# Opportunities for ecosystem-based adaptation to climate change in coastal Pacific Island communities: Case studies of mangrove reforestation on Vanua Levu Island, Fiji

Harris, Melanie

University of the Sunshine Coast Australia

# Opportunities for ecosystem-based adaptation to climate change in coastal Pacific Island communities: Case studies of mangrove reforestation on Vanua Levu Island, Fiji.


Melanie Harris BA(Geography/Biology)/BSEd, *UniSC*


**Thesis Due Date: 12th February, 2024**

Primary Supervisor: Professor Patrick Nunn

Co-supervisors: Dr Adrian McCallum and Professor Catherine Yule


School of Science, Technology and Engineering, Australian Centre for Pacific Islands Research, and Sustainability Research Centre,

University of the Sunshine Coast, Sippy Downs, QLD, Australia.

# Abstract

The impacts of climate change, particularly sea-level rise, have been identified as among the greatest threats to rural subsistence-oriented Pacific Island communities. The potential negative impacts include damage to infrastructure, shoreline erosion, soil salinisation, and a reduction in the productivity of coastal ecosystems. These factors undermine food security for many people following subsistence lifestyles in the region. Most previous interventions aimed at reducing the impacts of climate change in coastal Pacific Island communities have failed to achieve the desired results and, in some cases, have even increased their vulnerability. Ecosystem-based Adaptation (EbA), such as mangrove restoration, represents a long-term approach to reducing the impacts of climate change and enhancing ecosystem services by increasing biodiversity and reducing shoreline erosion. This research addresses literature gaps in the processes and outcomes of Pacific Island community-based mangrove restoration projects of local ecosystems. Understanding communities' perceptions of climate change, coastal resource commercialization, and associated risks aids in documenting and replicating similar projects. A combination of methods was used to collect qualitative data from the five selected case study villages on Vanua Levu Island, Fiji: Talanoa-style group discussions with community members and observations of the mangrove restoration sites and seawalls. Identifying and addressing the opportunities and challenges of EbA in communities is an essential step towards building autonomous adaptive capacity for Pacific Island people. This research finds that while communities possess the capacity to implement EbA, they may benefit from support and guidance in planning, monitoring and evaluation of projects, as EbA is largely out of the scope of traditional resource management practices. Additionally, streamlining the integration of global scientific knowledge with traditional and local knowledge (TLK) may be beneficial for the sustainability of EbA projects while fostering community engagement and support, both factors that influence project success. Communities identified the need for increased local and regional-level support in contemporary resource management, which would also positively contribute towards an EbA project. Communication and compliance with COVID-19 restrictions by the case study communities presented an opportunity to reassess the management of coastal resources to complement EbA initiatives. This research concludes that nature-based solutions (NbS), such as EbA, are an optimal approach to adaptation for rural Fijian coastal communities facing the challenges of sea-level rise and may provide lessons for the wider Pacific Islands region. However, EbA is part of an overarching adaptation strategy or hybrid approach that may need to include built structures or plans of relocation. Over time, EbA is a more cost-effective and sustainable approach than built structures, like seawalls, and the increase in ecosystem productivity resulting from an EbA project contributes to food security and income for the community. Notably, EbA projects need to be nuanced to suit each community and the local environment as what has worked in one location may not be suitable for another. The

outcomes from this research may assist policy-makers in adaptation planning across all levels of governance. The findings of this research are of paramount importance because delaying action may limit available options, particularly as the climate becomes increasingly unstable and ecosystems further degraded.

# Contents

# Keywords

Ecosystem-based adaptation, nature-based solutions, community-based adaptation, mangrove reforestation, sustainable livelihoods, food security, Pacific Islands, Fiji, climate change, traditional and local knowledge, resource management, COVID-19, pandemic.


# Field of Research

## - Australian and New Zealand Standard Research Classification

- (4406) Human geography
    - (440604) Environmental geography

- (4101) Climate Change Impacts and Adaptation
    - (410102) Ecological impacts of climate change and ecological adaptation

# Declaration of authorship

This thesis is composed of original work by the author and contains no material previously published or written by another person except where due reference has been made in the text.

I have clearly stated the contribution of others to my thesis as a whole. The content of my thesis is the result of work carried out since the commencement of my higher degree by research candidature and does not include work that has been submitted for any other degree or diploma in any university or tertiary institution.

| | |
|---|---|
| _____ | 10.2.24 |
| Melanie Harris | Date |

## Publications included in this thesis

No publications included.

## Submitted manuscripts included in this thesis

No manuscripts submitted for publication.

# Contributions by others

**My supervisors**

I received invaluable assistance and guidance throughout this research journey from my primary supervisor, Professor Patrick Nunn. His support included refining the research proposal, devising an appropriate methodology, and sharing his extensive knowledge and experience of working with Pacific Island communities. Additionally, my co-supervisors, Dr. Adrian McCallum and Professor Catherine Yule, who joined my supervisory team later in the process, provided a wealth of knowledge and inspiration. Dr McCallum provided support and guidance in my scientific methods, while Professor Yule offered her expertise on mangroves and mangrove rehabilitation. The team's collective insights influenced the direction of this interdisciplinary project, and their much-appreciated editorial assistance improved the final product.

**My translator/interpreter/in-country liaison**

This project would not have been possible without the contacts and expertise provided by Mr Maleli Qera. His in-country knowledge made it possible to collect the data required to complete this research as he acted as a guide and local liaison for the visits to each community. He played a pivotal role in organising transportation and supplies and facilitated the cultural protocols required to enter Fijian villages, resulting in warm welcomes from each community. Furthermore, Maleli translated group discussion questions from English to Fijian and vice versa, providing essential context to many comments made during these sessions as well as verifying the interview transcripts for accuracy in their translation, contributing to the overall success of the data collection process.

# Acknowledgements

The **University of the Sunshine Coast** offered both financial and academic support that contributed to the completion of this research. Throughout my degree, the university also presented numerous opportunities and encouraged student engagement and collaboration with peers and academics, fostering the development of my research skills.

This research was further supported and made possible through an **Australian Government Research Training Program Scholarship,** which allowed me to undertake my degree as a full-time student.

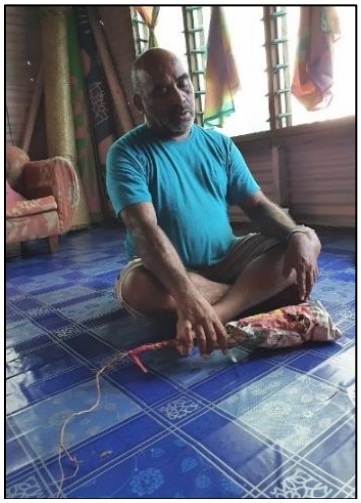
The **Australian Centre for Pacific Islands Research** provided additional financial assistance for this research, for which I am sincerely grateful. Additionally, they facilitated a collaborative network with academics and students who share research interests in the Pacific Islands. The Centre also initiated programs to enhance my knowledge and skills as a researcher - resources that will undoubtedly contribute to the progression of my research career.

My supervisor, **Professor Patrick Nunn**, cultivated my initial thoughts of pursuing an academic career and sparked my interest in Pacific Island research. Without his superior knowledge and unwavering support, my research journey would not have come to fruition.

**My family** has been a constant source of support, standing by me and endorsing my decision to follow my dreams. Their encouragement motivated me throughout my PhD journey. I hoped that undertaking a higher degree would not only fulfil personal goals but inspire my beautiful daughters, demonstrating that no dreams are too ambitious.

The success of this research is indebted to the generosity and support of my **Fijian families and friends** who welcomed me into their communities and actively contributed to the data collection process. From those who provided transport to and from villages, to the Provincial Officers, the families who provided meals and accommodation, the *Turaga ni koro* and group discussion participants from each case study village – their collaborative efforts were crucial. Special appreciation goes to my guide, translator, and friend, Maleli Qera, without whom this research would not have run so smoothly.

*Travelling from Navunievu to Naivaka Village.*



*Mr Qera performing the sevusevu at Raviravi Village.*

## Ethics and Permissions

Ethics approval for this project was granted by the Chair of the USC Human Research Ethics Committee on the 20th of December, 2019 – approval number S191385 (Appendix A). Several amendments were submitted and approved during the course of the research due to delays and travel restrictions caused by COVID-19, as well as a change in the supervisory team. An extension approval was granted until the 20th of December, 2023 by the USC Human Research Ethics Committee via email on the 22nd of November, 2022.

Permission to conduct research in Fiji communities was sought and granted by the Permanent Secretary for iTaukei Affairs (PSIA) (Appendix B). Email contact was made with the *Roko Tui* of the appropriate Provincial Council Office to facilitate the visits to each community, as advised by the PSIA. The Roko Tui made initial contact with the *Turaga ni Koro* (village head person) to seek permission to enter the village. On arrival, a traditional ceremony, known as *sevusevu* was performed. This involves presenting the head of the village with a bundle of *yaqona* while providing introductions, asking for permission, and offering an explanation for the purpose of the visit. When departing, a similar ceremony, known as *iTatau* is conducted, which shows appreciation to the community for your visit.

# List of Figures and Tables

# List of Appendices

# Abbreviations and Acronyms

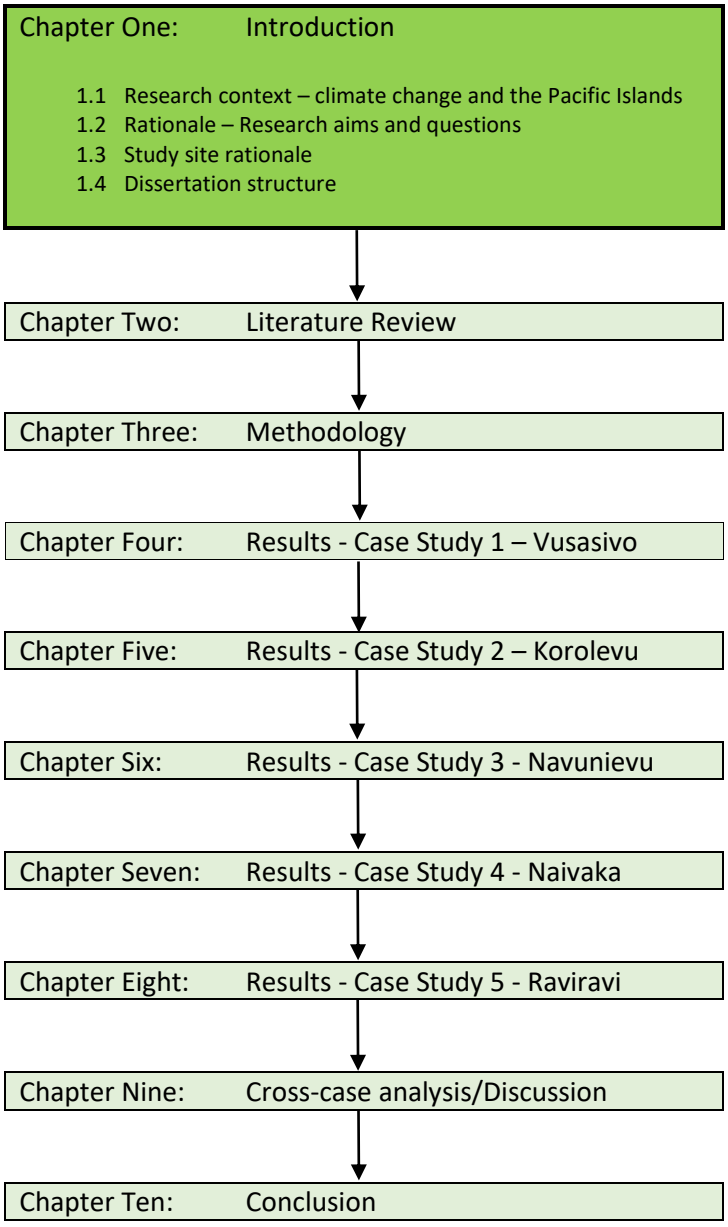
| | |
|---|---|
| EbA | Ecosystem-based Adaptation |
| NbS | Nature-based Solutions |
| CbA | Community-based Adaptation |
| LLA | Locally led adaptation |
| LEK | Local Ecological Knowledge |
| TEK | Traditional Ecological Knowledge |
| IPCC | Intergovernmental Panel on Climate Change |
| C3 | Community Centred Conservation |
| NGO | Non-government organisation |

# Glossary of Terms

| | |
|---|---|
| *iTatau* | A traditional offering of *yaqona* on departure from a village as a demonstration of gratitude. |
| *iTaukei* | Relates to Indigenous Fijians. |
| Mangrove sapling | This is the intermediate stage of a mangrove plant that has developed beyond the seedling stage but is yet to reach full maturity. They are generally up to a metre tall depending on the species. |
| Mangrove seedling | Mangrove seedlings refer to germinated propagules/ hypocotyls that have developed young shoots and roots. |
| *Masi/tapa* | A cloth made from pounding the bark from a mulberry tree and dyed using extract from mangrove stems and aerial roots. These are used in decorating homes and in traditional ceremonies in Fiji. |
| Propagule/hypocotyl | This is the dry seed structure that will develop into a new individual once it falls from the parent plant and settles into suitable conditions. The two terms have been used interchangeably throughout this document. |
| *Roko tui* | The title for the executive head of each of the Provincial Councils of Fiji. |
| *Sevusevu* | A traditional offering of *yaqona* while seeking permission to enter as a visitor to a village. |
| *Talanoa* | An ingrained concept within largely oral cultures, including Fiji, Tonga, Samoa and Indigenous Australians. The translation means 'to talk', 'to tell stories', or 'to yarn'. |
| *Turaga ni Koro (*or *Marama ni Koro)* | Village headman (or headwoman) elected by the people of the village. |
| *Yaqona (Kava)* | This is a beverage made from the grounded root of the *Piper methysticum* plant that is often used in traditional ceremonies and for relaxation. |

# CHAPTER ONE: Introduction

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 1.1 Research context – climate change and the Pacific Islands

Climate change has contributed to unprecedented changes in global climate systems, resulting in weather and climate extremes across the globe. Since 1970, global surface temperatures have increased at an accelerated rate, surpassing any 50-year period in the past 2000 years. Additionally, global mean sea level has risen faster since 1900 than during any century in the past 3000 years. These shifts in climate include intensified heatwaves, marine heatwaves, and increased frequency and severity of heavy precipitation followed by drought (IPCC, 2022a), having adverse impacts on coastal ecosystems, resulting in irreversible losses to organisms, ecosystems, communities, and infrastructure (Lewis et al., 2023).

The Pacific Islands region, despite contributing only 0.03% to global carbon emissions, bears a disproportionate burden of the impacts of climate change due to factors such as low-lying elevation, extensive coastlines relative to land area, economic security, geographic location and isolation, and in certain cases, constraints on space and freshwater availability (Klöck & Fink, 2019; Kumar, Jayasinghe, Gopalakrishnan, & Nunn 2020; Mycoo et al., 2022). Currently, more than half of the Pacific Islands' population resides within 500 metres of the coastline, with nearly 97% living within 10 kilometres of the ocean (Andrew et al., 2019; Kumar et al., 2020). Marine ecosystems hold significant importance for Pacific Island livelihoods, as seafood provides up to 90% of the animal protein in their diet (Marrero & Mattei, 2022). Apart from climate change pressures, additional environmental challenges, such as population growth, pollution, and exploitation and overharvesting of resources may increase vulnerability for rural subsistence-based communities such as those in the Pacific Islands, as their coastal buffer and ecosystem services are diminished by degraded coastal ecosystems (Campbell, 2015).

The common narrative of vulnerability for the Pacific Islands fails to consider the geographic, social, cultural, and economic diversity across the region or acknowledge the demonstrated history of strength and resilience in adapting to climatic changes (Nalau, Becken, Schliephack, et al., 2018; Nunn, Joseph, et al., 2019; Walshe et al., 2018). More broadly, the concept of resilience is defined as the capacity of social, economic, and environmental systems to cope and respond after an event in a way that maintains the essential function, identity, structure and capacity to adapt (Begum et al., 2022). Resilience can also include livelihoods and the capacity across generations to sustain and improve well-being despite environmental, economic, social, and political disturbances (Tanner et al., 2015). One notable example of the resilience of Pacific Island people is the transformative societal change triggered by the AD 1300 event between the Medieval Warm Period (AD 750-1250) and the Little Ice Age (AD 1350-1800). This event, characterised by an 80 centimetre fall in sea level, led to a food crisis and regional conflict, prompting Pacific Island people to relocate to fortified upland areas. Throughout Fiji, evidence of these *koronivalu* (hillforts or war-towns)

can be seen. Marine shellfish remains have been found on many mountaintops indicating the occupants were accustomed to coastal living (Nunn, 2012; Nunn et al., 2019).

The increasing recognition of traditional and local knowledge (TLK) in climate change adaptation at a local scale underscores the need to integrate TLK with global scientific knowledge to effectively manage contemporary environmental challenges and pressures on coastal ecosystems (Nunn et al., 2021; Piggott-McKellar, McNamara, et al., 2020; Westoby et al., 2019). Unsustainable Western-focused practices such as seawall construction persist within the Pacific Islands resulting in adverse consequences for the coastal ecosystem and the local population dependent on these ecosystem services (Nunn et al., 2021). Addressing these challenges requires innovative approaches that will effectively address the long-term needs of local communities, mitigate the adverse impacts of climate change, and stem the decline of biodiversity, while respecting cultural practices (Jupiter et al., 2014; Parsons et al., 2016; Pilbeam et al., 2019). In response to these complex challenges, some researchers suggest a blended knowledge approach. This type of approach involves the incorporation of local knowledge with pertinent global scientific knowledge to gain a nuanced understanding of the complexity of managing the impacts of climate change on severely degraded ecosystems, and the outcomes of various response measures (Dumaru, 2010; Fink et al., 2021; Makondo & Thomas, 2018).

Considering the reliance of Pacific Island subsistence communities on local marine resources, optimising the health and functionality of coastal ecosystems, particularly mangroves, becomes imperative (Meriwether et al., 2018). Healthy ecosystems can increase resilience against the impacts of climate change but also enhance ecosystem services critical for livelihoods (Chand et al., 2020; Rizvi et al., 2015). Favouring NbS offers promising avenues to restore biodiversity and ecosystem services to local communities, while aligning with cultural values (Cohen-Shacham et al., 2016). EbA represents one such NbS approach that integrates traditional biodiversity and ecosystem conservation with sustainable economic development, forming part of a comprehensive strategy to adapt to climate change and food security challenges (Bertram et al., 2017; Mercer et al., 2014).

A community-based approach, incorporating traditional resource management, is an important consideration in sustainable EbA (Reid, 2016), making it a significant aspect of this research. The COVID-19 pandemic provided a unique opportunity as some lost traditional practices were revived during this period (Farrell et al., 2020). Insights into how the pandemic was managed became of interest as case numbers were kept under control throughout the Pacific Islands region(Leal Filho et al., 2020). The following section outlines the significance of this research by highlighting its relevance in addressing critical gaps in current knowledge. It also underscores the specific aims and research questions that guided the investigation, illuminating the framework upon which this study was developed.

## 1.2 Rationale – Research aims and questions

This research aims to bridge existing knowledge gaps within the context and application of EbA in rural coastal Pacific Island communities. Currently, there is a paucity of data regarding the outcomes of EbA efforts initiated by these local communities (Mcleod et al., 2019), yet these projects demonstrate resilience and autonomous coping capacity in a changing climate, including disaster risk reduction. Given the dependence of coastal Pacific Island communities on the health of mangroves for daily provisions (Gilman et al., 2006; Pearson et al., 2020), mangrove ecosystems were chosen as the focal point of this research. Additionally, mangroves play a crucial role in reducing coastal erosion and promoting the health of the offshore reef ecosystems (Koshiba et al., 2013; Olds et al., 2013), upon which coastal communities are also reliant.

While some coastal communities have undertaken mangrove planting projects, there is limited data concerning the motivation, planning, scale or outcomes of these projects. Although EbA projects are site-specific, the overarching principles are universally applicable (Scarano, 2017). Addressing the identified knowledge gaps is crucial to replicate or enhance sustainable EbA projects on a scale sufficient to improve biodiversity and reduce the impacts of climate change.

The following research questions were developed to achieve the intended outcomes of this research:

1. How does the community utilise their local mangrove ecosystem and what is the community members' understanding of the impacts of climate change on food security and coastal ecosystem services?
2. What climate change adaptation strategies have been implemented in the community, to what extent was external assistance provided, and if so, did the planning incorporate traditional and local knowledge? Did the strategy achieve the desired outcome?
3. How did COVID-19 impact the community and are there any lessons that can be drawn from their management of COVID-19 to improve the outcomes of climate change adaptation and resource management in rural Pacific Island communities?

The research aims and questions will be achieved by:

a) documenting an Indigenous Fijian *(iTaukei)* perspective on the importance, use, and management of mangrove ecosystems by rural coastal Fijian communities;
b) understanding the coastal changes that have occurred at a particular site and the impacts these changes have had on local livelihoods;

c) examining the motivation, planning involved, and outcomes for the mangrove planting projects undertaken by each case study community; and
d) analysing the findings to assess how they might contribute to effective and sustainable approaches to adaptation for rural Pacific Island communities.

## 1.3 Case study site rationale

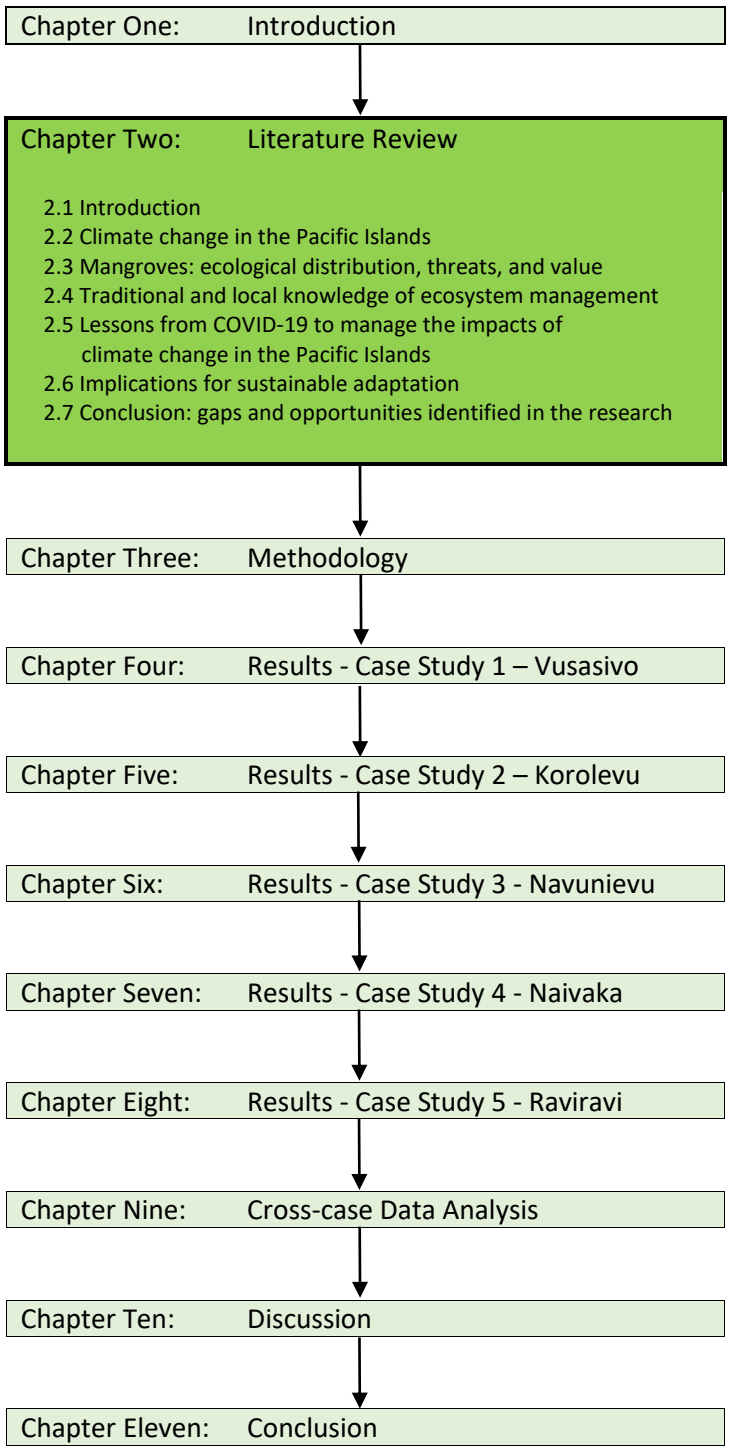
Coastal communities on Vanua Levu Island, Fiji, were selected as the case study sites for this research due to their remote location and their endeavours to undertake mangrove planting projects. Details on site selection are outlined in Section 3.2. Data collection through group discussions aims to fill the knowledge gap by gaining insight into how rural coastal villages in Fiji value and manage their mangrove ecosystems. Additionally, it seeks to explore each community's traditional methods of overcoming the challenges associated with climate change and food security. It is crucial to address these challenges as climate-related hazards and degraded coastal ecosystems have the potential to undermine rural livelihoods by damaging infrastructure and food crops, claiming land, and diminishing catch sizes for consumption, trade, or income (Campbell, 2015; Medina Hidalgo et al., 2020; R. R. Prasad et al., 2022; Syddall et al., 2022). Further details regarding the case study sites are in Section 3.2.

## 1.4 Dissertation structure

This document adheres to a traditional thesis structure and contains a thesis guide at the beginning of each chapter to highlight its position within the document. Following this introductory chapter, a review of the relevant literature is presented, identifying the research gaps and providing the means to formulate the framework for this research. Chapter 3 elaborates on the methodology undertaken to complete this research, providing insight into the rationale for the project design, case study sites, and data collection and analysis techniques. The subsequent five chapters showcase the research results, each dedicated to a case study, which has ensured that each community is fully discussed and their nuances documented. Chapter 9 provides a cross-case analysis of these results, leading to the discussion in Chapter 10. The discussion is organised around three core themes: adaptive capacity and community resilience, drivers and opportunities for adaptation, and rethinking transformation adaptation and adaptive capacity. Finally, the concluding chapter summarises the research findings, acknowledges the research limitations, and presents recommendations and considerations that emerged as a result of this research.

# CHAPTER TWO: Literature Review

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 2.1 Introduction

This chapter draws on the relevant academic literature that supports the main premise of this research project: EbA may be an economically, environmentally, and culturally sustainable approach for reducing the impacts of climate change and sea-level rise for rural Pacific Island communities. To encompass all aspects of EbA in a Pacific Island context, this literature review is divided into four main sections.

The initial section (2.2) provides an overview of how the people of the Pacific Islands have responded to changes in their environment and resource availability, both historically and in a more contemporary context of anthropogenic climate change. It explores different methods of adaptation, including Nature-based Solutions and EbA. The subsequent section (2.3) examines mangrove ecology, distribution, threats, and value of mangrove ecosystems in Pacific Island livelihoods. Section 2.4 examines traditional and local knowledge of ecosystem management. Following this, Section (2.5) considers the strategies employed the Pacific Islands region in managing the outbreak of the COVID-19 pandemic, aiming to extract lessons applicable to climate change adaptation. Lastly, Section (2.6) identifies the gaps in the literature and opportunities that emerge as a result of these findings (2.7).

## 2.2 Climate change in the Pacific Islands

### 2.2.1 Pacific Islands people's response to environmental and resource changes

For thousands of years, people have occupied most of the islands in the tropical Pacific, mostly living in coastal settlements due to the bountiful supply of marine resources compared to inland areas (Nunn, 2013). In the past, Fijian and other Pacific Islanders responded to changes in sea levels differently than they do today (Fink et al., 2021). Evidence suggests that settlements shifted over time from many small coastal settlements to larger, more isolated coastal communities, then back to smaller inland and outer island settlements as a response to changing climatic conditions and food supply (Nunn et al., 2007). Earlier Pacific Island dwellings were made from locally sourced materials and were well-designed to suit the climate and weather. They were simple structures that were ideal for a semi-permanent lifestyle and could be rebuilt or repaired easily, while also withstanding the strong winds of tropical cyclones (Nunn & Campbell, 2020; Nunn & Carson, 2015).

The introduction of Christianity and foreign diseases during the European colonisation of the Pacific Islands led to profound societal changes (Nunn, 2009). The devastating impact of diseases, to which local populations had little immunity, resulted in widespread fatalities and destabilisation of island societies (Nunn, 2007). Missionaries took advantage of this upheaval and gained traction as they conducted conversions during the societal disruption. Influenced by missionaries and colonial authorities, Pacific Island communities transitioned back to predominantly coastal living in more permanent structures, as well

as a shift towards a cash economy. This societal transformation has had enduring effects, including the erosion of traditional knowledge and the exploitation of coastal ecosystems. During this period, mangroves were perceived as disease-prone and were systematically removed. Additionally, pressure for agricultural land and coastal development accelerated the deforestation of mangrove habitats (Nunn, 2000). The loss of traditional knowledge and ecosystem productivity, coupled with the transition towards a cash-based economy, contributed to changes in diet within Pacific Island communities (O'Meara et al., 2023), compounding climate change vulnerability (Mycoo et al., 2022).

For the last three decades, the Pacific Islands have been recipients of substantial development and climate-related aid which has had minimal impact on sustainable development or improved resilience (Nunn & Campbell, 2020). The impacts of climate change are expected to increase, particularly for low-lying coastal communities, therefore it is imperative to find sustainable adaptation options that will decrease Pacific Island community's vulnerability to these impacts (Nunn & McNamara, 2019).

### 2.2.2 Climate change vulnerability and resilience of Pacific Islands people

Vulnerability within this context of climate change adaptation research refers to the tendency or predisposition to experience negative impacts caused by climate change, including susceptibility to harm and the inability or capacity to cope or adapt (Bergstrand et al., 2015). In contrast, resilience is defined as the ability of social, economic, and environmental systems to handle a hazardous event or disturbance, responding and reorganising to preserve their essential function, identity and structure. This includes the ability to adapt, learn and transform, or to revert to a previous stage following a disturbance (Fisichelli et al., 2016; Tanner et al., 2015). The vulnerability of people and ecosystems to the impacts of climate change is influenced by socioeconomic factors, resulting in variability across and within regions (Begum et al., 2022). Vulnerability and resilience are complex as there can be characteristics of both, simultaneously. Levels of vulnerability and resilience are also dynamic and can increase or decrease due to external factors, such as a change of governance, the magnitude of a hazard, or the implementation of an adaptation strategy (Medina Hidalgo et al., 2021).

A critical element in reducing vulnerability is enhancing adaptive capacity through the identification of specific vulnerabilities and the development of robust adaptation strategies, despite uncertainties about the precise impacts of climate change (Thornton et al., 2014). Unsustainable use of natural resources is a key driver that can increase the vulnerability of people and ecosystems and lessen the capacity to adapt, particularly for societies that are dependent on the services provided by these local ecosystems for their needs (Mycoo et al., 2022). For instance, coastal Pacific Island communities depend on the resources supplied by coastal ecosystems, like mangroves and inshore reefs for their daily food requirements, making

them less resilient when these ecosystems are degraded (Medina Hidalgo et al., 2020; Taylor et al., 2016; Tui & Fakhruddin, 2022).

There is now certainty that global mean sea level is rising which is expected to impact low-lying communities and islands (Becker et al., 2023; Vousdoukas et al., 2023). The Pacific Islands are exposed to compounding processes of sea-level rise and other climate-related changes, leading to loss and damage of land and cultural heritage, destruction of settlements and infrastructure, and reduced agricultural productivity (Campbell, 2015; Mycoo et al., 2022). Resilience to the impacts of climate change can also be impacted by damage to equipment used to source or collect food, such as boats, fishing gear or baskets during climatic extremes (Thomas et al., 2019). Both economic and non-economic loss and damage can lead countries or communities into an inefficient cycle of dependence and depreciating resilience by diverting public funding into repair and maintenance instead of building resilience through sustainable development (Begum et al., 2022).

Some researchers question the narrative of vulnerability for Pacific Islands people as it reinforces stereotypes, disempowers, and does not account for the diversity of island geographies in the region (Kelman, 2020). Walshe and Stancioff (2018) state that an important aspect of successful adaptation and resilience building is through consideration of a community's perception of the risks of climate change and the influence of culture on these perceptions.

### 2.2.3 Adaptation to climate change and sea-level rise in small islands

Adaptation in the context of human systems refers to the process of adjustment to the impacts of actual or expected climate impacts that will limit harm or take advantage of beneficial opportunities (Begum et al., 2022). The same report outlines the options being used to reduce the risks for small island coastal communities from the impacts of increased wave energy and sea-level rise. *Figure 2.1 (a)* illustrates that in 2020, the elevation of many coastal communities is close to the mean high tide level. Under the current projections for sea-level rise, by 2100 these low-lying coastal villages will be inundated as they will be below the mean high tide sea level, (Fox-Kemper et al., 2021), with uninhabitable areas indicated with a red cross *(Figure 2.1 b)*.

Many coastal Pacific Island communities have been experiencing flooding and coastal erosion for several decades and have been responding to these impacts in a number of ways. The most commonly used methods within many of the Pacific Islands have been in-situ adaptation *(Figures 2.1 c)*, including the construction of protective structures like seawalls (Nunn et al., 2020; Piggott-McKellar, Nunn, et al., 2020) that can be seen throughout the Pacific Island *(Figure 2.2)*. More recently, the use of ecosystem-based measures, such as planting mangroves has become of interest. Many communities have autonomously

relocated some homes to higher ground following the impacts of flooding and erosion *(Figures 2.1 d)*, in addition to complete externally-sponsored relocation (McMichael & Katonivualiku, 2020; Singh et al., 2020).

