-compostable waste, such as cans and plastics.	1.58	1
S33	Protected areas in forests is an effective way of stopping logging on customary lands.	1.58	1
S22	Improving roads access to the community will help business opportunities.	1.37	3
S4	Our rivers and streams are drying up more frequently than before.	1.26	4
S26	Forest conservation will be more successful once people are secure and economically prosperous.	0.84	5
S28	Forest protected areas will be good for attracting tourists.	0.74	6
S6	We have enough toilet, washing, and cleaning facilities for all the people in the village.	0.58	7
S2	It is important to bring more livestock into the community to provide for food.	0.37	8
S3	There are weather-related natural disasters happening today, such as cyclones and heavy rain.	0.37	8
S5	Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	0.32	10
S9	I get enough good, reliable drinking water in my community.	0.32	10
S12	It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	0.21	12
S23	I would be able to spend more time in my community if there was a more equal share of housework between men and women.	0.21	12
S31	Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	0.16	14
S1	My garden is producing less food than it was before.	0.11	15
S14	Neighbouring communities trespass on our customary land and marine resources without our permission.	0.11	15
S20	Tourism offers many good opportunities for business in my area.	0.11	15
S13	We should do more to stop our special kastom places from falling into disrepair.	0.00	18
S24	I would like to grow surplus food, but I cannot get the food to markets to sell it.	-0.05	19
S21	I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	-0.11	20
S19	I would like to earn more cash from selling food or handicrafts.	-0.16	21
S29	Reducing use of our forest resources is essential for conservation and good for the community.	-0.16	21
S25	I feel that I can influence community decisions about logging and mining on customary lands.	-0.21	23

S11	If we had more tourists we wouldn't have enough food, water, and waste facilities to cope with them.	-0.26	24
S30	We are cutting down too much forest to make space for more gardens.	-0.32	25
S16	There are less traditional medicine plants growing than there used to be.	-0.37	26
S7	I would know what to do to feel safe in the next natural disaster.	-0.47	27
S15	If our community protected its forest in a protected area, it should be paid for that work.	-0.47	27
S18	If I could borrow some money I would start a small business.	-0.53	29
S34	Mining companies offer good jobs and money.	-0.68	30
S17	Kastom knowledge of resource use and the land is being forgotten.	-0.79	31
S32	If we conserved our forests in protected areas from certain uses, we would need new alternative livelihood options.	-0.79	31
S10	I would like better ways to cook food, so we don't have to use firewood cut from the forest.	-0.89	33
S27	Enforcing protected area rules and taboos in my community is very hard.	-1.16	34
S36	The benefits from logging are shared fairly across everyone in the community.	-1.16	34
S35	Mining and forestry offer enough benefits to make up for their environmental impact.	-1.63	36

9.2 Eliote

Data collection for the community of Eliote was carried out on 23rd July 2024. Eliote (Figures 45 and 46) lays midway along the Maramasike Passage on higher ground at the end of a spring-fed and tidal inlet through a mangrove forest. This mangrove forest (Figure 47 and 48) provides key food resources for the community, including mud crabs and shellfish (Figure 49). There are approximately 69 households and a population of around 400 people. The village is not connected to the wider region by any road and access by boat is restricted to high (and near-high) tide only (Figures 50 and 51). At lower tides the access channel is much diminished in depth and is not navigable by boats or canoes. The community lays on higher ground, well above the high-water mark (5-6m above) on a narrow ridge extending towards the channel. It is surrounded by estuarine mangrove forest on three sides.

Figure 45: Eliote village

Figure 46: Eliote and environs

Figure 47: Extent of estuarine mangrove forest around Eliote (hatched area)

Figure 48: Typical, relatively healthy, mangrove forests around Eliote

Figure 49: Shell middens around Eliote, showing the importance of wild harvested food from mangrove forests

Figure 50: Accessible channel into Eliote at high tide

Figure 51: Channel into Eliote at low tide. Figure also demonstrates poor state of Eliote's docking facilities.

9.2.1 Community transect

Data from the community transect for Eliote is reported in Table 10.

Table 9: Community transect findings for Eliote community

Subject domain	Notes
Community demographics	• 69 households. This excludes those households that live more permanently in Honiara, which would increase the number to around 90-100 households. • Population is between 300 and 400 people. • Migration in and the village is common, with people working in, going to school in, and migrating to Honiara (in particular). • New household formation is common from marriages.
Community hazards	• People report that temperatures are rising, and dry seasons (4 to 6 months of the year) are become hotter (and therefore drier). Overall, the weather patterns and seasons are becoming less predictable. • Local logging has degraded the forest. Logging is accepted as a short-term way of generating income, but the community accepts unsustainable logging practices are not viable in the long run. Licences are usually held by parties external to South Malaita communities. Some community members have worked in the logging sector. • Unusually high tides are become increasingly more noticeable. • Heavy rain sometimes causes flooding.
Infrastructure and risks	• Primary and secondary school (up to Form 3); the land on which the school sits belongs to the tribe (not the government). School population is around 130-140 students. The secondary school lacks sufficient classrooms and administrative buildings and does not have a direct water supply, for which grants have been sought. • Jetty at access channel has sunk into the mud and has not been replaced (Figure 51). Otherwise, most infrastructure is not subject to particular hazards (apart from a few older buildings). • A few houses are located on slightly lower ground, which may become subject to inundation in the long term.
Pollution and waste management	• Littering and waste pollution is become a serious issue with little community cooperation around planning for managing the issue. Imported food is main culprit.

	• There is no centralised waste management of separation of waste streams.
Exposures & vulnerability	• It is felt that there is insufficient shelter for cyclone protection. • Limited support available to community following natural disaster. There is currently no disaster committee.
Water resources and sanitation	• Water supply for the community is from shared taps. There is a permanent spring close to the mangrove channel out of the community. • Alternative sources are more than 30 minutes walk away. • A bore hole was recommended as a project. • Some houses have rainwater tanks. • Shared community toilets., which was funded by World Vision, however, it took around three years to build four small toilets! Installed toilets were flush toilets but there was no installed water tank and supply water for flush.
Power sources	• A few small solar systems. • People mainly use firewood for cooking, sourced from both the forest and the mangrove forests. This is coming under pressure and people are travelling further to find firewood.
Conservation efforts	• Eliote has hosted a number of conservation efforts, including MESCAL, EREPA, and now PEBACC+. • There has also been (4) tribal owned conservation efforts, but implementation has been very slow and inconsistent. Weak provincial coordinators were implicated. Support begins strongly, but then slows, and stops.
Gardens, farming, fishing, and collecting	• Household gardens is generally on higher (but flat) ground well above the high water level. Some gardens are in and around the community, others are a significant (2 hour) paddle away. (Note that access by even canoe is limited at low tide.) • Forested areas are being cut to make way for gardens. • It was suggested that this might be an indicator of falling soil fertility. Fallow periods have been "disrupted" and have been shortened. • There is agricultural extension services and field officers in Afio, but there are no regular visits to Eliote. There have been new crops and varieties introduced from other communities and islands. • Produce, such as betelnut, is sold into local markets and to Honiara. • Mangrove forests are used extensively for mud crab and shellfish collection. Mud crabs are sold (live) to markets in Honiara and are becoming increasingly scarce. People must travel further to secure the same numbers, making access to mud crabs more inequitable, as not everyone has motor boats. It wasn't made clear what taboos existed on collecting mud crabs (e.g. are there taboos on collecting female carbs.) Shell fish also extensively collected. • Fish catch changes over season. • Cattle paddocks were established in the 1960s but ceased operation around 20 years ago. This has left a significant patch of grassland that is only slowly recovering (Figure 52).
Tourism	• There is no tourists and no planned tourism ventures. • There is a perceived potential for tourism through mangrove and forest conservation efforts.

Figure 52: Recovering grassland around Eliote

9.2.2 Community asset inventory

The community asset inventory for the Eliote community in reported in Table 11.

Table 10: Community asset inventory for Eliote

Item	Quantity / notes	Item	Quantity / notes
Schools	1 primary school 1 secondary school 1 early learning centre	Police posts	Nearest at Afio
Churches	1 (Catholic)	Aid posts	Clinic at Afio
Poultry / hatchery	0	Womens' Centres	0
Cattle farms	0 (one shut down around 20 years ago)	Community Halls	1 (the chief's house)
Piggeries	A few individual pigs reared but no farm	Banks	0
Other plantations	0	Money transfers	Only via internet
Tilapia ponds	0	Post offices	0
Docks	1 (but dilapidated)	Market houses	1 weekly marketplace at Matangasi
Shops	3 canteens and 1 shop	Air strips	1 at Parasi
Cooperatives	0	Phone network	Adequate (1 carrier)
Boats	2 private, no community owned		

9.2.3 Individual statement ranking

A ranked list of statements by average score for all respondents from Eliote (n=22) is reported in Table 12. No factor analysis is undertaken here (see Section 8).

Far and away the highest ranked statement for the Eliote community was the desire for improved fishing gear in order to travel further to sea to reduce pressure on local catches. This links to the community transect (Table 9) where there was considerable concern over the sustainability of the mud crab harvest (which is export to markets in Honiara) and the need to travel further afield to maintain the fishery. The second most important statement was poor access to markets to sell surplus food. Eliote is not linked by road and the only access is by boat and canoe, which is both limited by tides. In contrast, there was low support for improving road access (ranked second last). Perhaps reflective of the difficulty of enforcing customary rights in marine areas, there was high concern around trespass and enforcing customary rules and taboos. There was considerable opposition to the logging and mining and the prospect for benefits sharing.

Table 11: Raw statement ranking for Eliote community members (no factor analysis applied)

Ref	Statement	Mean	Mean rank
S26	I would like the equipment to catch fish further out sea, to reduce pressure on the reef fishery.	2.64	1
S29	I would like to grow surplus food, but I cannot get the food to markets to sell it.	1.68	2
S32	Neighbouring communities trespass on our customary land and marine resources without our permission.	1.45	3
S22	There are less traditional medicine plants growing than there used to be.	1.41	4
S33	If I could borrow some money I would start a small business.	1.41	4
S28	I would like better ways to cook food, so we don’t have to use firewood cut from the forest.	1.36	6
S12	There are weather-related natural disasters happening today, such as cyclones and heavy rain.	1.23	7
S25	Enforcing customary resource rules and taboos in my community is very hard.	1.23	7
S8	If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.	1.09	9
S19	Tourism offers many good opportunities for business in my area.	0.95	10
S13	We should do more to stop our special kastom places from falling into disrepair.	0.91	11
S20	I feel that I can influence community decisions about conservation of customary lands.	0.91	11
S2	Protected areas in forests is an effective way of stopping logging on customary lands.	0.59	13
S9	It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	0.50	14
S23	Kastom knowledge of resource use and the land is being forgotten.	0.45	15
S15	Mining and forestry offer enough benefits to make up for their environmental impact.	0.14	16
S14	I would like to earn more cash from selling food, fish, or handicrafts.	0.09	17
S5	Reducing use of our marine resources is essential for conservation and good for the community.	0.00	18
S6	Our community needs better places to throw away non-compostable waste, such as cans and plastics.	0.00	18
S31	If we had more tourists we wouldn’t have enough food, water, and waste facilities to cope with them.	-0.05	20
S17	Our rivers and streams are drying up more frequently than before.	-0.14	21
S27	My garden is producing less food than it was before.	-0.14	21
S24	I worry that young people don’t want to stay in the village, as there are more opportunities in big towns and Honiara.	-0.23	23
S11	Marine and mangrove protected areas will be good for attracting tourists.	-0.68	24

S7	I would be able to spend more time in my community if there was a more equal share of housework between men and women.	-0.77	25
S3	Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	-0.82	26
S34	I get enough good, reliable drinking water in my community.	-0.82	26
S1	Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	-1.05	28
S16	We are cutting down too much forest and mangrove to make space for more gardens.	-1.09	29
S18	I would know what to do to feel safe in the next natural disaster.	-1.14	30
S21	It is important to bring more livestock into the community to provide for food.	-1.27	31
S30	We have enough toilet, washing, and cleaning facilities for all the people in the village.	-1.45	32
S4	Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	-1.55	33
S10	If our community protected its marine resources in a protected area, it should be paid for that work.	-1.77	34
S35	Improving roads access to the community will help business opportunities.	-2.18	35
S36	The benefits from logging and mining are shared fairly across everyone in the community.	-2.91	36

9.3 Ori Ore

Ori Ore is a small settlement towards the southern end of the Maramasike Passage (Figure 53 and 54). There are approximately 19 households and a population of around 35 people in the village itself and a further ~125 people who live in settlements along the passage, away in Honiara, and overseas, in Australia. Parts of the village is low laying, spreading up the hill well above the high-water mark. There are significant nearby mangrove forest that provides significant livelihood (Figure 55). The village is serviced by a lighted jetty that is serviceable at both low and high tides and day and night (these is a key advantage) (Figure 56).

Figure 53: Ori Ore community.