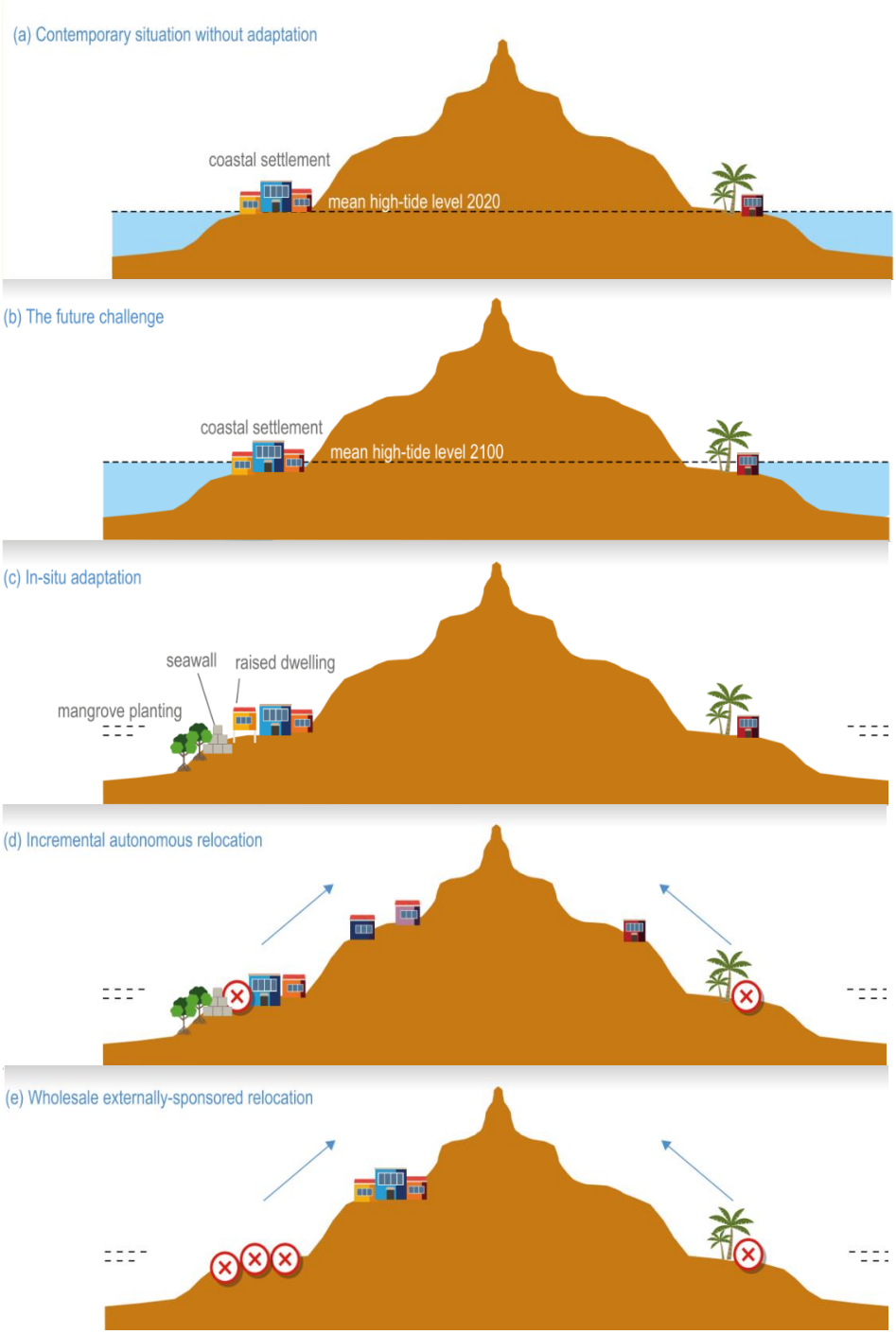



***Figure 2.1*** *shows different adaptation options for rural coastal communities on small islands The dotted lines in c, d, and e indicate the 2020 and 2100 mean high tide level, while the red crosses indicate areas that are no long habitable.* ***(a)*** *Long-established coastal communities are being more regularly inundated today as a result of rising sea level.* ***(b)*** *In some places the sea level may have risen by 1 m or more by the end of this century, making many coastal communities mostly uninhabitable, outlining the need for anticipatory adaptation.* ***(c)*** *In situ adaptation is a preferred option as it is a cheaper alternative that is less disruptive than relocation. Examples of in situ adaptation include replanting mangroves, seawall construction and raising dwellings.* ***(d)*** *Incremental relocation is a second option, whereby any new homes are built further inland and upslope.* ***(e)*** *Complete relocation of vulnerable coastal communities with external support is a third option (Mycoo et al., 2022).*


***Figure 2.2*** *Examples of seawalls built in rural Fijian communities to protect village infrastructure and reduce erosion* ***(a)*** *Narikoso, Ono Island, Fiji (Source: Author, 2019).* ***(b)*** *Under construction at Vabea, Ono Island, Fiji (Source: Author, 2019).* ***(c)*** *Navunievu, Vanua Levu, Fiji (Source: Author, 2018).*

A seawall can have negative impacts on a community and local ecosystems, in turn increasing a community's vulnerability to the impacts of climate change. Cases where methods of adaptation lead to unintended negative outcomes or limit long-term adaptive capacity for the community are referred to as maladaptation (Piggott-McKellar, McNamara, Nunn, & Sekinini, 2019). There are many examples of maladaptation in the Pacific Islands, such as flooding or pooling of both rain and seawater on the landward side of the seawall which can lead to infrastructure damage, increased soil salinity and habitat for disease-carrying mosquitoes. Additionally, erosion of sediment often increases on the seaward side of a vertical seawall due to strong wave deflection hitting the structure that then undermines the structural integrity of the seawall and causes its collapse (Magnan et al., 2016; Nunn et al., 2021; Piggott-McKellar, Nunn, et al., 2020).

Further negative outcomes noted about seawalls is that when they are built in remote locations, such as rural Pacific Island communities, they are often constructed using locally sourced materials of beach rock and sand, causing damage to the coastal ecosystems (Fink et al., 2021; Nunn et al., 2021). Such artificial structures along a coastline also provide unfavourable conditions for nearby mangrove ecosystems as they can reduce the nutrient and sediment supply and block the natural sapling migration; a natural response to changes in sea level (Gilman, Elison, & Coleman, 2006). Researchers in this field question why seawalls are still commonly used today despite their ineffectiveness and often negative impacts (Nunn et al., 2021). Fink et al. (2021) suggest a number of explanations, including limited knowledge sharing on the success and failures of projects, ineffective integration of local and Western knowledge, and the disconnect

between the Government and local communities. Additionally, the potentially mutually reinforcing mechanisms of learning and emulation, where communities perceive the apparent effectiveness of hard built structures in one context and consider it as an appropriate response to coastal erosion (Klöck et al., 2022).

Community relocation is a form of adaptation that suits gradual changes in, for example, sea-level rise and is an example of planned retreat where people and assets are moved upland or inland to an area of less risk (*Figure 2.1 d and e*) (Barnett & McMichael, 2018). Relocation in Pacific Island communities is difficult because contemporary lifestyles are more permanent compared to traditional (pre-European) settlements. Lifestyle, place attachment, and investment in infrastructure have been identified as reasons for reluctance to use relocation as a form of adaptation (Fink et al., 2021; Gharbaoui & Blocher, 2016; Pill, 2020; Singh et al., 2020). Yet, planned relocation may be a probable scenario for many Pacific Island communities. Fiji is just one example where over 80 communities have been identified by the Government of Fiji as potentially requiring relocation in response to climate risks (Barnett & McMichael, 2018; Piggott-McKellar, McNamara, & Nunn, 2019). In 2018, the Government of Fiji published its planned relocation guidelines which outline that relocation will be used when all other adaptation options have been exhausted. This document was developed to ensure the affected community's needs were met and the relocation plan and process were embedded with humanitarian principles (Government of Fiji, 2018). Some communities, such as Navunievu (*Figure 3.2*), have begun incremental autonomous relocation, suggesting all new dwellings be built further upslope from the current village (Mycoo et al., 2022). Other Fijian villages, such as Vunisavisavi (Singh et al., 2020) and Denimanu, Yadua Island (Martin et al., 2018) (*Figure 3.2*), have undergone externally sponsored relocations where assistance to relocate the entire village was required.

Many negative livelihood outcomes have been reported as a result of climate-induced relocation due to uncertainty of the future and strong ties to the land and sea. Emotional and psychological trauma may result, particularly when villages have to move some distance away from their original location or to an inland location where diets and lifestyles require a major adjustment. In cases where relocation is the only option, the process needs to improve livelihoods to achieve a positive outcome (Barnett & McMichael, 2018; Piggott-McKellar, Pearson, et al., 2019).

Soft solutions to climate change adaptation may include natural capital or community empowerment, therefore projects that involve raising community awareness and education, integration of local environmental knowledge, and incorporating systems that support or strengthen livelihood resources are included in this category (McNamara, 2013; Sovacool, 2011). Concepts such as community-based adaptation (CbA) may fall into the category of soft solution, as it includes initiatives that incorporate behavioural change and social adaptation (McNamara & Buggy, 2017; Riera-Spiegelhalder et al., 2023).

Adaptation involving the natural environment or Nature-based solutions are also often categorised as 'soft' adaptation, while some researchers place them into an independent category (H. P. Jones et al., 2012; Riera-Spiegelhalder et al., 2023).

### 2.2.4 Nature-based Solutions (NbS)

Nature-based solutions are those that harness the benefits provided by natural ecosystems to address the challenges of climate change, food and water security, natural disasters, and loss of biodiversity and have become increasingly recognised as a more sustainable method of adaptation over artificially engineered solutions (Cohen-Shacham et al., 2016). Findings reveal that NbS have a far better cost/benefit ratio than hard solutions (Narayan et al., 2016) and can be applied across scales from a single beach to an entire coastline, giving a further advantage over hard methods of adaptation. The concept of NbS is gaining traction but is still considered to be in its infancy, therefore further research into how NbS can achieve stakeholder acceptance and trust, collaboration across disciplines, and a governance structure that supports an alliance between ecology, economy and society is required (van der Meulen et al., 2022).

An example of NbS could be the stabilisation of a coastline using beach nourishment and coastal vegetation (van der Meulen et al., 2022). In some cases, NbS might be suitable as a complementary solution rather than an alternative (Ison et al., 2018). That is, it may be part of a hybrid adaptation which is a combination of other adaptation options (hard and soft) (Riera-Spiegelhalder et al., 2023). As a risk reduction solution, natural coastal habitats such as mangrove forests can significantly reduce wave energy (Bryant et al., 2022). Yet, the combination of mangrove forests, coral reefs and seagrass beds together has proven to provide maximum benefit in coastline protection (Guannel et al., 2016). As NbS has become more mainstream, its meaning has become an umbrella term for solutions that involve the use of ecosystem services to improve livelihood outcomes, for example, Ecosystem-based Adaptation.

#### *2.2.4.1 Ecosystem-based Adaptation*

EbA is an integrative approach that has emerged as one form of NbS, developed as a framework for lessening the impacts of climate change by enhancing ecosystem services (ES) through the restoration of degraded ecosystems, sustainable resource management, and biodiversity conservation (CBD 2009). EbA is not simply the practice of conservation of an ecosystem although it is associated with traditional biodiversity and ecosystem conservation approaches (Reid et al., 2009). An effective EbA intersects three key elements: people, nature, and climate change adaptation (Bertram et al., 2017) (*Figure 2.3*). The application of an EbA aims to provide social, economic, and cultural co-benefits to communities, particularly in developing countries (Jones et al., 2020; J. M. Prasad et al., 2022; Riera-Spiegelhalder et al., 2023), all of which are distinguishing features compared to other adaptation approaches. In their report,

Bertram et al. (2017) outline the elements and criteria to qualify as an EbA. Firstly, EbA helps people adapt to climate change by reducing social and environmental vulnerabilities and generating societal benefits in the context of climate change adaptation, which includes addressing current and future climate risks. Secondly, EbA makes active use of biodiversity and ecosystem services by restoring, maintaining or improving ecosystem health. Finally, EbA is part of an overarching adaptation strategy that is backed by policies at multiple levels, supports equitable governance, and enhances the coping capacity of a community.

Ecosystem biodiversity and climate change have an interconnected relationship whereby climate change impacts biodiversity and changes in biodiversity can contribute to either exacerbate or mitigate climate change (CBD, 2009). Understanding the relationship between the drivers of negative change, the well-being of people, and the factors impacting ecosystem health and the services it provides can allow for issues to be resolved and multiple benefits achieved (Pedersen Zari et al., 2020).

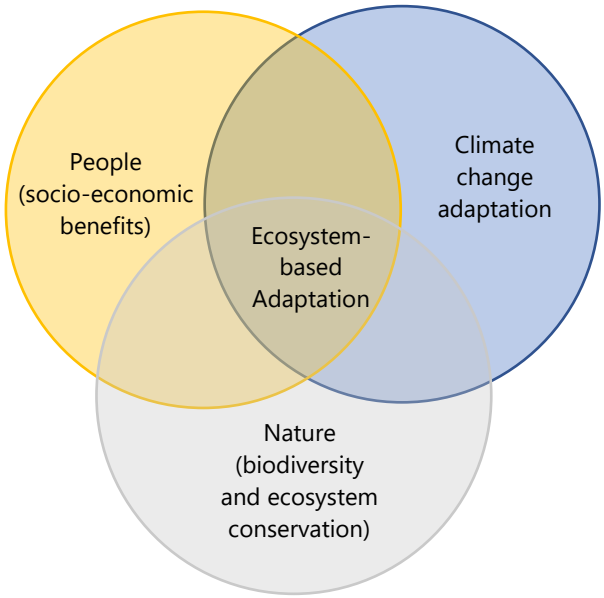



***Figure 2.3*** *EbA is the intersect of three essential elements: people, nature and adaptation to the current and future impacts of climate change. Adapted from Bertram et al. (2017).*

EbA can be integrated into a broader strategy, that may include engineered or hybrid methods to increase the effectiveness of adaptation outcomes (UNEP, 2019). This shift in the design of engineered structures may reduce the negative impacts that these options often have on surrounding ecosystems (Cheong et al., 2013). A study into regions that would significantly benefit from EbA found the Pacific Islands to be a 'global hotspot' due to their exposure, sensitivity, and adaptive capacity to sea-level rise and impacts of climate change and their extensive overlap of reef and mangrove ecosystems (Jones et al., 2020).

Adaptation strategies modelled on a systems approach bring interdisciplinary perspectives to address complex issues such as food security (Currenti et al., 2019). Undertaking this type of holistic approach considers climatic and non-climatic drivers that contribute to ecosystem health or decline and is more likely to lead to positive social and ecological outcomes and long-term resilience across the social-ecological system (Currenti et al., 2019). Strategies within a holistic approach considered cultural elements and include re-implementing traditional management techniques, adjusting the social norms around local exploitation of resources, and improving governance systems, while considering the development aspirations of the community (Trudinger et al., 2023).

In a Pacific Island context, one key aspect of EbA is the incorporation of indigenous, traditional and local knowledge and relevant scientific knowledge that considers cultural views outside Western concepts. Knowledge integration and a 'bottom-up' approach make a project relevant and initiate ownership within a community (Nalau, Becken, Schliephack, et al., 2018; Pearson, 2020; J. M. Prasad et al., 2022; Reid, 2016). Fiji's National Adaptation Plan (NAP) draws specific attention to the suitability of EbA as an adaptation strategy particularly suitable for rural communities, stating EbA principles should be prioritised, acknowledging that these communities can be most disadvantaged by degraded ecosystems (Government of the Republic of Fiji, 2018). Additionally, the NAP recognises the importance of training and awareness in climate change and monitoring and evaluation of projects.

EbA in a coastal Pacific Island community might be a project aimed at restoring native coastal vegetation, like mangrove trees and native grasses to reduce coastal erosion that is claiming land and damaging infrastructure (Scarano, 2017). This revegetation may reduce erosion but will have the co-benefit of also increasing the community's resilience to climate change through the increase of ecosystem services provided, such as protection from storm surges and habitat for local fauna that may provide a source of food (Huq et al., 2013; Pedersen Zari et al., 2020). The NAP (Government of the Republic of Fiji, 2018) also prioritises vertical integration into adaptation planning, therefore local communities are involved in the process.

### 2.2.5 Community-based Adaptation (CbA)

Processes, such as livelihood diversification, capacity building, and risk management form the foundation for the CbA Framework for resilient communities. CbA initiatives are intended to reduce vulnerability and risk exposure caused by climate change (Shammin et al., 2022). CbA is increasingly being endorsed and positioned as a more acceptable and culturally appropriate response to climate change adaptation as it occurs at a local level in communities that are vulnerable to the impacts of climate change and has been described as empowering, participatory and community-led (McNamara & Buggy, 2017). The premise

behind CbA is that projects are developed through a process that engages local people and aligns with the cultural norms. Local community involvement is one way to reduce barriers to sustainable adaptation as the initiatives are more inclined to be driven by local priorities and have long-term support from the community (Piggott-McKellar, McNamara, Nunn, & Watson, 2019; Westoby et al., 2021). An increase in climate change awareness and understanding is an additional benefit for the communities that participate in many CbA projects (Remling & Veitayaki, 2016), and this type of training has been identified as an important step to autonomous adaptation (Government of the Republic of Fiji, 2018). Mills-Novoa (2023) found that top-down approaches that lack community involvement often leave communities to repair and maintain projects in which they had minimal involvement.

Despite the positive shift towards community-based approaches, some challenges and deficiencies have been identified in their implementation, leading to opportunities for improvement and for the approach to evolve (Clissold & McNamara, 2020; Kirkby et al., 2018). Some of these deficiencies are the lack of monitoring and evaluation of projects, and the 'western scientific' framing of adaptation that often underpins projects (Kirkby et al., 2018). Clarke et al. (2019) confirm this critique, suggesting projects are often underreported on their level of success, implementation, outcome, and long-term impact. Lack of reporting may mean that CbA projects are difficult to replicate or remedy, particularly with the added complexity of contextual differences throughout the Pacific Islands (Buggy & McNamara, 2016; Kirkby et al., 2018). Additionally, women in Pacific Island communities significantly contribute to community resilience but often face barriers that exclude them from the decision-making process aligned with projects. Therefore, ensuring an in-depth understanding of context and of the complexity and diversity within a community, which includes acknowledgement of the differences in gender responsibilities or a gender framework would likely improve the support and outcome of CbA initiatives (Bertana & Blanton, 2022; Clarke et al., 2019; Clissold & McNamara, 2020; Pearson et al., 2019; Singh et al., 2022; Veitayaki & Holland, 2016).

Enhancing the outcomes of CbA projects involves securing community approval and ownership, ensuring shared access to and benefits from project outcomes (McNamara et al., 2020). Walshe and Stancioff (2018) conclude that effective adaptation strategies should prioritise community needs, acknowledging diverse priorities, perceived risks, and solutions among different cultures and community groups, rather than imposing solutions from a Western perspective.

Kirkby et al. (2018) state that an effective CbA will involve the community at each stage of a project and those projects are ideally vulnerability-led that identify climate-related vulnerabilities and the underlying causes to inform project design. Additionally, Remling and Veitayaki (2016) suggest the intention of CbA can go beyond climate risks to address broader stressors affecting communities. Critically, some CbA

projects are noted as 'short-term focused', potentially leading to maladaptation. To counteract this, it is recommended that projects should adopt an anticipatory approach that future climate-related impacts, alongside present-day issues (reactionary) (Dumaru, 2010; McNamara et al., 2020). Emerging research supports a co-learning, complementary approach that integrates local knowledge and global scientific knowledge to develop sustainable adaptation projects (Dumaru, 2010; McNamara et al., 2022; Syddall et al., 2022). The challenges associated with CbA have led to 'fine-tuning' and development of local-level adaptation initiatives.

### 2.2.6 Locally-Led Adaptation (LLA)

Locally-level adaptation initiatives have emerged as a refined method of CbA and as LLA is vertically designed, including the community at all levels of planning and decision-making, should be grounded in local realities and ensure equity and inclusivity. An LLA project may not be restricted to expertise within one community and instead could draw on a whole island, be a multi-community project, or involve local institutions (McNamara et al., 2022). The inclusion of surrounding communities may be useful in filling knowledge gaps where traditional knowledge has been reduced within an individual community (Pisor et al., 2022; Westoby et al., 2021).

Through LLA, traditional governance systems are supported and external parties become facilitators and enablers (McNamara et al., 2022; Westoby et al., 2021). Projects, where communities decide on an adaptation option that will meet their needs, are more likely to be supported and not become a burden, therefore increasing the prospect of long-term success (Medina Hidalgo 2021). An example of successful sustainable LLA is Gau Island in Fiji, where local communities determined the expected impacts of climate change on their local practices, relations, responsibilities, and knowledge and then planned projects to overcome these challenges (Veitayaki & Holland, 2016). Food security was established through multi-community ecosystem management and the introduction of alternate livelihoods. An example of initiatives undertaken by the local communities of Gau include reducing deforestation and rehabilitating coastal habitats (Remling & Veitayaki, 2016), such as mangroves, which are vital to local livelihoods (Veitayaki et al., 2017).

## 2.3 Mangroves: ecological distribution, threats, and value

Mangroves are highly specialised plants with adaptations, such as aerial roots, viviparity, salt-secreting glands, and floating propagule distributed by water which allow for survival and reproduction in the intertidal zone (Tomlinson, 2016; Van der Stocken et al., 2019). There are approximately 70 species classified under nine orders, 20 families and 27 genera (Alongi, 2002).

### 2.3.1 Distribution of mangroves

The global distribution of mangroves occurs within the tropics and subtropics, with the highest number of species found in the Indo-Pacific region *(Figure 2.5)*. Cool sea surface and atmospheric temperatures limit the range of mangroves, with ideal conditions above 24°C water temperature (McLeod & Salm, 2006). Within the Pacific Islands region, there is a decline in species diversity and forest stature from west to east because mangroves evolved in the Indo-Malayan region and spread outwards. The region has a total of 34 true mangrove species and three hybrids, yet the islands to the east and many to the north do not contain any mangroves, while Papua New Guinea, New Caledonia, Solomon Islands, and Fiji have some of the largest and most diverse forests (Bhattarai & Giri, 2011; Gilman et al., 2006).

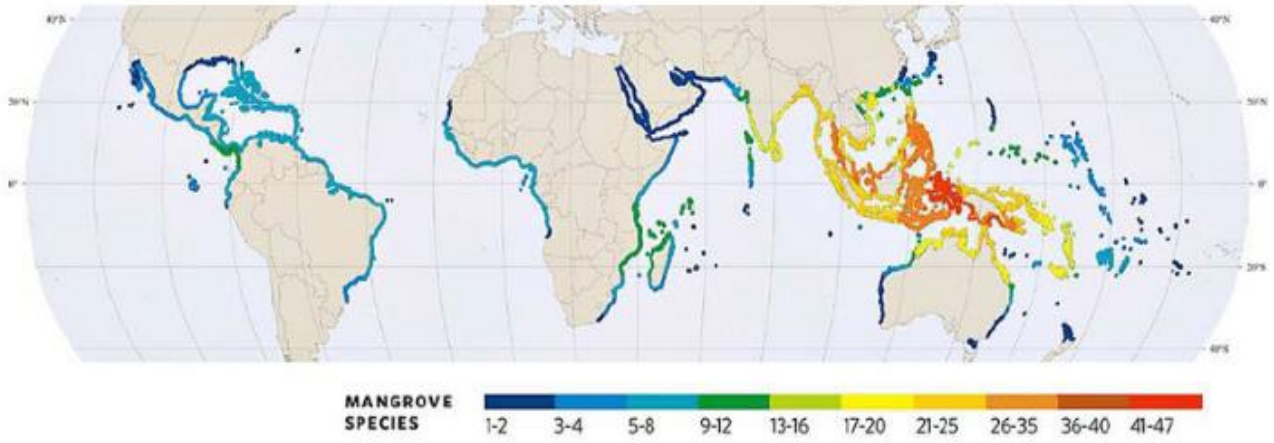



***Figure 2.4*** *Global distribution of mangrove ecosystems and number of species per ecosystem (Spalding et al., 2010).*

### 2.3.2 Threats to mangrove ecosystems

Globally, mangrove ecosystems have experienced severe degradation, with estimated losses ranging from 35% to 86% over the past quarter-century (Duke et al., 2007). These losses primarily result from anthropogenic pressures, including the conversion of mangroves for coastal development, aquaculture, mining, the extraction of timber for fuel, and for construction materials. Furthermore, heightened pressures on the mangrove-associated fauna, marked by the overexploitation of fish, crustaceans, and shellfish contribute to ecosystem decline (Bunting et al., 2022; Cameron et al., 2020). Recent large-scale mangrove mortality event caused by climatic extremes associated with climate change have been noted within pertinent research (Cameron et al., 2020). The increasing intensity of climatic extremes has the potential to hinder mangrove recovery following mortality events (Sippo et al., 2018).

In a Fijian context, the conversion of mangrove forests dates back to approximately 1896, coinciding with the development of the sugar industry where crops were planted on reclaimed mangrove land (Lal, 1990).

More recently, 77% of the loss of mangroves in Fiji, equating to approximately 11% annually from 2001 to 2018, is attributed to damage caused by tropical cyclones, primarily affecting taller stands of forest along the northern coastlines of Viti Levu and Vanua Levu. The mangrove loss on the southern coastlines of Fiji has been mainly linked to small-scale harvesting (Cameron et al., 2020).

The impacts of climate change pose an even greater threat to mangrove ecosystems, particularly beyond 2ºC of warming (Cameron et al., 2020; Friess et al., 2022). While mangroves typically adapt well to changes in sea level through natural landward migration, coastal squeeze has become an increasing issue. The present rates of sea-level rise, coupled with many forests' natural migration pathways blocked by topography or man-made structures like seawalls impede a forest's adaptability (Ellison, 2000; Gilman et al., 2006; Lovelock et al., 2015; Ward et al., 2016). An investigation into the migratory potential of mangroves estimated that a considerable percentage of the forests in the East Asia and Pacific region are likely to experience flooding or 'ponding' behind the forest due to sea-level rise, and cases where a forest's adaptive capacity is hindered will lead to potential ecosystem loss (Blankespoor et al., 2017).

Climatic extremes caused by climate change, such as changes in precipitation and temperature, can alter sediment and nutrient supply to mangroves ecosystem, negatively impacting growth, distribution and propagule survival, as well as flowering and fruiting (Friess et al., 2022). The projected increase in the intensity of tropical cyclones due to climate change (Chand et al., 2020) is expected to contribute to extensive forest mortality, impacting the function of coastal ecosystems (Sippo et al., 2018).

While some climatic changes may benefit mangroves, such as increased atmospheric carbon dioxide, higher temperatures, and areas receiving above-average rainfall, these favourable can have devastating impacts on the ocean and linked ecosystems, causing ocean acidification and coral bleaching, ultimately affecting the overall health of the coastal ecosystem (Gilman et al., 2008; Golbuu, 2011; Olds et al., 2013).

### 2.3.3 Value of mangrove ecosystems

As an ecosystem, mangroves are one of the most productive in the world and they exhibit some of the highest rates of carbon sequestration and storage in comparison to other ecosystems, therefore playing a critical role in the mitigation of climate change (Cameron et al., 2020). Additionally, their ability to accumulate and retain organic matter and sediment helps stabilise coastlines, as well as provide nursery grounds and breeding sites for many marine and terrestrial species (Alongi, 2002; Krauss et al., 2014). The benefits received from ecosystems, such as mangroves, are known as ecosystem services.

#### *2.3.3.1 Ecosystem services*

Ecosystem services refer to the contribution that ecosystems make to human well-being. These services can be divided into four categories, in which there is some overlap *(Table 2.1)* (Haines-Young & Potschin,

2018; Millennium Ecosystem Assessment, 2005). In a broad context, yet at a local scale, ecosystems provide essential services including basic materials such as water, food, and fuel, as well as benefits for health, well-being, and security through climate regulation. More specifically, ecosystems are involved in the provision of food, disease management, climate regulation, spiritual fulfilment, and aesthetic enjoyment. These provisions can be impacted by both indirect and direct drivers of change. For example, the economy may be an indirect driver, while resource use and climate change may be a direct driver. Wealthier countries are impacted by a loss in ES, yet in developing countries, the degradation of ES can further increase poverty (Millennium Ecosystem Assessment, 2005) and have a greater negative impact on communities that a reliant on ES to sustain their livelihoods (Atkinson et al., 2016).

***Table 2.1*** *Four categories of ecosystem services according to Millennium Ecosystem Assessment (2005)*

| **Provisioning Services**<br>*Products obtained from ecosystems*<br>• Food and fibre<br>• Fresh water<br>• Fuel (sources of energy)<br>• Genetic resources<br>• Biochemicals, natural medicines and pharmaceuticals | **Regulating Services**<br>*Benefits obtained from regulating ecosystem processes*<br>• Climate regulation<br>• Disease regulation<br>• Water regulation<br>• Water purification<br>• Pollution mitigation<br>• Decomposition of wastes | **Cultural Services**<br>*Non-material benefits obtained from ecosystems*<br>• Spiritual and religious<br>• Recreation and ecotourism<br>• Aesthetic<br>• Inspirational<br>• Educational<br>• Sense of place<br>• Cultural heritage |
|---|---|---|
| **Supporting Services**<br>*Services necessary for the production of all other ecosystem services*<br>• Soil formation | • Nutrient cycling | • Primary production |

### 2.3.4 Mangrove Ecosystem Services (MES) in a Pacific Island Context

The biological and genetic diversity of mangrove ecosystems means they are valued for their ecological and economic contribution as nursery grounds and breeding sites for a large variety of organisms (Alongi, 2002; Sandilyan & Kathiresan, 2012). Mangroves provide a host of ecosystem services, such as timber, carbon sequestration, and shoreline and infrastructure protection in weather events (Duke et al., 2007). Additionally, these ecosystems accumulate sediment, contaminants, and nutrients which protect reef ecosystems. Many research gaps have been identified particularly in the area of cultural ecosystem services provided by marine and coastal ecosystems (Rodrigues et al., 2017).

In a Pacific Island community context, mangroves encompass all four categories of ecosystem services (Lal, 2003). Research linking the Community Capitals Framework (natural, cultural, human, social, political, financial and physical) to MES identified that mangroves encompass all seven capitals for coastal communities in Fiji, validating the critical role mangrove ecosystems contribute to the well-being and livelihoods of Pacific Island people (Pearson et al., 2019). They provide a source of food and income for local communities, such as fish, shellfish and crabs that are eaten and sold, as well as timber sourced for building materials and fuel for cooking (Atkinson et al., 2016; Bhattarai & Giri, 2011; Cavanaugh et al., 2014; Ellison, 2014; Veitayaki et al., 2017). The benefits that mangroves provide to Pacific Island communities may be taken for granted or not fully recognised until these benefits are no longer available; that is, when the mangroves have been removed or damaged (Greenhalgh et al., 2018). It is widely known that mangrove forests reduce erosion on coastlines and riverbanks, particularly those subjected to intense weather systems and storm surges (Bryant et al., 2022; De Dominicis et al., 2023; Meriwether et al., 2018). Mangroves do this by trapping and building up sediment and by obstructing the direct impact of waves and wind, which is critical in regions prone to tropical cyclones (Chand et al., 2020; Guannel et al., 2016; Krauss et al., 2014). Mangroves maintain the health and biodiversity of local reefs by trapping sediment – preventing it from silting coral, and providing breeding sites for many marine species (Guannel et al., 2016; Olds et al., 2013; Veitayaki et al., 2017). Finally, mangroves are culturally significant to Pacific Island people, being used for medicinal purposes and to make dye to print cloth for decorating homes and making clothing for traditional ceremonies (Pearson et al., 2019). The loss and damage of the less tangible MES is an area of limited research but has been identified as important for protecting the culture of subsistence-based communities (McNamara et al., 2021).

Mangrove ecosystems have been managed for generations through cultural and traditional methods. In recent decades, an increasing demand on coastal resources has reduced the services that mangroves and coastal ecosystems once provided (Campbell, 2015; Medina Hidalgo et al., 2020; Syddall et al., 2022; Taylor et al., 2016; Thomas et al., 2019). One way to improve food and livelihood security for Pacific Island people in a changing climate may be through the EbA and the restoration and conservation of local mangrove ecosystems (Albert & Schwarz, 2013; Gilman et al., 2008).

### 2.3.5 Mangroves in an EbA context

Mangroves have been identified as an ideal entry point for EbA in those coastal Pacific Island communities located on volcanic islands, given these ecosystems naturally occur there and due to the array of ecosystem services they provide. Pacific Island people have an intimate local knowledge of managing mangroves (Pearson et al., 2019). Planting or re-establishing a damaged mangrove ecosystem can enhance resilience by providing food security (Lo, 2016) and physical protection (De Dominicis et al., 2023), and is more cost-

effective and sustainable when compared to a hard structure, which deteriorates over time (Nunn et al., 2021; Piggott-McKellar, Nunn, et al., 2020; van der Meulen et al., 2022). Mangroves are ecosystem engineers as they can trap and anchor sediment, so they not only reduce erosion but also build shorelines (van der Meulen et al., 2022). Planting mangroves may be necessary in eroded or degraded ecosystems because the propagules are less likely to regenerate naturally (Mohale et al., 2023).