Figure 54: Ori Ore and environs

Figure 55: Location and extent of mangrove forest around Ori Ore

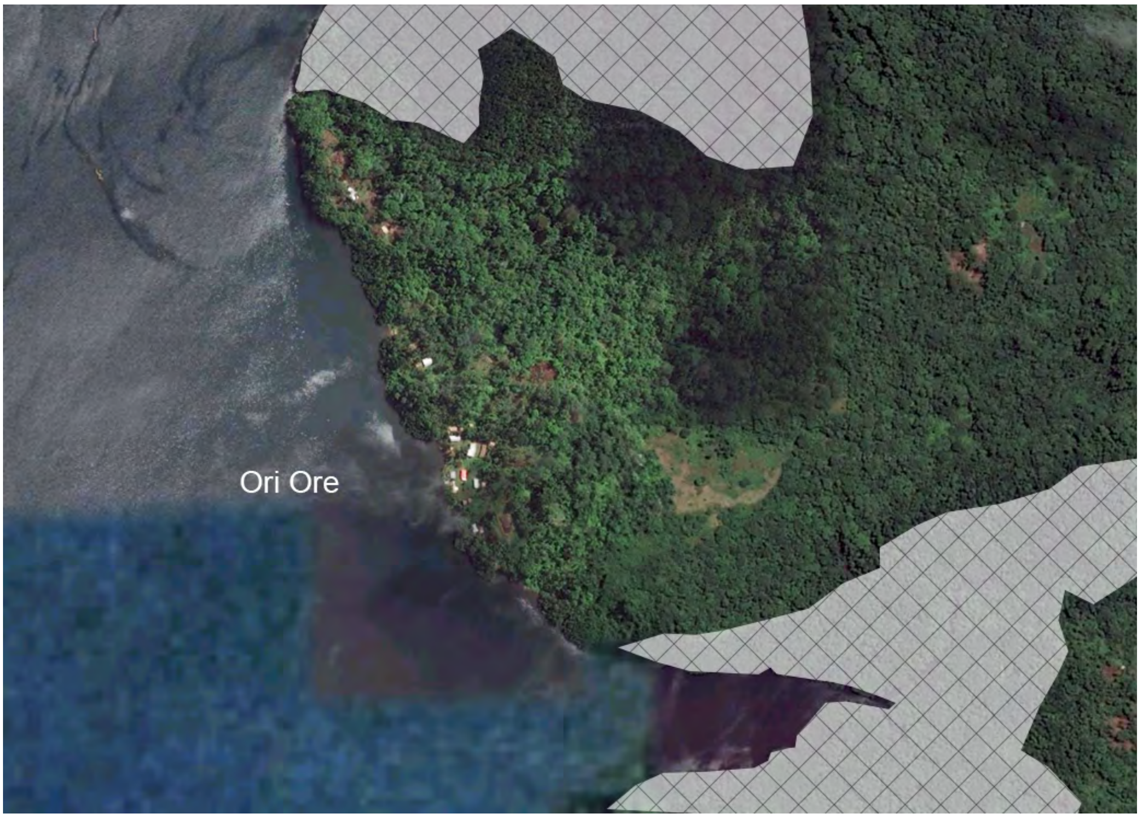


Figure 56: Serviceable jetty at Ori Ore

9.3.1 Community transect

The community transect findings for Ori Ore are recorded in Table 13.

Table 12: Community transect findings for Ori Ore community

Subject domain	Notes
Community demographics	• 19 households in the village. The population is 34 in the village with a further ~125 living along the passage, or away in Honiara or overseas. The population is now growing, after having fell for a while. • Complaints that community leaders receive less respect than before.
Community hazards	• There is a reported change in the weather and climate, with abnormal droughts (during dry season), cold and wet, and shifting seasons. • Nearby logging has caused degradation of nearby forests and has increased sediment deposition in the mangroves. • Reported falling fish stocks and damage to reefs. • Sea level rise is detected, with increased erosion and inundation of lower laying areas. • Mangrove forests are being cut for building materials. • No community / collective action to begin to manage emerging risks. • Some concern over fish stocks.
Infrastructure	• There are no houses that are specifically vulnerable to sea level rise. There is also further higher ground available to which to retreat.
Pollution	• Main pollution risk is from sedimentation of water courses from upstream logging. There is noticeable blanketing in the mangrove forests.
Exposures & vulnerability	• There is sufficient cyclone sheltering for the village but a low level of knowledge about disaster readiness, response, and recovery. • There is no disaster management committee (or natural resource management committee).

Water resources and sanitation	•	All water is sourced from streams and rivers. When there is no rain for two or three weeks, many sources begin to dry up. (This is being exacerbated as the climate warms.)
	•	Water quality is sometimes compromised during high rainfall.
	•	There is currently only one house that has a rainwater tank as a back-up.
Waste management	•	There is no proper non-compostable waste management system; much of it ends up in the mangroves and the oceans. There are no plans for improved waste management.
Power sources	•	All households use solar for lighting.
	•	Households cook using firewood from forests and mangroves, which is sourced nearby. There is no apparent shortage. (However, one respondent reported that they are having to walk further for collections.)
Conservation efforts	•	There is no current forest, mangrove, or fisheries conservation efforts though collective management systems are in place. However, there is early discussions around what more formal arrangements might look like.
	•	There are some rules of mud crab catch.
	•	Demarcation of customary areas is done through marker sticks.
Gardens and farming	•	Cultivation still uses a fallow system, rotated every 5 to 6 years, which is getting shorter.
	•	There is reported falling soil fertility – yams and taro is not growing as well as before. Gardens are expanding into forests and are getting further away, as the community pushes deeper into the forest.
	•	There is little or no new technological inputs or ideas; merely incremental changes. There are extension services in Afio but no formal arrangements.
	•	Produce is sold into markets in Afio, which occur 2-4 times each week. It is mostly betelnut, fish, crab, and garden produce.
	•	Fish stocks are falling. People must travel further for same catch.
Tourism	•	There is no tourism or tourism ventures. Only family visits.

9.3.2 Community asset inventory

Table 13 reports the community asset inventory for Ori Ore.

Table 13: Community asset inventory for Ori Ore

Item	Quantity / notes	Item	Quantity / notes
Schools	1 primary school Secondary school in Afio	Police posts	Nearest at Afio
Churches	2 (Catholic and Anglican church at Matangasi)	Aid posts	Clinic at Afio
Poultry / hatchery	1 poultry farm that produces eggs	Womens' centres	0
Cattle farms	0	Community Halls	1
Piggeries	A few households rear pigs	Banks	0
Other plantations	Betelnut and tick tree (?)	Money transfers	0
Tilapia ponds	3 that has just been started	Post offices	0
Docks	1 boat jetty (serviceable at low and high tide)	Market houses	1 weekly marketplace at Matangasi
Shops	1 canteen	Air strips	1 at Parasi
Cooperatives	1 women group, associated with the church	Phone network	Adequate (1 carrier)
Boats	1 boat with engine		

9.3.3 Individual survey

A ranked list of statements by average score for all respondents from Ori Ore (n=9) is reported in Table 15. No factor analysis is undertaken here (see Section 10).

The statement with the highest mean level of agreement was support for mangrove and marine conservation and the links to the community's sense of overall prosperity. Second-placed, and also very supportive of the concept of conservation, was the importance of protected area status as being an effective way of securing forested areas against logging. Further statements associated with conservation (marine and mangrove) were all scored highly. Overall, there was considerable concern around the impacts of logging impacting waterways (ranked 3rd) and the lack of benefits sharing from logging operations (ranked last – i.e. disagreed with the most). There was little interest in business opportunities and no consideration that improvements in road infrastructure would aid in building businesses. (Note that Ori Ore had good boat access to Afio and markets along the Maramasike Passage and a new jetty that can function at low tide.)

Table 14: Raw statement ranking for Ori Ore community members (no factor analysis applied)

Ref	Statement	Mean	Mean rank
S26	Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	2.00	1
S33	Protected areas in forests is an effective way of stopping logging on customary lands.	1.90	2
S31	Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	1.60	3
S5	Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	1.50	4
S29	Reducing use of our marine resources is essential for conservation and good for the community.	1.50	4
S8	Our community needs better places to throw away non-compostable waste, such as cans and plastics.	1.30	6
S23	I would be able to spend more time in my community if there was a more equal share of housework between men and women.	1.30	6
S32	If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.	1.10	8
S12	It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	1.00	9
S15	If our community protected its marine resources in a protected area, it should be paid for that work.	0.80	10
S28	Marine and mangrove protected areas will be good for attracting tourists.	0.70	11
S3	There are weather-related natural disasters happening today, such as cyclones and heavy rain.	0.60	12
S13	We should do more to stop our special kastom places from falling into disrepair.	0.40	13
S19	I would like to earn more cash from selling food, fish, or handicrafts.	0.40	13
S35	Mining and forestry offer enough benefits to make up for their environmental impact.	0.30	15
S30	We are cutting down too much forest and mangrove to make space for more gardens.	0.20	16
S4	Our rivers and streams are drying up more frequently than before.	-0.10	17
S7	I would know what to do to feel safe in the next natural disaster.	-0.20	18
S20	Tourism offers many good opportunities for business in my area.	-0.20	18
S25	I feel that I can influence community decisions about conservation of customary lands.	-0.20	18
S2	It is important to bring more livestock into the community to provide for food.	-0.30	21
S16	There are less traditional medicine plants growing than there used to be.	-0.30	21
S17	Kastom knowledge of resource use and the land is being forgotten.	-0.60	23
S21	I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	-0.60	23

S27	Enforcing customary resource rules and taboos in my community is very hard.	-0.60	23
S34	I would like the equipment to catch fish further out sea, to reduce pressure on the reef fishery.	-0.70	26
S1	My garden is producing less food than it was before.	-0.80	27
S10	I would like better ways to cook food, so we don’t have to use firewood cut from the forest.	-0.80	27
S24	I would like to grow surplus food but I cannot get the food to markets to sell it.	-1.00	29
S6	We have enough toilet, washing, and cleaning facilities for all the people in the village.	-1.10	30
S11	If we had more tourists we wouldn’t have enough food, water, and waste facilities to cope with them.	-1.10	30
S14	Neighbouring communities trespass on our customary land and marine resources without our permission.	-1.20	32
S18	If I could borrow some money I would start a small business.	-1.30	33
S9	I get enough good, reliable drinking water in my community.	-1.40	34
S22	Improving roads access to the community will help business opportunities.	-1.70	35
S36	The benefits from logging and mining are shared fairly across everyone in the community.	-2.40	36

10 Q-method factor analysis

This section reports the results of our Q-methodology (Q) factor analysis. It draws upon the quantitative results – the statistical relationships between the different factors and our qualitative interpretations of the factors. This is done by considering the 'composite sort' (sometimes called the 'ideal sort'). The composite sort of a factor is a hypothetical sort of a respondent who fits 100% in that factor (in reality, the threshold for placement into a factor is typically any respondent fitting more than >40%). Therefore, the composite sort exemplifies the characteristics of a person who aligns with that factor. This is based on a theory that people have coherent mindsets, or views of the world, and therefore think relatively consistently about different aspects of their world. For example, people who are more entrepreneurial than the rest of the population will likely rank business-related statements with similar importance as other people who entrepreneurial. In addition, they *may*, hypothetically, also rank statements more associated with tradition, less importantly. In this way, we build up a general picture of different groups of people in the community and we can make judgements about what other aspects of their lives (that aren't necessarily recorded on the ranked statements) might be important to them.

Using the composite sorts generated by the KADE software we generated common language summaries of each factor (Figures 57 to 60). Interpretation of the composite factor is best achieved by considering the placement of strongly negatively- and positively-salient statements (in the +/-5, +/-4, and +/-3 columns) and distinguishing statements—those where the z-score variance reaches a defined threshold (Sneegas et al., 2021). When approaching our factor interpretations, we considered such questions as:

- *What are the factor's social, economic, and environmental concerns?*
- *What links does the factor make between these concerns and outside pressures, such as climate change, or commercial logging and mining?*
- *What activities, projects, or institutions does the factor believe best support management of these concerns?*
- *What are issues is this factor relatively indifferent about?*

10.1 Summary results

We extracted 4 factors using the statistical method described in Section 8. Table 16 reports a summary of results and shows factor correlations – *how like one factor is every other* (1 is a perfect correlation). Eleven respondents fitted factor 1, seven respondents fitted factor 2, ten respondents fitted factor 3, and thirteen respondents fitted factor 4. Five respondents did not fit either factor or were confounding (fitted into both factors) [9].

[9] It is assumed in Q that these respondents did not fully understand the task, completed the task with insufficient accuracy, or could not express fully coherent viewpoints.

Table 15: Factor correlations (How similar is each factor to one another)

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1	-0.0967	0.2797	0.3061
Factor 2		1	-0.1341	-0.0922
Factor 3			1	0.3147
Factor 4				1

Table 16 reports the rankings of all statements by each factor. Where one factor has placed a statement very significantly differently to than another ($p < 0.01$) (this being an important aspect of factor description) we denote this with two asterisks (**) and an arrow, ▼ for lower than and ▲ for higher than.

Box 3: Scores and rankings in Q methodology

Factors can be assessed using a range of metrics from their composite sorts, including z-scores, rankings, and column placements. Table 6 reports the full results for each factor.

The z-score is a standardized measure of the relationship between a statement and a factor, calculated by subtracting the mean score of all statements from the score of the individual statement and then dividing by the standard deviation of all scores. The z-score can, therefore, be interpreted as the number of standard deviations that a statement is above or below the mean. Average ranking is a less informative measure than the z-score, as it does not take into account the distribution of the scores and is overly influenced by outliers.

For example, Factor 1's highest ranked statement (S9) has a z-score of +2.27, demonstrating a very high salience with this factor, whist Factor 4's highest ranked statement (S30) has a z-score of +1.61, demonstrating the strength of salience of this statement, despite being ranked highest, was somewhat less.

Table 16: Factor z-scores and rankings for sampled Malaita communities

Ref	Statement	Factor 1		Factor 2		Factor 3		Factor 4	
		Z-score	*Rank*	*Z-score*	*Rank*	*Z-score*	*Rank*	*Z-score*	*Rank*
1	My garden is producing less food than it was before.	-0.23	20	1.48**▲	3	-1.36**▼	32	0.19	17
2	It is important to bring more livestock into the community to provide for food.	-0.47*▼	23	0.67	12	1.17*▲	6	0.02	20
3	There are weather-related natural disasters happening today, such as cyclones and heavy rain.	1.04**▲	5	-0.45	25	-1.45**▼	33	-0.63	27
4	Our rivers and streams are drying-up more frequently than before.	-0.30	22	1.19**▲	4	-1.02	31	-1.82**▼	35
5	Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	1.59**▲	3	-1.04**▼	31	-0.03	17	-0.19	23
6	We have enough toilet, washing, and cleaning facilities for all the people in the village.	-0.21	19	0.80	10	1.54**▲	3	-1.14**▼	31
7	I would know what to do to feel safe in the next natural disaster.	0.27**▲	14	-1.38	33	-0.31	23	-1.04	30
8	Our community needs better places to throw away non-compostable waste, such as cans and plastics.	1.14**▲	4	-0.25	20	0.13	15	0.48	12
9	I get enough good, reliable drinking water in my community.	2.27	1	2.36	1	-0.26	20	-1.31**▼	32
10	I would like better ways to cook food, so we don't have to use firewood cut from the forest.	-0.96	31	-1.65**▼	34	-0.42	24	-0.75	28
11	If we had more tourists we wouldn't have enough food, water, and waste facilities to cope with them.	-0.86	29	0.19	14	0.26	13	-1.36*▼	33
12	It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	0.13	15	-0.73**▼	27	1.51**▲	4	0.72	9
13	We should do more to stop our special kastom places from falling into disrepair.	1.03	6	-0.82	29	-0.47	26	0.93	7
14	Neighbouring communities trespass on our customary land and marine resources without our permission.	-0.70*▼	27	0.81	9	-0.19	18	0.65	11
15	If our community protected its marine resources in a protected area, it should be paid for that work.	-0.27	21	0.47	13	-0.58	29	0.29	15
16	There are less traditional medicine plants growing than there used to be.	-1.43*▼	35	-0.01	16	-0.93	30	0.30	14
17	Kastom knowledge of resource use and the land is being forgotten.	-0.58	26	0.7	11	-0.47	25	0.83	8
18	If I could borrow some money I would start a small business.	-1.33**▼	34	-0.06	17	0.44	10	0.12	18
19	I would like to earn more cash from selling food, fish, or handicrafts.	0.12	16	-0.35*▼	23	0.27	12	1.15**▲	6

20	Tourism offers many good opportunities for business in my area.	0.29	13	-1.67**▼	35	0.26	14	1.23**▲	5
21	I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	-0.49	24	0.83**▲	8	-0.50	28	-0.40	24
22	Improving roads access to the community will help business opportunities.	-0.53*▼	25	1.16	5	2.43**▲	1	-0.12	22
23	I would be able to spend more time in my community if there was a more equal share of housework between men and women.	0.43	12	-1.70**▼	36	0.91*▲	8	-0.09	21
24	I would like to grow surplus food than but I cannot get the food to markets to sell it.	0.01	17	1.67**▲	2	-1.57**▼	35	0.11	19
25	I feel that I can influence community decisions about conservation of customary lands.	-0.02	18	1.02	7	-0.29	22	1.61*▲	1
26	Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	0.79	8	-0.76**▼	28	1.72	2	1.54	3
27	Enforcing customary resource rules and taboos in my community is very hard.	-0.70	28	-0.49	26	-0.48	27	0.24**▲	16
28	Marine and mangrove protected areas will be good for attracting tourists.	0.75	9	1.16	6	1.00	7	1.45	4
29	Reducing use of our marine resources is essential for conservation and good for the community.	0.97	7	-0.37**▼	24	0.40	11	1.58**▲	2
30	We are cutting down too much forest and mangrove to make space for more gardens.	-0.88	30	-0.15	18	0.01	16	-1.61**▼	34
31	Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	0.58**▲	11	-0.86	30	-0.22	19	-0.85	29
32	If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.	0.73	10	-0.28**▼	22	0.80	9	0.70	10
33	Protected areas in forests is an effective way of stopping logging on customary lands.	2.22**▲	2	-1.10**▼	32	1.23	5	0.35	13
	This statement was discounted from the factor analysis as a different, and more relevant, statement was presented to the three communities.								
35	Mining and forestry offer enough benefits to make up for their environmental impact.	-1.15	33	-0.24	19	-1.81**▼	36	-0.49	25
36	The benefits from logging and mining are shared fairly across everyone in the community.	-2.12	36	-0.27**▲	21	-1.47	34	-2.18	36

10.2 Factor interpretations

This section describes the key features of each of the four factors. Visual representations of these factors are in the Appendix as Figures 57 to 60.

10.2.1 Factor 1: Climate change concerns

Social, economic, and environmental concerns:

Unsupportive of logging and mining activities; relatively concerned about climate change and the impacts of climate change on agricultural productivity and community safety during more intense natural disasters; concerned about kastom places falling into disrepair; concerned about waste management.

Links made between these concerns and outside pressures, such as climate change, or commercial logging and mining:

Benefits of logging are not shared fairly, nor are they sufficient to make up for environmental impacts; sediment from deforestation from logging damages water quality in rivers and oceans.

Activities, projects, or institutions that best support management of these concerns:

Protected areas / conservation areas can effectively prevent logging activities in forest areas and marine conservation will be good for the community.

Relative indifference about...

Little concern about access to good drinking water, business and business opportunities, and loss of traditional medicines. There is sufficient firewood and the impact of collection from forests is low; no concern about trespassing of neighbouring tribes; and no demand for introducing more livestock.

10.2.2 Factor 2: Food concerns

Social, economic, and environmental concerns:

Concerns about generating more surplus food and getting to market; concern over food gardens reducing in productivity; concern over rivers and streams drying up; and concern over young people leaving the community.

Links made between these concerns and outside pressures, such as climate change, or commercial logging and mining:

Livelihood improvements can be linked to conservation through tourism but overall, there is relatively low support for greater conservation efforts; and this factor was more sanguine about logging, believing the benefits are relatively fairly shared.

Activities, projects, or institutions that best support management of these concerns:

Improving access (e.g. roads) to markets and other business opportunities will be a benefit; conservation areas can attract tourists; conservation areas *will not* necessarily keep loggers at bay, nor will conservation make people prosperous.

Relative indifference about...

Access to good quality drinking water is adequate; there is equal share of housework; waste management options are adequate; there is little concern over climate change; or loss of kastom knowledge of dances and ceremonies; and little interest in earning more cash from sale of produce and products.

10.2.3 Factor 3: Conservationists

Social, economic, and environmental concerns:

Very concerned that the benefits of logging not shared fairly, nor are the benefits sufficient to make up for environmental impacts; concerned about passing down kastom knowledge of culture and ceremony; concern about fairness in the allocation of domestic labour; concern about rivers drying up more often and gardens are not producing sufficient food.

Links made between these concerns and outside pressures, such as climate change, or commercial logging and mining:

Conservation of resources will improve people's well-being and protected area status will be effective in keeping logging at bay.

Activities, projects, or institutions that best support management of these concerns:

Improving road access is most important; improving roads can also help business opportunities; conservation areas will assist in natural resource conservation; and more livestock will improve food security.

Relative indifference about...

Growing surplus food for sale to market; little concern over the sufficiency of water for sanitation and washing.

10.2.4 Factor 4: Pro-tourism

Social, economic, and environmental concerns:

Not supportive of logging and mining and very concerned about the environmental impacts and the lack of benefit sharing; concerned about mangroves and forests being cut down to make room for gardens; concern over rivers and streams drying up and there is insufficient access to water for drinking, sanitation, and washing; there is insufficient enforcement of rules and restricting trespass maybe difficult; and there is a loss of kastom knowledge and ceremony.

Links made between these concerns and outside pressures, such as climate change, or commercial logging and mining:

Reducing use of natural resources through conservation will be good for the community; and conservation is linked to community prosperity. However, if there was greater commitment to conservation, new livelihood options would be needed (e.g. tourism).

Activities, projects, or institutions that best support management of these concerns:

Factor feels that they do have impact over decision making in the community and subsequent conservation activities; there is desire to earn more cash from sale of products and produce; tourism can generate business opportunities; and conservation efforts will attract tourists.

Relative indifference about...

More tourists would not put pressure on local natural resources; not concerned about climate change nor the impacts of natural disasters.

10.3 Summary and composite sorts

Table 18 compares each factor across broader categories of concern, based on groupings of the statements for that factor. The colour scheme is based on intensity of feeling, based on either a 'concern for', or 'support for'.

The key conclusions that can be drawn from this analysis are:

- Support for conservation is correlated with support for kastom practices. Lack of support for kastom practices is correlated with lower support for conservation.
- Support for customary practices is correlated with support for business and tourism, but this is not always the case. This suggests that these two concepts are not incompatible. *Business opportunities can be pursued with an apparent concern for loss of kastom practices*.
- Support for conservation is correlated with lower concern for provision ecosystem services (food, materials, medicines, and livestock). Where there is greater concern for provisioning ecosystem services there is lower support for conservation. *There is a strong link between security of livelihoods and support for conservation*.
- Concern over climate change and disasters can be correlated with support for conservation, but this is not always the case. There can still be support for conservation where concern about climate change and disasters is modest.
- Support for conservation efforts can be compatible with support for more business opportunities (including tourism) but this is not always correlated.
- There are considerable differences between the concern over water provision, suggesting this is very location-dependent.
- Concern over pollution (waste and environmental) is related to a support for conservation efforts but is not a requirement. Support for conservation is broader than concern over pollution.

Table 17: Category of concern for the four factors

Category of concern	F1	F2	F3	F4
Concern for food, raw materials & medicine	-0.73	0.23	-0.26	-0.28
Concern for climate and disasters	0.83	-0.12	-0.19	0.45
Concern for provision on water	0.59	1.45	0.09	-1.42
Concern about pollution	0.86	-0.56	-0.05	-0.19
Support for kastom practices	0.18	-0.30	0.21	0.91
Support for business and tourism	-0.12	0.32	0.47	0.66
Support for conservation	1.05	-0.35	1.09	0.92

11 Community feedback

Between 07/04/2025 and 09/04/2025 a joint Griffith University and SPREP team visited the communities of Ori Ore, Eliote, and Tapa'atewa to conduct follow-up sessions with community members. The purpose of these sessions was to:

(a) Report back to the community on the main findings of the ESRAM process. E.g., provide information on the identified climate risks, individual survey findings, and community transects.

(b) Present the high-level recommendations for ecosystem-based adaptations detailed in Section 11.

(c) Confirm with the communities the perceived risks to key ecosystems and resources/uses presented by climate change and general environmental and socio-economic change.

(d) Make recommendations on the prioritisation of EbA projects and present new ideas.

(e) To thank the community and close off this stage of the PEBACC+ project.

11.1 Approach

Our approach in the community was a four-phase approach. Following team introductions, the team firstly presented the key findings from the ESRAM study (climate projections, ecosystem mapping, Q-methodology, and the EbA recommendations). Secondly, we divided up the attendees into groups (1, 2, or 3 depending on the number of attendees and the particular exercise) to undertake three tasks, associated to the three prompt questions below. The tasks were ranking exercises, where groups were requested to sort a series of statements (see below) into order of importance, using a similar sorting mat to the Q-method component. Groups were mixed (men and women), and after each sorting exercise, a member from each team (alternating between men and women) was invited to present their decision to the broader group and explain the reasoning behind their thinking.

1. **Knowing what you know now, which ecosystems / habitats do you see as being most at-risk from climate change, and socio-economic and environmental change?**

   Groups were invited to rank the key ecosystems identified in the ESRAM ecosystem mapping process (forests, freshwater wetlands and rivers, coral reefs, deep ocean, plantations, bush/scrublands, mangrove forests, sea grass beds, and household gardens (and 'Maramasike Passage waters' for the communities of Eliote and Ori Ore [10]) in order of which they see to be of greatest risk from climate, environmental, and human-induced change.

2. **Which resources / resource uses do you see as being most at-risk from climate change, and socio-economic and environmental change?**

   This activity was focussed on community use and harvesting of provisioning ecosystem services – tangible resources that are used in their final state directly by the community (Boyd & Banzhaf, 2007). Groups were invited to rank the resources identified through the ESRAM consultation process (drinking water, water for washing and toilets, timber for building frames [11], building

[10] In this instance it was felt that the option of the immediate marine environment (generally) would be a more useful way of enabling the communities of Ori Ore and Eliote to demonstrate concern for their immediate marine surroundings rather than using the distinction between coral reefs, sea grass beds, and the open ocean.
[11] The distinction was made between timber resources for building frames and other less durable building materials to enable the communities to demonstrate a concern for a shortage of accessible large trees.

materials (general), kastom places, fruit, vegetables, & nuts, traditional medicines, other crops for cash, tourism opportunities, Bush meat, betelnut for sale, cows, pigs, and goats grazing, honey) in order of which they see to be of greatest risk from climate, environmental, and human-induced change. Groups could also add additional resources freely.

3. **What EbA projects are most important**

   This activity was focussed on community perceptions of their favoured interventions. The list presented included components (and sub-components) from Section 11. This included: marine conservation, mangrove replanting, mud crab fishery sustainability study, water and sanitation project (noting this isn't strictly, or always an EbA approach) agricultural extension, fish attracting devices (not for Tapa'atewa), tree planting and tree nursery. We also tested an opinion on prohibitions on mining projects, the development of tourism projects, and investment in further opportunities for access to food markets. Greater focus in the facilitation was given to the generation of new ideas.

11.2 Tapa'atewa

Rankings for the most at risk ecosystems and resources for the community of Tapa'atewa are reported in Tables 18 and 19. (Note that marine ecosystems and marine resources were not included in this exercise). Unsurprisingly, forests and household gardens were ranked top of the ecosystems of concern. The community has been the site of recent (but now ceased) commercial logging, which is felt to have not delivered much benefit to the community. Through all initial consultations, concern over logging (and mining) and the desire for forest conservation, very strongly through the statement ranking (see Table 8 in Section 9.1).

Table 18: Most at-risk ecosystems for the community of Tapa'atewa

Ecosystem		Group 1	Group 2	Mean	Rank
E5.	Forests	4	4	4	1
E11.	Household gardens	3	5	4	1
E2.	Freshwater wetlands & rivers	5	0	2.5	3
E7.	Bush / scrub land	2	-1	0.5	4
E6.	Plantations	0	0	0	5
E8.	Grassland	0	-3	-1.5	6

The resources of concern for Tapa'atewa also reflect the statement ranking with both drinking water and general water being rank highly as being at-risk. There was also a concern about the future risks to timber for building frames (Table 19).

Table 19: Most at-risk resources to the community of Tapa'atewa

Resources		Group 1	Group 2	Mean	Rank
R4.	Drinking water	3	5	4	1
R7.	Timber for building frames	4	3	3.5	2
R3.	Water for washing and toilets	2	4	3	3
R1.	Kastom places	3	2	2.5	4

R10.	Fruit, vegetables, & nuts	2	3	2.5	4
R15.	Medicines	1	4	2.5	4
R6.	Building materials	0	3	1.5	7
R17.	Other crops for cash	1	2	1.5	7
R2.	Tourism	2	0	1	9
R14.	Bush meat	2	0	1	9
R16.	Kava / Betelnut	1	1	1	9
R5.	Cows, pigs, and goats grazing	1	0	0.5	12
R12.	Honey	1	0	0.5	12

11.3 Eliote

The ecosystems consider most at risk to the community of Eliote were the immediate waters of the Maramasike Passage, nearby freshwater sources, plantations, and mangrove forests. This aligns well with the statement ranking (Table 11, Section 9.2.3), which listed the desire to catch fish further out to see, to relieve stocks in nearby waters as a key concern. Note that Eliote is a considerable distance from open water, has access difficulties at low tide (and no roads) and is completely surrounded by mangrove forests.