The majority of research on mangrove rehabilitation/reforestation and a mangroves ability to protect shorelines from wave attenuation has mostly occurred on simulations and larger-scale projects (Barnuevo et al., 2017; Bryant et al., 2022; De Dominicis et al., 2023), which may not necessarily be transferrable to a rural Pacific Island context.

The differences in meaning between reforestation and forest rehabilitation, and restoration should also be clarified. Reforestation being the natural or intentional regeneration of tree cover following forest loss, may not necessarily be done with native species or with any intention to recover biodiversity. Forest rehabilitation or restoration are interchangeable terms that refer to a holistic approach to recover the structure, biodiversity and function of an ecosystem. An EbA approach will include some form of ecosystem restoration in addition to the management of threats associated with the impacts of climate change and anthropogenic activities (Bertram et al., 2017). In some cases, reforestation may be considered the initial step towards forest rehabilitation or ecosystem restoration.

There are gaps that exist within this emerging field of research, notably understanding how EbA can be incorporated into a long-term adaptation strategy for rural coastal communities, its possible limitations or challenges, and how communities can be effectively supported in implementing EbA projects (Lo, 2016; UNEP, 2019). Although restoration may pose challenges, particularly in degraded ecosystems, it remains a valuable approach. Even if combined with alternative adaptation responses, like relocation, ecosystem restoration can yield multiple benefits, encompassing food security and income generation for local communities (Meriwether et al., 2018; Salgado & Martinez, 2017).

## 2.4 Traditional and local knowledge of ecosystem management

In the context of this research, the definition of traditional and local knowledge (TLK) demonstrates the accumulation of place-based knowledge passed down through oral communication between generations and shaped by non-western worldviews (Nunn & Kumar, 2022). TLK also includes the historical and contemporary experiences of colonialism and is not static, but an evolving body of knowledge, practice and beliefs that change over generations as new challenges and opportunities arise, imparting awareness of the relationship between people and their environment (Dumaru, 2010; Lam et al., 2020). Additionally, TLK can be gender specific, where the varying roles of men and women throughout the Pacific region allow

for the acquisition of unique knowledge and skill sets (Clissold & McNamara, 2020; Pearson et al., 2019; Rabbitt et al., 2022).

The consideration of TLK in terms of climate change adaptation and ecosystem management is important because global science-informed solutions may be less valued than local people's worldviews (Galappaththi & Schlingmann, 2023; Nunn & Kumar, 2022). The failure to include TLK in climate change adaptation has been attributed to the failure of some projects. Aligning adaptation with locally informed priorities and aspirations allows for the development and implementation of fair policies that may lead to adaptation initiatives that can increase community resilience, sustainable livelihoods and disaster preparedness (Nalau, Becken, Schliephack, et al., 2018; Parsons et al., 2017; Pearson, 2020). The erosion of traditional knowledge in more recent decades, caused by socio-economic changes has the potential to reduce a community's self-sufficiency and resilience (Janif et al., 2016).

The traditional management practices of Pacific Island cultures have long demonstrated a profound connection to both their land and the ocean (Fache et al., 2022). Traditional food systems provided resilience against external shocks and contributed to food security (Taylor et al., 2016) through customary practices of food preservation and storage, resilient crops, and networks of exchange and mutual support. Examples include burying to ferment 'cyclone foods', such as breadfruit (*Artocarpus altilis*) and plantain (*Musa balbisiana*) when community members became aware of an approaching cyclone (Janif et al., 2016; Marrero & Mattei, 2022). The advent of colonisation, capitalism, and globalisation triggered a decline in these traditional food systems and fishing practices. This shift has increased dependence on imported foods, prompting a reassessment of sustainable pathways for the future. Researchers, recognising the intrinsic value of traditional knowledge, advocate for a revival of these practices (Campbell, 2015; Kitolelei et al., 2021) as communities that uphold traditional knowledge are shown to be more resilient and less likely to rely on external aid (Korovulavula et al., 2019; Nunn et al., 2019; Nunn & Kumar, 2019).

Notably, research measuring the impacts of peripherality on Pacific Islands communities reveals a correlation between distance from a major town and the preservation of traditional knowledge. The remoteness of a community, marked by reduced government influenced and limited access to resources, foster the utilisation of locally available resources, including implementation of their own methods of adaptation (Korovulavula et al., 2019; Nunn et al., 2014). The resilience demonstrated by remote communities is contradicts the common narrative that isolation or smallness is an indicator of climate change vulnerability (Kelman, 2020). Community resilience was further underscored during the COVID-19 pandemic, where remote communities, less reliant on imported goods, experienced fewer disruptions in the face of supply chain challenges and lockdowns (Ferguson et al., 2022).

## 2.5 Lessons from COVID-19 to manage the impacts of climate change

Many researchers have likened the challenges and effects of climate change to those of the COVID-19 pandemic, proposing that lessons learned from the pandemic can be applied to better manage climate change and natural resources (Ford et al., 2022; Klenert et al., 2020; Madelyn, 2020; Rolando et al., 2020). Therefore, next section outlines the pandemic's impacts on the Pacific Islands and explores possible lessons to draw upon.

SARS-CoV-2, the virus responsible COVID-19, is believed to have originated in a wet market in Wuhan, China in December 2019 and quickly escalated from an epidemic to a global pandemic (Mizumoto et al., 2020). COVID-19 caused disruptions to supply chains and changes in the supply and demand of goods and services, both globally and in Pacific Island countries (Farrell et al., 2020; Nhamo & Ndlela, 2021).

### 2.5.1 COVID-19 in the Pacific Islands

Throughout the Pacific Islands region, there was a diverse approach to managing the COVID-19 pandemic (O'Brien, 2021). Initially, the geographic remoteness allowed for easy isolation and avoidance of the disease, favouring prevention as the primary management strategy. Strict border control measures were implemented to stop the spread of the virus (Gay et al., 2022; Leal Filho et al., 2020). Most Pacific Island countries responded rapidly and closed their borders before the virus could enter. By 1st April 2021, almost 18 months into the pandemic, many Pacific Island countries still had very low or no reported cases (Leal Filho et al., 2020; Sheel et al., 2022). Further into the pandemic, on 8th November 2021, to mid-2022 there were countries, such as Kiribati, and Pitcairn Island which remained with low or no recorded cases (Pacific Community, 2023; Sheel et al., 2022). The development of COVID-19 vaccines led most Pacific Island countries to continue using prevention as their management tool and they launched mass vaccination campaigns (Gay et al., 2022). Vaccine supplies were mostly acquired through donor countries and COVAX, a multi-stakeholder group responsible for purchasing COVID-19 vaccines (Gleckman, 2021). As with most low- and middle-income countries, vaccine inequity and misinformation led to comparatively low vaccination uptake in many of the Pacific Islands (Yemoh & Yemoh, 2022).

The food crisis that unfolded in the Pacific Islands during COVID-19 revealed the fragility of their food systems which are projected to worsen under the influence of climate change (Campbell, 2015; Farrell et al., 2020; Trudinger et al., 2023). Communities reliant on imported foods to meet their nutritional requirements reported shortages during the pandemic, whereas self-sufficient communities maintained their subsistence lifestyle with minimal impact. Additionally, some Pacific Island countries faced natural disasters, such as cyclones and a tsunami during the pandemic, exacerbating food security challenges and increasing dependence on imports (Ferguson et al., 2022). As a result of the pandemic, agricultural

production strategies were reassessed and shifted towards localisation efforts (Iese et al., 2021). It remains to be seen whether there will be a return to pre-pandemic systems and processes or if these localisation efforts will persist.

### 2.5.2 Social and economic impacts: immediate and long-term

The resilience and social bonds of Pacific Island culture provided the foundation for a support network for community members affected by COVID-related job loss and lockdowns. The crisis saw a revival of communal capital – kinship-based social networks, goods exchange, and collective labour among many Pacific Island countries (Ratuva, 2021). A study conducted in Fiji and Solomon Islands showed that rural and urban households increased food production in home gardens and barter systems during the pandemic (Farrell et al., 2020). Some communities were producing 100% of their vegetables, however, there were reports that the increased demand for food production in rural regions led to some unsustainable land clearing (Iese et al., 2021). Disruptions to supply chains and inter-island and urban/rural transport led to food price and availability changes, along with high amounts of food wastage and loss as most farmers lack storage facilities and some produce could not be sold (Farrell et al., 2020). Increased social conflicts related to food security, such as land disputes, theft of crops and livestock, and reduced availability of seedlings, labour, and equipment in urban areas were noted by researchers (Iese et al., 2021).

To overcome market closures, a Suva resident launched an initiative, 'Barter for a better Fiji' via Facebook as a cash-free trading system. It reached over 90,000 members within a week. Similar movements began in the Solomon Islands, Papua New Guinea, followed by Samoa (Williams, 2020). On Malaita and the Russell Islands in Solomon Islands, rural populations increased by up to 7.1 % during the pandemic, requiring catch limits to be placed on marine species as local fishing increased by up to 50 % (Davila et al., 2021; Eriksson et al., 2020).

Seasonal work abroad is a common practice for many Pacific Island people. Leading up to 2019, before the pandemic, Australia (and New Zealand) employed approximately 10,000 workers from the Pacific Islands region, mainly in the agricultural sector (Gibson & Bailey, 2021). This scheme provided co-benefits as the workers played a crucial role in these countries' agricultural sector by addressing labour shortages, while providing employment and income for Pacific Island communities (Bedford et al., 2018). The imposition of COVID-19 travel restrictions and the absence of Pacific Island workers contributed to economic pressure for the agricultural sector, increasing food prices in Australia and New Zealand, while resulting in wage loss for the workers (Nagar, 2020).

Countries where tourism is a key income contributor, such as Fiji, Samoa, Palau, and Vanuatu, were impacted by travel restrictions. Many people lost their paid employment in tourist-related businesses

(Connell, 2021; Movono & Scheyvens, 2020). Loss or reduction of some household income decreased consumer spending, further impacting other local businesses (Connell & Taulealo, 2021). Pre-COVID, it is estimated that up to 100,000 Fijian residents were employed directly and indirectly within the tourism industry, contributing to about 40 per cent of Fiji's GDP. In 2019, almost 900,000 visitors arrived in Fiji, while Vanuatu had around 300,000. In 2020, just three months following international border closures, half of the tourism-related businesses in Fiji had closed down or gone into hibernation, creating a migration of people moving back to their ancestral/traditional communities where they re-engaged with community life (Connell, 2021).

Despite the financial strain that job loss placed on some households, there were reports that people in the Pacific Islands stated that their mental health was reasonable and, in some cases, said it had improved with the chance to reconnect with family and traditional practices of living off the land (Scheyvens & Movono, 2020). Positive mental health results were not all-encompassing. As in the aftermath of other natural disasters, COVID-19 disproportionately impacted women in the Pacific Islands as they are usually responsible for providing enough food for the family. Market vendors, who are usually women, were noted coordinating the transportation of goods to ensure the movement of produce continued through the restrictions (Eriksson et al., 2020; Farrell et al., 2020). Domestic duties fall mainly on women in the Pacific and these demands increased as family members moved back from urban centres (Davila et al., 2021), while caring for children or sick family members also falls on women (Connell & Taulealo, 2021). As with many other countries experiencing lockdown pressures, gendered violence became more prevalent (Borah Hazarika & Das, 2021).

Overarching lessons that may be drawn from the global management of COVID-19 are:

1. The need for prompt action and delays are costly (Klenert et al., 2020; Salas et al., 2020);
2. Effective communication of timely and accurate information and the development of trust can trigger behavioural change (Ruiu et al., 2020);
3. Self-reliant communities were more resilient to the impacts of COVID-19 as they could utilise the resources supplied by their local environment (Botzen et al., 2021; Heyd, 2020; Hochachka, 2020; Klenert et al., 2020; Madelyn, 2020).

Similar points can be noted about the impacts of climate change, where communities that have maintained traditional practices are more likely to have resilient ecosystems that can support the community against the impacts of climate change and other natural disasters (Farrell et al., 2020). Therefore, supporting communities to maintain traditional knowledge and effectively manage their local resources is key to climate resilience (Farrell et al., 2020; Whitney et al., 2017). Drawing on the first lesson, although the impacts of climate change are considered as slow and incremental, they are projected to continue increasing for

decades and delays in implementing long-term projects like EbA may be costly as ecosystems reaching tipping points may be no longer viable to revegetate or regenerate (Begum et al., 2022). Additionally, increasing knowledge about the impacts of climate change is considered essential for communities to achieve autonomous sustainable adaptation. Yet, if this information does not come from a trustworthy source, it may be dismissed, hindering adaptive capacity, as was noted in the vaccine rollout in many countries. Therefore, building trust and effective communication on the impacts of climate change and what it means for each community may lead to sustainable adaptation in Pacific Island communities (Ruiu et al., 2020).

## 2.6 Implications for sustainable adaptation

Climate change disproportionately affects countries like the Pacific Islands, despite their minimal contribution to the global climate crisis compared to larger carbon-emitting nations (Enari & Viliamu Jameson, 2021). The impacts of climate change present challenges that threaten livelihoods, increase risks, and, in certain instances, could make islands or homelands uninhabitable (Mycoo et al., 2022; Oakes & Oakes, 2019). Despite the considerable outlay of resources that have been committed to reducing the impacts of climate change in the Pacific Islands, there has been very little progress made in sustainable adaptation (Klöck et al., 2022; Nunn & McNamara, 2019). Pacific Island leaders have voiced their support for climate action, emphasising that wealthier, carbon-producing nations should do the same (Leal Filho, 2020). Support for sustainable adaptation needs to be administered by dismantling the 'deficit framing' misconceptions that portray the weakness and vulnerability of Pacific Island people (Kelman, 2020; McNamara et al., 2022). Instead, by drawing on the strengths, ingenuity, and uniqueness of each community, more equitable and sustainable adaptation pathways can be facilitated, empowering communities with the freedom to foster resilience (Janif et al., 2016; Kelman, 2020).

## 2.7 Conclusion: gaps and opportunities identified in the research

The purpose of this literature review was twofold: to examine the current literature on climate change adaptation in Pacific Island communities, with a particular focus on localised and nature-based solutions, and to identify gaps in the research. One notable gap that has emerged is the lack of conclusive evidence to support the effectiveness of EbA (Rizvi et al., 2015). Jones et al. (2020) suggest the need for a consistently applied framework for addressing EbA options that integrates considerations of equity, stakeholders, social, economic, bio/geophysical, and technical elements. A criticism of EbA includes inadequate monitoring, evaluation and learning (MEL) of projects, with outcomes often being justified with anecdotal evidence and vague qualitative results like 'stakeholder participation increased'. The ambiguity in assessing EbA outcomes can be attributed to the overarching nature of its objectives, such as 'enhancing resilience'

and 'ensuring food security,' which tend to be broad rather than specific (Donatti et al., 2020). Additionally, given the long-term nature of EbA projects, it is likely that donors will no longer be involved in a project by the time notable outcomes are achieved (Lo, 2016). Leal Filho (2020) suggests a shift away from traditional development aid which usually funds a specific project by a single donor to an integrated funding program. This would be a more holistic approach that would provide support for longer than the usual three to five years. While Donatti et al. (2020) suggest the incorporation of 'gold standard' indicators to measure the adaptation outcomes of EbA concerning assets, food security, livelihoods, safety and resource security, and health.

A number of researchers identify the need for innovative local-level educate and training to build capacity to identify and implement strategies and practical ways to prevent environmental risks (Fahey et al., 2016; Leal Filho, 2020; McNamara et al., 2022; Weir, 2020). Achieving human health, economic resilience, and ecosystem and planetary health necessitates transitioning to climate-resilient development, beginning with the restoration of degraded ecosystems (P. Chand et al., 2023; Hardy et al., 2013; Lewis et al., 2023).

A recurring theme in the literature is that adaptation options that community-based or locally-led options are more likely to meet the needs of the community , as opposed to a 'top-down' approach, (Forsyth, 2013; Kirkby et al., 2018; McNamara & Buggy, 2017; Reid, 2016; Remling & Veitayaki, 2016; Westoby et al., 2019). Ecosystem-based approaches fall within this category of community-based or bottom-up model, but are also site-specific not a 'one-size-fits-all' solution. In the context of Pacific Island communities, further investigation into EbA is crucial to ensure projects can be sustainably managed by the community and be inclusive of TLK (J. M. Prasad et al., 2022; Sakapaji, 2022). Addressing challenges like the lack of long-term support and the prevalence of top-down approaches limiting the inclusion of TLK may be overcome by transitioning from community-based adaptation to a nuanced focus on locally-led adaptation. This shift may reduce the implementation of unsustainable projects and enable in-country organisations to cultivate relationships with communities and provide long-term support for adaptation projects.

To ensure the sustainability of projects, future research into the impacts of climate change on coastal ecosystems and species at a local level is also recommended (Friess et al., 2022; Jones et al., 2020). There are complexities involved when working with dynamic coastal ecosystems and these interactions also need to be taken into account. Further to this, successful adaptation through EbA requires additional measures, such as reducing human pressure on ecosystems (Salgado & Martinez, 2017). This could be done through alternative livelihood programs which would be incorporated into an EbA project (Johnson et al., 2020).

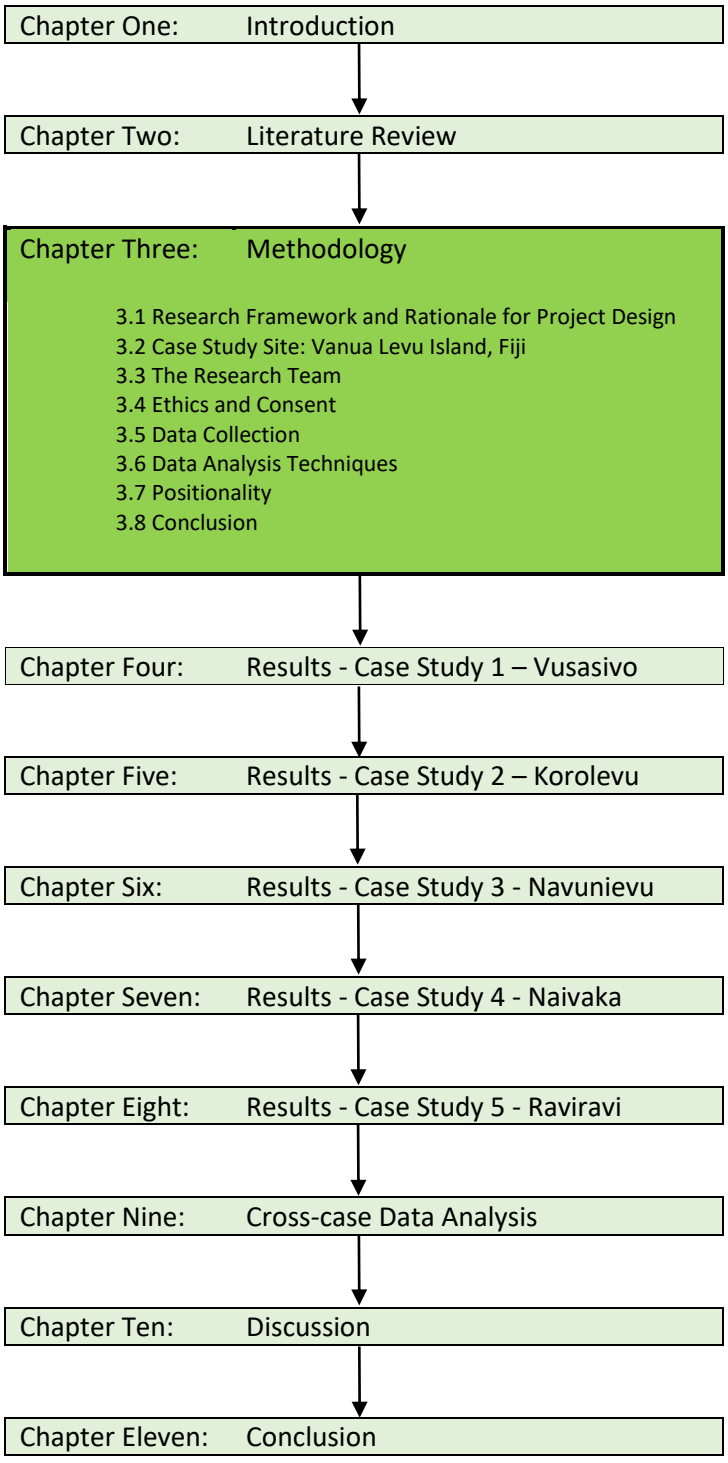
Moving forward, this research aims to fill some of the gaps identified in the relevant literature by exploring how cultural perspectives can enhance autonomous adaptive capacity, food security, and sustainable livelihoods, as well as investigating how Western influence and policy support effective adaptation options.

In addition, this research will explore the transferability of lessons learned from managing and communicating messages about COVID-19 in rural Pacific Island communities to increase resilience by building climate change knowledge and traditional resource management practices.

The following section outlines the methodology and methods undertaken to collect the necessary data to complete this project. The chosen method of *talanoa*-style discussions with rural Pacific Island community members who have undertaken mangrove forest restoration in their local ecosystem is detailed along with the case study communities. The conversations with participants aim to uncover the processes used by each community to implement these mangrove planting projects, any challenges that may have been encountered and successes achieved, as well as how their projects may be scaled up to assist other Pacific Island communities facing similar challenges.

# CHAPTER THREE: Methodology

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



This chapter presents the methodological approach undertaken to complete this research. Section 1.4 introduced the three research questions that guided the project, focusing on local ecological knowledge and sustainable climate change adaptation, particularly ecosystem-based adaptation within rural Pacific Island communities. These questions established the framework for the research design outlined in Section 3.1. Following this, Section 3.2 provides an overview of the study sites and considerations required to conduct research in Fiji, including the cultural context's influence on the study design. A brief introduction of the research team and ethics and consent are provided, followed by details of the data collection methods. The chapter concludes with the data analysis techniques used, the research limitations, and reflections on positionality, which can influence the interpretation of the data and conclusions.

## 3.1 Research Framework and Rationale for Project Design

This section outlines the research approach and rationale, including the sequence of steps followed to completion (*Figure 3.1*). Given the limited data available on the outcomes of autonomous EbA in rural Pacific Island communities, this research is largely exploratory and aimed to provide insight and direction into further research required to ensure smaller-scale local projects can provide meaningful change for local communities. The nature of exploratory research is largely qualitative and allows for flexibility in the project design, often involving discussions with people who are impacted by the area of research (Swaraj, 2019). Additionally, an exploratory research approach is pertinent for research in Fiji, as it suits the cultural context of Pacific Island people. Conversational-style (*talanoa*) group discussions aimed to encourage trust and knowledge sharing between the local community members and research team are explored in Section 3.2.2.

The data collection process, including permission protocols and style of group discussions aligned with the Vanua Research Framework (VRF). VRF is an indigenous theoretical approach that recognises Fijian world views, knowledge systems, lived experience, culture, and values. Using culturally appropriate methods puts Indigenous people at the heart of the research, allowing for the recognition of Indigenous worldviews and providing it with methodological integrity (Nabobo-Baba, 2008).

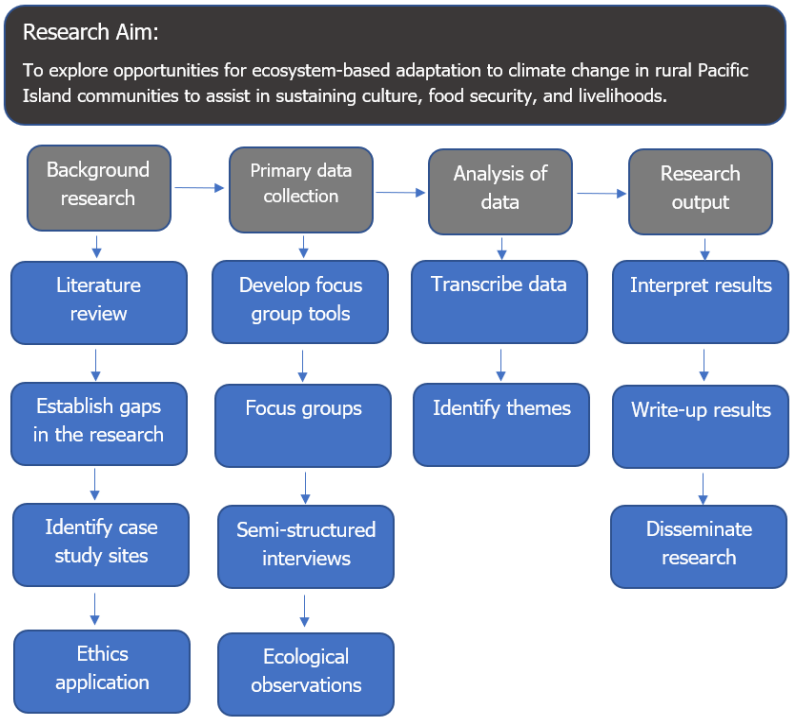



***Figure 3.1*** *Flowchart of research methodology*

## 3.2 Case Study Site: Vanua Levu Island, Fiji

Vanua Levu is the smaller of the two main islands in Fiji's archipelago, located in the South Pacific Ocean. Vanua Levu was chosen for its remoteness compared to Viti Levu, the largest island in the island group. Three sites and a backup site were selected for data collection in the original research proposal. The study sites were all coastal villages and selected based on their challenges with coastal erosion, requests for seawalls, and attempted mangrove (re-)planting projects, but little was known about them prior to data collection. The research could have been done with any coastal community within this region as many are facing similar challenges, therefore these communities were chosen, largely on recommendations from the Provincial Officers and local experts' advice. On arrival at the Cakaudrove Provincial Office, an additional site (Korolevu) was suggested and a visit was arranged by the Conservation Officer as he stated it would be of interest due to the extensive and successful mangrove rehabilitation project that the village had undertaken. The Bua Provincial Office also arranged a visit to the backup site (Naivaka). This increased data set of five villages (Vusasivo, Korolevu, Navunievu, Naivaka, and Raviravi) resulted in four additional group interviews and sites well-distributed across the three provinces (Bua, Cakaudrove, Macuata) of Vanua Levu Island *(Figure 3.2)*.

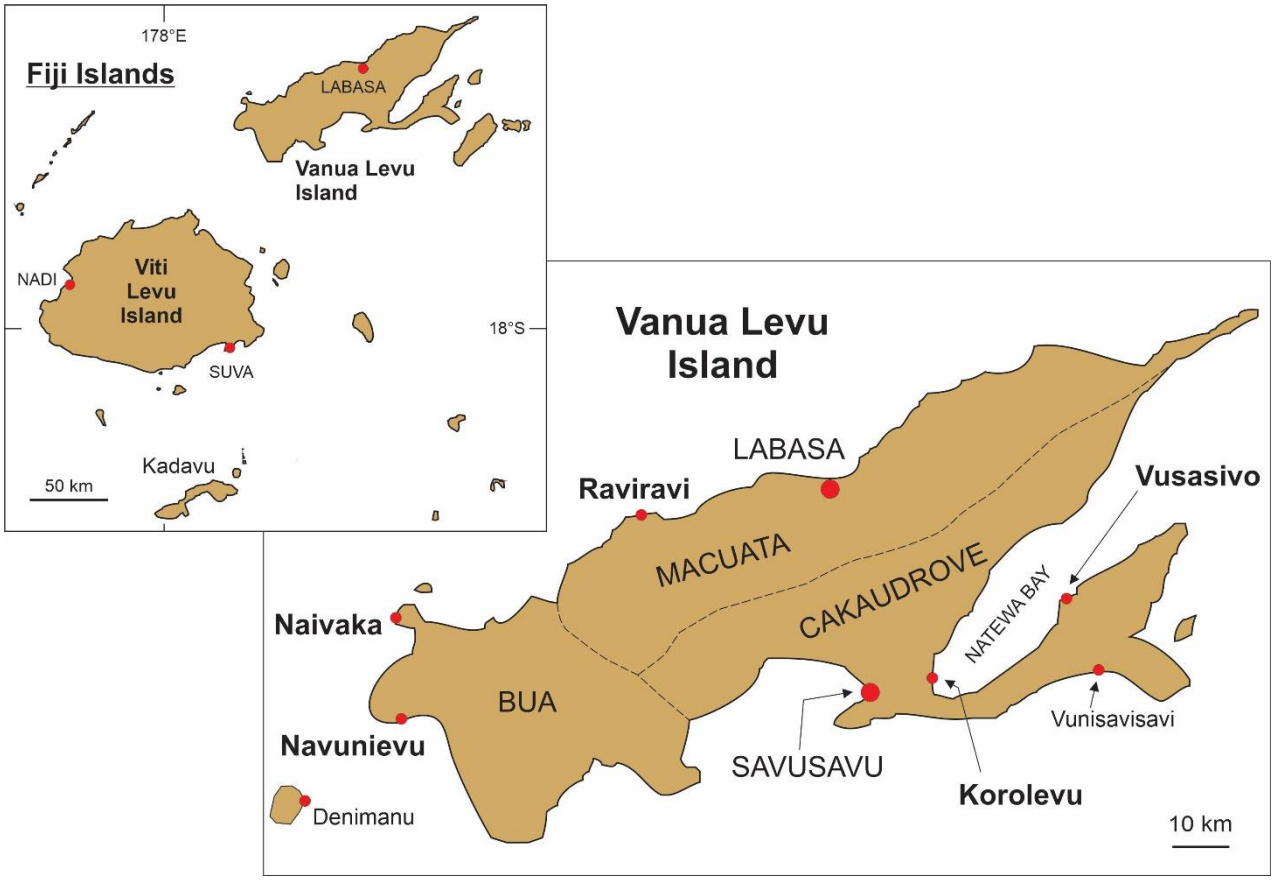



***Figure 3.2.*** *The top left map shows the larger islands within the Fiji archipelago with the three major towns. The bottom right map shows Vanua Levu Island and the five communities where data collection for this research took place (Vusasivo, Korolevu, Navunievu, Naivaka, and Raviravi), together with the boundaries of the three provinces. Two of the larger urban centres, Labasa and Savusavu are also shown, along with other villages that are referred to throughout the document.*

### 3.2.1 Case Study Communities

This section provides some background of each case study village. This data was collected during conversations with the local community members and knowledgeable others, like the Provincial Officers, as well as observations during site visits.

#### *3.2.1.1 Vusasivo Village (16°34'17"S 179°45'43"E)*

Vusasivo can be accessed via an unsealed road completed circa 1980 and is located approximately 80 km away from the town of Savusavu. This road requires a high ground clearance vehicle and a four-wheel drive following heavy rain. A public bus is available twice per day at a cost of approximately FJ$22 (10 USD) return, prohibitively expensive for a rural Fijian income (World Bank Group, 2020). At the time of the researcher's visit, Vusasivo did not have a motorised boat as it had been damaged in a cyclone and had not yet been replaced. To access the local inshore reef to catch fish the women used a raft made of bamboo,

known as a *bilibili*. Vuanisaiki Primary School is located in the village and also accepts children from surrounding villages. This school was built in 1985 and then rebuilt in 2016 following damage inflicted by TC Winston. The nearest secondary education facility is Navatu Secondary School, over 40 km away towards Savusavu[1]. There is a health centre at the entrance of Vusasivo Village which services the entire Natewa district and where a medical professional is permanently based. Vusasivo has limited mobile phone service and no access to the internet in the main area of the village, although it is available at the primary school.

#### *3.2.1.2 Korolevu Village (16°34'24"S 179°33'44"E)*

Korolevu is approximately 28 km away from Savusavu township, the closest urban centre. The village is divided into two sections: the original village site and a new site where some community members have relocated to due to flooding and difficulty accessing the old village site. A public bus travels along the road that runs through the new village providing access to the town centre three times in the morning and returns from Savusavu back towards Korolevu three times during the afternoon. The cost of travel is FD$7 return (3.20 USD) with school students travelling free. Accessing the original village site from the main road requires crossing the river via *bilibili* and a 500 metre walk along an unsealed road. Nearby services include Navakaka Nursing Station, approximately two kilometres from the new village and Navatu Secondary School which is four kilometres away. This is the same school the Vusasivo students attend (Section 3.2.1.1). Nasinu District School is the closest primary school to Korolevu, which is located next to the secondary school. The village has no internet access and mobile phone service through Vodafone.

#### *3.2.1.3 Navunievu Village (consists of two neighbouring villages – Waitabu and Tacilevu) (16°48'31"S 178°32'42"E)*

Access to Navunievu is via an unsealed road, requiring a four-wheel drive or high clearance vehicle. The closest urban centre is Nabouwalu, located 38.4 kilometres away (approximately two hours by road) which offers major services such as a hospital, Police and Fire Station and costs FJ$7 return (3.20 USD) via a public bus. The larger town of Labasa is 120 kilometres away. Mobile phone service is available in Navunievu but there is weak internet access. There is a nursing station 10 kilometres away in Bua Lomanikoro Village along with the nearest secondary school facility, Naikavaki High School. Vatubogi Primary School is located two kilometres away from Navunievu.

#### *3.2.1.4 Naivaka Village (16°38'52"S 178°31'22"E)*

Naivaka is the most isolated of all the communities included in this research, located approximately 115 km away from Labasa, the nearest major town. As the road is often impassable, the most frequent method

[1] *The bus is free for children travelling to and from school.*

of travel to and from Naivaka to Labasa or other urban centres is by boat to Nasau Village, where a public bus departs in the early morning and returns in the afternoon at a cost of FJ$24 (10.80 USD). The distance from Navaika to Nasau is approximately 10 kilometres by road or boat. Naivaka to the urban centre of Labasa is approximately a three-hour journey, depending on the conditions of the sea and roads, that would begin from Naivaka at around 5:00 a.m.