Table 20: Most at-risk ecosystems ranked for Eliote

Ecosystem		Group 1	Group 2	Mean	Rank
E1.	Maramasike Passage waters	4	5	4.5	1
E2.	Freshwater wetlands & rivers	3	4	3.5	2
E6.	Plantations	4	3	3.5	2
E9.	Mangrove forests	5	2	3.5	2
E11.	Household gardens	2	4	3	5
E5.	Forests	3	1	2	6
E7.	Bush / scrub land	1	3	2	6
E8.	Grassland	0	2	1	8
E3.	Coral reefs	2	-5	-1.5	9
E10.	Sea grass beds	1	-4	-1.5	9
E4.	Deep ocean	0	-4	-2	11

The resources that are considered most at risk from future climate, environmental, and anthropogenic changes were drinking water (and general water, ranked 4^{th}) and shellfish and mud crabs (both sourced from in and around the surrounding mangrove forests). Shellfish play a large role in local diets and mud crabs play a role in both local diets and for generating cash for sale into Honiara.

Table 21: Most at-risk resources for Eliote

Resource		Group 1	Group 2	Mean	Rank
R4.	Drinking water	5	3	4	1
R11.	Shell fish	3	5	4	1
R13.	Mud crabs	4	4	4	1
R3.	Water for washing and toilets	4	3	3.5	4
R6.	Building materials	2	3	2.5	5
R10.	Fruit, vegetables, & nuts	3	1	2	6
R7.	Timber for building frames	1	2	1.5	7
R8.	Deep water fishing	3	0	1.5	7
R16.	Kava / Betelnut	1	2	1.5	7
R17.	Other crops for cash	2	1	1.5	7
R1.	Kastom places	1	1	1	11
R9.	Reef fishing	0	2	1	11
R15.	Medicines	2	0	1	11
R2.	Tourism	0	1	0.5	14
R14.	Bush meat	1	0	0.5	14
R5.	Cows, pigs, and goats grazing	0	0	0	16
R12.	Honey	0	0	0	16

11.4 Ori Ore

The ecosystems considered most at risk from climate, environmental, and anthropogenic change to the community of Ori Ore include the mangrove forests, the immediate waters of the Maramasike Passage, nearby freshwater sources, and forests. This aligns well with the statement ranking (Table 14, Section 9.3.3), which ranked mangrove and marine conservation, protected area status of forests, and marine pollution (sediment), and a lack of reliable fresh water as key concerns.

Table 22: Most important ecosystems for the community of Ori Ore

Ecosystem		Group 1	Group 2	Mean	Rank
E9.	Mangrove forests	4	5	4.5	1
E1.	Maramasike Passage waters	5	2	3.5	2
E2.	Freshwater wetlands & rivers	3	3	3	3
E5.	Forests	4	2	3	3
E11.	Household gardens	3	3	3	3
E3.	Coral reefs	1	4	2.5	6
E10.	Sea grass beds	1	4	2.5	6
E6.	Plantations	2	1	1.5	8
E7.	Bush / scrub land	2	-1	0.5	9
E4.	Deep ocean	0	0	0	10
E8.	Grassland	-1	0	-0.5	11

The resources that are considered most at risk from future climate, environmental, and anthropogenic changes by the community of Ori Ore were drinking water (and general water, ranked 4th), timber for building frames, and shellfish and mud crabs (both sourced from in and around the surrounding mangrove forests). As with Eliote, shellfish play a large role in local diets and mud crabs play a role in both local diets and for generating cash for sale into Honiara. This community also specifically listed the mangrove bean as being at risk. This is likely due to a high level of community dependency rather than a specific shortage.

Table 23: Most at-risk resources for Ori Ore

Resources		Group 1	Group 2	Mean	Rank
R4.	Drinking water	5	5	5	1
R3.	Water for washing and toilets	4	4	4	2
R7.	Timber for building frames	4	2	3	3
R11.	Shell fish	3	3	3	3
R13.	Mud crabs	2	4	3	3
R18.	Mangrove bean		3	3	3
R9.	Reef fishing	2	3	2.5	7
R10.	Fruit, vegetables, & nuts	3	2	2.5	7
R6.	Building materials	3	1	2	9
R17.	Other crops for cash	2	2	2	9
R15.	Medicines	1	2	1.5	11
R5.	Cows, pigs, and goats grazing	1	1	1	12
R16.	Kava / Betelnut	1	1	1	12
R1.	Kastom places	0	1	0.5	14
R8.	Deep water fishing	1	0	0.5	14
R12.	Honey	2	-1	0.5	14
R2.	Tourism	0	0	0	17
R14.	Bush meat	0	-4	-2	18

11.5 Combined results from Eliote and Ori Ore

Given the similarities of the geographies and the climate and environmental risks of the communities of Eliote and Ori Ore, Tables 24 and 25 report the means from all groups combined. Together, both communities see the pressures on the immediate waters of the Maramasike Passage as being of the greatest concern, along with threats to the mangrove forests. Freshwater ecosystems – the evident source of freshwater resources were also, combined, consider at great risk (Table 24).

Table 24: Combined scores for Eliote and Ori Ore

Ecosystem		Mean for two communities	Rank
E1.	Maramasike Passage waters	4	1
E9.	Mangrove forests	4	1
E2.	Freshwater wetlands & rivers	3.3	3
E11.	Household gardens	3	4

E5.	Forests	2.5	5
E6.	Plantations	2.5	5
E7.	Bush / scrub land	1.3	7
E3.	Coral reefs	0.5	8
E10.	Sea grass beds	0.5	8
E8.	Grassland	0.3	10
E4.	Deep ocean	-1	11

Unsurprisingly, given the acute concern over freshwater ecosystems (including rivers), freshwater (for drinking and general) was considered the resource most at risk from climate, environmental, and anthropogenic changes, followed by key food resources from the mangrove forests (shellfish, mud crabs, and mangrove beans) (Table 25).

Table 25: Most at-risk resources combined for all groups from Eliote and Ori Ore

Resources		Mean of groups	Rank
R4.	Drinking water	4.5	1
R3.	Water for washing and toilets	3.75	2
R11.	Shell fish	3.5	3
R13.	Mud crabs	3.5	3
R18.	Mangrove bean	3	5
R6.	Building materials	2.25	6
R7.	Timber for building frames	2.25	6
R10.	Fruit, vegetables, & nuts	2.25	6
R9.	Reef fishing	1.75	9
R17.	Other crops for cash	1.75	9
R15.	Medicines	1.25	11
R16.	Kava / Betelnut	1.25	11
R8.	Deep water fishing	1	13
R1.	Kastom places	0.75	14
R5.	Cows, pigs, and goats grazing	0.5	15
R2.	Tourism	0.25	16
R12.	Honey	0.25	16
R14.	Bush meat	-0.75	18

12 Adaptation priorities

This section identifies EbA (and other project) priorities, based on the lines of evidence presented in Sections 2, 3, 5, 7, and from feedback from the follow-up visit described in Section 11.

In making high level adaptation recommendations we draw on our position of taking an EbA *approach* and seeing adaptations along a spectrum (Figure 3). Therefore, our recommendations do not specifically draw solely on pure 'nature-based solutions' (Hermelingmeier and Nicholas, 2017; IUCN, 2020) but instead lean in to the FEBA qualification criteria, including:

- reduces social and environmental vulnerabilities;
- generates societal benefits in the context of climate change;
- restores, maintains, or improves the health of ecosystems;
- is supported by policies at multiple levels; and
- supports equitable governance and enhances capabilities.

(FEBA, 2018)

12.1 Short term priority projects

12.1.1 Fisheries harvest and marine management

Mud crab fishery

Commercially, mud crabs command high prices from resorts and hotels in Guadalcanal as a desired seafood commodity for tourism guests. Higher prices can encourage some fishers to conduct more unsustainable harvest practices, such as catching and trading immature crabs or egg-carrying females. It was widely reported in the communities of Eliote and Ori Ore that the harvest of mud crabs was coming under pressure, resulting in people having to travel further and for longer to maintain supply. Economically, this increases the costs of the harvest, which can provide a localised correcting mechanism, where the harvest rate returns to a more sustainable rate. However, if market prices of mud crab continue to rise, as a result of growing scarcity in the markets of Honiara, then local harvests can be pushed higher and likely closer, and potentially beyond, maximum sustainable yields, putting the mud crab population at risk of catastrophic and potentially permanent loss (Daly and Farley, 2004) [12]. It was not disclosed whether the communities of Eliote and Ori Ore held to established taboos for the management of the mud crab harvest (such as closures, or taboos on bag size and the harvesting of females).

Mangubhai et al. (2024) identified three main challenges and constraints on development of the mud crab fishery (in this instance, from Fiji):

1. Supply and demand: there is currently insufficient supply to meet the growing domestic demand.
2. Capacity to add value is low: few fishers invest in fattening mud crabs prior to sale to increase the weight of the crabs.

[12] It is known in fisheries science that fishery collapse can lead to irrecoverable situations, where even long term closures do not result in a recovery of the fishery as the breeding population is too small Daly, H., & Farley, J. (2004). *Ecological Economics: Principles and Applications*. Island Press, Connecticut. .

3. Insufficient data: there are insufficient data on the volumes of mud crabs being harvested and how much income the fishery generates annually for households and contributes to the local economy.

A mud crab sustainability project would provide an entry point for a worthwhile EbA project. There are examples of successful implementation of modest management plans for mud crab fisheries in the Pacific region (see Giffin et al., 2019).

Fish attracting devices

More broadly, it is highly likely that local fisheries are under pressure, or the harvesting of reef fish is impacting on coral cover on the reefs of Maramasike Passage. Whilst we have included locally managed marine conservation areas in the potential longer-term priority list (see below), shorter term solutions, such as the deployment of fish attractive devices (FADs) can be considered. FADs are already widely used in the Pacific as a means to improve fisheries production in oceanic and, more recently, inshore fisheries and to take pressure off coral reef fisheries. Innovations in FAD design, deployment selection and depth have improved the potential of FADs. Studies show they can provide a very health return on investment and considerable co-benefits (Sharp, 2011). The community of Eliote considered improvements in fishing equipment and technology to be their number one priority (with less emphasis on marine conservation areas).

12.1.2 Forest regeneration / forest heritage park

South Malaita's landscape has been very significantly impacted by deforestation from both commercial logging and clearing and regrowth from agriculture and subsistence cultivation. As a result, much of the high-ecosystem integrity rainforest and high-value tree species have been extracted and remain only in patches where the topography is less accessible. The activities of commercial logging represent an unsustainable, extractive process where the natural capital of the landscape is degraded, all for little apparent community benefit, as reported through by all communities and all factors in the Q-method studies (see Sections 7 and 8). In all three communities, concern over the impact of the commercial logging sector was ranked with most concern. Climate change impacts and likely further commercial logging pressures are likely to compound forest integrity.

Forests capture, store, and regulate the release of rainwater, which plays a critical role in generating ecosystem services for the whole catchment. These services can include reducing downstream flooding, regulating levels of the water table by improving water infiltration, preventing erosion, and assuring a high-quality water supply for aquatic species and people and agriculture further downstream. As the planet heats these forests will play an ever-stronger role in regulating more extreme regional droughts and floods and ensuring downstream water security for both ecological and economical functions, including drinking water for hundreds of millions of people.

Tropical primary forest catchments are also integral to coastal and marine ecosystem integrity, such as coral reefs, sea grass beds, and inshore fisheries. In the tropics, this is dubbed the 'ridge to reef' concept in landscape management, whereby the integrity of forested catchments is linked to the health of inshore marine habitats and communities. Coral reefs, for example, are particularly vulnerable to disturbed catchments, which produce additional sedimentation and nutrient-laden river flows, both of which set in train damaging threatening pathways that degrade the important ecosystem services generated by coral reefs, such a coastal protection, fishing and collecting, and tourism.

Whilst coordinated forested conservation and access to funds for reducing deforestation and forest degradation are considered amongst longer-term priorities (see below), in the shorter-term, tree planting projects should be considered, in particular, in partnership with remain commercial logging operators as part of their statutory rehabilitation requirements. High value timber trees should be considered within the mix, as well as food baring trees, given the likely importance of commercial logging in the area into the future.

A model for an approach to forest conservation for South Malaita is that of the **Barana Community Nature and Heritage Park** [13] in the hinterland of Honiara. The conservation area is 5,000 ha and owned by the Barana Community. The rehabilitated area is set to generate very significant catchment-based ecosystem services to the city (especially freshwater). The extent of natural and secondary forest in South Malaita is 27,000 ha under a number of layers of customary ownership. A priority should be to identify communities for joint inclusion in managing a conservation estate as integrous as possible. A model for this is. work undertaken in the Ensuring Resilient Ecosystems and Representative Protected Areas in the Solomon Islands (EREPA) project on Rennell Island (Rennell and Bellona Province) where the project has worked towards gaining agreement and consent from four different communities for conservation of more than 10,000 ha of forest around Lake Tegano [14].

Priority should be given to forested areas where the ecosystem service benefits will be greatest; i.e., where the greatest number of people would benefit from better regulated flows, cleaner freshwater flows, and improved water quality conditions in the coral reef lagoon. Whilst, in the short term, revenue generating opportunities will be limited (this is not the case with the Barana Nature and Heritage Park), access to revenue can be linked to longer term prioritise through REDD+ and payments for ecosystem service schemes (see Section 12.2).

12.1.3 Mangrove monitoring and replanting

Though currently the mangrove forest does not appear to be under significant pressure, it was reported that mangrove forest is being marginally lost as a result of cutting for firewood and for expansion of the cultivated area. In addition, the (relatively low resolution) data from Global Mangrove Watch (2024) also pointed to a steady loss of mangrove forest along the Maramasike Passage. High integrity mangrove forest is vital to the communities of Eliote and Ori Ore – for food and for coastal protection. In the future, these mangrove forests could also become the source of significant livelihood opportunities through the development of payment for ecosystem services schemes and blue carbon projects. In the shorter term, mangrove education projects and small-scale mangrove rehabilitation projects should be considered.

12.2 Longer term priorities

12.2.1 REDD+ and payments for ecosystem services

Given the widespread activity of commercial loggers in South Malaita and the desire for greater conservation catchment forest conservation projects remain a priority. All communities showed a desire to pursue livelihood development through income generating activities. This suggests that conservation efforts need to be linked to opportunities to further develop local incomes in alternative ways to extractive activities. This broadly supports the intent of Solomon Islands forestry and development strategies.

Payment for ecosystem services (PES) schemes are 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

[13] See https://www.sprep.org/news/barana-nature-and-heritage-park-a-conservation-milestone-for-solomon-islands
[14] See https://www.thegef.org/projects-operations/projects/9846

transactions (Pagiola, 2008; Salzman et al., 2018). PES compensate communities for pursuing sustainable forest management practices, such as protected area status, which generate positive externalities through ecosystem services (Engel, Pagiola, and Wunder, 2008) in lieu of extractive uses, such as logging, mining, and land-use change to agricultural uses (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 '+' (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, Arcenas, and Platais, 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.

12.2.2 Agricultural extension and agro-forestry

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

- Local food security during change climates and through natural disasters, ensuring the community has a reliable supply of a variety of foods but also systems in place to recover quickly or store reserves if harvesting is interrupted.
- Nutrition: Local agriculture can help to improve nutrition by providing access to a variety of nutritious foods, such as fruits, vegetables, and meats.
- Economic development: Agriculture can be a major economic driver. A robust farming system can help to create jobs, generate income, and boost exports. Experimentation in new, export-orientated niche products (coffee, cocoa) can generate income but come at a risk to producing farmers, in terms of marketing investments and forgone effort towards foods that directly support their own and their community's livelihoods.
- Agro-forestry: Sustainable land-management through expansion of agro-forestry systems can increase the overall yield of the land by combining the production of crops, including tree crops, and forest plants on the same land. At a local level, maintaining ground cover and providing shade, reduces moisture-loss and protects soil from sunlight, and provides for a structure that enables some food plants to grow more efficiently. Agroforestry systems, featuring perennial crops can also be more efficient by demanding less maintenance than annual plants and maintaining crop diversity insures against crop diseases and pests.

12.2.3 Marine conservation areas

Marine conservation was strongly supported by Factors 3 and 4 and moderately supported by factor 1. There was considerable support for marine (and mangrove) conservation in Ori Ore. Marine protected areas (MPAs) are zone-based, mixed management marine areas, targeted at ensuring sustainability in the management of fisheries and integrity of coastal coral reef ecosystems. Zones can be managed along a spectrum from 'no-visit' and 'no-take' to temporary closures or gear restrictions. In social cost benefit analysis, marine conservation does not appear to generate significant economic benefits, however, when combined with broader conservation planning, where the formal structures can work across both biomes, they can provide net benefits (for a detailed social cost benefit analysis of a MPA project see Buckwell et al., 2018). It is likely that marine conservation will require a high degree of coordination amongst the communities of Maramasike Passage as it will involve the differentiation of a range of marine zones, which may include the demand for high integrity / low harvest zones focussed on marine tourism. This significantly adds to the complexity of such arrangements and likely requires further coordination with existing and potential tourism operators in Honiara and tourism strategists from the Solomon Islands government.

12.3 Project prioritisation

The final exercise undertaken in the feedback sessions at all three communities was a consideration of project priorities. For this exercise the groups were disbanded to form one group in Ori Ore and Eliote to facilitate a broader ranging discussion. Though two groups were kept in Tapa'atewa. Participants were also given greater encouragement to think of new ideas or to fine-tune the pre-existing project recommendations.

Whilst an ESRAM is explicitly undertaken to identify EbA / NbS projects, given the nature of the process–that of identifying key climate, environmental, and anthropogenic risks to ecosystems and communities, and the nature of community consultations to focus on more immediate, material needs–it is unsurprising that some project ideas put forward by the communities include those that are not necessarily direct EbA or NbS projects and have a bias towards short term livelihoods generation. EbA / NbS projects can have long lead times, which need to be considered against high discounting applied to decision making (the demand for immediate survival prioritisation) (Matousek et al., 2022) and potentially limited knowledge of future climate change. (This was explicitly discussed by the groups in Tapa'atewa.) Notwithstanding some project outcomes can be achieved through combined infrastructure and EbA approaches (e.g., water security) by solving immediate needs (a new, or more reliable water source) at the same time as preparing for and investing in more sustainable, landscape level EbAs, such as catchment afforestation.

Community priorities feed into the next and final section where considerations of costs and timing are considered in an adaptations pathway framework (CoastAdapt, 2017).

12.3.1 Tapa'atewa project priorities

The community priorities for Tapa'atewa are reported in Tables 26 and 27. The raw scores from two groups are reported in Table 26; Table 27 reports and describes the project priorities. The description reflects discussion and any specific requirements for each of the projects.

Table 26: Project scores and ranking for two groups from Tapa'atewa

Project	Group 1	Group 2	Mean	Rank
Water and sanitation	5	5	5	1
Forest conservation areas	4	3	3.5	2
Tree re-planting	3	4	3.5	2
More food markets	4	2	3	4
Agricultural extension program	2	4	3	4
Tree nursery	3	3	3	4
Tourism project	2	0	1	7
Ban on mining projects	0	1	0.5	8

Table 27: Community adaptation priorities for Tapa'atewa

Rank	Project	Notes
1	Water and sanitation	The community's primary, and overwhelming concern (both groups ranked it first, independently) is for access to secure clean water and sanitation. It was recognised that this could be achieved through short term, engineering approaches (e.g., exploration for bore water, septic tanks, rainwater capture) and through longer term approaches (e.g., catchment rehabilitation following the recent logging activity). There was concern for the quality of sanitation, which can impact water courses and ground water. Sanitation projects are specifically about engineered infrastructure.
2	Forest conservation areas	Though there is virtually no primary forest remaining on South Malaita, forest rehabilitation associated with the implementation of forest community conservation areas will begin to regenerate greater forest integrity, which will increase ecosystem service flows. A key objective will be to ensure that remaining and rehabilitating forest is managed in a way to ensure that it does not cross critical (downward) thresholds (e.g., fire and drying) to maintain catchment integrity. Following a period of relatively intense commercial logging (and subsequent cessation, following a dispute) the community prioritises forest conservation and rehabilitation. This can be achieved through pursuit of immediate actions (establishing a seedling nursery and a replanting project) and medium term objectives, such as setting up formal forest community conservation areas and protected areas.
3	Tree planting	
4	Tree nursery	
4	More food markets	As result of the recent logging operations the community has had good access to markets along Maramasike Passage and into the regional centre and port of Afio. Improving livelihoods through access to markets can improve community resilience; but can also lead to further unsustainable degradation of resources as new markets can absorb greater surpluses.
4	Agricultural extension program	Improved productivity of household agriculture can be achieved through adaptations in management of gardens, such as incorporating new crop varieties (climate-resilient crops) and growing techniques, irrigation, improving soil fertility, and introducing higher value crops (Buckwell et al., 2020). This can be achieved through extension officers and demonstration plots.

12.3.2 Eliote project priorities

Community priorities for Eliote are reported and described in Table 28. The description reflects discussion and any specific requirements for each of the projects.

Table 28: Community adaptation priorities for Eliote

Rank	Project	Notes
1	Access to more food markets	Eliote has poor access to markets. It has no roads and boat access is limited to higher tides. Improving access could improve livelihoods that can improve community resilience; but can also lead to further unsustainable degradation of resources as new markets can absorb greater surpluses.
2	Mud crab fishery sustainability assessment	Mud crab harvesting is an important part of the community economy and a local food source, though one of high status. Mud crabs are sold into markets in Honiara and can fetch a high price. As a result, they are over-harvested, with people travelling further to find them. It is highly likely mud crabs are being harvested beyond the maximum sustainable yield and there was little evidence of any specific taboos (such as bag limits, limits on size, and harvesting only males). Understanding the state of the mud crab population would be an important input into a broader program of work to establish a marine protected area.

2	Sea weed farming support	The community of Eliote has recently begun trialling sea weed farming in the waters of the Maramasike Passage. It is currently on a small scale trial, with no external support, with production aim at cosmetics industry. So far, there has been no harvests. The community sees sea weed farming as an opportunity to develop a low impact (arguably, a positive impact) industry to support cash incomes and livelihoods. Aquaculture extension programs could support research and development of sea weed farming.
3	Forest conservation areas	Though there is virtually no primary forest remaining on South Malaita, forest rehabilitation associated with the implementation of forest community conservation areas will begin to regenerate greater forest integrity, which will increase ecosystem service flows. A key objective will be to ensure that remaining and rehabilitating forest is managed in a way to ensure that it does not cross critical (downward) thresholds (e.g., fire and drying) to maintain catchment integrity.
3	Mangrove carbon project	In the longer-term options will become available for the development of mangrove conservation projects that are linked to carbon and biodiversity investments, such as payments for ecosystem services schemes. These projects are complex and have a long lead time and demand a high level of community capacity to promulgate, implement and monitor and evaluate.
3	Marine conservation areas	Marine protected areas (MPAs) are zone-based, mixed management marine areas, targeted at ensuring sustainability in the management of fisheries and integrity of coastal coral reef ecosystems. Zones can be managed along a spectrum from ‘no-visit’ and ‘no-take’ to temporary closures or gear restrictions. Implementation and effective management of MPAs can increase fish diversity and biomass in the wake of climate change and threats to coral reefs.
4	Mangrove replanting	Mangroves are in a good condition and are not necessarily particularly threatened by human pressures (see Section 6.1.2). Nevertheless, mangrove replanting can generate an easy entry point for community development to establish community capacity to tackle larger projects of greater complexity in the future.
4	Tree nursery	Establishment of tree nursery can be a relatively modest investment to generate community capacity to support the development of more complex, longer term projects, particularly associated with the establishment of forest community conservation areas. In Eliote, a tree nursery should focus on food trees, such as nuts, oils, and fruits.
5	Fish attracting devices	FADs increase fish availability, making it easier for local fishers to catch fish and reduce fishing pressures on local coral reefs (thereby massively improving reef resilience and ecosystem services). FADs increase catch efficiency, saving fuel and time for fishers, thus improving livelihoods. Eliote fishers would have to travel significant distance to access FADs in oceanic waters outside the passage.
6	Agricultural extension program	Improved productivity of household agriculture can be achieved through adaptations in management of gardens, such as incorporating new crop varieties (climate-resilient crops) and growing techniques, irrigation, improving soil fertility, and introducing higher value crops (Buckwell et al., 2020). This can be achieved through extension officers and demonstration plots.
6	Tourism development	Low priority was associated with development of tourism activities in the community.

12.3.3 Ori Ore project priorities

Community priorities for Ori Ore are reported and described in Table 29. The description reflects discussion and any specific requirements for each of the projects.

Table 29; Community adaptation priorities for Ori Ore

Rank	Project	Notes
1	Mud crab fishery sustainability assessment	Mud crab harvesting is an important part of the community economy and a local food source, though one of high status. Mud crabs are sold into markets in Honiara and can fetch a high price. As a result, they are likely over-harvested, with people travelling further to find them. It is highly likely mud crabs are being harvested beyond the maximum sustainable yield and there was little evidence of any specific taboos (such as bag limits, limits on size, and harvesting only males). Understanding the state of the mud crab population would be an important input into a broader program of work to establish a marine protected area. Mud crab fisheries in the Pacific is under studied, with very little information on population status, distribution patterns, abundance, threats, and economic value (Mangubhai et al., 2017).
2	Fish attracting devices	FADs increase fish availability, making it easier for local fishers to catch fish and reduce fishing pressures on local coral reefs (thereby massively improving reef resilience and ecosystem services). FADs increase catch efficiency, saving fuel and time for fishers, thus improving livelihoods. Ori Ore would be able to easily access FADs that are positioned in oceanic waters outside the passage.
2	Marine protected area	Marine protected areas (MPAs) are zone-based, mixed management marine areas, targeted at ensuring sustainability in the management of fisheries and integrity of coastal coral reef ecosystems. Zones can be managed along a spectrum from ‘no-visit’ and ‘no-take’ to temporary closures or gear restrictions. Implementation and effective management of MPAs can increase fish diversity and biomass in the wake of climate change and threats to coral reefs.
3	Forest conservation area	Though there is virtually no primary forest remaining on South Malaita, forest rehabilitation associated with the implementation of forest community conservation areas will begin to regenerate greater forest integrity, which will increase ecosystem service flows. A key objective will be to ensure that remaining and rehabilitating forest is managed in a way to ensure that it does not cross critical (downward) thresholds (e.g., fire and drying) to maintain catchment integrity.
3	Mangrove replanting	Mangroves are in a good condition and are not necessarily particularly threatened by human pressures (see Section 6.1.2). Nevertheless, mangrove replanting can generate an easy entry point for community development to establish community capacity to tackle larger projects of greater complexity in the future.
3	Mangrove carbon project	In the longer-term options will become available for the development of mangrove conservation projects that are linked to carbon and biodiversity investments, such as payments for ecosystem services schemes. These projects are complex and have a long lead time, and demand a high level of community capacity to promulgate, implement and monitor and evaluate.
4	Agricultural extension	Improved productivity of household agriculture can be achieved through adaptations in management of gardens, such as incorporating new crop varieties (climate-resilient crops) and growing techniques, irrigation, improving soil fertility, and introducing higher value crops (Buckwell et al., 2020). This can be achieved through extension officers and demonstration plots.

4	Honey development	Honey was mentioned as a niche product that could provide possibilities that improve livelihoods and also for ecosystem services provided by the bees. As Ori Ore has reasonable access to markets to Honiara, this would provide a good outlet for the product.
4	More food markets	Ori Ore has reasonable access to food markets. It has no roads, but boat access is unrestricted and there is a weekly market close by. Improving access to markets could improve livelihoods that can improve community resilience; but can also lead to further unsustainable degradation of resources as new markets can absorb greater surpluses.

13 Adaptation pathways

13.1 Adaptation pathways approach

This final section sets out climate adaptation pathways for Tapa'atewa, Eliote, and Ori Ore. A pathways approach to adaptation is designed to schedule adaptation decision-making, particularly identifying the decisions that need to be taken now and those that may be taken in future. It can also be sensitive to budget and increase community capacity to implement more and more complex projects over time. The approach supports strategic, flexible and structured decision-making. It also allows for decisions to be made at the most appropriate time as more certainty over the impacts of climate change becomes greater. In this instance, we assessed the priorities in terms of:

1. **Budget envelope** – the level if investment required (small, modest, significant, very significant);
2. **Social return on investment** – evidence from social benefit cost analysis [15] (unknown, modest, high, very high);
3. **Project complexity** – level of complexity in implementation of the project; also relative to the likely level of community preparedness (low, medium, high, very high); and
4. **Timing** – the potential for timing for implementation; relative to budget, project complexity, community preparedness and social return on investment (immediate, short term, short to medium term, medium term, long term).