The primary school, located on the outskirts of Naivaka Village, has held classes in temporary tents for the past 18 months due to damage caused by Tropical Cyclone Yasa in December 2020. The closest high school is Lekutu Secondary, located 23 kilometres away. This school provides boarding for students from Naivaka and other isolated communities during the school term. Students return to the village only on long weekends and school holidays.

The nearest medical facility is Navakasiga Nursing Station, near Nasau. For more serious conditions Lekutu Health Centre is located 23 kilometres away, near the Secondary school, otherwise, patients are referred to Nabouwalu Hospital or Labasa Hospital, which are 64 and 115 kilometres away respectively. There is no mobile phone service in Naivaka and internet access is available only at the primary school.

#### *3.2.1.5 Raviravi Village (16°28'32"S 178°56'06"E)*

Raviravi is approximately 55 kilometres from the town of Labasa. Some supplies and the closest nursing station are available from the closer town of Seaqaqa, but due to the condition of the roads, this trip can take up to 45 minutes and require a high-clearance vehicle. Distance from an urban centre is correlated with the preservation of traditional knowledge and autonomous adaptation capacity (Nunn & Kumar, 2019), but for this rural community, the distance from some services has forced community members to leave their village for extended periods, such as during the school term. The nearest school is Korotolutolu Primary and parents of these students will often relocate to a dwelling near the school as the travel to school cannot be done daily, particularly during wet weather. The nearest secondary school is in Seaqaqa. During wet weather, secondary school students are required to walk some distance to meet the bus in the morning or walk the remainder of the way home to the village in the afternoon as the conditions of the road can make it impassable getting to and from the village. Transport from the village by bus one way to Labasa is FJ$5.60 or FJ$2.60 to Seaqaqa.

### 3.2.2 Context of Conducting Research in Fiji (Governance Structure)

Through numerous conversations with members of the local community and the Provincial Officers, who initiated our contact with the community leaders, the governance structure of Fiji was explained. Fiji is divided into provinces; each province is divided into districts and each district is made up of a number of villages. Each village has a headman (or headwoman), the *Turaga ni Koro (*or *Marama ni Koro)* who is elected by the people of the village. There is also a hereditary system of chiefly positions that influence decision-making within districts and villages.

Each province also has an appointed Conservation Officer who supports communities to develop their 'Sustainable Resilient Development at Village Level' plan where they work together to provide solutions to challenges the village is facing and assist in looking for opportunities to create a sustainable future for the village. Examples of other government departments that may be involved in community sustainability and the implementation of projects are the Ministry of Education, Heritage and Arts, Ministry of Fisheries, Ministry of Forestry, and Ministry of Waterways and Environment.

When conducting research in Fiji, there are traditional and cultural protocols that must be followed. For example, before entering a village, permission must be sought through the Ministry of *iTaukei* Affairs, who will notify the *Roko Tui,* head of the appropriate Provincial Office. The *Roko Tui* initiates contact with the *Turaga ni Koro* of the village. In Fiji, it is customary to offer a bundle of *yaqona* (also known as *kava*), which is the root of the *Piper methysticum* plant when asking for permission to enter a village or household in a traditional ceremony, known as *sevusevu* (Feetham et al., 2022).

*Talanoa* is an ingrained concept within largely oral cultures, like many Pacific Island countries, including Fiji, Tonga and Samoa. The translation means 'to talk' or 'to tell stories' or, as is common among Indigenous Australians, 'to yarn'. *Talanoa* usually follows the *sevusevu* where usually the men of the village make their acquaintance with the visitors.

## 3.3 Ethics and Consent

The Human Research Ethics Application (HREA) approval was granted in 2019 and has been outlined on supplementary page *xvii* in addition to a copy of the original approval letter (*Appendix A*). Several amendments to the HREA application were required throughout the project mainly as the result of COVID-19 travel restrictions; these included a change of location for data collection and an extension to the completion date. There were also amendments made to the supervisory team during the project.

Further permission was acquired before conducting the fieldwork from the Ministry of *iTaukei* Affairs Office (*Appendix B*). As instructed in the approval letter, contact was made with the *Roko Tui* of each relevant

Province who facilitated the community visits. Once on site and before conducting the group interviews, the research and data collection procedures were discussed with the *Turaga ni Koro* and a Research Project Information Sheet (RPIS) (*Appendix C*) was provided to sign, giving consent on behalf of the participants. Verbal consent was also obtained from each participant before commencing the group discussion, at which time they were provided with an explanation about the research and offered a copy of the Research Project Information Sheet (*Appendix C*), as well as ask for permission to voice record the session for accuracy during transcribing, which would later be deleted.

## 3.4 The Research Team

The research team consisted of the researcher (author) and a local Fijian, Maleli Qera, who works for C3 Fiji, a non-government organisation assisting and educating rural communities in all aspects of social and environmental challenges. Mr Qera was integral to the data collection process as he conducted the *sevusevu* and other official protocols which allowed data collection to take place. He was also present at each group interview and transect walk through the coastal ecosystems, translating from English to *iTaukei* and vice versa. He is a language specialist and therefore able to understand and speak many of the local dialects of Fiji, which was beneficial as different dialects are commonly spoken in the different provinces. Mr Qera was also interviewed as he holds first-hand knowledge of the intricacies of implementing sustainable conservation projects in rural Fijian communities.

The remainder of the research team, including Professor Patrick Nunn, Dr Adrian McCallum, and Professor Catherine Yule were not directly involved in the data collection process.

## 3.5 Data Collection

For this research, mixed-methods exploratory and ethnographic techniques were used to collect qualitative data as this provided the most comprehensive scenario for understanding the impacts and coping mechanisms of climate change of the case study communities. The research team stayed in five rural coastal villages with local families from the 19$^{th}$ of July to the 4$^{th}$ of August 2022, where 13 semi-structured group discussions (six men's groups, six women's groups, and one young adult group), two one-on-one interviews, and five ecological observations/transect walks were conducted (*Table 3.1*). Details of these sessions, including the length of the interview and the number of participant details are outlined in the results section (*Chapters 4 – 8*) of this thesis.

*Talanoa*-style focus groups and guided ecological observations/transect walks with 'experts' were chosen as the culturally appropriate data collection methods for this research. These methods align with the VRF, therefore maximising the likelihood of information sharing in the limited time available with each

community. Focus group style data collection ideally ranges from 4 – 12 participants and through a facilitator, can stimulate in-depth discussions, allowing the researcher to observe group interactions that would not be captured in one-on-one interviews (Davis, 2016).

***Table 3.1*** *Summary of data collection activities conducted throughout July/August 2022.*

| Location | Type | Number of Participants | Gender | Age Range |
|---|---|---|---|---|
| Vusasivo | Group discussion | 12 | Female | 29 - 60 |
| Vusasivo | Group discussion | 10 | Male | 40 - 70 |
| Vusasivo | Group discussion | 11 | Male | 20 - 34 |
| Vusasivo | Interview | 1 | Male | 53 |
| Vusasivo | Site observation (with guide) | 3 | Male | 19 - 53 |
| Vusasivo | Informal interview | 1 | Male | 25 - 30 |
| Korolevu | Group discussion | 6 | Male | 23 - 65 |
| Korolevu | Group discussion | 9 (4) | Female (Male) | 29 - 60 |
| Korolevu | Site observation (with guide) | 3 | Male | 18 - 80 |
| Navunievu (Waitabu) | Group discussion | 12 | Female | 31 - 73 |
| Navunievu (Waitabu) | Group discussion | 12 | Male | 26 - 66 |
| Navunievu (Tacilevu) | Group discussion | 6 | Female | 21 - 75 |
| Navunievu (Tacilevu) | Group discussion | 11 | Male | 20 - 77 |
| Navunievu (Tacilevu) | Site observation (with guide) | 3 | Male | unsure |
| Naivaka | Group discussion | 14 | Male | 20 - 83 |
| Naivaka | Group discussion | 19 | Female | 27 - 70 |
| Naivaka | Site observation | No guide | | |
| Raviravi | Group discussion | 10 | Male | 22 - 86 |
| Raviravi | Group discussion | 12 | Female | 30 - 75 |
| Raviravi | Site observation | No guide | | |
| Raviravi | Site observation | 2 (1) | Female (Male) | unsure |
| Raviravi | Interview | 1 | Male | 53 |

### 3.5.1 Participant Selection

As is common in Fiji, participants for the *talanoa* session were recruited by the *Turaga ni Koro*. To encourage open dialogue, discussion groups were segregated by gender, acknowledging that women might not feel as comfortable expressing themselves in the presence of older males. It was the intention to speak with younger adults (ages 18 – 25) from each community, yet this was possible only in Vusasivo as many of this age group were not available elsewhere. Instead, any participants in this age group who were available were invited to join either the male or female discussion group. The inclusion of younger participants is important and ensures that differing opinions on climate change adaptation and resource management are included as they have be ability to heighten awareness and they are most likely be exposed to far greater risks to the impacts of climate change (Begum et al., 2022)

The only inclusion criteria were that participants were over the age of 18 and reside in the village. It is important to note that in Fijian village situations, women have often grown up in another village and then relocate to their husband's village, therefore local knowledge may have a gender bias, something noted in the transcripts.

### 3.5.2 *Talanoa* (Semi-structured Group Discussions)

The primary data collection method of *talanoa* group discussions were relaxed and conversational, pertinent to rural Pacific Island communities in Fiji, and the VRF (Feetham et al., 2022; Nabobo-Baba, 2008). Discussions were semi-structured and facilitated using a written guide consisting of a series of probing questions (*Appendix D*). The questions were translated into Fijian dialects by Mr Qera to ensure there was no misinterpretation. Successful group discussions occur when there is trust between the interviewer and participants (Bosco & Herman, 2010) so it was important to build rapport with participants before commencing discussions. This was done through sharing a meal, spending time in casual conversation, or joining in with everyday community activities.

The probing questions were formulated around topics that would guide the conversation and assist in answering the research questions, such as the community's understanding of climate change, methods of adaptation, resource management practices, and TLK. The conversational nature of the sessions meant that in some instances the questions were not asked as the topic had already been raised. There was purposeful intention not to use specific terminology, such as 'climate change' when guiding the conversation as the researcher did not want to influence any participant's responses. Further detail on the development of the probing questions is outlined in Section 3.6.1.

Group interviews are ideal to gain collective views and ascertain the reasoning behind those views. Group dynamics can be a limitation in group discussion as some participants may hesitate to speak freely among certain members of the group or some participants may be more outspoken and dominate the conversation (Nyumba et al., 2018). In some cases, group dynamics impacted collecting data from all participants, such as in Naivaka where one gentleman was a spokesperson for the entire group. When this occurred, every effort was made to involve all of the participants or to confirm the consensus of the group on important topics. It is common in Fiji for younger community members to not speak over or disagree with more senior members.

Printed mangrove identification cards were used to open the discussion about the local mangrove species and to confirm identification and common names (*Appendix E*) (*Figure 3.4*) and note-taking was kept to a minimum throughout the sessions to keep the discussions conversational and free-flowing.

Pacific Island women's perspectives are largely excluded from climate change literature, meaning less robust and equitable programs and policies emerging that lack the valuable traditional knowledge held by women (Bertana & Blanton, 2022; McLeod et al., 2018). Given women's interactions with mangroves in Fiji, their perspectives were important to this dataset. Although every effort was made to separated sessions by gender and open conversation encouraged, there were occasions when the men started drinking kava nearby, which resulted in them joining the women's session part way through.

***Figure 3.3*** *Women's group discussion at Naivaka Village engaging with the mangrove identification cards (Source: Author, 2022).*

### 3.5.3 Semi-structured Interviews and Conversations

Where possible and appropriate, one-on-one interviews were conducted and recorded with participants sourced through a purposive sampling technique. Purposive sampling is when a researcher deliberately chooses a participant because of the knowledge they possess in relation to the project (Tongco, 2007). These participants were community elders or those who had played a key role in initiating the mangrove replanting projects. To remain pertinent to conducting research in Fiji, these interviews were conducted in a similar manner to the group discussions - largely relaxed and conversational. The probing questions used to initiate the conversation were focused on the details of the mangrove planting projects. In Fijian communities, much time is often spent sitting and talking. These informal type discussions also provided valuable insight and context that contributed to the research findings.

### 3.5.4 Ecological observations (mangrove transect walks)

Transect walks led by local experts through ecologically significant sites, provided personal insight into the mangrove planting initiatives. These walks were also conducted in a style appropriate for Fiji, and were relaxed and conversational, allowing the community members to point out details they believed to be significant. This offered a unique opportunity to explore how community members engage with and utilise their local environment. Additionally, the walks allowed for first-hand observation, documentation, and to photograph the site and to gain context to the information provided during the group sessions.

The primary objectives of these walks included identifying the types of mangrove species planted, assessing their survival rates, and evaluating the overall health of the plants. Key indicators, such as plant height, new shoots, flowers, and fruit were used for this purpose. Observations also extended to planting techniques, with a focus on additional factors that may influence the survival rate of the planted mangrove propagules. This encompassed considerations like management of the site, the substrate that the mangroves had been planted in, and the presence of waste affecting the mangrove habitats.

## 3.6 Data Analysis Techniques

Exploratory and qualitative data analysis often begins in the field, allowing for theories to begin and often stimulating new lines of enquiry that may not have been obvious during the research planning and proposal phase of the project (Pope et al., 2000). This new line of enquiry occurred on many occasions during the site visits. For example, at Korolevu Village, where they men stated they had planted mangroves to stimulate mullet breeding, and the women from a number of villages explained their reasons for taking undersized crabs from the mangroves. These new findings stimulated several lines of enquiry that

contributed to the depth of the research, providing a greater insight into community decision-making regarding resource management.

On completion of the data collection, the voice recordings from the group discussions were transcribed into English. Typed transcriptions and recordings were sent to Maleli Qera for confirmation of accuracy, particularly sections that were difficult to hear or understand due to external noise or language accents. Following their accuracy check, the transcriptions were analysed based on themes of the probing question used in the group discussions, such as knowledge and use of mangroves, resource management, TLK, and preference for different adaption options. Data were displayed separately for each village as adaptation options in rural communities are not a one-size-fits-all approach (Nunn et al., 2020), therefore it is important to showcase the nuances of each. Chapter 9 is a cross-case analysis where data from each village is examined for similarities in responses, followed by the discussion of this research in Chapter 10. A summary of the findings, limitations that were identified, and recommendations that emerged from the research are then provided in the concluding chapter (11).

### 3.6.1 Frameworks for Data Collection and Analysis

The data for this research were collected under the guiding principles of an updated Sustainable Livelihoods Framework (SLF) (Natarajan et al., 2022). This framework addresses key shortcomings of the original version, recognising changes in the development space over the last 20 years. It aligns with contemporary rural community livelihoods, taking into account the impacts of climate change and environmental degradation. The updated SLF places greater emphasis on how social aspects, such as gender or power, may influence livelihoods and shape rural communities. The objective of this research is to understand how autonomous EbA projects can influence sustainable livelihoods. To achieve this, the principles of the updated SLF were utilised in developing the discussion guide (Appendix D) which contains the probing questions for the *talanoa* discussion sessions.

Each community's mangrove planting projects (excluding Naivaka) were assessed against the Friends of Ecosystem-based Adaptation (FEBA) Framework (Bertram et al., 2017). Naivaka was excluded from being assessed against this framework as they had not undertaken any mangrove planting or NbS project. The FEBA framework provided a set of standards to assess the design, implementation, and monitoring of EbA projects using three elements, five qualification criteria, and 20 quality standards and example indicators. Based on data provided during the group discussions, one-on-one interviews and site observations, each case study site was rated on a scale from 0 to 8. This rating provided the ability to assess the likelihood of the mangrove planting projects remaining sustainable as well as providing the foundation for the cross-case analysis.

## 3.7 Positionality

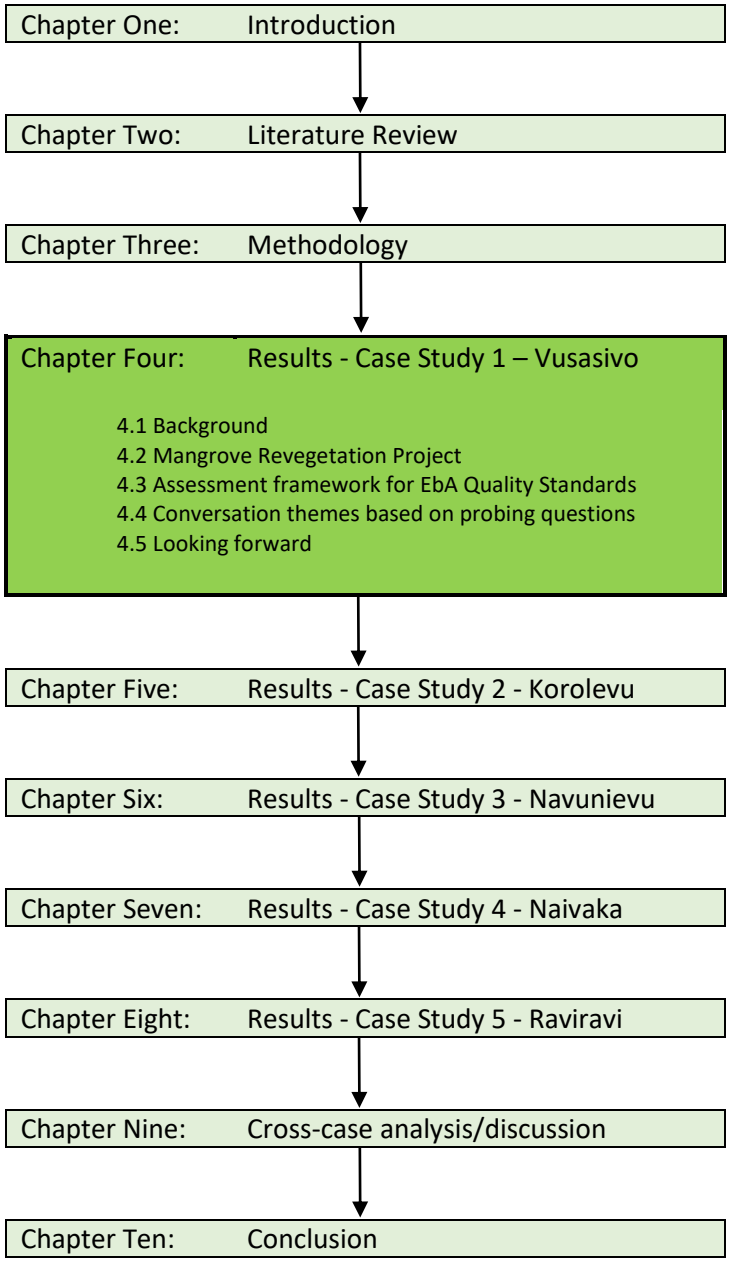
Considering one's positionality when conducting research and implementing projects in Pacific Island countries, where non-Western traditions and culture are deeply embedded in society is important. Reflecting on how a Caucasian female might impact the collection and interpretation of data from a rural Pacific Island community is a factor that requires deliberation. Therefore, considerable effort was made to ensure data was collected and analysed without the influence of outside perspectives. Worldviews may differ from those of the participants, hence, a level of cultural awareness and sensitivity needs to be adopted, which may include consideration of dress, use of language, and body language. Experiencing the daily lifestyles of the local community members where the research is being undertaken is one way to expose differences in worldviews (Feetham et al., 2022). Taking time to join in with any community activities where appropriate, such as assisting in meal preparation, gardening, cleaning, drinking tea in the same way it is taken by local people, participating in *kava* sessions, and making attempts to speak the local language may demonstrate our level of equality. Drawing on previous experiences working in rural Pacific Island communities has been advantageous in conducting this research.

## 3.8 Conclusion

This chapter has outlined the research approach, methods, and frameworks used to undertake this research, including the ethics and cultural protocols required for conducting fieldwork in Fiji. The subsequent chapters present the data collected from each community, which have been divided into themes based on the probing questions used during the *talanoa* group discussions.

# CHAPTER FOUR: (Results) Case Study One – Vusasivo Village

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 4.1 Background

Vusasivo is a rural coastal village located in the southeast of Natewa Bay on the northern side of Tunuloa Peninsula, Cakaudrove Province, Vanua Levu Island (*Figure 4.1*). It was chosen as a suitable site for this research due to its comparatively remote coastal location and because the Roko Tui from the Cakaudrove Provincial Office advised that this village had self-initiated a mangrove planting project. The village terrain is approximately one metre above sea level, slightly increasing in elevation towards the inland access road. Two small streams flow through Vusasivo village to the sea, originating upland behind the village. In July 2022, at the time fieldwork was conducted, there were approximately 70 houses in the village. Located on the opposite side of the road, the village has marginally elevated farmland, where the community grows a large proportion of their food and house some livestock and horses. As with many rural Pacific Island communities, the people of Vusasivo are semi-subsistence farmers, selling a proportion of their farm produce and marine resources at local markets. Many of the people in the village also grow food, such as taro, cassava and papaya, for home consumption in small gardens located around their houses.

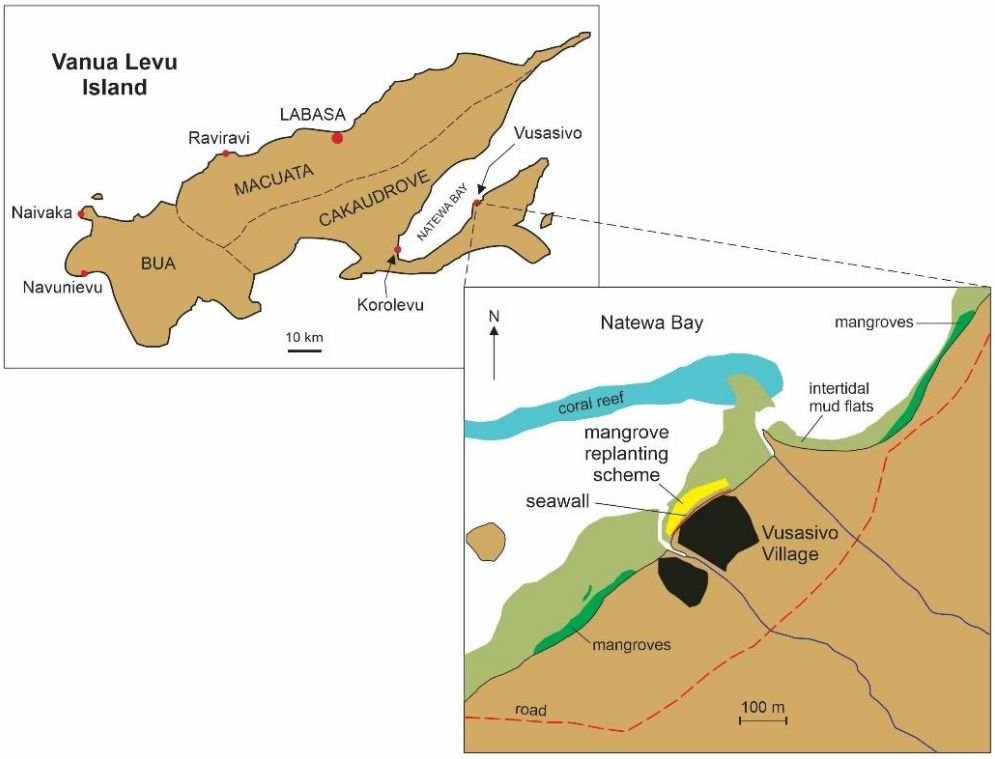



***Figure 4.1*** *Map of Vanua Levu Island showing the location of Vusasivo in Natewa Bay. The inset map details the surrounding area of Vusasivo Village, including the access road, the remaining original mangrove forest, the local reef, seawall, and the location of the mangrove replanting site.*

Flooding within the village occurs several times per month, usually during spring tides[2], but becomes worse during heavy rain or extreme weather events. Vusasivo has a comparatively new seawall (completed in 2015) located along the shoreline in front of the village (*Figures 4.1 and 4.2*), stretching from the natural vegetation on the northeastern side of the village to the stream to the southeast of the village, which is designed to limit this type of inundation. Such structures are commonly built on coastlines throughout the Pacific Islands to reduce the impacts of flooding from storm surges and extreme high tides as well as to limit coastal erosion (Nunn et al., 2021). The intertidal zone in front of the village is a substrate ranging in size from pebbles to small and medium rocks (*Figure 4.2 and 4.9 a*), becoming mud as it extends seaward, and an offshore reef consisting of rock and coral encircles the bay in which the village is located.

Data were collected from three focus group discussions and a one-on-one semi-structured interview with Timoci Bele, who was born and has lived in Vusasivo for over fifty-five years. He maintained the first mangrove planting project in 2009 after the Arbour Week[3] project was concluded. The *Turaga ni Koro*, Aselemo Baleicau, was also a key informant for this research. He is in the final year of his three-year appointment in this role and is relatively young to hold this position (approximately late 20s to early 30s). A position like this is typically held by the elder men of the village, but Aselemo mentioned he had graduated from university and the village believed this knowledge would be beneficial.

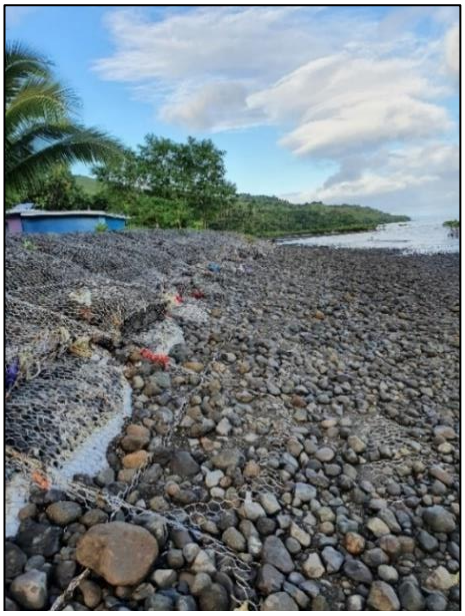


***Figure 4.2*** *The seawall at Vusasivo that was completed in 2015 is made of small to medium-sized rocks held together by wire but has been damaged causing the rocks to fall away (Source: Author, 2022).*

[2] *Spring tides occur twice in a lunar month during new moon and full moon.*

[3] *Arbour Week was explained as a week where there is a focus on planting trees and is supported by the Ministry of Education so children are often involved in the planting activities.*

### 4.1.1 Participant details

*Table 4.1* outlines the data collection carried out at Vusasivo over three days in July 2022.

***Table 4.1*** *On-site data collection details from Vusasivo*

| Group/ Participant | Number of Participants | Age Range | Duration of session | Comment |
|---|---|---|---|---|
| Women<br>(recorded) | 12 | 29 – 60 | 75 mins | The leader of the Village Women's Group (known as the Senivonokula Womens' Group), is 29 years old and contributed a lot of information to the discussion. She was also one of the newest members of the community as she had been living there for less than 10 years. The majority of the women had married into the village and therefore had only been living there from the approximate age of 20 onwards. |
| Men (recorded) | 10 | 40 - 70 | 50 mins | The meeting was cut short due to heavy rain. |
| Younger adults<br>(recorded) | 11<br>(including the *Turaga ni Koro*) | 20 - 34 | 50 mins | The eldest man was the spokesperson for the group. The younger participants were prompted for responses but they were hesitant to speak. The Turaga ni Koro falls in this age range but arrived late as he had been absent from the village. He contributed to the discussion once he arrived. |
| Timoci Bele (with his wife, Litia present)<br>(recorded) | 2 | 53 | 30 mins | Timoci has lived in the village his whole life. He had the idea of continuing with the community mangrove planting project in 2009 after the Arbour Week project was completed. |
| Timoci Bele and two youths<br>(not recorded) | 3 | | 2 hours | Walked through the intertidal mangrove reforestation area and natural forest to the southwest of the village. |
| Aselemo Baleicau (*Turaga ni Koro*)<br>(not recorded) | 1 | | 2 hours | Lengthy conversation, to discuss and view the role and responsibilities of a *Turaga ni Koro*, walk around the village and the seawall (to observe construction and drainage issues), the mangrove planting project, cyclone damage, and snorkel to observe health of the coral reef. |

### 4.1.2 General information collected through conversation and observation

The following information was collected through both formal and informal conversations and observations while in the village. It is relevant to this research because it provides background information and context to the current situation of the village and some of the resource management decisions.

Throughout the 1960s, copra was Fiji's second main export crop, the first being sugar (Watters, 1965). The older men of Vusasivo recalled that throughout the 1960s or 70s to the early 90s (community members were not sure of the exact decades), the mangroves in front of the village were cut down and used to fuel

copra dryers. Copra is the dried flesh of a coconut from which coconut oil is extracted. The men mentioned that copra drying was a common occurrence in many villages throughout Fiji at that time but today the processing of copra is done at a mill at Savusavu. Despite copra being a predominant cash crop for Vanua Levu, the industry experienced a decline throughout the 1990s, which has been attributed to a decrease in the price of coconut oil. This downturn was also linked to a decline in productivity due to the age of many of the coconut trees, which were cost-prohibitive to replace (Barbour & McGregor, 2019).

The area cleared of mangroves in front of the village allowed easy access to vehicles and therefore the site was chosen for sand and gravel extraction to supply materials for the construction of the road behind the village. The men of Vusasivo attributed the removal of the finer substrate to some of the changes in their coastline and suggested it is one of the reasons the village now becomes inundated with seawater during some high tides. The men's reasoning has merit as it is probable that the removal of substrate would lead to increased erosion. However, it is more likely that the removal of mangroves was the major contributing factor to the coastal erosion and flooding during high tides in Vusasivo and as the mangrove forest diminished, shoreline erosion increased, with the proportion of finer particles in the intertidal zone decreasing even before the beach mining took place (Bryant et al., 2022; Marois & Mitsch, 2015). Figure 4.3 shows a comparison of the foreshore from 2010 to 2017, which is before and after the construction of the seawall. A home is visible in Figure 4.3 (a) that is not in (b), verifying what was mentioned by the community during the group discussions.

***Figure 4.3*** *Spatial imagery shows the Vusasivo village shoreline - 16°34'18.44"S; 179°45'43.70"E* ***(a)*** *The image to the right was taken in July 2010. There is a home close to the shoreline that is no longer visible in the second image.* ***(b)*** *The latest available Google Earth imagery shows the Vusasivo village shoreline in August 2017, several years after the seawall was constructed along the foreshore (Google, 2018).*

Construction of a seawall was first attempted in the 1970s, which coincides with data collected by other research on coastal changes and coastal zone management in Fiji (Nunn, 2000). This seawall had been built using large rocks (referred to as soapstone [marl] by the men). The rocks to build this first seawall were transported during low tide using bamboo rafts from Bequlevu Island, located approximately 500 metres from the village. Due to the labour-intensive method of transporting materials and building without machinery, the wall was never completed.

The current seawall, constructed in 2015 and funded by the United States Agency for International Development (USAID), consists of gabion baskets, which are wire cages that angle downwards towards the sea, filled with small rocks and referred to by USAID as a rock mattress revetment. This design is different to most older-style vertical seawalls seen throughout the Pacific Islands, which cause waves to reflect and remove substrate from the beach zone (Nunn et al., 2021). According to Aselemo, the construction of the current seawall took approximately three months and could be carried out only at low tide, so construction would often take place throughout the night with men from the village providing assistance to the aid agency workers.

Despite the new seawall, the community members of Vusasivo stated that the village still floods in what they referred to as king tides[4]. Flooding in the village also occurs following even small rain events where water pools on the landward side behind the seawall (*Figure 4.4*). The *Turaga ni Koro* considered the flooding as a result of inadequate drainage in the seawall as the water becomes trapped by the structure. Drainage pits are located at various locations along the landward side of the seawall but often need clearing as they become blocked with leaves and overgrown with vegetation (*Figure 4.5*). Aselemo said the design was questioned by the community members at the time of construction but they were told by USAID that the plans could not be altered at this stage of construction. Such a lack of consultation between the donor and the recipient community is an issue that is commonly raised with externally funded projects and is a potential barrier to sustainable adaptation (McNamara et al., 2020).

In 2020, Tropical Cyclone (TC) Yasa caused damage to the current seawall and now the two lowermost gabion cages are no longer in place and the rocks contained within them have fallen away (*Figure 4.2*). Seawater has caused rusting of the gabion wire which now has sharp protruding edges which are a potential health risk (*Figure 4.6*). The *Turaga ni Koro* indicated that their community was not able to maintain this seawall and they had not received any subsequent assistance from USAID after the wall was

*[4] In the Pacific Islands, community members often use the term 'king tide' when referring to any abnormally high tide. The general concept of king tides refers to any high tide that is above average height but is generally known as the highest of the spring tides, which usually occurs once during summer and once during winter. Atmospheric conditions that lead to storms and tropical cyclones can also raise water to these same levels, therefore bringing some confusion into the concept.*

constructed, which is another point commonly raised with externally funded projects (Piggott-McKellar, McNamara, Nunn, & Watson, 2019).