Budget envelope and social return on investment data has been sourced from:

- Buckwell et al. (2020) for agricultural extension and forest and marine conservation area establishment;
- Sharp (2011) for costs and benefits associated with the establishment of FADs.
- Gerber et al. (2011) and Kinrade et al. (2014) for costs and benefits associated with composting toilets and water.

Table 30: Assessment of all projects against estimated costs, social return on investment, and complexity to determine best timing for implementation.

Project	Budget envelope	Social return on investment	Project complexity	Timing
Mud crab fishery sustainability assessment	Modest	Unknown	Low	Immediate
Support for sea weed farming	Modest	Unknown	Low	Short term
Fish attracting devices	Modest	High	Low	Short to medium term
Marine protected area	Significant	Modest	High	Medium to long term
Forest conservation area	Significant	Modest	High	Medium to long term
Tree planting	Small	Unknown	Low	Immediate
Tree nursery	Small	Unknown	Low	Immediate

[15] A social return on investment is a metric used in social cost-benefit analysis to measure the broader social, environmental, and economic value created by a project or initiative, relative to the investment made. It goes beyond traditional financial returns by capturing the value of social and environmental outcomes.

Mangrove replanting	Small	Unknown	Low	Short term
Mangrove carbon project	Significant	Very high	High	Long term
Agricultural extension	Very significant	Very high	Very high	Long term
Honey development	Small	Unknown	Low	Short term
Water and sanitation project	Very significant	Very high	High	Long term
More food markets	Modest	Unknown	High	Long term

13.2 Adaptation pathways

13.2.1 Tapa'atewa

Immediate actions (small budget, low complexity)

1. Pursue funding for establish tree nursery.
2. Pursue funding for tree planting program.
3. Preparation work for setting up forest community conservation areas; setting up committees, beginning mapping work.
4. Explore international donor funding options for water and sanitation project from community development sector.

Medium term options (larger budgets, high complexity)

5. Establish forest community conservation areas; maintain tree nursery and tree planting to support catchment rehabilitation, which will support high quality water security.
6. Explore options for funding of agricultural extension program.

13.2.2 Eliote

Immediate actions (small budget, low complexity)

1. Pursue funding for mud crab fishery sustainability assessment (in conjunction with Ori Ore community).
2. Seek support from Solomon Islands government for optimising sea weed farming.

Medium term options (larger budgets, higher complexity)

3. Marine conservation program of work, bringing together knowledge from mud crab study, setting up management committees, establishing rules (taboos, maps, zones etc), potential implementation of FADs.
4. Seek support for establishing mangrove and forest conservation schemes linked to international schemes for payments for ecosystem services (particularly for carbon).

13.2.3 Ori Ore

Immediate actions (small to medium budget, low to medium complexity)

1. Pursue funding for mud crab fishery sustainability assessment (in conjunction with Ori Ore community).
2. Setting up local cooperatives to install and manage FADs in open water outside the Maramasike Passage.

Medium term options (larger budgets, higher complexity)

3. Marine conservation program of work, bringing together knowledge from mud crab study, setting up management committees, establishing rules (taboos, maps, zones etc).
4. Seek support for establishing mangrove and forest conservation schemes linked to international schemes for payments for ecosystem services (particularly for carbon).

References

Adame, M. F., Brown, C. J., Bejarano, M., Herrera-Silveira, J. A., Ezcurra, P., Kauffman, J. B., & Birdsey, R. (2018). The undervalued contribution of mangrove protection in Mexico to carbon emission targets. *Conservation Letters*, *11*(4), e12445-e12445. https://doi.org/10.1111/conl.12445

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

Ahmed, B., & Kelman, I. (2018). Measuring Community Vulnerability to Environmental Hazards: A Method for Combining Quantitative and Qualitative Data. *Natural Hazards Review*, *19*(3), 04018008. https://doi.org/10.1061/(ASCE)NH.1527-6996.0000290

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

Akhtar-Danesh, N., Baumann, A., & Cordingley, L. (2008). Q-methodology in nursing research: a promising method for the study of subjectivity. *Western journal of nursing research*, *30*(6), 759-773.

Allen Coral Atlas. (2024). *Allen Coral Atlas*. Arizona State University,. https://allencoralatlas.org/atlas

Allen, M. G., Bourke, R. M., Evans, B. R., Iramu, E., Maemouri, R. K., F, M. B., Pollard, A. A., Wairiu, M., Watoto, C., & Zotalis, S. (2006) *Solomon Islands Smallholder Agriculture Study* (Provincial Reports, Issue. AusAID. AusAID, Canberra. https://www.dfat.gov.au/sites/default/files/solomon_study_vol4.pdf

Anderson, A. B., Thilsted, S. H., & Schwarz, A. M. (2013) *Food and nutrition security in Solomon Islands*. WorldFish. WorldFish, Solomon Islands. http://hdl.handle.net/1834/27337

Anderson, C. (2009). Gendered dimensions of disaster risk management, natural resource management, and climate change adaptation in the Pacific. *The SPC Women in Fisheries Information Bulletin*, *20*.

Anderson, T. (2006). On the economic value of customary land in Papua New Guinea. *Pacific Economic Bulletin*, *21*(1), 138-152. https://www.researchgate.net/profile/Tim-Anderson-2/publication/266796904_On_the_economic_value_of_customary_land_in_Papua_New_Guinea/links/543c719e0cf24ef33b762825/On-the-economic-value-of-customary-land-in-Papua-New-Guinea.pdf

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

Banasick, S. (2018). *Ken-Q Analysis*. Retrieved 01/03/2024 from https://shawnbanasick.github.io/ken-q-analysis/

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

Bell, J., Taylor, M., Amos, M., & Andrew, N. (2016) *Climate change and Pacific Island food systems: The Future of Food, Farming, and Fishing in the Pacific Islands Under a Changing Climate*. CCAFS and CTA, Copenhagen. https://pacific-data.sprep.org/system/files/Bell_16_Climate_Change_PI_Food_Systems.pdf

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

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

Bird, Z., Iese, V., Des Combes, H. J., Alungo, B., & Wairiu, M. (2023). Assessing rural household's food groups-and-sources and dietary diversity pattern in Malaita Province. *Scientific Reports*, *13*(1), 13251. https://doi.org/10.1038/s41598-023-39124-3

BMT WBM & SPREP (2018a) *Solomon Islands Ecosystem and Socio-Economic Resilience Analysis and Mapping (ESRAM), Volume 1: Introduction and national assessment*. S. o. t. P. R. E. Programme, Apia, Samoa. https://pacific-data.sprep.org/system/files/solomon-islands-esram-vol1_0_2.pdf

BMT WBM & SPREP (2018b) *Solomon Islands Ecosystem and Socio-Economic Resilience Analysis and Mapping (ESRAM), Volume 2: Wagina Island (Choiseul Province)*. S. o. t. P. R. E. Programme, Apia, Samoa. https://www.sprep.org/sites/default/files/documents/publications/solomon-islands-esram-vol2.pdf

BMT WBM & SPREP (2018c) *Solomon Islands Ecosystem and Socio-Economic Resilience Analysis and Mapping (ESRAM), Volume 3: Honiara*. S. o. t. P. R. E. Programme, Apia, Samoa. https://www.sprep.org/sites/default/files/documents/publications/solomon-islands-esram-vol3.pdf

BOM. (2023). *Cyclone tracks - Southern Hemisphere*. Bureau of Meteorology. http://www.bom.gov.au/cyclone/history/tracks/beta/

BOM & CSIRO (2014) *Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports*. Bureau of Meteorology and Commonwealth Scientific and Industrial Research Organisation. B. CSIRO, Canberra. https://www.pacificclimatechangescience.org/wp-content/uploads/2014/07/PACCSAP_CountryReports2014_WEB_140710.pdf

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

Boyd, J., & Banzhaf, S. (2007). What are ecosystem services? The need for standardized environmental accounting units. *Ecological Economics*, *63*(2), 616-626. https://doi.org/10.1016/j.ecolecon.2007.01.002
Brander, L., de Groot, R., Guisado Goñi, V., van 't Hoff, V., Schägner, P., Solomonides, S., McVittie, A., Eppink, F., Sposato, M., Do, L., Ghermandi, A., & Sinclair, M. (2024) *Ecosystem Services Valuation Database (ESVD)*. Foundation for Sustainable Development and Brander Environmental Economics. Foundation for Sustainable Development and Brander Environmental Economics, Wageningen, Netherlands.
Brewer, T., Cinner, J., Green, A., & Pressey, R. (2013). Effects of Human Population Density and Proximity to Markets on Coral Reef Fishes Vulnerable to Extinction by Fishing. *Conservation Biology*, *27*(3), 443-452. https://doi.org/10.1111/j.1523-1739.2012.01963.x
Brodie, J., & Waterhouse, J. (2012). A critical review of environmental management of the 'not so Great' Barrier Reef. *Estuarine, Coastal and Shelf Science*, *104*, 1-22.
Brown, C., Jupiter, S., Albert, S., Klein, C., Mangubhai, S., Maina, J. M., Mumby, P., Olley, J., Stewart-Koster, B., Tulloch, V., & Wenger, A. (2017). Tracing the influence of land-use change on water quality and coral reefs using a Bayesian model. *Scientific Reports*, *7*(1), 4740-4740. https://doi.org/10.1038/s41598-017-05031-7
Brown, S. (1980). *Political subjectivity: Applications of Q methodology in political science*. Yale University Press, New Haven.
Bryan, E., Kritjanson, P., & Ringler, C. (2015). *Why paying attention to gender matters for Climate Change adaptation*. Retrieved 01/03/2024 from https://www.ifpri.org/blog/why-paying-attention-gender-matters-climate-change-adaptation
Buckwell, A., Ariki, M. P., Oiire, C., Unga, C., & Fleming, C. (2024). Twenty five years of world heritage status: Show us the benefits! *Journal of Environmental Management*, *358*, 120849. https://doi.org/10.1016/j.jenvman.2024.120849
Buckwell, A., Fleming, C., Bush, G., Zambo Mandea, J., Taye, F., & Mackey, B. (2023). Assessing Community Readiness for Payments for Ecosystem Service Schemes for Tropical Primary Forest Protection in the Democratic Republic of Congo. *The Journal of Development Studies*, *59*(7), 1023-1045. https://doi.org/10.1080/00220388.2023.2182682
Buckwell, A., Fleming, C., Muurmans, M., Smart, J. C. R., Ware, D., & Mackey, B. (2020). Revealing the dominant discourses of stakeholders towards natural resource management in Port Resolution, Vanuatu, using Q-method. *Ecological Economics*, *177*, 106781-106781. https://doi.org/10.1016/j.ecolecon.2020.106781
Buckwell, A., Fleming, C., Smart, J., Ware, D., & Mackey, B. (2020). Challenges and sensitivities in assessing total ecosystem service values: Lessons from Vanuatu for the Pacific. *Journal of Environment and Development*, *29*(3), 329-365. https://doi.org/10.1177/1070496520937033
Buckwell, A., & Morgan, E. (2022). Chapter 3: Ecosystem services and natural capital: Application to sustainable finance. In T. Cadman & T. Sarker (Eds.), *De Gruyter Handbook of Sustainable Development and Finance* (pp. 41-70). De Gruyter, Berlin, Boston. https://doi.org/10.1515/9783110733488-003
Buckwell, A., Ware, D., Fleming, C., Smart, J. C. R., Mackey, B., Nalau, J., & Dan, A. (2020). Social benefit cost analysis of ecosystem-based climate change adaptations: a community-level case study in Tanna Island, Vanuatu. *Climate and Development*, *12*(6), 495-510. https://doi.org/10.1080/17565529.2019.1642179
Bunting, P., Rosenqvist, A., Hilarides, L., Lucas, R. M., Thomas, N., Tadono, T., Worthington, T. A., Spalding, M., Murray, N. J., & Rebelo, L.-M. (2022). Global Mangrove Extent Change 1996 - 2020: Global Mangrove Watch Version 3.0. *Remote Sensing*, *14*(15), 3657. https://www.mdpi.com/2072-4292/14/15/3657
Carpenter, S., DeFries, R., Dietz, T., Mooney, H., Polasky, S., Reid, W. V., & Scholes, R. J. (2006). Millennium Ecosystem Assessment: Research needs. *science*, *314*(5797), 257-258. https://doi.org/10.1126/science.1131946
Chakraborty, J., Tobin, G., & Montz, B. (2005). Population Evacuation: Assessing Spatial Variability in Geo-Physical Risk and Social Vulnerability to Natural Hazards. *Natural Hazards Review*, *6*(1), 22-23. https://doi.org/10.1061/(ASCE)1527-6988(2005)6:1(23)
Cheal, A. J., MacNeil, M. A., Cripps, E., Emslie, M. J., Jonker, M., Schaffelke, B., & Sweatman, H. (2010). Coral–macroalgal phase shifts or reef resilience: links with diversity and functional roles of herbivorous fishes on the Great Barrier Reef. *Coral Reefs*, *29*(4), 1005-1015. https://doi.org/10.1007/s00338-010-0661-y
Cinner, J., Graham, N., Huchery, C., & MacNeil, M. (2013). Global effects of local human population density and distance to markets on the condition of coral reef fisheries. *Conservation Biology*, *27*(3), 453-458.
Climate Change Knowledge Portal (2023) *Solomon Islands: Current ClimateTrends and Significant Change against Natural Variability*. World Bank Group. World Bank Group, New York. https://climateknowledgeportal.worldbank.org/country/solomon-islands/trends-variability-historical
Daly, H., & Farley, J. (2004). *Ecological Economics: Principles and Applications*. Island Press, Connecticut.
de Groot, R., Brander, L., van der Ploeg, S., Costanza, R., Bernard, F., Braat, L., Christie, M., Crossman, N., Ghermandi, A., Hein, L., Hussain, S., Kumar, P., McVittie, A., Portela, R., Rodriguez, L., ten Brink, P., & Beukering, P. (2012). Global estimates of the value of ecosystems and their services in monetary units. *Ecosystem Services*, *1*, 50-61.
Djoudi, H., & Brockhaus, M. (2011). Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. *International Forestry Review*, *13*(2), 123-135. https://doi.org/10.1505/146554811797406606