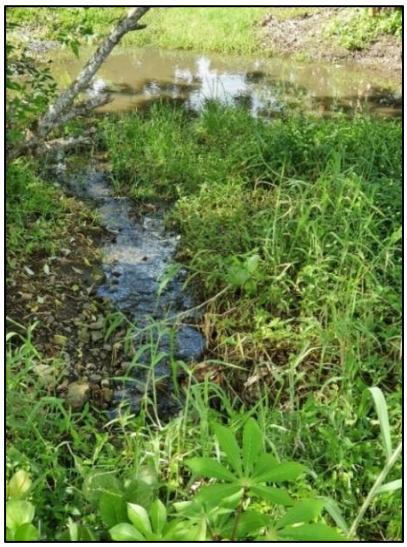


***Figure 4.4*** *Flooding and pooling of rainwater occurs in the village behind the seawall as it is unable to drain away (Source: Author, 2022).*

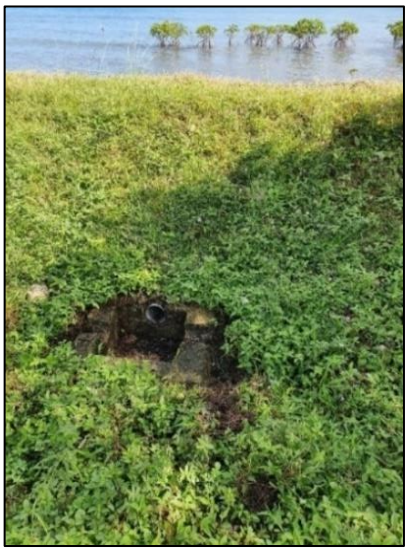


***Figure 4.5*** *The drainage point behind the Vusasivo Village seawall often becomes overgrown and blocked with leaves which contributes to flooding in the village (Source: Author, 2022).*

***Figure 4.6*** *Broken and rusting wire in the seawall built in 2015 at Vusasivo Village can be a potential health risk to community members, no longer holds the rocks in place, and causes waste to become trapped (Source: Author, 2022).*

Considerable amounts of waste were noted on the ground around the houses in Vusasivo village and on the foreshore, in addition to rubbish entangled in the seawall and the mangroves. This rubbish appeared to be a combination of that which had washed in from the ocean as well as an accumulation from the village due to an inadequate waste management plan and included plastic bags filled with disposable baby diapers, old clothing, and building materials (*Figure 4.7*). There is a pit for waste disposal near the foreshore to the southwestern side of the village which would most likely become filled with seawater during extreme high tides. Pieces of rubbish were scattered around the pit suggesting further training in waste management may be beneficial to the community and may assist with protecting newly planted mangroves.

***Figure 4.7*** *Examples of some of the waste on Vusasivo Village foreshore. The community members explained this rubbish often damaged their newly planted mangrove saplings (Source: Author, 2022).*

## 4.2 Mangrove Revegetation Project

Although exact details of the distribution of species of mangroves prior to the 1970s and 80s were not given during the group discussions, the mangrove forests that exist on either side of Vusasivo would likely have extended in front of the village foreshore. This assumption is based on aerial views of the mangrove distribution in the area and the knowledge that extensive mangrove clearing took place. When this original forest existed there would have been minimal coastal erosion and flooding in Vusasivo due to the protection provided by this coastal vegetation (Nunn, 2000). Regeneration of the coastal vegetation through mangrove planting initially began as a project during Arbour Week 2009 (*Figure 4.8 a*), organised by the school and the *Turaga ni Koro* of the time. During the one-on-one discussion with Timoci, an elder from Vusasivo, he advised that he continued the project after Arbour Week, which involved the children of the village planting propagules approximately once per month throughout 2009.

Timoci's motivation for undertaking this project were his observations while walking to school that places with coastal vegetation remained intact while those that lacked coastal vegetation exhibited extensive coastal erosion. *Figure 4.8 (b)* shows a section of the coastline where Timoci walked to school and could note a build-up of sand when mangroves were present. His revegetation plan involved planting a single strip of mangroves close to the shoreline that ran the length of the bay in front of Vusasivo village, which is the area he was hoping for sediment accumulation *(Figure 4.8 c)*. Natural mangrove ecosystems occur on either side of Vusasivo, which is where the propagules were collected for planting. The technique used for planting is to clump three to five propagules together *(Figure 4.8 d)*. Timoci stated that this is because they noticed saplings grew faster and the survival rate was higher than when planting a single propagule.

Although out of the scope of this research, this planting technique requires further investigation if it can help communities achieve a greater success rate.

No recorded data were available on the quantity, species, or growth rate of mangrove propagules that were planted. Based on the description provided by Timoci, it is estimated that approximately 40 percent of the mangroves planted in 2009 remain intact, while the rest were damaged during weather events over the past 14 years. The remaining trees range in height from approximately 40 cm to 2 m. This height is small in comparison to the average growth rate of 1.6 cm/month of mangrove saplings in other mangrove rehabilitation research (Hilmi et al., 2022). The growth rate of mangroves is impacted by a range of environmental factors including nutrient availability (Reef et al., 2010) and it is likely the seedlings planted at Vusasivo were stunted because the rocky substrate was not providing the nutrients required for healthy growth (Asian Development Bank, 2018). Both Timoci and the women's group were concerned that the fate of the new plants could be similar to the ones planted in 2009 and questioned whether they could do something to increase the propagules' chance of survival.


***Figure 4.8 (a)*** *Mangrove planting projects at Vusasivo. The two clumps of taller mangroves (background) were planted during Arbour Week 2009 and the saplings were planted throughout 2019 – 2022 as part of the current mangrove restoration site (Left to right: Timoci, who initiated one of the planting projects and Maleli Qera, research assistant).* ***(b)*** *Shoreline and uncleared mangrove forest in the village beside Vusasivo.* ***(c)*** *Remaining mangroves from the revegetation project initiated by Timoci throughout 2009, following the Arbour Week project.* ***(d)*** *Planting technique using three to five propagules together resulted in an increased survival rate, according to Timoci (Source: Author, 2022).*

The women stated that it was a community decision to recommence the new mangrove planting project and throughout early 2022 planting has become one of the tasks allocated on Village Day to the women, children and younger community members. Village Day occurs usually once a month in Vusasivo and is a day where all community members are allocated tasks to assist in village maintenance The women mentioned that as well as planting propagules they would also uproot naturally occurring seedlings and saplings from within the original forest located on either side of the village and move them to locations where the replanting project was taking place. They said that many of these did not survive when planted this way, probably due to damage to the roots during the uprooting process. Where possible, encouraging natural forest rehabilitation through ecological management rather than replanting is more likely to result in a resilient fully functioning ecosystem (Lewis et al., 2019). That is, understanding the species and hydrology of the site, removing external stressors from existing forests and the rehabilitation site will allow mangrove seedlings to establish naturally. The same researchers suggest that planting propagules should take place when it is determined that natural recruitment will not reach the quantitative goals of the restoration project.

## 4.3 Assessment framework for EbA quality standards

EbA focuses on three core elements: people, nature, and climate change adaptation. Based on these core elements, developed a set of five criteria based on 'best-practice EbA' which form the foundations for the FEBA framework (GIZ et al., 2020). Based on the information provided by the community members and site observations, the mangrove planting project was rated on a scale from 0 to 8. This section outlines and justifies Vusasivo's project rankings according to the framework (*Tables 4.2, 4.3 and 4.4*).

### **Criterion 1.** Reduced social and environmental vulnerabilities

Based on the information provided during the *talanoa* sessions and transect walk of the mangrove project area at Vusasivo, all Criterion 1 Quality Standards have been rated weak or very weak (*Table 4.2*) based on the limited planning of the project in the absence of a vulnerability assessment and future impacts of climate change and climate variability sourced from quality data.

### **Criterion 2.** Generates societal benefits in the context of climate change adaptation

Societal benefits were rated strong or very strong (*Table 4.2*) although most were ranked 'requiring further research' or 'somewhat confident' as the standard was unable to be fully assessed using available data. The high rating was based on the outcomes for the community and whether the project was sustainable or at an appropriate scale, as this would provide monetary and non-monetary benefits, including physical protection equitably for all members of the community.

### **Criterion 3.** Maintains or improves ecosystem health

All quality indicators in Criterion 3, within Element B - *Making active use of biodiversity and ecosystem services*, were ranked weak, very weak, or low due to the limited scale, evaluation and monitoring of ecosystem and species health and services, as well as the limited number of stakeholders between sectors that are providing support (*Table 4.3*). This criterion also accounts for the extent to which human pressure is removed from the ecosystem through alternate livelihoods and the sustainable use of resources.

### **Criterion 4.** Is supported by policies at multiple levels

Within Element C - *Part of an overall adaptation strategy*, Criterion 4 assesses how the EbA project is supported through policy and legal frameworks and the level of multi-sector engagement. The mangrove planting at Vusasivo was a community-initiated and regulated project. No support was received from the government or private sectors, therefore ranked 'weak ' and 'very weak ' for these criteria (*Table 4.4*).

### **Criterion 5.** Supports equitable governance and enhances capacities

Criterion 5 focuses on the extent to which the project centres on community and gender inclusivity. While the women in Vusasivo participated in the mangrove planting, the degree of their involvement in the planning, monitoring and evaluation of the project was not determined. Two of the quality standards were ranked 'somewhat confident' and 'requiring further research' as the amount of time spent with community members was insufficient to substantiate these factors. However, the input level of local and Indigenous knowledge was ranked high, as this project was entirely community-led (*Table 4.4*).

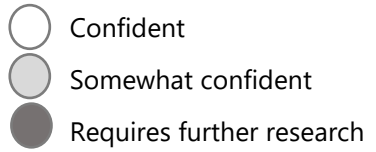



***Table 4.2*** *Assesses Element A of the Assessment Framework for EbA Quality Standards – Helping people to adapt with regard to Vusasivo's mangrove project.*

| Qualification Criteria | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #1. Reduced social and environmental vulnerabilities | **1.1** Use of climate information | Yes, short-, medium-, and long-term | | | Very limited or not at all | • Extent of information about future climate change used<br>• Quality of climate data sources |
| | **1.2** Use of local and traditional knowledge | Yes | | | Very limited or not at all | • Extent and relevance of local resources consulted (individuals, communities, NGOs)<br>• Participation of affected natural resource users during the planning process<br>• Quality of consultation process |
| | **1.3** Taking into account findings of vulnerability assessment (VA) | Yes, clearly integrating findings of climate change vulnerability assessments | | | Very limited or not at all | • Extent to which information from VA is being considered<br>• Consideration of climate risk reduction potential<br>• Extent to which ecosystem services are assessed by the VA |
| | **1.4** Vulnerability reduction at the appropriate scale | Land/seascape scale or larger | | | Local-scale | • n or % of the population with reduced vulnerability<br>• Effects from different scales of ecosystems are considered |
| #2. Generates societal benefits in the context of climate change adaptation | **2.1** Quantity and quality of societal benefits compared to other adaptation options | Very high | Would likely be the case at an appropriate scale. | | Comparable | • Quantity of monetary and non-monetary benefits provided (e.g. income, resource access, reduced risks)<br>• Quantity and quality of provisioning ecosystem services (e.g. water, food, fibre), regulating ES (e.g. erosion prevention, extreme event buffering, climate regulation) as well as supporting and cultural ES<br>• Extent of physical asset damage or destruction avoided (e.g. Saved Wealth index)<br>• Extent of avoided deaths and injuries (e.g. Saved Health index) |
| | **2.2** Timescale of societal benefits demonstrated | Short-, medium, and long-term | | | Short- and/or medium-term | • Sustainability of provided benefits<br>• Estimated or projected benefits |
| | **2.3** Economic feasibility and advantages compared to other adaptation options | Very high | | | Low | • Positive economic and non-economic assessments (taking into account a quantification of ecosystem services benefits) |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **2.4** Number of beneficiaries | High | | | Low | • n or % of benefitting people |
| | **2.5** Distribution of benefits | Fair and transparent | | | Distribution questionable | • Distribution of benefits within and between different groups |

Confident
Somewhat confident
Requires further research

***Table 4.3*** *Assesses Element B of the Assessment Framework for EbA Quality Standards – Making active use of biodiversity and ecosystem services with regard to Vusasivo's mangrove project.*

| Qualification | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #3. Restores, maintains or improves ecosystem health | **3.1** Appropriate scale of management | Land/seascape scale or larger | | | Small scale ○ | • Size of the area (e.g. in ha) under management |
| | **3.2** Prioritisation of key ecosystem services within management | Yes, clear | | | Very low ● | • n of indicator species (e.g. IUCN Red list) showing the quality of the ecosystem and its services<br>• Valuation of n ecosystem services (esp. supporting, regulating and cultural) over time |
| | **3.3** Monitoring of ecosystem services health and stability | Yes | | | No ○ | • Results of IUCN Red List of Ecosystems categories and criteria<br>• Results of ecosystem risk assessments |
| | **3.4** Protection and management area coverage/diversification of land use | High coverage | | ● | Very little coverage | • Size or % of protected area<br>• Size or % of restored area<br>• Size or % of sustainably managed area<br>• Size or % of different land use systems |
| | **3.5** Level of co-management (government, communities, private sector) | Very high | | | Limited ○ | • n of (community) management plans<br>• n of stakeholders engaged in management<br>• Level of cooperation between government, local stakeholders and private sector |

Confident
Somewhat confident
Requires further research

***Table 4.4*** *Assesses Element C of the Assessment Framework for EbA Quality Standards – Part of an overall adaptation strategy with regard to Vusasivo's mangrove project.*

| Qualification | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #4. Is supported by policies at multiple | **4.1** Compatibility with policy and legal frameworks and policy support | Very high | | | Limited | • n of direct links between EbA measure with policies and legal frameworks<br>• Quality and type of policies that support the implementation of the EbA measure as well as its replication and upscaling<br>• n of political decision-makers engaged in the process |
| | **4.2** Multi-actor and multi-sector engagement (communities, civil society, private sector) | Very high, with different actors/sectors | | | Limited | • Level or % of civil society engagement in policy discussions<br>• Level or % of private sector engagement in policy discussions<br>• n of sectors involved<br>• n or % of people participating in activities |
| | **5.1** Accountability and group representation | Clearly demonstrated (up and down) at the relevant scale | | | Very little demonstrated, with decisions made externally | • Level of accountability and transparency<br>• Level or % of civil society engagement in governance<br>• Level or % of private sector engagement in governance<br>• n or % of people participating in awareness raising or training sessions |
| | **5.2** Consideration of gender balance and empowerment | Explicit part of the proposal | | | None | • Gender balance within each benefiting group |
| | **5.3** Status of Indigenous and local knowledge and institutions | Respected or incorporated | | | Not respected or incorporated | • n or % of indigenous or local people represented in the governance structure. |

| | | | | | | |
|---|---|---|---|---|---|---|
| #5. Supports equitable governance and enhances capacities | **5.4** Long-term capacity to ensure sustainable governance | Very strong | | | Little or none | • n or % of individuals in a group of beneficiaries directly involved in governance framework |

## 4.4 Conversation (*talanoa*) themes based on probing questions

The following section highlights the main themes that arose from the discussions with local residents. It should be noted that for data consistency there was an aim to cover the same themes during each interview, yet the conversational nature of the *talanoa* style data collection meant this was not always possible.

### 4.4.1 Knowledge and use of mangroves

Mangroves and the services they provide are integral to Pacific Island community livelihoods and have therefore been managed for generations using customary practice. More recently, less traditional methods have been integrated into management practices, such as mangrove replanting (Pearson et al., 2020). During discussions with residents of Vusasivo, it was hoped to gain an understanding of their intention and processes behind their mangrove planting initiative as this would help build the cultural aspect of the framework for successful EbA projects in such rural communities. To begin the conversation, community members were asked about their understanding of the importance of mangroves to the environment and people. The women of Vusasivo described both the ecological and cultural significance of mangroves by stating that:

> "*Mangroves attract fish and they make their homes there. This is helpful because the mangroves are close so we don't need to go out to the deep sea. And we use mangroves for making of masi. It's made from the bark of a mulberry tree and painted. You can see it in houses. It's for a ritual custom"*.

*Masi* (referred to as *tapa* in some villages) cloth is made by pounding the bark taken from a mulberry tree until it is paper thin. The colours are created by making dye and paint obtained from mangrove stems and aerial roots, through an involved process of boiling and drying. Stencils are created using large leaves or today can be made of cardboard or plastic which are used to create repeated patterns. The women proceeded to show me a recent creation which they said they could sell for FJ$300 (*Figure 4.9*). Another woman said that mangroves, *"prevent soil from the shore going into the ocean. It holds it together because of the roots, and they can stop big waves*".

***Figure 4.9*** *A large (approx. 3 m x 1.5 m) masi (tapa) cloth made by one of the women in Vusasivo Village that is used to make clothing or decoration for traditional ceremonies (Source: Author, 2022).*

The men and younger adult group of Vusasivo respectively, stated that:

> "*Mangroves supply oxygen and take in carbon dioxide. They give us life. When the previous elders destroyed the mangroves, they destroyed our lives too, so we want to restore the mangroves to restore our lives*", "*mangroves were a buffer for strong winds and they increased marine biodiversity*".

These quotes eloquently convey the profound importance of mangroves to the community and reflects a deep understanding of the ecological significance of mangroves with the clear link between the destruction of mangroves and the deterioration of their lives, underscoring the connection between environmental health and human well-being.

Moreover, the recognition of the mangroves acting as a buffer for strong winds and increasing marine biodiversity showcases the community's comprehensive awareness of the complex benefits mangroves provide, acknowledging the role they play in safeguarding the community from environmental hazards and food security. The statements not only reveal the community's sound ecological knowledge but also expose a profound emotional connection to their local ecosystem. The desire to restore mangroves is not just an ecological initiative but an endeavour to reclaim a way of life that is impacted by the health of their local environment. This emotional resonance underscores the intrinsic value of mangroves beyond their ecological contributions, highlighting their crucial role in sustaining the fabric of rural livelihoods.

Mangrove species were not discussed with the men or younger adult group but the women stated that they had two types of mangroves growing near the village. Using the mangrove identification cards (*Appendix E*), the women identified *Rhizophora samoensis* as the mangrove species that were growing on the intertidal flats, known locally as *Tiri,* and *Bruguiera gymnorhiza* as the type they refer to as *Dogo Tu*. The women said *Dogo Tu* grows at the sides of the village and this is the mangrove they use for making

the dye. Some research has claimed that men have greater knowledge and more frequently use mangroves, while others indicate that women do (Pearson et al., 2019). In Vusasivo, it was determined that both men and women have similar knowledge, management roles, and use of mangroves, although their uses differ slightly. For example, they both use the dye from mangroves, but for different purposes.

### 4.4.2 Resource management

Examples of traditional practices of conserving and managing resources in Fiji are the implementation of *tabu* areas and the use of knowledge sharing, both orally and through observations of day-to-day activities and cultural practices (Pearson et al., 2020). Through conversations with community members, this research aimed to collect data on the cultural perspectives of current management practices of resources as this would assist in establishing sustainable EbA projects.

When asked about the management of the newly planted mangroves, the women said: "*It is like a marine protected area. People are not supposed to take from that area"*. They also stated that: *"before there were no fish but now plenty come in".* The women claimed that in the past, Vanua Levu and this area was known as a '*sawana mate*', meaning '*dead zone*', which is one of their motivations to plant mangroves. They explained:

> *"We compared to what other communities have. Other villages that have a lot of mangroves have plentiful supplies. Once we planted the mangroves our chief said it is tabu [6]in that area. The ladies have to go out further to fish".*

When 'sawana mate' was raised during the subsequent conversation with the men, they said: "This name no longer applies as our marine resources are plentiful". They aver it received that name from the use of unsustainable methods of fishing, like using large nets and the fish poisoning plant, duva (Derris trifoliata), which has been illegal for approximately 20 years, according to Maleli. One of the men's comments contradicted the women about the abundance of fish available to the village, as he stated: "In my mother's time they could go out to sea twice in a day and catch lots of fish in very little time but now they can be there for hours or a whole day with only a few fish caught". Another man said: "People should be fishing for their families but they often come back with more than they need".

This last quote indicates that fish are being caught to sell rather than the Fiji tradition of only taking what is needed for family consumption (Fache & Pauwels, 2020). Interpreting quantitative details can be challenging in a rural Pacific Island community context as responses can be ambiguous, as shown in the

[6] *A traditional method of placing a restriction on an area, such as a 'no-take' zone.*

last four quotes. Without catch data available it is not possible to determine whether this community now spends longer fishing for the same amount, or whether they catch less or smaller fish than they did 10 or 20 years ago, or compared to other villages with an intact mangrove forest. However, the Ministry of Fisheries and other researchers (Karcher et al., 2020; Kitolelei et al., 2021; Long, 2018; Prince et al., 2021) indicate that catch sizes and the size of fish being caught have decreased and accurate data are needed to develop new management policies in Fiji. For anyone in Fiji to sell their catch they are required to hold a current fishing licence. To maintain this licence, a report on the details of each catch needs to be completed by the licence holder and submitted to the Ministry of Fisheries. Yet, during conversations in another village, a community member disclosed that this information is usually made up as their licence is coming up for renewal. This comment not only indicates the need for new management policies but more stringent ways of enforcing these policies to ensure the sustainability of fisheries which has been backed by research saying that small-scale fisheries in Fiji are largely unregulated and unmonitored (Glaus et al., 2019).

The men of Vusasivo reflected on changes in practice from when they were younger. One elder said:

> *"During our elders' time, we used to use knives to clear the land but this time around we use weedicides and pesticides and other practices which are totally different from what our parents used to do. Our mothers and grandmothers used small individual nets with sticks on each end where they can control the size of fish caught. Now the women are using long nets that they use as a group, which rake in any sized fish. We have this fishing net but our mothers had small ones, now we have long ones. The small ones are now used only for catching prawns".*

These changes in resource management practices may not be in place across all communities but are an indication of factors that need to be considered during the community consultation and planning phase of an EbA project.

### 4.4.3 Traditional and Local Knowledge (TLK)

Traditionally, local knowledge is passed down orally or through observation. During discussions in Vusasivo about traditional knowledge, the women claimed that people living in rural communities had superior local environmental knowledge than someone from an urban centre, quoting: *"We need to learn more because we are far from civilisation"*. This quote also aligns with the notion of peripherality previously discussed, whereby communities that are further from urban centres are more likely to preserve traditional knowledge (Korovulavula et al., 2019).

The women also stated that it was their role to teach the children traditional knowledge but said children also learn about things like conservation and the environment at school. The younger adult group

explained that their ecological knowledge was mostly obtained from the school curriculum but the cultural knowledge came from observation and information they had acquired from their mothers. When the men were asked about their role in passing down local knowledge to the younger generation, one stated:

> *"Now they have access to what the world is offering, which affects traditional knowledge. Like Facebook. It has more influence over the things we are telling them. They're more interested in technology"*.

The men felt this availability of new information that the children had was impacting the preservation of traditional knowledge. When the discussion was directed towards traditional knowledge about caring or planting of mangroves was raised, the women expressed that their understanding was limited, and they had not received any formal assistance or training. They conveyed a willingness to receive guidance or reassurance about their efforts. This point made by the women serves as evidence that although mangroves play an important role in rural livelihoods, planting mangroves is not something that has traditionally been done. Where contemporary ecosystem management strategies are being implemented, such as planting mangroves, the integration of global scientific knowledge may benefit the community (Dumaru, 2010; McNamara et al., 2022).

The men talked about a *tabu* being a traditional resource management technique in Fiji but how today management is controlled by the Ministry of Fisheries, an example of traditional practice being displaced by top-down (western science-informed) practice. In addition to *tabu,* inshore fisheries management has also more recently been supplemented by Locally Managed Marine Areas (LMMAs). These are protected areas that are set up with additional support from The Fiji Locally Managed Marine Areas Network (Long, 2018) but the men expressed concern that they felt they no longer had the same control over their fishing areas.

### 4.4.4 'Hard' versus 'other' solutions

An outcome of this research was to determine the preferred method of climate change adaptation within coastal communities. Without directly asking the question it was revealed that physical structures, such as a seawall were preferred or at least given an equalled preference to ecosystem-based adaptation. This opinion was evidenced when one woman said: *"the seawall needed some improvement"*, and suggested that *"the height of the wall needed to be increased as a measure to stop the waves from entering the village"*. Opinions such as this can be due to the sense of security felt by having a defensive structure in place (Piggott-McKellar, Nunn, et al., 2020). Yet, the women were also very motivated to plant mangroves and understood the benefits of this. Although they said they were not consulted in the design, the women

mentioned that it had been a community decision to request a seawall. The women said the seawall had improved their situation as prior to it being built they had, *"lost a house into the ocean and water would come right up to that house"* [pointing to a house located well back from the shoreline].

As discussions continued, the women said they still experienced flooding as waves would overtop the seawall and enter the village, quoting that: *"sometimes the level of the sea is higher than the seawall"*. When water has entered the village, it cannot escape and when coinciding with heavy rain, the women claimed that the village will remain flooded for prolonged periods – a sentiment also noted about other seawalls (Nunn et al., 2021). One member of the group stated that parts of the seawall had been damaged during a cyclone not long after being built. Given the age of the seawall it was assumed they were referring to TC Winston in 2016. The women of Vusasivo mentioned that community members had begun discussions about the relocation of some houses and gardens as an option. Relocation is a viable adaptation option for Vusasivo as they have the land to do so.

### 4.4.5 Understanding of climate change

To gain a true understanding of community awareness of climate change it was important not to use words that might prompt answers. Therefore, terms such as 'climate change' were avoided in the conversation until they were introduced by one of the community members. When the women were asked what they believed the primary reason for sea water entering the village was, they replied, "*climate change*", then continued to mention other changes that they attribute to climate change, saying, *"This time of year used to be the hot season (July/August), but now it is raining more. The wet season is from November to April but now it keeps on raining. The fruit trees used to fruit every year but now many trees are not bearing"*.

The men confirmed this sentiment by mentioning that many years ago it was common to eat just two meals per day and lunch was skipped as there was always an abundance of fruit to eat in the gardens and farms but this is no longer the case. The men attributed this change to variations in temperature and rainfall and an increase in insects, which often damaged the fruit, but they did not mention the term 'climate change'.

### 4.4.6 Trust in faith for challenge management

The reliance of faith on climate change adaptation and risk management was not discussed at Vusasivo because the significance of this information was only realised after leaving this village.

### 4.4.7 Impacts of COVID-19

Given the connections that relevant literature uncovered between the timely management of the pandemic and responding to climate change and the timing of this fieldwork, just after many countries, including Fiji, had reopened their borders, it was pertinent to raise the topic of COVID-19 where possible, during the discussion sessions.

The opportunity to discuss COVID-19 did not arise during conversations with the women. However, the men stated that the pandemic did not have a big impact on their community and they felt like they were safe from the disease because of the movement restrictions imposed by Government officials. That is, they were not supposed to leave their homes or gather in groups for any reason, including church services. The men continued, saying that many people in the village chose not to be vaccinated as a result of the negative information they had heard through social media, despite the awareness programs about the importance of getting vaccinated (*Figure 4.10*). The police, medical officials and the Provincial Council staff visited the village providing posters and advice about the disease and how to stay safe. Two primary teachers in the local school were unable to retain their employment due to their refusal to be vaccinated.

During the group discussion with the younger adults, it was mentioned that they found one of the biggest impacts of COVID-19 was the reduction in the price they received for their surplus crops, which led to difficulty meeting other needs, such as buying store-bought food items. School closures were also recognised as having a big impact and the younger adult group claimed there was reluctance from the children to return to school once it reopened as they had become accustomed to free time and preferred working on the farms and around the home.


***Figure 4.10*** *An example of the flyers provided by the Fiji Government that were distributed by medical officials, the Provincial Office and the Red Cross (Source: Maleli Qera, 2022).*

## 4.5 Looking forward

This section outlines some key points of interest raised by community members that identify challenges and opportunities available to Vusasivo and other coastal communities in Fiji and the wider Pacific Islands region.

One question the community was asked is whether they found it offensive to have an outsider with a different cultural background coming into their village asking questions. They responded that they had learned a lot during the discussions and they appreciated any assistance they could get. We discussed the idea of blending knowledge and why it is important, explaining that we both have a lot to learn from each other and by doing this ensures any assistance or projects will better align with community needs.

USAID, the donor agency involved in building the coastal protection in 2015 for Vusasivo, was part of a larger community adaptation project in operation from October 2012 to February 2019. Hobgood et al. (2019) proclaim their use of a community-centred approach through community mapping. These maps were developed to help communities understand how climate variability, natural disasters and climate change projections interact with the community's built and natural infrastructure and were then used to assess vulnerability and prioritise adaptation to increase community resilience to the impacts of climate change and natural disasters. Through this process, aimed at empowering communities and other involved parties to make democratic decisions, some communities prioritised projects such as clean drinking water, or a shelter/evacuation centre to use in the event of a cyclone. The agency worked with the Fiji Government, other non-government organisations, and community partners to complete the projects, which were supposed to include ongoing maintenance of completed projects (Hobgood et al., 2019). According to the community members, there was little consultation regarding the design and no one in the community mentioned the agency drawing a map that identified Vusasivo's vulnerability or impacts on climate change projections nor had there been any follow-up since the completion of the project.

The site selection methodology of this USAID adaptation project was prioritised based on geography (coastal or located along an estuary or delta); governance (strong governance structure, successful previous partnerships on a development project); demographics (population of greater than 100); and degradation (evidence of environmental degradation and susceptibility to climate change and natural disasters) - criteria that Vusasivo no doubt met (Hobgood et al., 2019). The report describes Vusasivo's coastal protection project as the installation of a rock mattress revetment that is designed to prevent coastal erosion, yet there is no mention that the structure is designed to keep water out of the village, which was the expectation of the community members. There is a possibility that the community's expectations were not taken into account during the consultation process, which is a frequent criticism of donor-funded

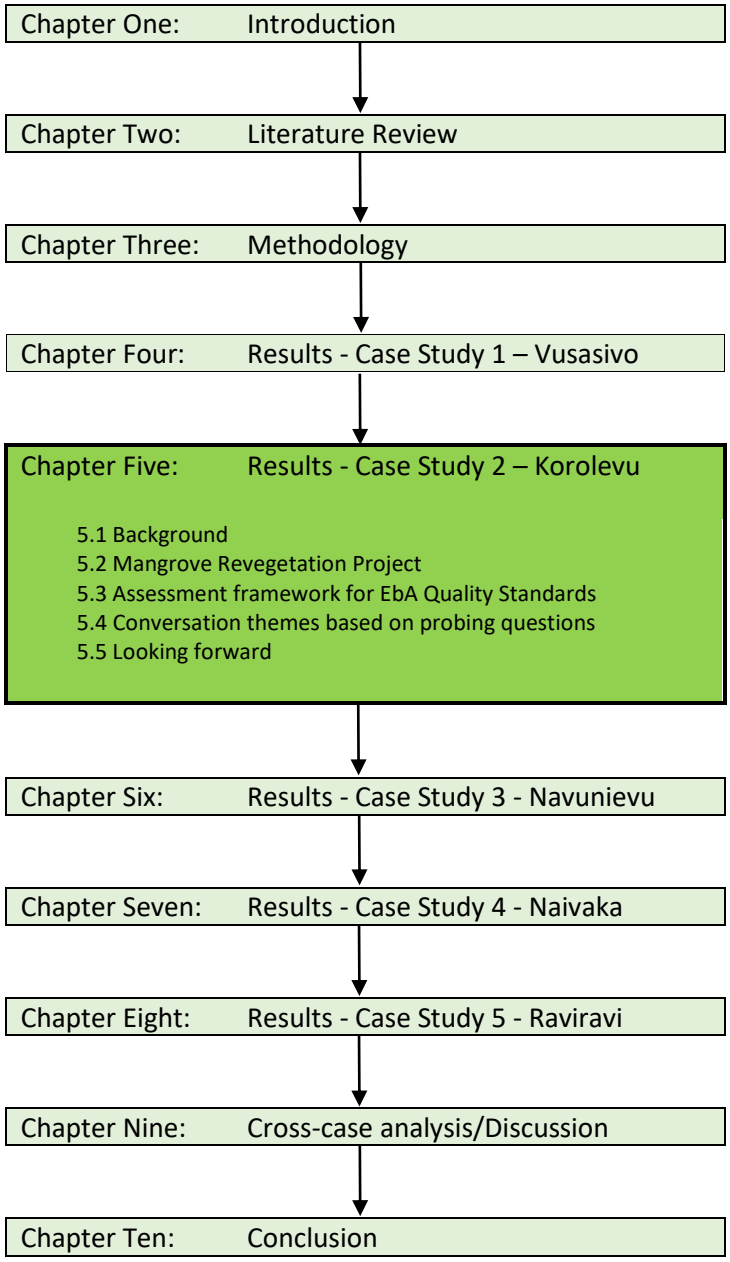
adaptation projects (McNamara, 2013). The intention of this critique is not to discredit aid organisations but merely to point out that improvements can be implemented to ensure projects are sustainable and meet the needs of the local community.

The women enquired about whether implementing an oyster farm would have any impacts on their mangroves as they had been approached by the Ministry of Fisheries to be involved in a new project but they were still in discussions about whether to go ahead. This is an example of a project that has the potential to be unsustainable as the recipient community has questions and doubts. Ensuring that the community is provided with the opportunity to raise any concerns and that the donor gains the full support of the community before the project is initiated will increase the likelihood of such a project's success (Vasseur, 2021; Westoby et al., 2021).

In addition to a higher seawall, the women said they would like their houses built farther from the shoreline and added that some of the people in the village had already started relocating their homes and gardens. Further to this the women also requested some advice or training to improve the outcome of the mangrove planting project. Other researchers have noted that local and culturally appropriate community awareness and education in climate change adaptation would benefit communities (McNamara, 2013; McNamara et al., 2022). The younger adults group also mentioned that they would benefit from training in environmental awareness and were particularly interested in involving the children of the village.

# CHAPTER FIVE: (Results) Case Study Two - Korolevu Village

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 5.1 Background

Korolevu (*Figure 5.1*) was chosen as a case study site through a recommendation from the Conservation Officer of the Cakaudrove Provincial Office who advised that this village would welcome the visit and be open to any advice available. Additionally, Korolevu had recently initiated a large mangrove planting project on the intertidal mud flats in front of their village, which the Conservation Officer thought may be of relevance to this research. The *Turaga ni Koro* of Korolevu, Lepani Tusoba, is in the first six months of his three-year role and like Vusasivo's *Turaga ni Koro*, is also relatively young for this position. Lepani was keen to be involved in the research and asked many questions throughout the length of our stay. Data were collected from two focus group discussions and a transect walk through the village and mangrove planting site with the *Turaga ni Koro*.

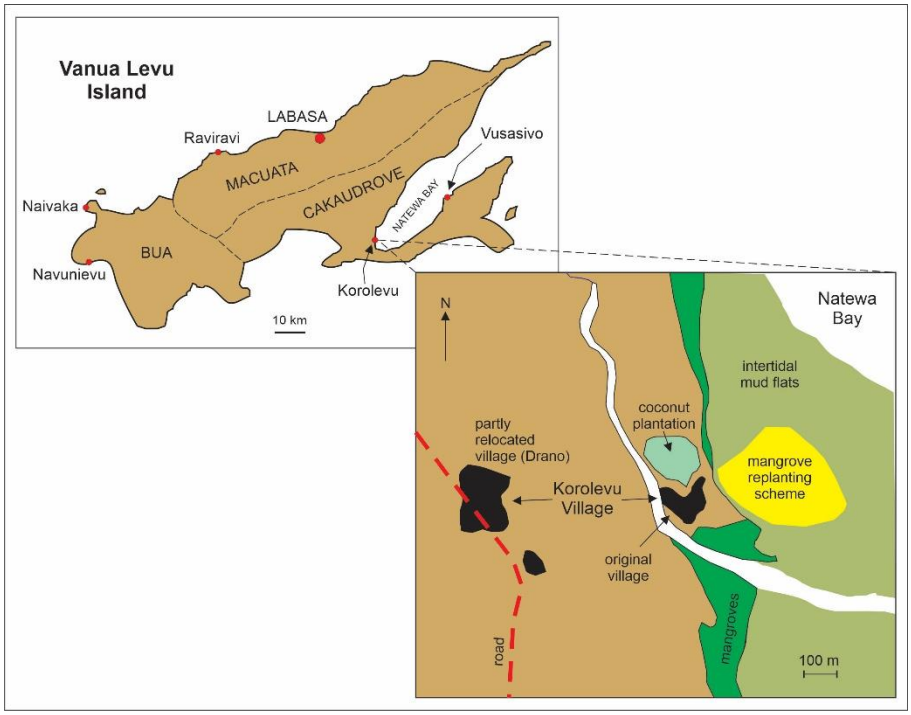



***Figure 5.1*** *Map of Vanua Levu Island showing the location of Korolevu in Cakaudrove Province, at the head of Natewa Bay. The inset map details the surrounding area of Korolevu Village (original and partly relocated site) and the river that requires crossing to reach the original village, the area of the mangrove planting scheme, and the natural mangrove forest.*

Historical accounts describe Korolevu as a significant resting place that involved feasting and dancing when people commonly did an overland trek of the island, known as *sala volivoli* (Sayes, 1984). Today, Korolevu is a comparatively small rural village that is a flat, open grassy clearing located on the coast at the head of Natewa Bay, Cakaudrove Province, Vanua Levu Island. The village has been partially relocated across the river to a new site the men called, Drano, due to regular flooding that occurs at the original village site during spring tides and heavy rain. Drano is an inland and elevated location nearer to the main road than

the original village site (*Figure 5.1*). The men in the village described the original village as '*like being on an island*' as they appear separated from the mainland by a river. The only way to access the original village is to cross this river via a *bilibili,* a small hand-crafted bamboo raft that is guided by a wire (*Figure 5.2 a*). A bridge once existed approximately 30 years ago but was damaged during a storm and was never rebuilt. There are six houses, an old church, and a new church under construction at the original village site and nine houses at the new inland site. Korolevu has a large coconut plantation located on the outskirts of the old village to the northeast, which is one of their main sources of income. Those still living in the old village are reluctant to leave as they said it is their home. This sense of place-belongingness is one factor that influences adaptation decision-making (Yee et al., 2022), and within the context of Fijian culture, the land provides a sense of connection to historical and ancestral origins (Nabobo-Baba, 2006). This point is explored further in Chapter 6.

Discussions with community members and the *Turaga ni Koro* revealed several challenges that impact the daily lives of the people of Korolevu at the old village site. Firstly, their access to running water is limited to about one hour per day. Each morning water sourced from the Drano community is pumped over to Korolevu so the people of Korolevu can fill containers with water, to be used prudently, because it needs to sustain the village for the following 23 hours. Secondly, access to the village is challenging and can be dangerous and restricted during heavy rain when the river is fast flowing. Transporting supplies is also onerous and heavy loads are restricted by what can be carried by hand to the river and floated via the *bilibili*, including building materials and the bags of coconuts that are sold at markets and to coconut oil manufacturers. The women mentioned that following a harvest they will package the coconuts into 20 kg bags and carry them on their shoulders to the shoreline ready to transport across the river. Having the village split between the old and new site appeared to provide some additional challenges, particularly for the women, who do not have the social structure and support usually available in larger communities for general household duties and looking after the children as only five women, including the priest's wife, remain permanently located in the original section of the village.

Unlike the majority of coastal Pacific Island communities experiencing a retreating coastline due to erosion, Korolevu's shoreline has been expanding outwards and they now have new land on which vegetation, including mangrove seedlings, have naturally established (*Figure 5.2 b and c)*. The men of Korolevu attributed this accretion to the village living up to its name, which translates to *koro* 'village', *levu* 'big' in *iTaukei*, and to their healthy mangrove ecosystem and the newly planted mangroves. The accretion of sediment may be due to a combination of factors, such as Korolevu's geographical location at the head of a bay. In addition to this, logging occurs upstream, therefore, it is probable that sediment runoff is entering

the river system and being deposited downstream beyond the river mouth, which has formed a large delta consisting of a fine sand/mud substrate extending almost one kilometre into Natewa Bay, adjacent to the original village (*Figure 5.2 d*). This notion is substantiated by the fact that the men in the village also believed the river was becoming shallower. The impact that this sediment may have on other coastal ecosystems was raised but the men stated that there was no evidence that this sediment was damaging the coral located towards the middle of Natewa Bay.

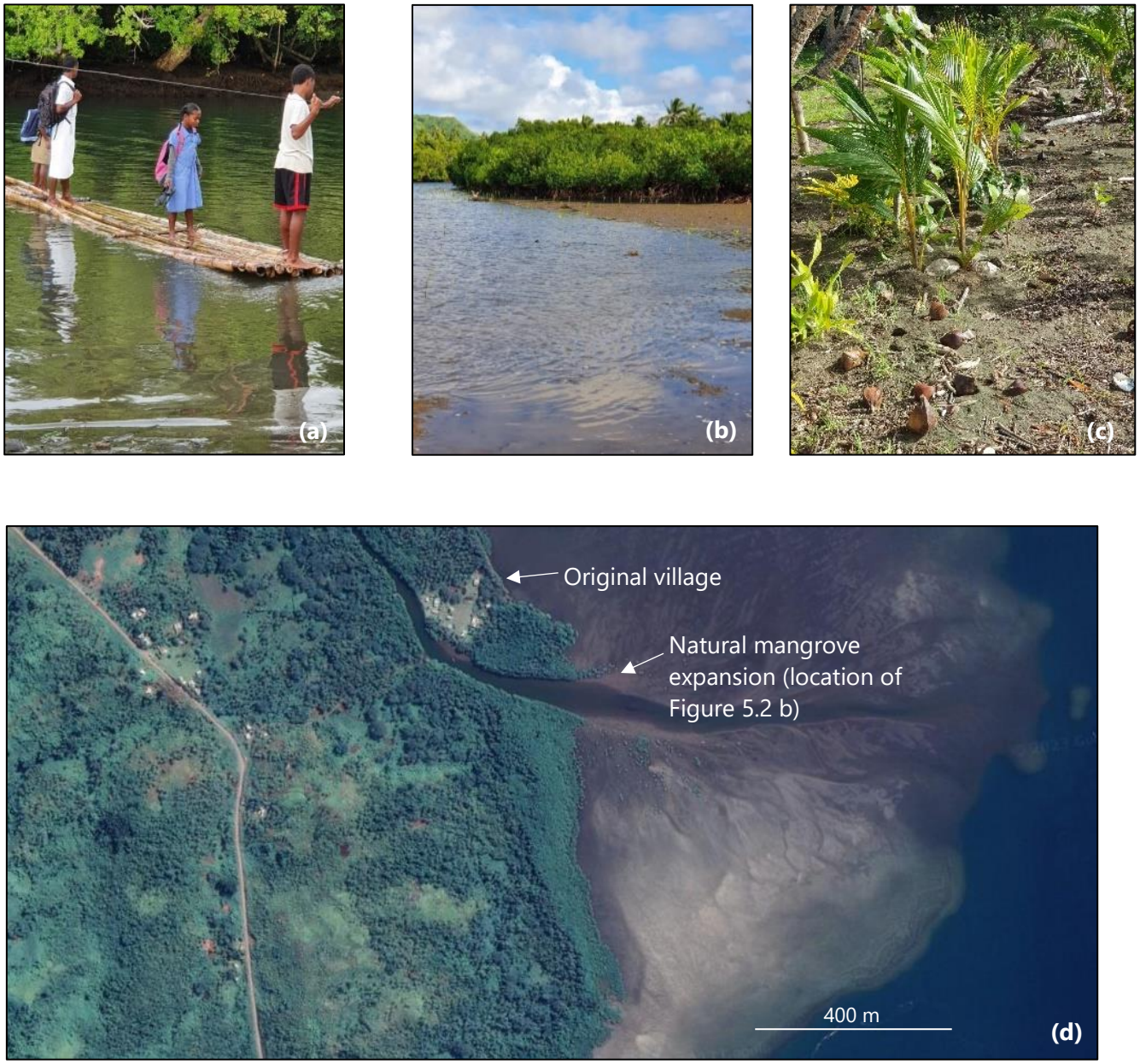



***Figure 5.2 (a)*** *The children of Korolevu travelling to school via a 'bilibili'.* ***(b)*** *The natural mangrove forest expansion at the mouth of the river adjacent to Korolevu.* ***(c)*** *Natural establishment of coastal vegetation in the newly formed foreshore of Korolevu (Source: Author, 2022).* ***(d)*** *Aerial image of the original (16°44'11.86"S; 179°28'53.52"E) and the new (16°44'12.98"S; 179°28'35.24"E) Korolevu village, the river and delta. The natural expansion of mangroves is also visible (Google, 2018).*

### 5.1.1 Participant details

Data collection carried out at Korolevu over two days in July 2022 is outlined in *Table 5.1*.

***Table 5.1*** *On-site data collection details from Korolevu.*

| Group/Participant | Number of Participants | Age Range | Duration of session | Comment |
|---|---|---|---|---|
| Men (recorded) | 6 | 23 – 65 | 90 mins | The recording of this discussion started mid-conversation as the men began asking a range of pertinent questions during the *sevusevu.* |
| Women<br><br>Men joined the discussion after 40 minutes<br><br>(recorded) | 9 women<br><br>4 men | 29 – 60 | 75 mins | The women were very quietly spoken and hesitant to speak. This appeared to be due to the men sitting close by listening to the lady's responses and adding comments. It was suggested that we move away but Maleli asked the men to stop responding and this worked for some time. The discussion became a whole village discussion after approximately 40 minutes as the men joined the conversation. |
| Lepani Tusoba *(Turaga ni Koro) and a youth. An elder joined towards the end*<br><br>(not recorded) | 2 (3) | | 2.5 hours | Walked through the intertidal mangrove reforestation area and natural forest at the mouth of the river to the south of the village and assisted with replacing some dead propagules. |

### 5.1.2 General information collected through conversation and observation

Data collected through informal conversations and observations are noted in this section. The current church minister has lived in Korolevu for two years. He claimed that the house he is living in was once located closer to the shoreline and the previous Minister who occupied the house mentioned seawater coming up to his home and he would use bamboo and beach debris as a barrier to stop the waves entering the outdoor cooking area. Today the kitchen is inside the house but the water no longer comes near the house and the shoreline is well over thirty metres away due to the build-up of sediment (*Figure 5.3*). Flooding now occurs only on the river side of the village.

There are grass-covered hills behind Korolevu, which have been previously logged and burnt. The men said these hills had been cleared before they were born (over six decades ago) but burning commonly occurred throughout their childhood. Burning was a common technique used to find wild yams, which were difficult to see in dense undergrowth. Yam shoots would sprout soon after burning and were easily

visible in the blackened vegetation. Burning is also used to clear agricultural land but it is a technique used much less today than in the past (Roos et al., 2016).

In addition to mangrove planting, Korolevu has started a reforestation project which aims to revegetate these grass hillsides with native forest and fruit trees as the community believe it will improve the water quality of the river and coastal ecosystems. The Ministry of Forestry offered support for this initiative by supplying seedlings for the project and a nursery has been built along the road between the river and new village site to house the native and fruit tree seedlings and saplings until they are ready to plant (*Figure 5.4*).

***Figure 5.3*** *The Minister's house with the old church in the background. High tides would often reach the outdoor kitchen of this house which is now well back from the shoreline (Source: Author, 2022).*

***Figure 5.4*** *Forest and fruit tree nursery along the road between the old and new village site (Source: Author, 2022).*

During this discussion, the men elaborated on the positive impact that a healthy land-based ecosystem can have on adjacent marine ecosystems. This knowledge was most likely acquired through training provided as part of the 'Ridge to Reef' Program. This program was mentioned several times at the other case study sites, as well as Korolevu. It was a project implemented by the United Nations Development Program in Fiji from January 2015 to December 2022, and aimed to address the negative impacts of land-based activities on important marine ecosystems through catchment management plans, encouraging sustainable land use practices, and riparian and forest restoration. It covered eight catchments across a number of districts, including sites on Vanua Levu Island (Government of Fiji & United Nations Development Programme, N.D.).

In addition to mangroves and native forest and fruit trees, the *Turaga ni Koro* said they have also planted Vetiver grass along the river banks. Vetiver grass (*Chrysopogon spp.)* is hardy, drought and salt-tolerant, and has dense foliage. Its application has been used to reduce runoff and control erosion (Truong, 2000).

The *Turaga ni Koro* presented Korolevu's 'Community Plan' to view. This is a document that is developed through consultation with the Provincial Office, Conservation Officer, and community leaders, identifying the challenges, opportunities, community goals, and plans to achieve these goals. Korolevu's plan focused heavily on the conservation and restoration of their surrounding ecosystems. During these same discussions, the *Turaga ni Koro* said he was unfamiliar with some terms contained within the document, such as SDGs, indicating that training for those new to community leadership positions may be beneficial if they are dealing with complex issues that incorporate global scientific terminology.

## 5.2 Mangrove Revegetation Project

The mangroves around Korolevu and other nearby bays are recognised by village elders as a breeding ground for a species of mullet, *Mugil cephalus* (*Kanace* in *iTaukei)*. According to the *Turaga ni Koro*, the Ministry of Fisheries acknowledges this area as a fish spawning site, which prompted the initiative to plant mangroves as a way to increase fish breeding habitats. The mangrove planting was initiated by an NGO called 'Partners in Community Development Fiji' (PCDF) and the Cakaudrove Provincial Office, along with Korolevu community members on the 18th of November 2021, however no official records were published in the PCDF annual reports for this project. At the time of data collection for this research (July 2022) the *Turaga ni Koro* stated that they had planted several thousand propagules. The planting took place on the intertidal flats in front of the village where the foreshore is an open beach with limited or newly established coastal vegetation. If the planting is successful the new mangroves should eventually connect with the nearby natural existing mangrove forest (*Figure 5.1*).

The technique used for planting involves pushing a single propagule into the substrate (*Figure 5.5 a*), which Lepani described as '*very easy*'. The single propagules - a combination of *Rhizophora* and *Gymnorhiza* - were picked from the nearby mangrove trees or collected from the foreshore and planted in rows approximately one metre apart (*Figure 5.5 b*). The *Turaga ni Koro* revealed from his records that on the 25th of February, 2022, all the propagules that had not survived were removed and replaced. The men attributed the dead propagules to the children picking those from the tree that were not yet mature. When it was explained that *Bruguiera* sp. are generally found at or above the high tide mark and not usually on the tidal flats the men said they did not consider this when planting and it may be why some hypocotyls did not survive. The men mentioned that they had seen the technique of planting three to five propagules together,

as was done in Vusasivo (see Section 4.4 and *Figure 4.7 d*), but said it was not necessary at Korolevu as it was usually only done at locations exposed to strong winds and wave action to increase the plants' survival rate. An updated image of the planted mangroves was provided by the *Turaga ni Koro* in May, 2023, where several new leaves can be noted on some plants (*Figure 5.5 c*).

After engaging in discussions with the community members, it became evident that adopting a blended knowledge approach could have enhanced the overall success of the mangrove planting project. Specifically, integrating training on species knowledge to improve the propagule survival rate with site-specific insights from the local community may improve outcomes and ensure long-term support from the community. This suggestion aligns with the findings of other researchers, who advocate for a collaborative strategy of knowledge integration (Fink et al., 2021; McNamara et al., 2022; Syddall et al., 2022).

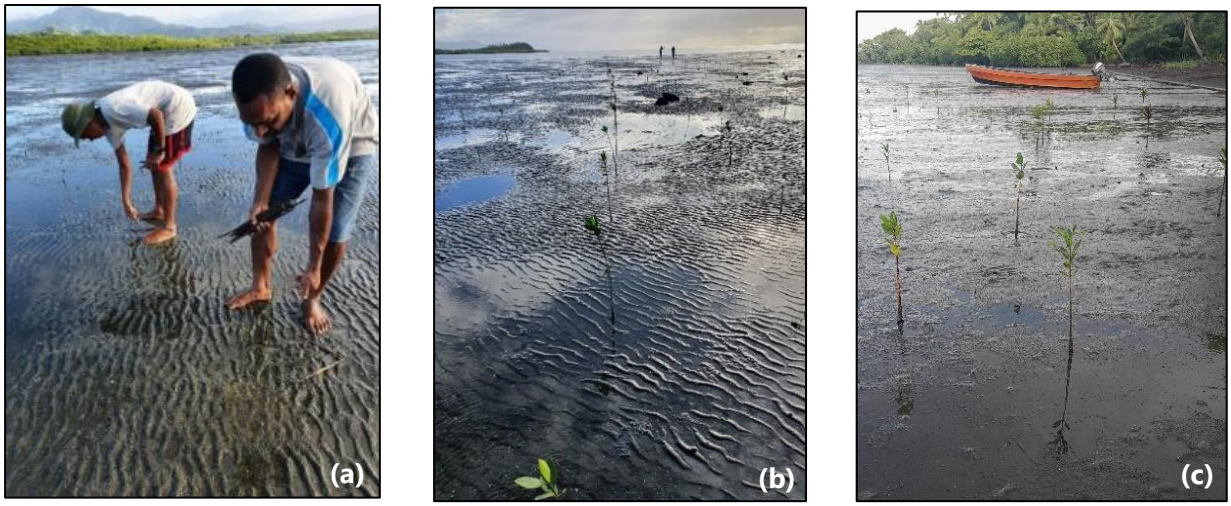



***Figure 5.5 (a)*** *Turaga ni Koro and a young member of Korolevu demonstrate how they plant mangrove propagules on the intertidal flats.* ***(b)*** *The mangrove saplings were planted in rows in the afforestation project in Korolevu (Source: Author, 2022).* ***(c)*** *Mangrove saplings approximately 18 months after planting (Source: Turaga ni Koro, 2023).*

During discussions about monitoring the mangrove project, the men mentioned that the Ministry of Forestry had come to the site to count the number of propagules planted but the village had not been trained to do any monitoring themselves. The men hoped that further into the project they may receive some training on monitoring but contributed the infancy of the project to why this has not yet happened. The *Turaga ni Koro* mentioned that he kept his own records of each project that the community undertakes, mainly recording the date and quantity of propagules planted. Project monitoring and evaluation have been identified as key components to the long-term success of projects and minimise the risk of failure. However, monitoring and evaluation of projects in developing countries often tend to be dominated by

external parties; this can decrease the local support and sustainability of a project (Otieno, 2019). The men stated that there was no formal monitoring in place, but that they instinctively managed the mangroves through their daily activities. During the meeting, it was stated that rubbish and seaweed that often surrounds the young plants would be removed, and that children of the village would not be allowed to play or gather shellfish near the newly planted seedlings.

The women of the village were asked about their involvement with the mangrove project. They said they had participated in some planting and would remove rubbish if it was seen while they were in the mangroves but they mostly supported those doing the planting by preparing food for when they arrived back to the village. Although out of the scope of this research, the limited inclusion of the women is noteworthy for future research given the emerging recognition of the critical role of women in fisheries and food security in the Pacific Islands (Bertana & Blanton, 2022; Clissold & McNamara, 2020; Rabbitt et al., 2022).

## 5.3 Assessment framework for EbA quality standards

The following section outlines the application of the FEBA framework against Korolvu's mangrove planting project.

### **Criterion 1.** Reduced social and environmental vulnerabilities

Information provided during the *talanoa* sessions and transect walk of the mangrove project area at Korolevu allowed for Criterion 1 Quality Standards to be assessed. Based on the data collected during the group discussions and observations of the planting site these Quality Standards have been rated between strong, weak and very weak (*Table 5.2*). Korolevu's higher rating was based on the scale of their project compared to Vusasivo, Navunievu, and Raviravi, as well as their consideration of connecting ecosystems as part of their overall plan. In addition to planting mangroves, the community had committed to revegetating the nearby hills with native forest trees to limit the runoff to the reef. Korolevu's lower ratings were due to the absence of a vulnerability assessment and future impacts of climate change and climate variability sourced from quality data.

### **Criterion 2.** Generates societal benefits in the context of climate change adaptation

Societal benefits were mostly rated strong or very strong (*Table 5.2*) due to the low cost and high monetary and non-monetary benefits to the whole community that this project would provide.

### **Criterion 3.** Maintains or improves ecosystem health

Quality indicators in Criterion 3, within Element B - *Making active use of biodiversity and ecosystem services*, were mostly ranked between weak and very weak due to the limited evaluation and monitoring of ecosystem and species health and services done during project planning, in addition to the limited number of stakeholders between sectors that are providing support (*Table 5.3*). If human pressure was removed by implementing a marine protected area (MPA) this criterion would be rated higher.

### **Criterion 4.** Is supported by policies at multiple levels

Criterion 4 assesses how the EbA project is supported through policy and legal frameworks and the level of multi-sector engagement. The mangrove planting at Korolevu was initiated by an NGO, while the Ministry of Fisheries and Ministry of Forestry have provided some support and advice but the project is primarily implemented and managed by the Korolevu community, and it was evident that they would benefit from further support and training (*Table 5.4*).

### **Criterion 5.** Supports equitable governance and enhances capacities

Criterion 5 assesses the project's community and gender inclusivity. The women in Korolevu had limited involvement or consultation in the project but the benefits are community-wide and the project incorporates a high degree of local and Indigenous knowledge. The ranking for this criterion ranged from very strong to very weak (*Table 5.4*).

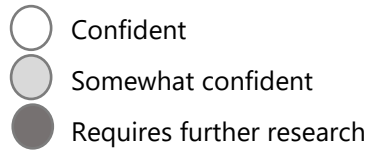



***Table 5.2*** *Assesses Element A of the Assessment Framework for EbA Quality Standards – Helping people to adapt with regard to Korolevu's mangrove project.*

| Qualification Criteria | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #1. Reduced social and environmental vulnerabilities | **1.1** Use of climate information | Yes, short-, medium-, and long-term | | | Very limited or not at all | • Extent of information about future climate change used<br>• Quality of climate data sources |
| | **1.2** Use of local and traditional knowledge | Yes | | | Very limited or not at all | • Extent and relevance of local resources consulted (individuals, communities, NGOs)<br>• Participation of affected natural resource users during the planning process<br>• Quality of consultation process |
| | **1.3** Taking into account findings of vulnerability assessment (VA) | Yes, clearly integrating findings of climate change vulnerability assessments | | | Very limited or not at all | • Extent to which information from VA is being considered<br>• Consideration of climate risk reduction potential<br>• Extent to which ecosystem services are assessed by the VA |
| | **1.4** Vulnerability reduction at the appropriate scale | Land/seascape scale or larger | | | Local-scale | • n or % of the population with reduced vulnerability<br>• Effects from different scales of ecosystems are considered |
| #2. Generates societal benefits in the context of climate change adaptation | **2.1** Quantity and quality of societal benefits compared to other adaptation options | Very high | | | Comparable | • Quantity of monetary and non-monetary benefits provided (e.g. income, resource access, reduced risks)<br>• Quantity and quality of provisioning ecosystem services (e.g. water, food, fibre), regulating ES (e.g. erosion prevention, extreme event buffering, climate regulation) as well as supporting and cultural ES<br>• Extent of physical asset damage or destruction avoided (e.g. Saved Wealth index)<br>• Extent of avoided deaths and injuries (e.g. Saved Health index) |
| | **2.2** Timescale of societal benefits demonstrated | Short-, medium, and long-term | | | Short- and/or medium-term | • Sustainability of provided benefits<br>• Estimated or projected benefits |
| | **2.3** Economic feasibility and advantages compared to other adaptation options | Very high | | | Low | • Positive economic and non-economic assessments (taking into account a quantification of ecosystem services benefits) |

| | | | | | |
|---|---|---|---|---|---|
| | **2.4** Number of beneficiaries | High | | Low | • n or % of benefitting people |
| | **2.5** Distribution of benefits | Fair and transparent | | Distribution questionable | • Distribution of benefits within and between different groups |

Confident
Somewhat confident
Requires further research

***Table 5.3*** *Assesses Element B of the Assessment Framework for EbA Quality Standards – Making active use of biodiversity and ecosystem services with regard to Korolevu's mangrove project.*

| Qualification | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #3. Restores, maintains or improves ecosystem health | **3.1** Appropriate scale of management | Land/seascape scale or larger | | | Small scale | • Size of the area (e.g. in ha) under management |
| | **3.2** Prioritisation of key ecosystem services within management | Yes, clear | | | Very low | • n of indicator species (e.g. IUCN Red list) showing the quality of ecosystem and its services<br>• Valuation of n ecosystem services (esp. supporting, regulating and cultural) over time |
| | **3.3** Monitoring of ecosystem services health and stability | Yes | | | No | • Results of IUCN Red List of Ecosystems categories and criteria<br>• Results of ecosystem risk assessments |
| | **3.4** Protection and management area coverage/diversification of land use | High coverage | | | Very little coverage | • Size or % of protected area<br>• Size or % of restored area<br>• Size or % of sustainably managed area<br>• Size or % of different land use systems |
| | **3.5** Level of co-management (government, communities, private sector) | Very high | | | Limited | • n of (community) management plans<br>• n of stakeholders engaged in management<br>• Level of cooperation between government, local stakeholders and private sector |

Confident
Somewhat confident
Requires further research

***Table 5.4*** *Assesses Element C of the Assessment Framework for EbA Quality Standards – Part of an overall adaptation strategy with regard to Korolevu's mangrove project.*

| Qualification | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #4. Is supported by policies at multiple levels | **4.1** Compatibility with policy and legal frameworks and policy support | Very high | | | Limited | • n of direct links between EbA measure with policies and legal frameworks<br>• Quality and type of policies that support the implementation of the EbA measure as well as its replication and upscaling<br>• n of political decision-makers engaged in the process |
| | **4.2** Multi-actor and multi-sector engagement (communities, civil society, private sector) | Very high, with different actors/sectors | | | Limited | • Level or % of civil society engagement in policy discussions<br>• Level or % of private sector engagement in policy discussions<br>• n of sectors involved<br>• n or % of people participating in activities |
| #5. Supports equitable governance and enhances capacities | **5.1** Accountability and group representation | Clearly demonstrated (up and down) at the relevant scale | | | Very little demonstrated, with decisions made externally | • Level of accountability and transparency<br>• Level or % of civil society engagement in governance<br>• Level or % of private sector engagement in governance<br>• n or % of people participating in awareness raising or training sessions |
| | **5.2** Consideration of gender balance and empowerment | Explicit part of the proposal | | | None | • Gender balance within each benefiting group |
| | **5.3** Status of Indigenous and local knowledge and institutions | Respected or incorporated | | | Not respected or incorporated | • n or % of indigenous or local people represented in the governance structure |
| | **5.4** Long-term capacity to ensure sustainable governance | Very strong | | | Little or none | • n or % of individuals in a group of beneficiaries directly involved in governance framework |

## 5.4 Conversation themes based on probing questions

Section 5.4 outlines the key themes that arose during the *talanoa* sessions.

### 5.4.1 Knowledge and use of mangroves

The importance of mangroves for Pacific Island communities has been a key component and emerging theme throughout this research. Discussions with both the men and women of Korolevu confirmed this importance yet there was a notable gender difference in mangrove knowledge. The men identified many ecological and provisional benefits of mangroves, stating:

> *"Some of the reasons for the planting is we understand that mangroves can be a good source to replenish the ecosystem where we can get a lot of marine species. And if we have a lot of mangroves, it will help build up the coastal land. Also, that climate change is affecting the marine ecosystem and mangroves can solve the problem of climate change. Another main reason is this area is a place for mullet spawning and breeding. If we grow mangroves, it will help mullet spawning."*

Despite the men's knowledge of mangroves, they were uncertain about the number and name of the types of mangroves growing in the area. One of the elders in the group discussion said:

> "*We have very limited knowledge of the mangroves just because we do not take much interest in them. Just recently, knowledge about mangroves has been brought in by experts. The thing about mangroves seems like a new thing. Before there has never been a concern about them. If there had been and the information was given from one generation to another it would have helped us. The issues about mangroves being important and something that needs to be taken into account has happened recently."*

This statement implies that resource management was not a concern until more recent times, perhaps following the larger-scale commercialisation of some provisional ecosystem services or lifestyle changes. For example, clearing mangroves for firewood to fuel copra dryers, the shift from subsistence to semi-subsistence livelihoods, or from traditional *bure* (huts) to larger timber houses (the timber often sourced from mangroves).

Contrary to the men, the women mostly focused on the cultural and provisional services provided by mangroves, such as fishing and crabs, wood, *masi* dying, medicine and making *salusalu* (a traditional garland). One of the women stated there were two different local mangrove species at Korolevu, *Dogo Tiri* and *Dogo Tu*, referring to *Bruguiera gymnorhiza* and *Rhizophora samoensis*. There was some disagreement

about this as another woman said there were three - another called *Dogo Bele,* which may be the case that there is a third species along the river banks. It was then discussed that the names the women use stem from the village they grew up in or even the village their mothers grew up in, hence some variations in common names. The woman who believed there were two species originated from the west of the main island, Viti Levu, while the minister's wife, who said there are three, is from a village on the periphery of Savusavu, Vanua Levu Island.

### 5.3.2 Conservation of resources

The point the men raised about the need to conserve mangroves being a new concept was further explored during the *talanoa* session. One elder explained:

> "*Most Fijians were never taught about conservation from our elders. We take it for granted that the resources are ours and that our ancestors have lived off it and now it's our time to live off it as well and it's always there to do whatever we want with it.* Another elder continued, stating: *"We were never informed by our parents about the importance of our resources. That's why we don't seem to care. For instance, if we go into the forest with a knife someone will just cut off a tree branch without a second thought or rest the knife by lodging it into the tree trunk."*

These statements identify the importance of finding knowledge gaps when implementing EbA which may be filled with knowledge from the broader Pacific Island community and Western knowledge (Nalau, Becken, Schliephack, et al., 2018; Nunn & Kumar, 2018; Reyes-García et al., 2019; Walshe et al., 2018). Other researchers have shown that traditional mangrove management systems align with the fundamental principles of EbA (Pearson et al., 2020).

The men of the village raised concerns about the number of people (outsiders) taking resources from the mangroves in front of the village. They said they have a plentiful supply of fish and beche-de-mer because of how they manage their resources now but they struggle to protect them. One man said:

> *"If you look out there at night [pointed towards the sea] you will see lights. Those are outsiders. They come to collect [crabs and sea cucumbers] from around the mangroves. They are benefiting from what we are doing."*

The men said they have plans to put a *tabu* in place but this is often not respected by people from neighbouring villages. The men stated:

"*This government changed the rules so everything from the beach down belongs to the public. We have no say in our own area. That's why anybody can come from anywhere*".

Within Fiji, the law recognises 410 traditional fishing grounds (*qoliqoli*) in which around 850 Fijian communities have communal rights to fish, meaning the state holds legal control and ownership rights over each *qoliqoli* (Prince et al., 2021). The same authors state that the Ministry of Fisheries (MoF) administers the Fisheries Act of 1942 (updated in 1979) and the supplementary Offshore Fisheries Management Act of 2014, controlling the licensing required for the commercial trade of coastal resources. Although it is the role of the MoF to enforce regulations they do not have enough resources to do so, leaving the day-to-day management of *qoliqoli* to each community.