Dryzek, J. (1994). *Discursive democracy: Politics, policy, and political science*. Cambridge University Press, Cambridge, UK.
Duke, N., Kovacs, J. M., Griffiths, A. D., Preece, L., Hill, D. J. E., Van Oosterzee, P., Mackenzie, J., Morning, H. S., & Burrows, D. (2017). Large-scale dieback of mangroves in Australia's Gulf of Carpentaria: a severe ecosystem response, coincidental with an unusually extreme weather event. *Marine and Freshwater Research*, *68*(10), 1816-1829. https://doi.org/https://doi.org/10.1071/MF16322
Dumaru, P. (2010). Community-based adaptation: Enhancing community adaptive capacity in Druadrua Island, Fiji. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(5), 751-763. https://doi.org/10.1002/wcc.65
Duvat, V. K. E., & Pillet, V. (2017). Shoreline changes in reef islands of the Central Pacific: Takapoto Atoll, Northern Tuamotu, French Polynesia. *Geomorphology*, *282*, 96-118. https://doi.org/https://doi.org/10.1016/j.geomorph.2017.01.002
Dyer, M. (2017). Growing Down Like a Banana: Solomon Islands Village Women Changing Gender Norms. *The Asia Pacific Journal of Anthropology*, *18*(3), 193-210. https://doi.org/10.1080/14442213.2017.1301544
Engel, S., Pagiola, S., & Wunder, S. (2008). Designing payments for environmental services in theory and practice: An overview of the issues. *Ecological Economics*, *65*(4), 663-674. https://doi.org/10.1016/j.ecolecon.2008.03.011
Failler, P., Pètre, É., Binet, T., & Maréchal, J.-P. (2015). Valuation of marine and coastal ecosystem services as a tool for conservation: The case of Martinique in the Caribbean. *Ecosystem Services*, *11*, 67-75. https://doi.org/https://doi.org/10.1016/j.ecoser.2014.10.011
Faivre, G., Tomlinson, R., Ware, D., Shaeri, S., Hadwen, W., Buckwell, A., & Mackey, B. (2022). Effective coastal adaptation needs accurate hazard assessment: a case study in Port Resolution, Tanna Island Vanuatu. *Climatic Change*, *170*(1), 10. https://doi.org/10.1007/s10584-021-03304-9
FEBA (2018) *Making Ecosystem-based Adaptation Effective*. https://www.iucn.org/sites/dev/files/feba_eba_qualification_and_quality_criteria_final_en.pdf
Fleming, E. (2007). Agricultural productivity change in Pacific island countries. *Pacific Economic Bulletin*, *22*(3), 32-47. http://hdl.handle.net/1885/157881
Friess, D. A., Rogers, K., Lovelock, C. E., Krauss, K. W., Hamilton, S. E., Lee, S. Y., Lucas, R., Primavera, J., Rajkaran, A., & Shi, S. (2019). The State of the World's Mangrove Forests: Past, Present, and Future. *Annual Review of Environment and Resources*, *44*(1), 89-115. https://doi.org/10.1146/annurev-environ-101718-033302
Garcia, B., Rimmer, L., Canal Vieira, L., & Mackey, B. (2021). REDD+ and forest protection on indigenous lands in the Amazon. *Review of European, Comparative & International Environmental Law*, *30*(2), 207-219. https://doi.org/10.1111/reel.12389
Gashaw, T., Tulu, T., Argaw, M., Worqlul, A. W., Tolessa, T., & Kindu, M. (2018). Estimating the impacts of land use/land cover changes on Ecosystem Service Values: The case of the Andassa watershed in the Upper Blue Nile basin of Ethiopia. *Ecosystem Services*, *31*, 219-228. https://doi.org/10.1016/j.ecoser.2018.05.001
Gerber, F., Holland, P., & Lal, P. (2011) *The DCCEE-IUCN project: assessing the social and economic value of climate change adaptation in the pacific region*. IUCN, Suva, Fiji. https://gsd.spc.int/sopac/docs/nre/Water%20security%20Final.pdf
Giffin, A. L., Naleba, M., Fox, M., & Mangubhai, S. (2019) *Women fishers in Fiji launch a mud crab management plan for their fishery* (SPC: Women in Fisheries Information Bulletin, Issue., Fiji. https://www.researchgate.net/publication/335572276_Women_fishers_in_Fiji_launch_a_mud_crab_management_plan_for_their_fishery
Giri, C., Ochieng, E., Tieszen, L. L., Zhu, Z., Singh, A., Loveland, T., Masek, J., & Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology and Biogeography*, *20*(1), 154-159. http://data.unep-wcmc.org/datasets/4
Global Forest Watch. (2024). *Maramasike (South Malaita)*. World Resources Institute,. https://gfw.global/4c7p3cw
Global Mangrove Watch. (2024). *Global Mangrove Watch,*. Global Mangrove Alliance,. Retrieved 05/03/2024 from https://www.globalmangrovewatch.org/
Goldberg, L., Lagomasino, D., Thomas, N., & Fatoyinbo, T. (2020). Global declines in human-driven mangrove loss. *Global change biology*, *26*(10), 5844-5855. https://doi.org/10.1111/gcb.15275
Hafezi, M., Sahin, O., Stewart, R., & Mackey, B. (2018). Creating a novel multi-layered integrative climate change adaptation planning approach using a systematic literature review. *Sustainability*, *10*(11), 4100-4100. https://doi.org/10.3390/su10114100
Hamilton, R., Almany, G., Brown, C., Pita, J., Peterson, N., & Choat, H. (2017). Logging degrades nursery habitat for an iconic coral reef fish. *Biological Conservation*, *210*(Part A), 273-280. https://doi.org/10.1016/j.biocon.2017.04.024
Hermelingmeier, V., & Nicholas, K. A. (2017). Identifying five different perspectives on the ecosystem services concept using Q methodology. *Ecological Economics*, *136*, 255-265. https://doi.org/10.1016/j.ecolecon.2017.01.006
Hoegh-Guldberg, O., Mumby, P., Hooten, A. J., Steneck, R., Greenfield, P., Gomez, E., Harvell, C. D., Sale, P. F., Edwards, A. J., Caldeira, K., Knowlton, N., Eakin, C. M., Iglesias-Prieto, R., Muthiga, N., Bradbury, R., Dubi, A., & Hatziolos, M. E. (2007). Coral Reefs Under Rapid Climate Change and Ocean Acidification. *science*, *318*(5857), 1737-1742. https://doi.org/10.1126/science.1152509

IPCC. (2023). Summary for Policymakers. In H. Lee & J. Romero (Eds.), *Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1-34). IPCC,, Geneva, Switzerland. https://doi.org/10.59327/IPCC/AR6-9789291691647.001

IUCN (2020) *Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS. First edition*. IUCN, Gland, Switzerland. https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf

Jakovac, C. C., Latawiec, A. E., Lacerda, E., Leite Lucas, I., Korys, K. A., Iribarrem, A., Malaguti, G. A., Turner, R. K., Luisetti, T., & Baeta Neves Strassburg, B. (2020). Costs and Carbon Benefits of Mangrove Conservation and Restoration: A Global Analysis. *Ecological Economics*, *176*, 106758. https://doi.org/10.1016/j.ecolecon.2020.106758

Kabutaulaka, T. (2005). Rumble in the jungle: land, culture and (un)sustainable logging in Solomon Islands. In A. Hooper (Ed.), *Culture and Sustainable Development in the Pacific*. ANU Press and Asia Pacific Press, Canberra. https://library.oapen.org/bitstream/handle/20.500.12657/33782/458927.pdf

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

Katovai, E., Edwards, W., & Laurance, W. F. (2015). Dynamics of Logging in Solomon Islands: The Need for Restoration and Conservation Alternatives. *Tropical Conservation Science*, *8*(3), 718-731. https://doi.org/10.1177/194008291500800309

Katovai, E., Katovai, D. D., Campbell, M., Laurance, S. G., Edwards, W., & Laurance, W. F. (2021). Structural Recovery of Logged Forests in the Solomon Islands: Implications for Conservation and Management. *Tropical Conservation Science*, *14*, 19400829211028125. https://doi.org/10.1177/19400829211028125

Keesing, R. M. (1982). Kastom and anticolonialism on Malaita:"culture" as political symbol. *Mankind*, *13*(4), 357-373. https://doi.org/10.1111/j.1835-9310.1982.tb01000.x

Kiddle, L., Stronge, D., & Pennary, M. (2017). *Giant African Snails: devastating gardens and livelihoods in Solomon Islands*. Development Policy Centre. Retrieved 02/09/2024 from https://devpolicy.org/giant-african-snails-devastating-gardens-livelihoods-solomon-islands-20170822/

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

Kleinschroth, F., Laporte, N., Laurance, W. F., Goetz, S. J., & Ghazoul, J. (2019). Road expansion and persistence in forests of the Congo Basin. *Nature Sustainability*, *2*(7), 628-634. https://doi.org/10.1038/s41893-019-0310-6

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

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

Mackey, B., & Ware, D. (2018). Limits to capital works for coastal zone adaptation. In W. L. N. J. Filho (Ed.), (pp. 301-323). Springer Publishing International, Berlin.

Mackey, B., Ware, D., Nalau, J., Buckwell, A., Smart, J., Fleming, C., Connolly, R., & Hallgren, W. (2017) *Ecosystem and Socio-economic Resilience Analysis and Mapping (ESRAM) and associated works at multiple scales in Vanuatu*. Apia, Samoa.

Mangubhai, S., Fox, M., Nand, Y., & Mason, N. (2024). Value chain analysis of a women-dominated wild-caught mud crab fishery. *Fish and Fisheries*, *25*(5), 781-792.

Marshall, S. D. G., Paudel, S., Mansfield, S., Richards, N. K., Tsatsia, F., Fanai, C., Suda, G., & Jackson, T. A. (2023). Coconut rhinoceros beetle in Solomon Islands: a tale of two invasions. *Biological Invasions*, *25*(8), 2659-2678. https://doi.org/10.1007/s10530-023-03063-x

McCook, L. (1999). Macroalgae, nutrients and phase shifts on coral reefs: scientific issues and management consequences for the Great Barrier Reef. *Coral Reefs*, *18*(4), 357-367.

McKenzie, L. J., Yoshida, R. L., Aini, J. W., Andréfouet, S., Colin, P. L., Cullen-Unsworth, L. C., Hughes, A. T., Payri, C. E., Rota, M., Shaw, C., Skelton, P. A., Tsuda, R. T., Vuki, V. C., & Unsworth, R. K. F. (2021). Seagrass ecosystems of the Pacific Island Countries and Territories: A global bright spot. *Marine Pollution Bulletin*, *167*, 112308. https://doi.org/https://doi.org/10.1016/j.marpolbul.2021.112308

MEA. (2003). *Ecosystems and Human Well-being: A Framework for Assessment*. Island Press, Washington DC.

Meng, Y., Bai, J., Gou, R., Cui, X., Feng, J., Dai, Z., Diao, X., Zhu, X., & Lin, G. (2021). Relationships between above- and below-ground carbon stocks in mangrove forests facilitate better estimation of total mangrove blue carbon. *Carbon Balance and Management*, *16*(1), 8. https://doi.org/10.1186/s13021-021-00172-9

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

Olds, A. D., Pitt, K. A., Maxwell, P. S., Babcock, R. C., Rissik, D., & Connolly, R. M. (2014). Marine reserves help coastal ecosystems cope with extreme weather. *Glob Chang Biol*, *20*(10), 3050-3058. https://doi.org/10.1111/gcb.12606

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

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

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

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

Paudel, S., Marshall, S., Tsatsia, F., Fanai, C., Kolubalona, M., Mansfield, S., & Jackson, T. (2021). Monitoring an invasive coconut rhinoceros beetle population using pheromone traps in Honiara, Solomon Islands. *New Zealand Plant Protection*, *74*(1), 37-41. https://doi.org/10.30843/nzpp.2021.74.11742

Pittock, J. (2010). Water quality and the Great Barrier Reef: can Australia control diffuse pollution? *Water 21*.

Porter, D., & Allen, M. (2015) *The Political Economy of the Transition from Logging to Mining in Solomon Islands* (SSGM Issue. Australian National University. A. N. University, Canberra. https://dpa.bellschool.anu.edu.au/sites/default/files/publications/attachments/2016-07/dp_2015_12_porterallenpdf.pdf

Rogers, B., Mackey, B., Shestakova, T., Keith, H., Young, V., Kormos, C., DellaSala, D., Dean, J., Birdsey, R., Bush, G., Houghton, R., & Moomaw, W. (2022) *Using Ecosystem Service Integrity to Maximize Climate Mitigation and Minimize Risk in International Forest Policy* (Science Informing Policy Briefing Note 2/22, Issue. Griffith University. Griffith University, Brisbane.

Rosegrant, M. W., Valmonte-Santos, R., Thomas, T., You, L., & Chiang, C. (2015) *Climate Change, Food Security, and Socioeconomic Livelihood in the Pacific Islands*. International Food Policy Research Institute. Asian Development Bank, Manila. https://www.adb.org/sites/default/files/publication/175046/climate-change-food-security-pacific.pdf

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

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

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

Sharp, M. (2011) *The benefits of fish aggregating devices in the Pacific*. Nearshore Fisheries Development Section, Coastal Fisheries Programme, Secretariat of the Pacific Community. SPC, https://spccfpstore1.blob.core.windows.net/digitallibrary-docs/files/30/305687f90ea59b387db4a09bc4143eb8.pdf?sv=2015-12-11&sr=b&sig=pGaaFJJduJym7M11nt7GhJIBpNNg5YroI19iFdReaU8%3D&se=2024-01-23T23%3A51%3A18Z&sp=r&rscc=public%2C%20max-age%3D864000%2C%20max-stale%3D86400&rsct=application%2Fpdf&rscd=inline%3B%20filename%3D%22FishNews135_27_Sharp.pdf%22

Sneegas, G., Beckner, S., Brannstrom, C., Jepson, W., Lee, K., & Seghezzo, L. (2021). Using Q-methodology in environmental sustainability research: A bibliometric analysis and systematic review. *Ecological Economics*, *180*, 106864-106864. https://doi.org/10.1016/j.ecolecon.2020.106864

Solomon Islands Government (2009) *Provincial Profile of the 2009 Population & Housing Census*. S. I. N. S. Office, Honiara. https://www.statistics.gov.sb/statistics/demographic-statistics/census

Solomon Islands Government (2019) *Census 2019*. National Statistics Office. Honiara. https://www.statistics.gov.sb/census-2019

Solomon Islands Government (2021) *Solomon Islands 2021: Nationally Determined Contribution*. C. C. Ministry of Environment, Disaster Management and Meteorology, Honiara, Solomon Islands. https://unfccc.int/sites/default/files/NDC/2022-06/NDC%20Report%202021%20Final%20Solomon%20Islands%20%281%29.pdf

Solomon, S., Plattner, G.-K., Knutti, R., & Friedlingstein, P. (2009). Irreversible climate change due to carbon dioxide emissions. *Proceedings of the National Academy of Sciences*, *106*(6), 1704-1709.