### 5.3.3 Traditional and Local Knowledge (TLK)

TLK is widely recognised as a key element for sustainable adaptation in the Pacific Islands (Westoby et al., 2021) and is therefore an important aspect of this research. Further to this, TLK is often passed down through storytelling which was the premise for the *talanoa*-style sessions with the community members for this research. An example of a story told by an elder during one of the sessions about why the mangroves no longer exist in front of the village was about some boys travelling by boat who tried to make some space to come ashore so they started cutting down the mangroves to create a path. When they got to the village the boys were told that they should not cut down the mangroves like that; instead, they should be planting them. The elder telling the story deduced from this that people from the village sometime in the past had the instinct to protect the mangroves and this was one way they conveyed this message to the next generation.

As the conversation continued, another man suggested that knowledge gaps have been created as Fijian knowledge is not recorded, stating:

"*One of the problems in Fiji is when we pass down knowledge nothing is written, it is all passed down through word of mouth.*"

Traditional knowledge was also passed down from elders to the next generation through hands-on practical field experience, which requires the knowledge holder to keep their skills alive by actively practicing them. This also applies to the new knowledge holders (the next generation), required to practice their new skills so they can also pass these on to the subsequent generation (Kitolelei et al., 2021). The same authors state that Pacific Island fishers are still continuously adding to their local knowledge base for

future generations but work on protecting and documenting this knowledge is key as many of the younger generation are no longer interested in learning traditional ways.

During discussions about the traditional practice of making *masi* (tapa), the women all knew the dye for printing the masi design came from mangroves, but the church minister's wife was the only one who had witnessed the process being done. When asked if many young people would know how to do this, one of the men replied:

> *"I don't think so. Nowadays, if people want tapa they buy it so it kills off that tradition* [knowledge/skill]. *It is very involved. You have to get the dye and make the stencil. A long process."*

It is believed that the men were implying that without this skill being practiced no one will know the process of traditional masi-making within the next few generations. Towards the end of a discussion with the whole group, they were asked their opinion on external assistance and blending Western and local knowledge. The men felt that blending knowledge was important for their village projects.

### 5.3.4 'Hard' versus 'other' solutions

In conversations to determine Korolevu's community perspectives on different approaches to adaptation (hard structures versus ecological solutions), one elder stated: "*We believe that any sea wall established will be destroyed eventually*." The *Turaga ni Koro* followed up this comment with: *"We believe that erosion can be alleviated properly through the use of natural means like mangrove planting and coastal re-establishment*", indicating their favouring of natural solutions over hard structures and their understanding of the role that coastal ecosystems play in stabilising a shoreline. Despite this preference, the men said they would like the funds to build a structure to reinforce and raise the river bank with the hope of reducing water entering the original village. In the meantime, they had planted mangroves and Vetiver grass along the river banks to stabilise the substrate which is eroding in some areas. This overarching preference for natural solutions differed from what was noted in the other case study villages, which all favoured (or at least had equal confidence in) seawalls. Korolevu's reasoning may be influenced by the fact that they are not experiencing the same shoreline erosion as other villages.

### 5.3.5 Understanding of climate change

The topic of climate change was not raised intentionally during the discussions to see if it was mentioned by community members. The men mentioned that their intention for mangrove planting was: "*Not just for Korolevu, but also for Fiji and the planet to help reduce climate change*", but did not elaborate further on

this. The women of Korolevu did not mention climate change. The fact that climate change was not a topic of great interest was perhaps because what Korolevu viewed as their greatest concerns were things such as an incomplete church, that cannot be attributed to climate change. The reason why a new church had been built was not determined during this visit. The old church had some visible damage which had been caused by TC Winston in 2016, along with several large trees within the vicinity of the old church that had fallen (*Figure 5.6*).

***Figure 5.6*** *One of several large trees in Korolevu Village uprooted by TC Winston in 2016 (Source: Author, 2022).*

### 5.3.6 Trust in faith for challenge management

Given the entrenched spiritual and religious beliefs in the Pacific Islands region, it is beneficial to explore how or if these beliefs influence sustainable climate change adaptation (Luetz & Nunn, 2020). The community's reliance on faith to overcoming community challenges was not spoken about during the *talanoa* sessions, yet during other conversations with the *Turaga ni Koro*, he expressed urgency in finishing the new church, stating his belief that if the church was complete, all their problems *[meaning the bridge, water supply, and flooding]* would be resolved. The foundations and walls of the church had been completed and the community were saving money for the windows, roof and internal fit-out. The *Turaga ni Koro* said our visit was a blessing and assurance that their prayers were being heard. Christianity impacts community decision-making, therefore externally-funded adaptation projects in the Pacific Islands need to adopt a faith-engaged approach if the project is to gain local support and be sustainable (Nunn, 2017).

### 5.3.7 Impacts of COVID-19

Both the men and women claimed that movement and social gathering restrictions due to COVID-19 impacted their community because in Fijian village life it is customary to socialise, talk and eat together. Substantiating this, while speaking with a woman at another case study site, the woman yelled in *iTaukei* to someone walking in the distance. She then apologised, saying: "*I'm sorry. I asked them to come and have tea. That's what we do here in Fiji*". The women of Korolevu added that they found the regulations applied to church services were particularly difficult given that their beliefs are such an important part of their daily lives. There was mention of negative consequences resulting from the school closures and some children resisting going back to school once they reopened, as they had also done in Vusasivo (see Section 4.3.7). The men mentioned there were older children who did not intend on returning to school or completing their senior schooling years after the forced break due to COVID-19.

Income for the village was affected by movement restrictions as they could not sell their coconuts during the lockdown period. When asked if their food security was impacted, they replied:

> "*No, luckily we have the farms and the sea to get food from*". "*The things we tried to have* [buy] *were sugar, salt and soap*".

As noted by other researchers, subsistence/semi-subsistence-based livelihoods fared comparatively well during COVID-19, while those communities with a greater reliance on imported foods are more likely to endure food insecurity during events such as COVID-19 or natural disasters (Ferguson et al., 2022).

We discussed how COVID-19 was communicated to the village and whether most people were assured by the messages about the vaccination and were compliant with the restrictions placed on them. One of the men from the group discussion replied that some of the negative comments posted on social media had raised concerns about the vaccination but a high percentage still chose to get vaccinated. They stated that everyone observed the order to stay inside their houses because the police would regularly come to the village to monitor their compliance. A positive impact of COVID-19 mentioned by the community was that children were more engaged in village activities, such as farming and the mangrove planting project.

## 5.5 Looking forward

As was noted in Vusasivo, there were challenges and opportunities for sustainable adaptation projects identified for Korolevu. This community has land available for relocation and gardens that are not impacted by salinisation. At the time of data collection (July 2022), Korolevu Village appeared to be well supplied

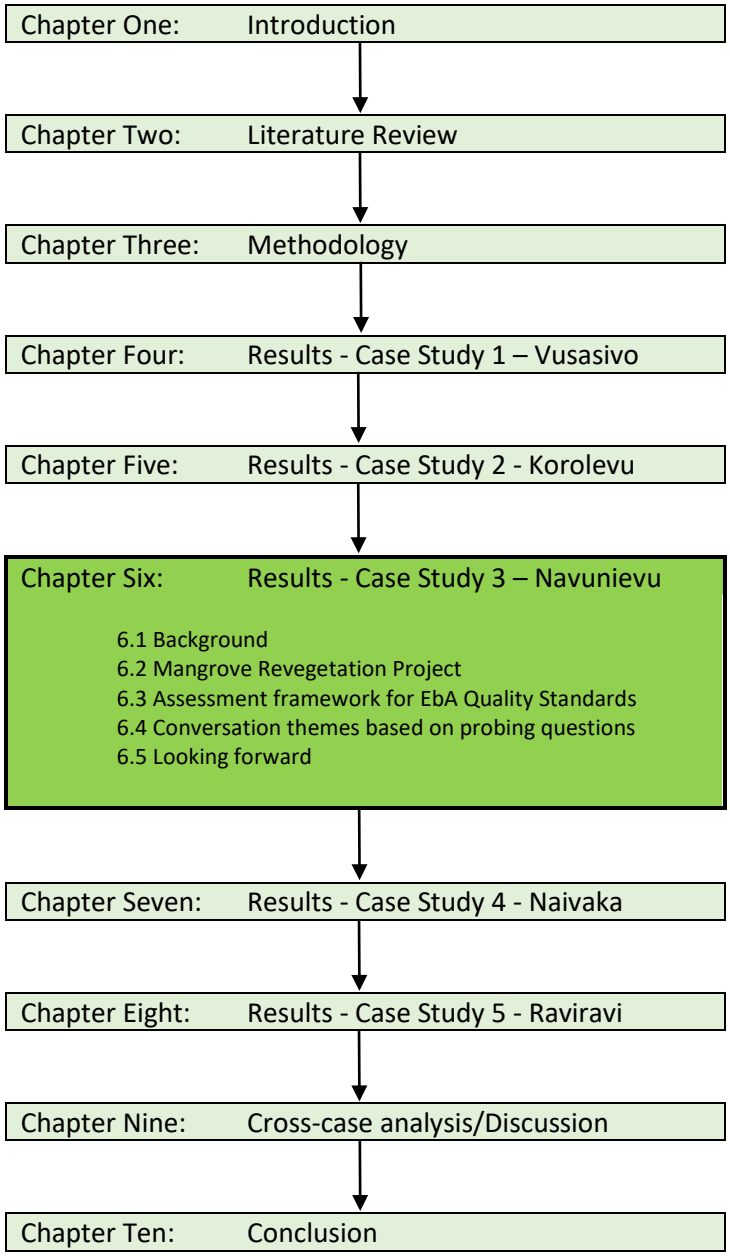
with fresh produce (fruits, vegetables, and marine resources) and less reliant on imported foods than some other case study sites.

The main challenges identified by the community were the church requiring completion, difficulty crossing the river to access the original village site, and the limited supply of freshwater. The men mentioned that they may receive some money from the government for planting trees, which they said they would spend on completing the church. The men concluded this conversation by saying that whether they are paid or not, they will still complete the planting of both the mangroves and the forest trees as they understand the benefits the community will receive by doing this. An alternative to the government providing a one-off payment to the community for planting the trees could be to improve the economic position of the community (Haak & Nakamura, 2021). For example, assisting to establish an alternative livelihood program that would provide a permanent source of income for the community, which would fund multiple projects, such as the church, bridge, water supply, and solar panels. Although there is limited literature on this, creating alternate and sustainable livelihoods for rural communities has been recognised as an important step in marine resource management as it can remove income dependence on the local ecosystems (Kronen et al., 2010). As such, non-government organisations such as C3 Fiji have focused on assisting and training communities to own and operate small business enterprises, such as screen printing and other handicrafts, apiculture, and the establishment of village stores.

The men also mentioned that they believed they would benefit from some training on planting mangroves, resource management and climate change. They were asked what is the most effective way to bring this type of knowledge into the community – by sending a community member to be trained and bring knowledge back to the community or bringing the training to the community where everybody would participate. They proposed the latter option, as they said there was no guarantee that the one or two people that participated in the training would share this knowledge with the rest of the community.

# CHAPTER SIX: (Results) Case Study Three – Navunievu (Waitabu and Tacilevu Villages)

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 6.1 Background

Navunievu is a rural coastal village in Bua Province, Vanua Levu Island, that consists of two adjoining villages, Waitabu and Tacilevu. Each village has their own *Turaga ni Koro* – Taisake Nabeca in Waitabu and Taione Ravusali in Tacilevu. The bay in which both villages are located opens towards the southeast, exposing them to the prevailing winds (*Figure 6.1*). The foreshore in front of the villages has had extensive coastal erosion and contains minimal coastal vegetation, but it does retain a seemingly healthy mangrove ecosystems bordering either side of the bay where the villages are located, with comparatively numerous propagules and sapling undergrowth (*Figures 6.2 a and b*). Fink et al. (2021) note that the Navunievu community was ordered by the colonial government to remove mangroves fringing their shoreline. Approximately a decade later, in the 1950s, they began to experience coastal changes.

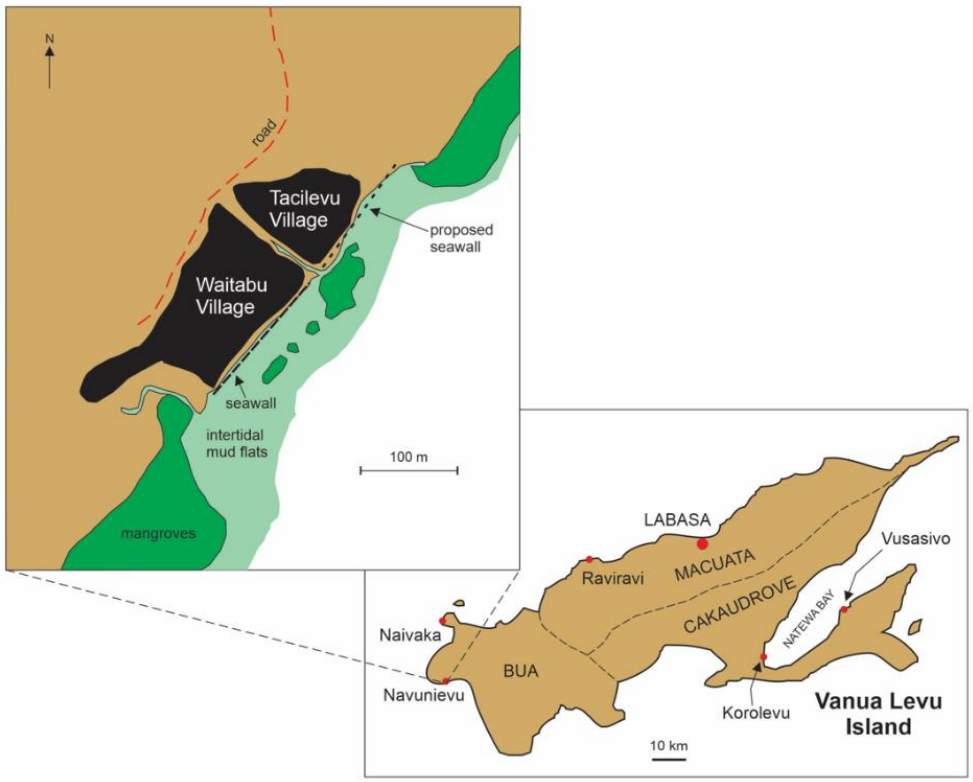



***Figure 6.1*** *Map showing Navunievu, which consists of two adjacent villages Waitabu and Tacilevu, as well as the access road that leads to the partially relocated village site, the seawall that is still under construction, proposed seawall site, and the existing mangrove forests.*

The community members have cut a path through the extensive root system of the mangrove forest to the northeast of the village to improve access to the inner section of the forest (*Figure 6.2 c*) where they source crabs to sell and consume, and timber, mostly used for firewood to fuel cooking stoves. A shallow intertidal zone consisting of mud substrate extends seaward approximately 100 metres from the villages' foreshore, and the flat grassy terrain on which the villages are located is less than one metre above sea level. There is

an unsealed road that provides land access to the urban centres and neighbouring villages, including the partly relocated Waitabu Village. At the time of fieldwork (July 2022), Navunievu consisted of approximately 20 houses in Waitabu and 12 houses in Tacilevu. The number of relocated houses was not precisely determined but reportedly numbers between 3-5 households.


***Figure 6.2 (a)*** *Healthy sapling undergrowth in the mangrove forest to the northeast of Tacilevu (2022).* ***(b)*** *Rhizophora mangrove and propagules often collected for planting in the forest to the northeast of Tacilevu (2022).* ***(c)*** *The Turaga ni Koro of Tacilevu showing the path cut through the mangroves to improve access into the centre of the forest (2022).* ***(d)*** *The eroding shoreline of Navunievu to the right of the remnants of two old seawalls: the first built in the 1970s and the second in the 1990s (2018).* ***(e)*** *The seawall under construction on the foreshore of Waitabu (2022) (Source: Author).*

Navunievu was selected as a relevant case study site due to the coastal erosion that has been impacting these two villages and to ascertain the extent to which nature-based solutions have been considered as an adaptation option. As noted by previous visits to Navunievu and other researchers (Fink et al., 2021; Nunn & Kumar, 2019), remnants of seawalls built during the 1970s and 1990s in response to coastal erosion (*Figure 6.2 d*) no longer provide physical protection to the community or coastline. The remnants of these old seawalls were removed, along with some established and newly planted mangroves during the construction of the new seawall in front of Waitabu. At the time of fieldwork (July 2022) the new seawall

was mid-construction but it was explained that it would eventually extend along the entire length of the foreshore in front of both villages (*Figure 6.1*). Soil sourced from behind the village has been piled approximately two metres high along the foreshore in front of Waitabu and large rocks stacked part way up the seaward side, which will eventually cover the entire structure (*Figure 6.2 e*). The men of Tacilevu indicated that the final plan involved planting Vetiver grass over the structure to hold the soil in place. This seawall is discussed in further detail in Section 6.4.4. Spatial images show the changes in the foreshore over time (*Figure 6.3)*, with the latest image from May 2024 showing the completed seawall running the length of the foreshore of both villages, confirming what was discussed during the group discussions.


***Figure 6.3*** *Google Earth imagery shows a comparison of Navunievu's foreshore from* ***(a)*** *March, 2010* ***(b)*** *August 2019 and* ***(c)*** *May 2024. Both (a) and (b) were taken before the new seawall had been started. A considerable amount of erosion can be seen between 2010 and 2019. The latest image has been captured after data collection, and it appears as though the seawall has been extended along the entire foreshore and has been backfilled to reclaim lost land (Google 2018).*

### 6.1.1 Participant details

The data collection carried out at Waitabu and Tacilevu over two days in July 2022 is outlined in *Tables 6.1 and 6.2*.

***Table 6.1*** *On-site data collection details from Waitabu.*

| Group/ Participant | Number of Participants | Age Range | Duration of conversation | Comments |
|---|---|---|---|---|
| Women (recorded) | 12 | 31 – 73 | 1 hour 25 mins | Heavy rain made some comments difficult to hear. |
| Men (recorded) | 12 | 26 – 66 | 1 hour 40 mins | This interview was held late in the evening after the men had been working all day. They were tired but willing to talk. |

***Table 6.2*** *On-site data collection details from Tacilevu.*

| Group/ Participant | Number of Participants | Age Range | Duration of conversation | Comments |
|---|---|---|---|---|
| Women (recorded) | 6 | 21 – 75 | 1.5 hours | Some women started to leave during the last 30 minutes as they needed to go fishing for bait during the low tide. |
| Men (recorded) | 11 | 20 - 77 | 2 hours | This discussion was very well received and men were keen to engage in a lengthy conversation. |
| Taione Ravusali and two men (not recorded) | 3 | | 2 hours | Walked through the village and intertidal flats along the fringe of the natural mangrove forest to the northeast of the village. Invited to join the women fishing for bait and witnessed a gentleman catching a crab from the mangroves. |

### 6.1.2 General information collected through conversation and observation

This section outlines general information collected during casual conversations with community members of both villages. The possibility of relocation was raised during discussions about the future of the village with rising sea levels and the likelihood that the seawall would be unsustainable in the long term. Research assistant Maleli Qera mentioned that he had spent time with the people of Vunidogoloa Village in Cakaudrove Province, saying they were 'heartbroken' at having to leave their homes and loved ones who were buried there. In 2014, Vunidogoloa was one of the first community-scale relocations undertaken in Fiji (Yee et al., 2022). For a number of years after relocating, members of the community would often return to the old village site to fish or reminisce. Research has shown that in some cases place attachment and the desire to preserve culture can inhibit this form of adaptation (Singh et al., 2020; Yee et al., 2022). Disruption to place-belonging may not always be the case with relocation when communities have the space available to relocate to higher ground within their boundaries of customary land (*mataqali*). This form of nearby relocation is a viable option for Navunievu as they have the space available and community members mentioned that the *Turaga ni Koro's* house and any other new dwellings are being built inland from the original village site.

In 2020, Tropical Cyclone Yasa[10] negatively impacted this community, including damage to houses and coastal ecosystems, including sections of the mangrove forests (*Figure 6.4 a and b*). Sustainable EbA may

[10] *Tropical Cyclone Yasa made landfall in Fiji as a category 5 system on the 17th December 2020 causing four deaths, flooding and extensive damage to crops, houses and infrastructure.*

be difficult to achieve if a project site is exposed to a cyclone or extreme weather event such as this during the early stages. In the case of mangroves, it is unlikely seedlings or young saplings would survive the impacts of wind and wave exposure of such an event (Cameron et al., 2020), and is something that should be considered during the planning phase.

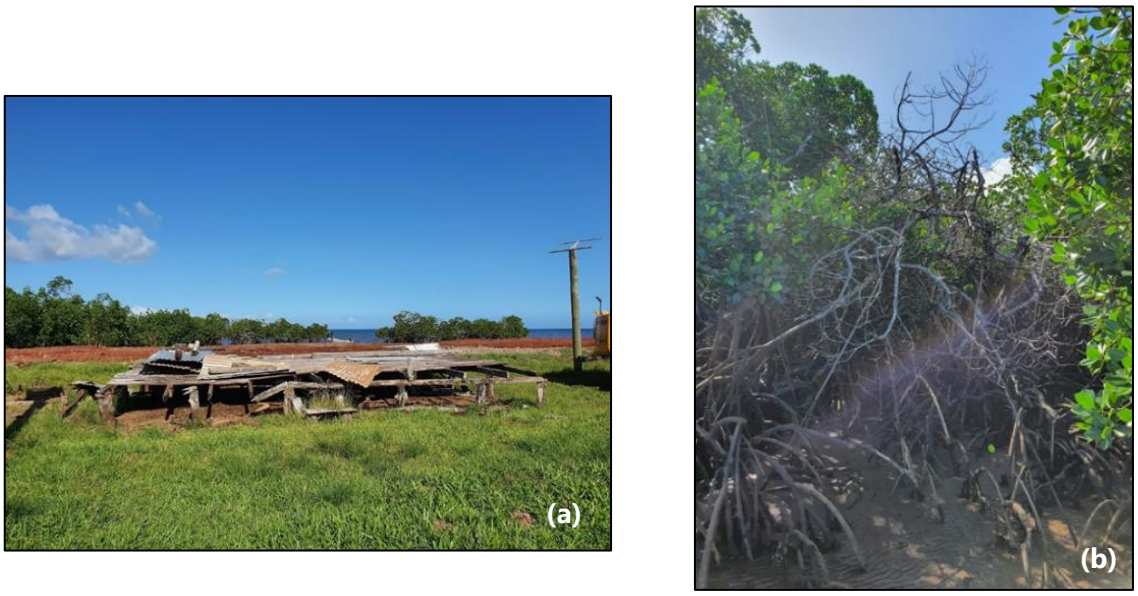



***Figure 6.4*** *TC Yasa (2022) had significant impacts on the Navunievu community, such as* ***(a)*** *Damage to infrastructure, and* ***(b)*** *damage to sections of adjacent mangrove forests (Source: Author, 2022).*

Forecasting the impact of anthropogenic climate change on tropical cyclones is based on climate models and although some progress has been made, researchers in this field suggest that there is still much improvement needed to more accurately project the impacts of TCs in the future (Walsh et al., 2016). The IPCC Sixth Assessment report suggests that based on the available data, TCs in the Pacific Islands region may decrease in frequency but may increase in intensity (Seneviratne et al., 2021). Tropical cyclones remain one of the most hazardous natural disasters for Pacific Island communities due to the strong winds, heavy rainfall, and large associated waves, coupled with rising sea levels and the adaptive capacity for such an event (Chand et al., 2020).

## 6.2 Mangrove Revegetation Project

There is currently no active mangrove project underway at Navunievu. The men of both communities provided knowledge of a mangrove project initiated in 2017 by the Minister of Youth, in conjunction with

the Pine Scheme[11] and the Ministry of Forestry, which involved the younger members of the community. The project's design did not appear to provide clear aims or objectives and minimal training or information was given to those involved. The community members were told to collect fallen propagules and shown the method by which to plant them but were not advised exactly where to plant or which propagules to plant and there was no follow-up or monitoring involved by those organising the project. When questioned about which of the two elongated propagules they planted as part of this project, the men of Tacilevu said they were not aware of the difference in propagules. When asked if they knew the reason for the project, one man said, "*climate change*". While another said:

> *"We think because of the logging. The trees are meant to receive the rain and because they were removed it washes to the ocean so the mangroves are meant to do the task. The soil runs down so the mangroves become the strainer."*

This comment led to a discussion about the impacts that runoff can have on the health of nearby reefs, which can create challenges when trying to catch fish to feed the family or to sell, of which the men were aware. The men mentioned that all the youth in the village had received training through the 'Ridge to Reef' project about the effects of runoff. Details of the Ridge to Reef project was discussed in Section 5.1.3.

The women of Waitabu claimed they knew very little about the 2017 mangrove planting project as they were not involved, but believed the project was to create a buffer to protect the community against strong winds. Each group discussion had slightly conflicting information regarding this project. The women of Tacilevu were aware that the project was connected to pine farming and said the people of Waitabu had received some training on mangrove planting before Cyclone Yasa. The same women said that around 1000 propagules had been planted but this was done in front of Waitabu, and Tacilevu had never planted any mangroves. When questioned why this was the case, the women said the beach in front of Tacilevu was a place they needed available to anchor their boats. When speaking with the men of Tacilevu, they said that the mangrove planting had been done on the tidal flats of Tacilevu but these mangroves did not survive. Their reasoning for this was that these seedlings may have been more exposed to weather than the seedlings in front of Waitabu. Both the weather and the lack of substrate may have contributed to the seedlings' failure to survive. Mangrove seedlings can easily uproot as a result of wave action if the young plants have not been established in the substrate (Sreeranga et al., 2021). A spatial image (*Figure 6.5 a*) of the two villages shows the location of substrate that had been deposited within the coastal vegetation

[11] *According to the Turaga ni Koro, the Pine Scheme was a government-led initiative undertaken decades ago by a limited number of communities. Pine trees were planted nearby each participating village that could be used by subsequent generations to build cost-effective housing.*

above the high tide mark by large waves during TC Yasa in 2021. This beach sediment, which consisted of sand, rocks and shells remained piled towards the back of the coastal zone, well above the high tide mark (*Figure 6.5 b*) which was pointed out by the Turaga ni Koro during the site visit.

Further factors that influence seedling survival are the depth and density in which they were planted, as well as the nutrient availability, particularly calcium and inorganic nitrogen, in the case of *Rhizophora spp*. The propagules planted at Tacilevu may have also been damaged by boat and foot traffic as this is an area where the community mentioned that they commonly anchor their boats.

The conflicting comments between the two communities are of interest to this research as understanding the social dynamics within communities has been identified as an important aspect of community-based adaptation project design (Buggy & McNamara, 2016; Clissold & McNamara, 2020). It would be important to consider the social dynamics of Navunievu during community-based adaptation planning, because it is two separate villages inhabiting the same geographic area, yet manage themselves as separate entities (Westoby et al., 2021).

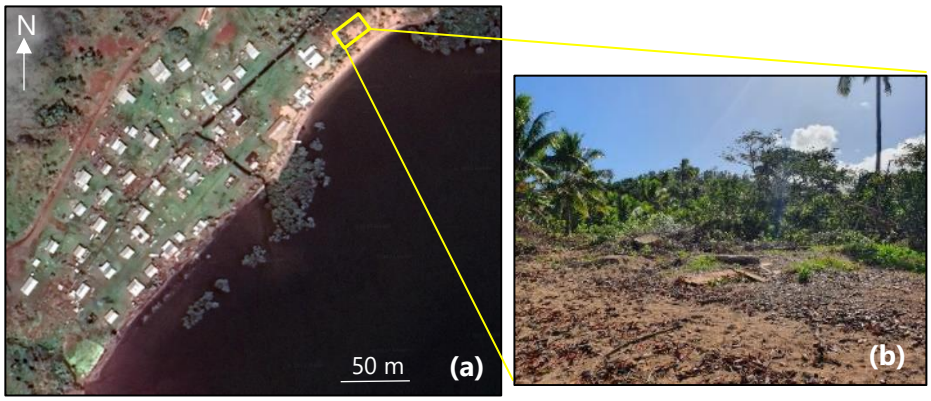



***Figure 6.5 (a)*** *Spatial imagery of the area (marked in yellow) where sediment washed up to during TC Yasa in 2021 (Google, 2018).* ***(b)*** *This is the on-ground view of the area (Source: Author, 2022). The community members were concerned with the impact the cyclone had on the back beach zone.*

The women of Waitabu identified the need to plant mangroves because they said that seawater would often enter the village and that mangroves would reduce this from happening. The men of Tacilevu admitted that they were keen to initiate a mangrove planting project and when Mr Qera explained the natural distribution and germination process of mangroves, they said this was all new information, indicating that some training would be beneficial if the project was to be sustainable. It was also mentioned

to the men of Tacilevu that some communities started their mangrove planting projects by setting up a mangrove nursery, which could be an option for them. They were interested in learning more about this.

## 6.3 Assessment framework for EbA quality standards

The following section provides an overview of the rankings given to Navunievu's mangrove project in accordance with the FEBA framework (Bertram et al., 2017), based on the information provided during the four *talanoa* sessions and observation of the seawall project and coastal vegetation at Navunievu.

### **Criterion 1.** Reduced social and environmental vulnerabilities

As Criterion 1 is based on reducing social and environmental vulnerabilities, this section has been ranked ranging from almost strong to very weak (*Table 6.3*) as the height and location of the seawall were possibly based on climate data and that there was a vulnerability assessment done in the planning stage. As the data for the planning of this project is not available the rankings have been given with 'somewhat confident' and 'requiring further research'. The intention of the seawall is to reduce vulnerability and provide protection for the community. Further research is required to determine the seawall's success once the project is complete.

### **Criterion 2.** Generates societal benefits in the context of climate change adaptation

The quality and quantity of societal benefits were rated low for Navunievu's seawall as although the seawall provides some protection, this will be short-term and it offers far fewer economic benefits when compared with other adaptation options (*Table 6.3*). This section also assesses the number of beneficiaries, which was ranked highly as all community members from both communities have equal benefit from the seawall.

### **Criterion 3.** Maintains or improves ecosystem health

As Criterion 3 is based on restoring, maintaining or improving ecosystem services all Quality Standards were ranked very low (*Table 6.4*) for Navunievu as mangroves were removed to build the new seawall, including some newly planted saplings.

### **Criterion 4.** Is supported by policies at multiple levels

Criterion 4 assesses how the EbA project is supported through policy and legal frameworks and the level of multi-sector engagement. For the purpose of this research, both Criterion 4 Quality Standards have been ranked 'very weak' as there are no EbA projects underway (*Table 6.5*).

### **Criterion 5.** Supports equitable governance and enhances capacities

Quality Standards for Criterion 5 (*Table 6.5*) have all been ranked low as this section focuses on community engagement and training, inclusivity and the degree to which the project enhances community capacity. The Quality Standards based on the level of an Indigenous voice to the project have been ranked 'weak' as although the community was consulted about the seawall project, the project itself does not make use of Indigenous knowledge (*Table 6.4*).