SPC (2015) *The Pacific Gender & Climate Change Toolkit: Tools for Practitioners*. Secretariat of the Pacific Community, Apia, Fiji. https://www.pacificclimatechange.net/sites/default/files/documents/Pacific_gender_toolkit_full_version.pdf

Stephenson, W. (1953). *The Study of Behavior; Q-technique and its Methodology*. University of Chicago Press, Chicago.

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

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

UN Statistical Division (2021) *System of Environmental Economic Accounting Ecosystem Accounting*. United National Statitical Division, New York. https://seea.un.org/ecosystem-accounting

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

UNEP. (2024). *Life Below Water*. Retrieved 07/08/2024 from https://www.unep.org/interactives/status-world-coral-reefs/

Veitayaki, J., Waqalevu, V., Varea, R., & Rollings, N. (2017). Mangroves in Small Island Development States in the Pacific: An Overview of a Highly Important and Seriously Threatened Resource. In R. DasGupta & R. Shaw (Eds.), *Participatory Mangrove Management in a Changing Climate: Perspectives from the Asia-Pacific* (pp. 303-327). Springer Japan, Tokyo. https://doi.org/10.1007/978-4-431-56481-2_19

Watts, S., & Stenner, P. (2012). Doing Q Methodological Research: Theory, Method & Interpretation. *2*(1), 67-91. https://doi.org/10.1191/1478088705qp022oa

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

Whetton, P., Hennessy, K., Clarke, J., McInnes, K., & Kent, D. (2012). Use of Representative Climate Futures in impact and adaptation assessment [journal article]. *Climatic Change*, *115*(3), 433-442. https://doi.org/10.1007/s10584-012-0471-z

Wolff, N. H., da Silva, E. T., Devlin, M., Anthony, K. R. N., Lewis, S., Tonin, H., Brinkman, R., & Mumby, P. (2018). Contribution of individual rivers to Great Barrier Reef nitrogen exposure with implications for management prioritization. *Marine Pollution Bulletin*, *133*, 30-43. https://doi.org/https://doi.org/10.1016/j.marpolbul.2018.04.069

World Bank. (2023). *GDP Deflator*. https://data.worldbank.org/indicator/NY.GDP.DEFL.ZS

World Bank Group (2021) *Climate Risk Country Profile: Solomon Islands*. World Bank Group. World Bank Group, New York. https://climateknowledgeportal.worldbank.org/sites/default/files/country-profiles/15822-WB_Solomon%20Islands%20Country%20Profile-WEB.pdf

Young, R. (2010). *Determining the economic value of water: concepts and methods*. Resources for the Future, Washington DC.

14 Appendix

Figure 57: Composite sort for factor 1 – Climate change concerns

-5	-4	-3	-2	-1	0	1	2	3	4	5
36. The benefits from logging and mining are shared fairly across everyone in the community.	** ◀ 18. If I could borrow some money I would start a small business.	10. I would like better ways to cook food, so we don't have to use firewood cut from the forest.	* ◀ 14. Neighbouring communities trespass on our customary land and marine resources without our permission.	** 4. Our rivers and streams are drying-up more frequently than before.	19. I would like to earn more cash from selling food, fish, or handicrafts.	** ▶ 31. Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	** 29. Reducing use of our marine resources is essential for conservation and good for the community.	** ▶ 8. Our community needs better places to throw away non-compostible waste, such as cans and plastics.	** ▶ 33. Protected areas in forests is an effective way of stopping logging on customary lands.	9. I get enough good, reliable drinking water in my community.
	* ◀ 16. There are less traditional medicine plants growing than there used to be.	** ◀ 34. I would like the equipment to catch fish further out sea, to reduce pressure on the reef fishery.	27. Enforcing customary resource rules and taboos in my community is very hard.	* ◀ 2. It is important to bring more livestock into the community to provide for food.	24. I would like to grow surplus food than but I cannot get the food to markets to sell it.	* 23. I would be able to spend more time in my community if there was a more equal share of housework between men and women.	** 26. Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	** ▶ 3. There are weather-related natural disasters happening today, such as cyclones and heavy rain.	** ▶ 5. Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	
		** 35. Mining and forestry offer enough benefits to make up for their environmental impact.	* 11. If we had more tourists we wouldn't have enough food, water, and waste facilities to cope with them.	21. I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	25. I feel that I can influence community decisions about conservation of customary lands.	20. Tourism offers many good opportunities for business in my area.	28. Marine and mangrove protected areas will be good for attracting tourists.	13. We should more to stop our special kastom places from falling into disrepair.		
			** 30. We are cutting down too much forest and mangrove to make space for more gardens.	* ◀ 22. Improving roads access to the community will help business opportunities.	** 6. We have enough toilet, washing, and cleaning facilities for all the people in the village.	** ▶ 7. I would know what to do to feel safe in the next natural disaster.	32. If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.			
				17. Kastom knowledge of resource use and the land is being forgotten.	* 1. My garden is producing less food than it was before.	** 12. It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.				
					15. If our community protected its marine resources in a protected area it should be paid for that work.					

Figure 58: Composite sort for factor 2 – Food concerns

-5	-4	-3	-2	-1	0	1	2	3	4	5
** ◀ 23. I would be able to spend more time in my community if there was a more equal share of housework between men and women.	** ◀ 10. I would like better ways to cook food, so we don't have to use firewood cut from the forest.	** ◀ 5. Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	** ◀ 12. It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	** ◀ 32. If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.	16. There are less traditional medicine plants growing than there used to be.	17. Kastom knowledge of resource use and the land is being forgotten.	* 25. I feel that I can influence community decisions about conservation of customary lands.	** ▶ 4. Our rivers and streams are drying-up more frequently than before.	** ▶ 24. I would like to grow surplus food than but I cannot get the food to markets to sell it.	9. I get enough good, reliable drinking water in my community.
	** ◀ 20. Tourism offers many good opportunities for business in my area.	** ◀ 33. Protected areas in forests is an effective way of stopping logging on customary lands.	** ◀ 26. Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	* ◀ 19. I would like to earn more cash from selling food, fish, or handicrafts.	18. If I could borrow some money I would start a small business.	* 2. It is important to bring more livestock into the community to provide for food.	** ▶ 21. I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	** 22. Improving roads access to the community will help business opportunities.	** ▶ 1. My garden is producing less food than it was before.	
		7. I would know what to do to feel safe in the next natural disaster.	13. We should more to stop our special kastom places from falling into disrepair.	** ◀ 29. Reducing use of our marine resources is essential for conservation and good for the community.	30. We are cutting down too much forest and mangrove to make space for more gardens.	15. If our community protected its marine resources in a protected area it should be paid for that work.	14. Neighbouring communities trespass on our customary land and marine resources without our permission.	28. Marine and mangrove protected areas will be good for attracting tourists.		
			31. Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	3. There are weather-related natural disasters happening today, such as cyclones and heavy rain.	35. Mining and forestry offer enough benefits to make up for their environmental impact.	11. If we had more tourists we wouldn't have enough food, water, and waste facilities to cope with them.	** 6. We have enough toilet, washing, and cleaning facilities for all the people in the village.			
				27. Enforcing customary resource rules and taboos in my community is very hard.	8. Our community needs better places to throw away non-compostible waste, such as cans and plastics.	34. I would like the equipment to catch fish further out sea, to reduce pressure on the reef fishery.				
					** ▶ 36. The benefits from logging and mining are shared fairly across everyone in the community.					

Figure 59: Composite sort for factor 3 - Conservationists

-5	-4	-3	-2	-1	0	1	2	3	4	5
** ◀ 35. Mining and forestry offer enough benefits to make up for their environmental impact.	** 36. The benefits from logging and mining are shared fairly across everyone in the community.	** 4. Our rivers and streams are drying-up more frequently than before.	27. Enforcing customary resource rules and taboos in my community is very hard.	25. I feel that I can influence community decisions about conservation of customary lands.	30. We are cutting down too much forest and mangrove to make space for more gardens.	** 29. Reducing use of our marine resources is essential for conservation and good for the community.	28. Marine and mangrove protected areas will be good for attracting tourists.	** ▶ 12. It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	26. Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	** ▶ 22. Improving roads access to the community will help business opportunities.
	** ◀ 24. I would like to grow surplus food than but I cannot get the food to markets to sell it.	** ◀ 1. My garden is producing less food than it was before.	21. I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	** 7. I would know what to do to feel safe in the next natural disaster.	5. Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	19. I would like to earn more cash from selling food, fish, or handicrafts.	* ▶ 23. I would be able to spend more time in my community if there was a more equal share of housework between men and women.	** 33. Protected areas in forests is an effective way of stopping logging on customary lands.	** ▶ 6. We have enough toilet, washing, and cleaning facilities for all the people in the village.	
		** ◀ 3. There are weather-related natural disasters happening today, such as cyclones and heavy rain.	15. If our community protected its marine resources in a protected area it should be paid for that work.	10. I would like better ways to cook food, so we don't have to use firewood cut from the forest.	* 14. Neighbouring communities trespass on our customary land and marine resources without our permission.	11. If we had more tourists we wouldn't have enough food, water, and waste facilities to cope with them.	32. If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.	* ▶ 2. It is important to bring more livestock into the community to provide for food.		
			* 16. There are less traditional medicine plants growing than there used to be.	13. We should more to stop our special kastom places from falling into disrepair.	** 31. Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	20. Tourism offers many good opportunities for business in my area.	18. If I could borrow some money I would start a small business.			
				17. Kastom knowledge of resource use and the land is being forgotten.	** 9. I get enough good, reliable drinking water in my community.	8. Our community needs better places to throw away non-compostible waste, such as cans and plastics.				
					34. I would like the equipment to catch fish further out sea, to reduce pressure on the reef fishery.					

Figure 60: Composite sort for factor 4 – Pro-tourism

-5	-4	-3	-2	-1	0	1	2	3	4	5
36. The benefits from logging and mining are shared fairly across everyone in the community.	** ◀ 30. We are cutting down too much forest and mangrove to make space for more gardens.	** ◀ 6. We have enough toilet, washing, and cleaning facilities for all the people in the village.	3. There are weather-related natural disasters happening today, such as cyclones and heavy rain.	* 22. Improving roads access to the community will help business opportunities.	** ▶ 27. Enforcing customary resource rules and taboos in my community is very hard.	14. Neighbouring communities trespass on our customary land and marine resources without our permission.	13. We should more to stop our special kastom places from falling into disrepair.	28. Marine and mangrove protected areas will be good for attracting tourists.	** ▶ 29. Reducing use of our marine resources is essential for conservation and good for the community.	* ▶ 25. I feel that I can influence community decisions about conservation of customary lands.
	** ◀ 4. Our rivers and streams are drying-up more frequently than before.	** ◀ 9. I get enough good, reliable drinking water in my community.	10. I would like better ways to cook food, so we don't have to use firewood cut from the forest.	5. Climate change is making it too hot and dry, and sometimes too wet, to grow our usual crops.	* 1. My garden is producing less food than it was before.	8. Our community needs better places to throw away non-compostible waste, such as cans and plastics.	17. Kastom knowledge of resource use and the land is being forgotten.	** ▶ 20. Tourism offers many good opportunities for business in my area.	26. Mangrove and marine conservation will be more successful once people are secure and economically prosperous.	
		* ◀ 11. If we had more tourists we wouldn't have enough food, water, and waste facilities to cope with them.	31. Sediment in our rivers from logging and mining is causing pollution in our lakes, rivers, and ocean.	21. I worry that young people don't want to stay in the village, as there are more opportunities in big towns and Honiara.	18. If I could borrow some money I would start a small business.	** 33. Protected areas in forests is an effective way of stopping logging on customary lands.	** 12. It is important to pass down customary knowledge of dances, songs, and ceremonies to the next generations.	** ▶ 19. I would like to earn more cash from selling food, fish, or handicrafts.		
			7. I would know what to do to feel safe in the next natural disaster.	35. Mining and forestry offer enough benefits to make up for their environmental impact.	24. I would like to grow surplus food than but I cannot get the food to markets to sell it.	16. There are less traditional medicine plants growing than there used to be.	32. If we conserved our mangroves, forests, and marine resources in protected areas from certain uses, we would need new alternative livelihood options.			
				34. I would like the equipment to catch fish further out sea, to reduce pressure on the reef fishery.	* 2. It is important to bring more livestock into the community to provide for food.	15. If our community protected its marine resources in a protected area it should be paid for that work.				
					* 23. I would be able to spend more time in my community if there was a more equal share of housework between men and women.					

KIWA INITIATIVE

Nature-based solutions for climate resilience

The Kiwa Initiative - Nature-based Solutions (NbS) for Climate Resilience aims to build the resilience of Pacific Island ecosystems, communities, and economies to climate change through NbS by protecting, sustainably managing and restoring biodiversity.

It is based on simplified access to funding for climate change adaptation and biodiversity conservation actions for local and national governments, civil society, and regional organizations in Pacific Island Countries and Territories.

The Initiative is funded by the European Union, Agence française de développement (AFD), Global Affairs Canada (GAC), Australia's Department of Foreign Affairs and Trade (DFAT) and New Zealand's Ministry of Foreign Affairs and Trade (MFAT). It has established partnerships with the Pacific Community (SPC), the Secretariat of the Pacific Regional Environment Programme (SPREP), and the Oceania Regional Office of the International Union for Conservation of Nature (IUCN - ORO).

For more information: www.kiwainitiative.org