Confident
Somewhat confident
Requires further research

***Table 6.3*** *Assesses Element A of the Assessment Framework for EbA Quality Standards – Helping people to adapt with regard to Navunievu's mangrove project.*

| Qualification Criteria | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #1. Reduced social and environmental vulnerabilities | **1.1** Use of climate information | Yes, short-, medium-, and long-term | | | Very limited or not at all | • Extent of information about future climate change used<br>• Quality of climate data sources |
| | **1.2** Use of local and traditional knowledge | Yes | | | Very limited or not at all | • Extent and relevance of local resources consulted (individuals, communities, NGOs)<br>• Participation of affected natural resource users during the planning process<br>• Quality of consultation process |
| | **1.3** Taking into account findings of vulnerability assessment (VA) | Yes, clearly integrating findings of climate change vulnerability assessments | | | Very limited or not at all | • Extent to which information from VA is being considered<br>• Consideration of climate risk reduction potential<br>• Extent to which ecosystem services are assessed by the VA |
| | **1.4** Vulnerability reduction at the appropriate scale | Land/seascape scale or larger | | | Local-scale | • n or % of the population with reduced vulnerability<br>• Effects from different scales of ecosystems are considered |
| #2. Generates societal benefits in the context of climate change | **2.1** Quantity and quality of societal benefits compared to other adaptation options | Very high | | | Comparable | • Quantity of monetary and non-monetary benefits provided (e.g. income, resource access, reduced risks)<br>• Quantity and quality of provisioning ecosystem services (e.g. water, food, fibre), regulating ES (e.g. erosion prevention, extreme event buffering, climate regulation) as well as supporting and cultural ES<br>• Extent of physical asset damage or destruction avoided (e.g. Saved Wealth index)<br>• Extent of avoided deaths and injuries (e.g. Saved Health index) |
| | **2.2** Timescale of societal benefits demonstrated | Short-, medium, and long-term | | | Short- and/or medium-term | • Sustainability of provided benefits<br>• Estimated or projected benefits |
| | **2.3** Economic feasibility and advantages compared to other adaptation options | Very high | | | Low | • Positive economic and non-economic assessments (taking into account a quantification of ecosystem services benefits) |

| | | | | |
|---|---|---|---|---|
| | **2.4** Number of beneficiaries | High | Low | • n or % of benefitting people |
| | **2.5** Distribution of benefits | Fair and transparent | Distribution questionable | • Distribution of benefits within and between different groups |

Confident
Somewhat confident
Requires further research

***Table 6.4*** *Assesses Element B of the Assessment Framework for EbA Quality Standards – Making active use of biodiversity and ecosystem services with regard to Navunievu's mangrove project.*

| Qualification | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #3. Restores, maintains or improves ecosystem health | **3.1** Appropriate scale of management | Land/seascape scale or larger | | | Small scale | • Size of the area (e.g. in ha) under management |
| | **3.2** Prioritisation of key ecosystem services within management | Yes, clear | | | Very low | • n of indicator species (e.g. IUCN Red list) showing the quality of ecosystem and its services<br>• Valuation of n ecosystem services (esp. supporting, regulating and cultural) over time |
| | **3.3** Monitoring of ecosystem services health and stability | Yes | | | No | • Results of IUCN Red List of Ecosystems categories and criteria<br>• Results of ecosystem risk assessments |
| | **3.4** Protection and management area coverage/diversification of land use | High coverage | | | Very little coverage | • Size or % of protected area<br>• Size or % of restored area<br>• Size or % of sustainably managed area<br>• Size or % of different land use systems |
| | **3.5** Level of co-management (government, communities, private sector) | Very high | | | Limited | • n of (community) management plans<br>• n of stakeholders engaged in management<br>• Level of cooperation between government, local stakeholders and private sector |

Confident
Somewhat confident
Requires further research

***Table 6.5*** *Assesses Element C of the Assessment Framework for EbA Quality Standards – Part of an overall adaptation strategy with regard to Navunievu's mangrove project.*

| Qualification | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #4. Is supported by policies at multiple levels | **4.1** Compatibility with policy and legal frameworks and policy support | Very high | | | Limited | • n of direct links between EbA measure with policies and legal frameworks<br>• Quality and type of policies that support the implementation of the EbA measure as well as its replication and upscaling<br>• n of political decision-makers engaged in the process |
| | **4.2** Multi-actor and multi-sector engagement (communities, civil society, private sector) | Very high, with different actors/sectors | | | Limited | • Level or % of civil society engagement in policy discussions<br>• Level or % of private sector engagement in policy discussions<br>• n of sectors involved<br>• n or % of people participating in activities |
| #5. Supports equitable governance and enhances capacities | **5.1** Accountability and group representation | Clearly demonstrated (up and down) at the relevant scale | | | Very little demonstrated, with decisions made externally | • Level of accountability and transparency<br>• Level or % of civil society engagement in governance<br>• Level or % of private sector engagement in governance<br>• n or % of people participating in awareness raising or training sessions |
| | **5.2** Consideration of gender balance and empowerment | Explicit part of the proposal | | | None | • Gender balance within each benefiting group |
| | **5.3** Status of Indigenous and local knowledge and institutions | Respected or incorporated | | | Not respected or incorporated | • n or % of indigenous or local people represented in the governance structure |
| | **5.4** Long-term capacity to ensure sustainable governance | Very strong | | | Little or none | • n or % of individuals in a group of beneficiaries directly involved in governance framework |

## 6.4 Conversation themes based on probing questions

The following sections separate the data into themes that were discussed during the *talanoa* sessions with the four groups (Waitabu men and women, and Tacilevu men and women).

### 6.4.1 Knowledge and use of mangroves

Both men and women of Waitabu and Tacilevu exhibited a high level of both ecological and cultural knowledge of mangroves. After the Waitabu women listed a range of uses they stated: "*They are the source for almost everything"*. Several additional uses mentioned by Waitabu women that had not yet been mentioned by the previous two villages were for hair dye, to conceal grey hair, a dye to print *sulus*[12], and to make string to tie up crabs taken from the mangroves when preparing them for selling. The women of Waitabu and Tacilevu were able to provide a clear description of the two different genera of local mangroves. *Rhizophora stylosa* is known locally as *Dogo vere* and *Bruguiera gymnorhiza* as *Dogo kani*. Women will often marry into a village so may refer to some species with a different name. One lady referred to *Bruguiera gymnorhiza* as *Dogo dina*. Another younger woman referred to this same mangrove species as *TiriTiri*. This young woman provided particularly detailed knowledge of mangroves and was questioned about where she had learned this information. She stated that she had been living in Tacilevu for nine years but grew up in Noco Village in the Province of Rewa, on the main island, Viti Levu, and had gained her knowledge from her grandmothers. Rewa is a delta with one of the largest mangrove forests in Fiji (Lata & Nunn, 2011).

The men of both villages also confirmed the local names, *Dogo vere* and *Dogo kani*, yet they were certain they had three different species. Through the use of the mangrove identification cards, it was explained that this area of Fiji has *Bruguiera gymnorhiza* and two to three different species of *Rhizophora,* but these are difficult to differentiate. Discussions of mangrove species led to explanations of the difference between the local mangrove species and what are often referred to as mangrove associates found in Fiji, such as the Puzzlenut Tree (*Xylocarpus granatum*) and Blinding Tree (*Excoecaria agallocha*), both of which the men were also familiar with.

While discussing the use of mangroves, the Waitabu men stated a negative impact of using mangrove timber for building is that it causes nails to corrode due to the high levels of salt within the wood, an interesting piece of information that had not been mentioned in previous conversations. The men of

[12] *A sulu is a piece of fabric tied around at the waist worn in Fiji by both men and women.*

Tacilevu said that when mangroves are used for firewood, only the dead trees are used and live trees are not cut down, demonstrating an understanding of conservation for mangroves.

To explore how the community members perceived any changes to the coastal vegetation in the small bay in which Navunievu is located, the groups were asked if there were ever mangroves in front of their village. The Waitabu women replied that the mangroves were used to build community infrastructure from time to time, such as a new community hall. Later in the conversation, an older woman recalled her parents processing copra here in the village and said the mangroves were cut down to fuel the dryers, but more recently, mangroves and newly planted seedlings had been removed during the construction of the new seawall. The women of Waitabu believed that the previous elders had planted the taller mangroves that exist towards the centre of the bay, in front of the drainage channel dividing the two villages (*Figure 6.4 a*). One of the men also mentioned that a previous seawall project involved mangrove planting, confirming the women's recollection.

### 6.4.2 Resource management

Understanding how a community manages their resources is an important aspect of determining the sustainability of an EbA project (Clissold & McNamara, 2020). During discussions, the women revealed that it was common practice to collect crabs, regardless of their size, which included spawning females. When the rationale behind the fishing laws was explained, the women of Waitabu replied, somewhat in jest: "*But they taste nice, why do we have to put it back?*" A side comment from Mr Qera during this time was that sometimes the response C3 Fiji receives when suggesting to a community that they should refrain from illegal practices, such as harvesting endangered species, is negativity and resistance. It is perceived that this is the land and resources of the community and their elders have been able to use these resources, therefore they can also. The women of Tacilevu explained that they had learned the laws regarding illegal harvesting as part of the training for their fishing licence but returning the spawning crabs means their income is reduced. In rural Fijian villages, women often provide a substantial contribution towards the household income (Bertana & Blanton, 2022). It was mentioned that without the source of income from the women selling crabs, the men have to work harder in the gardens. This reliance on income and the desire to still have crabs in their diet would make it difficult for the women to choose to return undersized and spawning crabs.

The women of both villages mentioned a project that had been introduced by a non-government organization, the Wildlife Conservation Society (WCS). This organisation set up a comparatively small MPA and then introduced a project where undersized or spawning crabs were to be put into small timber cages

located amongst the mangroves until they were large enough to sell or eat. The men from Tacilevu reaffirmed these details, calling it the 'crab fattening' project, and added that it was established around 2018 but was only in place for approximately 12 months as the cages were damaged by a cyclone. This described timeline aligns with TC Yasa. Although the cages are no longer in use, the MPA (*tabu*) remains in place and the women noted a bountiful supply of crabs because of it, questioning the need to take undersized crabs. The Waitabu men confirmed the abundance of crabs saying:

> "Y*ou can see the difference. We've experienced some spill-overs from the reserve. Those who go there have been witnessing the increase in the amount of crabs found there which did not always occur before.*"

When questioned about poachers coming to their MPA, the Waitabu men said:

> "*It is so close to their village so it is easy to monitor and no outsiders ever come there."* The men of Tacilevu contradicted this by saying: "*There are poachers. If we are there at night we see them. You can't see them from the village*."

In addition to the poachers acquiring resources from the MPA, a younger man from the group added:

> "*If we go with a torch at night and the crab walks out we get it. Who would want to go past a crab if they find it, tabu or no tabu, it goes in the bucket.*"

These last two statements indicate a need for stronger enforcement and policing of resources management strategies. During the *talanoa* session with the men of Waitabu regarding the disregard for the legal-size limits of crab, one gentleman responded:

> "*I am part of the conservation committee and we have learnt a lot about taking care of species, in terms of quality and quantity*".

When questioned about this, he explained that he had received training through workshops held in Labasa and Suva by the Ministry of Fisheries, WCS, and World-Wide Fund for Nature (WWF). He advised that every community should have a Conservation Committee and it is their role to enforce size limits on species, such as crabs and fish. This same gentleman also mentioned that WWF had come into the village with some coloured booklets to provide training on what species are under threat and the size limits on particular species. These same booklets had been provided to the research team by the Conservation Officer of Bua Province as arrangements were made for the community visits (*Figure 6.6*).


***Figure 6.6*** *Information booklets and brochures on sustainable fishing practices in Fiji. The Provincial Office and Ministry of Fisheries distribute these booklets to local communities and the information is provided as training when applying for a fishing licence. A fishing licence is required in Fiji by anyone wanting to sell their catch.*

These booklets provide in-depth information about the fishing regulations in Fiji and why the laws are important for the people of Fiji and the sustainability of the Fiji fishing industry. One of the booklets is written in *iTaukei* language with clear images and diagrams and includes the local names of common fish species. It also includes advice on other marine species, such as tropical species of turtles, sharks, rays, and shellfish (including molluscs, crustaceans, and echinoderms), as well as providing details on the importance of abiding by *tabu* area laws.

The women of Tacilevu were asked if their village had a Conservation Committee and if a woman could be a member of this committee. They replied, "*Yes*", and pointed to a women present at the group discussion. This female member of the committee confirmed that they meet once per month to discuss a range of items, such as beach clean-up campaigns. The rest of the group affirmed that it was the responsibility of the Conservation Committee and the *Turaga ni Koro* to monitor the adherence to species size regulations, but also mentioned that the committee was, "*not very active*". The men of Tacilevu confirmed this by saying that the village has eight committees that are responsible for different aspects of community functions and they each report to the *Turaga ni Koro*, who then has to submit a report to the Provincial Office on the village activities each month.

The men of Tacilevu mentioned that the women have a measuring device to determine if the crabs are large enough to take to the market and that villages usually have 'fish wardens' who have been trained by the Ministry of Fisheries. It is also the role of the fish warden to ensure size regulations are being met. One

younger man said that if any fish or crabs did not satisfy the size requirement they are returned to the mangroves, while another man said the undersized crabs are kept for household consumption. These variations in responses demonstrate there may be different adherence to resource management policies between households or hesitancy in revealing exactly what is the regular practice. Education and assistance in re-establishing the 'crab fattening' project may assist in establishing sustainable resource usage. The men of Tacilevu said the crab cages are simple to build and they could easily implement this project again. It was not determined why the crab project had not been resumed. A recent report on ways to increase the sustainability of mangrove restoration projects mentioned programs such as 'crab fattening' as a way to lessen the human pressure on mangrove resources; alternative livelihoods, such as beekeeping and fish farming were also suggested (Mohale et al., 2023).

The women of Tacilevu mentioned that large amounts of rubbish are washed in from the ocean and both of the women's groups mentioned that Fiji had placed restrictions on the disposal of waste into the ocean. Communal pits had been dug around the village and 'rubbish separation'[13] was something known by the people of the villages, but not everyone abided by the system. It is the responsibility of the *Turaga ni Koro* to identify these types of issues and provide solutions and training. The women from Waitabu said if they saw rubbish in the mangroves, they would sometimes collect it, but not always.

Fiji has implemented numerous waste awareness campaigns, including 'No plastic, that's fantastic', in 2012 and 2017, the 'Ecoschools Challenge' in 2013, and the 'Name and Shame' Campaign in 2015, but have not had noteworthy results (Sewak et al., 2021). These same researchers, focusing on community perspectives and engagement in waste management investigated the motives for improper waste disposal and poor waste management in Fiji, and found that negligence, lack of civic pride and personal responsibility, and lack of awareness and enforcement were the salient causes. In addition to this, awareness campaigns can instigate action because those with an understanding of the negative consequences of their actions are more likely to practice sustainable behaviour. Pollution can have negative consequences for local ecosystems, which can impact the livelihoods dependent on these resources and the sustainability of adaptation that makes use of these ecosystems. A further study indicated that a large percentage of waste in Fiji is non-organic, created from imported goods. In rural contexts, the proportion of this waste from imported goods would be much lower than in urban centres. However, plastics from, for example, food

[13] *Fiji does not have a recycling or rubbish separation policy, and currently an estimate of only 0.3 percent of waste is recycled (Sewak, A., Eshpande, S., Rundle-Thiele, S., Zhao, F., & Anibaldi, R., 2021). Within a rural community context, it was mentioned that 'rubbish separation' involved sorting waste into what could be fed to animals, what could be used as compost, and what was required to go to landfill.*

packaging and baby diapers can still become a burden on communities that do not have appropriate waste management practices in place (Jones et al., 2012).

When determining who takes on the role of monitoring to ensure the sustainable resource use of local ecosystems, the Waitabu men confirmed that women were mostly involved in work within the mangroves, such as catching crabs. When asked if the women report back if they notice any problems with the mangroves the men replied: "*No, they are focused on catching crabs*". Yet, the women from Tacilevu stated that it was also common for men to spend time in the mangroves catching crabs. In the past, traditional methods of managing resources were used to ensure a plentiful supply (Hickey, 2006; Kitolelei et al., 2021). For example, prior to a feast, a *tabu* would be implemented to ensure a sufficient quantity of resources were available for the event (Pearson et al., 2020). Other researchers have indicated (Granderson, 2017; Nalau, Becken, Schliephack, et al., 2018; Parsons et al., 2016), and conversations with community members have confirmed the benefit of co-designed management techniques to increase the sustainability of resource use as traditional practices seem less effective than they were in the past and top-down approaches are generally not supported by community members (Syddall et al., 2022). Commodification and increased global demand for marine resources, coupled with increasing economic pressures on rural Pacific Island communities, such as the increasing cost of fuel for boats have changed the landscape of traditional management practices. Fuel consumption has also increased as people are required to travel further out to sea to fish as near-shore resources are degraded (Purcell et al., 2018). Discussions with community members indicated that training and assistance in establishing formal monitoring of ecosystem health at a local level may be beneficial to ensure the sustainability of marine resources and keystone species.

### 6.4.3 Traditional and Local Knowledge (TLK)

During discussions about passing down knowledge, the two women's groups had similar responses. Waitabu women said they pass down their knowledge of mangroves to their children, who will also return from school with questions. While Tacilevu women stated they did not formally pass down knowledge but when children asked questions about something they did not understand, such as something unfamiliar they notice in the mangroves, then knowledge would be shared. The same women also added that if children stay in the village after completing their education they learn about the traditional uses of mangroves, but school-age children do not usually have a high level of detailed knowledge.

Maintaining the tradition of knowledge transfer is vital for livelihood sustainability, yet it has also been recognised that knowledge is being lost and recording it may be a way to avoid further losses (Kitolelei et

al., 2021). In Fiji, mat and basket weaving using pandanus leaves (*Figure 6.7*) contributes to the family income and provide household items that would otherwise need to be purchased. Ensuring that traditional practices such as this are passed down to younger people assists in the preservation of traditional knowledge.

***Figure 6.7*** *A woman from Waitabu drying leaves from Pandanus trees to use for mat weaving (Source: Author, 2022).*

One woman from Tacilevu said they will often use herbal medicines sourced from mangroves and other plants due to the prohibitive cost of going to a hospital. Transport is expensive if a patient is too ill to travel by public transport, and although health care is primarily free of charge through the public health sector in Fiji, the costs of medicine can be expensive. Research has indicated that the further away from an urban centre a community is located, the more likely they are to choose traditional over Western medicine (Nunn & Kumar, 2019).

The men of Tacilevu stated the need for awareness programs in conservation for the younger generation as they identified a lack of knowledge in this area. They added that it is difficult to be taught the things they know about mangroves and their local area as this knowledge is learned through observation, suggesting that perhaps the older generation were more involved in hands-on activities in their local environment than children are today. One reason for this may be because children in Fiji are spending longer in formal education than previous generations (Government of Fiji Ministry of Education National Heritage Culture and Arts, 2008).

### 6.4.4 'Hard' versus 'other' solutions

During conversations, it was mentioned that both Waitabu and Tacilevu are inundated with seawater at least once every month during high tide, and more frequently during periods of heavy rainfall, although it

was not determined if the flooding had changed since the construction of the new seawall. The women of Waitabu were in favour of the new seawall and believed: "*The shoreline will be saved from the effects of climate change*", despite the fact they had two previous seawalls which had a minimal sustained impact in reducing their shoreline erosion and inundation challenges. The women suggested the new seawall was an improved design as it was higher and built using larger rocks.

Discussions revealed that the original idea to build a new seawall arose from a community meeting. Amid this discussion, Mr Qera mentioned that he had seen many seawalls throughout Fiji that had not worked and explained some of the unintended consequences, such as flooding behind the seawall causing damage to crops and contamination of fresh water. The men's response to Mr Qera's comment was that the sea would drop again at some point in time. This comment was not explored further but may demonstrate that perhaps some of the men perceive climate change as climate variability – a point that has been noted in previous research in rural Fijian communities (Lata & Nunn, 2011). It may also be inferred that the men could have been referring to their ancestral history, stating that sea levels have changed in the past and their ancestors had managed to adapt and therefore they will also.

The women of Tacilevu expressed similar expectations of the seawall as the women from Waitabu, once construction is complete. When questioned about how they believe the seawall will stop flooding, the women said that the design incorporated floodgates that can be opened or closed. If this is the case, it may provide a solution to some of the common maladaptive challenges caused by seawalls in Fiji and other Pacific Island countries, although there was no visible evidence of floodgates being included in the design and no mention of this by the other groups. The same women demonstrated the knowledge that the seawall was not a sustainable solution and they expressed that planting mangroves should also be included as a longer-term measure. One challenge identified by the women who attended the discussion was the lack of interest amongst most of the women in the village to participate in such projects. They said that mangrove planting had to be something raised at a community meeting and out of the 26 women in the village, it would be likely only six would show an interest in being involved. Mr Qera suggested that a mangrove planting project should be something planned by the *Turaga ni Koro* as a community project, not something that is divided between men and women. He also said that the project can be designed so that it would not hinder their boat anchorage if that was a potential barrier to planting mangroves. Barriers at the community level have been identified as an area of priority requiring further research, as they can hinder sustainable adaptation (Piggott-McKellar, McNamara, Nunn, & Watson, 2019). One woman expressed her desire to be part of a rehabilitation program and said our visit was '*like an awakening*' and had they thought about some of the things discussed they would have started planting long before now.

When discussing comparisons between the previous seawalls and the new one, the men of Waitabu advised that one of the reasons the old seawalls were unsuccessful at reducing flooding was that they were never built along the entire shoreline. The men described the second seawall, built in the 1990s as laborious as it was constructed by hand with rocks transported from a nearby bay at low tide via a *bilibili*. They claimed that elders also planted mangroves in front of that seawall as part of the same project, but these mangroves, along with the remnants of the old seawalls were removed as part of the new seawall project.

The current district representative said he was the *Turagi ni Koro* of Waitabu for 19 years and throughout that time he had been requesting a seawall to be built but now it had been started he was uncertain how long it would remain in place. The new seawall, designed by the Ministry of Waterways, was going to be constructed using large rocks. The same man explained that he did not think it would have drain holes because the rocks were very large and the water should drain through. Pooling of water behind the seawall was noted after approximately 15 minutes of heavy rainfall (*Figure 6.8 a and b*) and the wall currently had no drainage points for the water to escape; it therefore appeared that the villages would be faced with some unintended consequences caused by the new seawall, as is the case with many other Pacific Island communities (Nunn et al., 2021; Piggott-McKellar, Nunn, et al., 2020).

Although it was not mentioned during interviews, access to the sea may be somewhat restricted once the wall is completed (*Figure 6.8 c*). This may also provide additional challenges as many Pacific Island livelihoods rely on marine resources for consumption and income, and restricted access has been identified as a negative consequence by other coastal Fijian communities that have had similar seawalls erected (Dacks et al., 2018; Kronen et al., 2010; Piggott-McKellar, Nunn, et al., 2020). Boats that are used for fishing and collecting other marine resources are usually anchored in the intertidal flats close to the village where they can be easily accessed and unloaded during high tide, which was also the concern raised by the Tacilevu women if they were to plant mangroves in this location.


***Figure 6.8 (a and b)*** *Flooding behind the new, partially-built seawall in Waitabu, after a small amount of precipitation.* ***(c)*** *Seawalls can create additional challenges for a rural village, such as limiting access to and from the village and the sea (Source: Author, 2022).*

Several men from the Waitabu group discussion shared the women's view that the seawall would not be a long-term solution. They suggested that within the next 10 to 15 years, it may not provide any protection but they had planned on planting mangroves to eventually replace the role of the seawall. The same men stated that the community had started building new houses upslope further back from the shoreline, which included the *Turaga ni Koro's* house. This may result in a gradual migration of the community and is an example of incremental autonomous adaptation (Fink et al., 2021; Mycoo et al., 2022; Nunn & Kumar, 2019). The men of Tacilevu had a similar sentiment that the seawall may not be a sustainable solution to their community challenges, leading Mr Qera to emphasise the importance of planting mangroves. He told the men about the similarly designed seawall at Raviravi (discussed in Chapter 8) that was opened by the Prime Minister in 2020, then badly damaged by Cyclone Yasa several months afterwards. He recalled that only the bottom half of the wall remained and all the Vetiver grass was gone and seawater had come into the village, and that mangroves could have reduced the impact of the cyclone and the damage to the seawall.

A study aimed at identifying factors that increase risk of project non-completion in the Pacific Islands found that projects where EbA was combined with hard-engineered structures, such as a seawall, had a significantly lower probability of completion compared to projects where EbA alone was used (Hasan et al., 2021). The same research suggests this may be because combining approaches could lead to contradictory implementation priorities, while they quote another researcher who states that ecosystem and engineered projects may be mutually exclusive because the two approaches are possibly incompatible, culturally, institutionally, logistically or physically. This claim is of interest and is explored further in Chapter

Nine; this is because three of the five case study sites had a recent seawall built and are in the early stages of EbA projects.

### 6.4.5 Understanding of climate change

Without probing with phrases such as 'climate change', information about what the men of Waitabu attributed the seawater flooding the village to was gathered. They did not initially mention climate change as a contributing factor, but said:

> "*At one point we realised the village is below sea level so at king tides waves come right into the village*". Much later in the conversation, the men added that: "*The new seawall will look different in 10 or 20 years as sea-level rises and climate is persisting*". They mentioned that: "*Houses once stood where the new seawall is built*".

The men of Tacilevu were asked about their understanding of seawater entering the village in a similar format and if this is a new phenomenon. Their response was: "*sea-level rise*", and claimed they had heard about this on the radio and from the Adventist Development Relief Agency (ADRA), which is a Seventh-Day Adventist group who offered training on good governance and food security to a selection of Fijian villages. During the session on food security, information about climate change had been provided. An impact of the flooding was mentioned by the same men, who stated that all of their taro crops had died after TC Yasa as seawater had flooded their village.

During this same discussion with the men of Tacilevu, they mentioned that they had noticed a bout of extremely high temperatures leading up to TC Yasa and TC Ana[14], along with extreme precipitation patterns, both droughts and floods which adversely affected their farm's agricultural productivity. The women of Waitabu attributed the extreme high tides that have become a regular occurrence to climate change. The youngest member (age 21) of the women's discussion group in Tacilevu talked about climate change and explained her understanding of the process and claimed she had learnt this in geography lessons at school. When the rest of the women were asked about their understanding of climate change, their responses were minimal, suggesting their limited confidence in explaining the phenomenon.

In cultures that are entrenched with oral traditions, storytelling is often well-received as it is a way to help ensure survival and the passing-on of traditional knowledge through generations (Nunn & Campbell, 2020). Mr Qera suggested a visual demonstration of the climate change process with the women of

[14] *TC Ana was one of three tropical cyclones that impacted Fiji in early 2021.*

Tacilevu. This involved some of the women participating in the roles of the sun, earth, atmosphere, and solar radiation and an explanation on how these interact to drive weather and climate. The women enjoyed this visual re-enactment and their laughing attracted the men to observe from the doorways of the community hall. Due to the success of the demonstration, it was decided to repeat it in the subsequent case study villages whenever there was some misunderstanding about the concept of climate change. This method of information sharing would be somewhat out of place in a Western context but was well suited in a Pacific Island context confirming that data collection and those working with communities need to think laterally.

### 6.4.6 Trust in faith for challenge management

Luetz et al. (2023) suggest that spirituality is still largely ignored or undervalued in most externally funded adaptation projects and that a closer alignment of spirituality and sustainable development would lead to more effective and sustainable outcomes in faith-grounded communities like Navunievu. These findings were supported by the men of Waitabu demonstrating the depth of their spiritual beliefs when dealing with challenges faced by the community. One man stated:

> "*We believe if we have true faith and serve the lord fervently, we can slow down or change the course of climate change because everything happens according to God's plan. The cyclones and everything is according to God's plan"*. A younger man followed up with a comment: *"During Yasa, all the mangroves were inundated and the waves came in but it did not affect them* [the community] *very badly. It didn't take away the houses because of how well we serve God*".

The women of Tacilevu also mentioned that faith can alleviate climate change and this was a topic often incorporated into the sermon delivered by the Minister during mass. This sentiment is repeated throughout the Pacific Islands, where church Ministers advise their assembly that their piousness is a reason for their good fortunes, such as 'making it through' a cyclone (Nunn, 2017). Projects that engage with people's spiritual beliefs are more likely to gain community support which may promote sustainable adaptation. Communication with rural communities impacted by climate change may be best done through the most influential channels, that of a spiritual leader. These leaders can provide messages that faith alone will not provide solutions to climate change but it may provide the incentive to be proactive. The men of Tacilevu demonstrated their understanding of this last point by saying that alongside their faith there is a need to adapt, mentioning the equal importance of planting mangroves and relocating homes and gardens, with worship.

### 6.4.7 Impacts of COVID-19

As was also noted in the two previous communities (Vusasivo and Korolevu), Provincial Officials, the Minister of Health, and the police came to visit Navunievu to provide information and training on COVID-19 and handwashing. The community members were supplied with posters and hand sanitiser during the initial visit, but police continued with regular follow-up visits. Members of the community said these visits would often occur during the evenings when the police would park their vehicles out of sight and walk into the village to spot-check that community members were complying with the movement restrictions by remaining in their houses.

When the women of Tacilevu were asked if everybody abided by the restrictions and made these imposed lifestyle changes, they all responded: "*Yes*". The men had the same response and when asked why, they said: "*The penalties were strict and they could go to jail for non-compliance*". Jokingly, the men were asked if the same punishment was given for taking undersized crabs, would they comply. They laughed, but then said: "*Yes, the main reason there is no adherence to these laws is because no one checks*", confirming that assistance in establishing and implementing resource management policies at the local level may be beneficial to ensure the sustainability of marine resources for future generations. Implementation of a sustainable EbA will require all community members, including those from surrounding villages to be committed to sustainable resource management, as well as requiring support from higher-level governance (Bertram et al., 2017), just as was done to ensure COVID-19 regulation compliance.

The women of Waitabu appeared quite afflicted as they reflected on the impacts that COVID-19 had on the community. They mentioned that they were not able to go to the hospital and had to remain in the village and rely on herbal medicine for the sick, as well as not being allowed to visit neighbouring villages or attend church to pay their respects when someone had passed away. Some of the community members also believe that COVID-19 had positive impacts. One of the gentlemen from Waitabu said that movement restrictions forced men to spend time at home with their family rather than going to neighbouring houses to drink 'grog' (*kava*) as they do most evenings, while the women are left at home to attend to household duties. The women of Tacilevu stated that the COVID-19 restrictions also positively impacted their resources as there was a noticeable increase in the crab populations following almost 12 months of limited trading. This visible evidence of increasing marine resources through limited harvesting may provide the motivation that communities need to adhere to the *tabu* area and size restriction laws.

## 6.5 Looking forward

As the discussion with the men from Waitabu came to a conclusion and they were asked if they had any questions, they replied that Fijian women do not go back to school and were intrigued about whether it was common for older women in Australia to study. When told that it was not uncommon, they said it had become a habit for many Fijian women to remain inside their houses when outsiders visit the village as they do not want to be involved, listen or learn. This comment and other similar comments throughout the *talanoa* sessions highlighted possible barriers to the implementation of externally funded sustainable community-based projects. Further examples of barriers to sustainable adaptation that arose at Navunievu are the discrepancies in responses between the groups, and the feeling of some rivalry between the two villages, established by minor comments made. CbA requires stakeholder cooperation, therefore power relations, gender inequality and the social dynamics within a community (or two in the case of Navunievu) need to be considered and overcome during all phases of a project if it is to be sustainable (Buggy & McNamara, 2016).

As the meeting with the Tacilevu women concluded, they were asked if they had any questions. They responded that they had learnt a great deal and they assured that they would share this new knowledge with the other women from the village who did not show up for the discussion, as well as look at starting some mangrove planting projects. This reaction was encouraging, yet it also confirmed the need for education and training in resource management and climate change as very minimal and basic information was provided yet this was claimed as new knowledge.

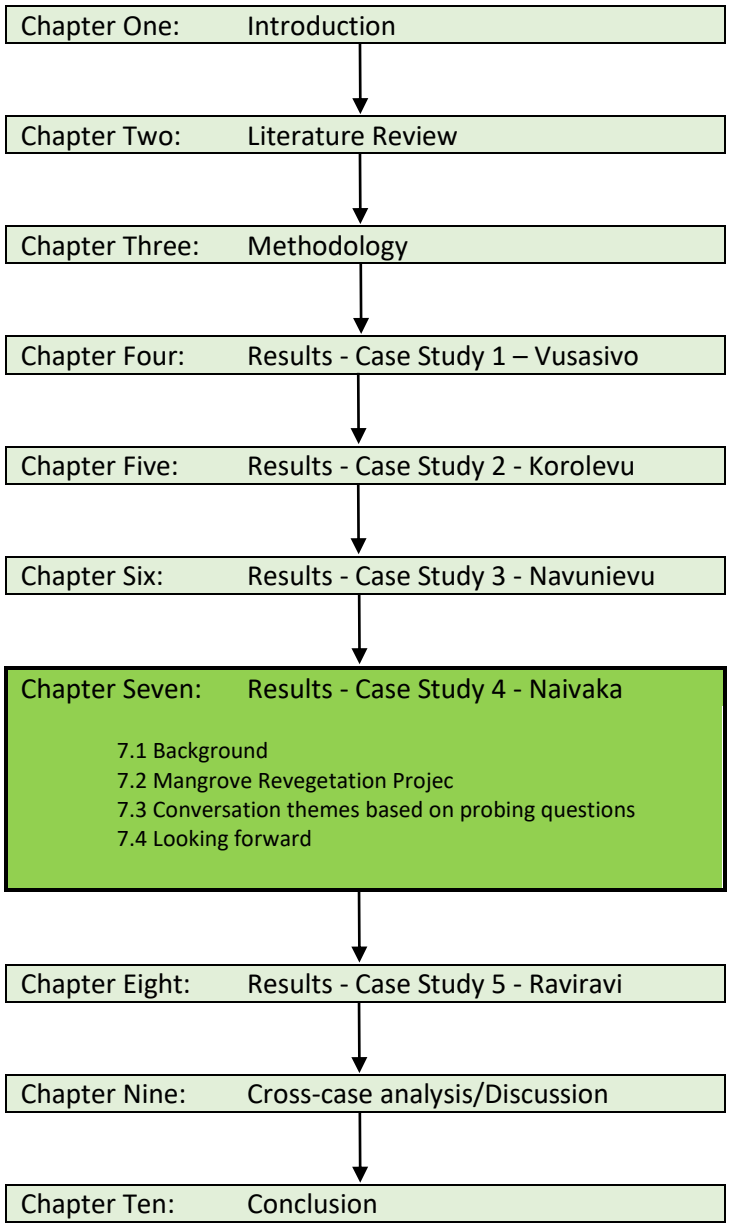
These two communities affirm the need for alternative livelihoods, the assistance (or motivation) to re-establish their 'crab fattening' project, and the means to enforce marine resource regulations, particularly within their *tabu* area. An unanswered question remains as to why the project with the crab cages was not re-established when the men said it was easy to do so, and whether they were restricted by time, resources, motivation, or other factors.

The key insights revealed by Navunievu are echoed across the region. A recent study in the Micronesian group of Pacific Islands revealed an extensive gap in the research pertaining to the adaptive capacity of ecosystems in the region, both in the context of climatic and non-climatic drivers (Lenz, 2023). This same research indicated that both climatic and non-climatic drivers needed to be assessed and addressed to enhance an ecosystem's adaptive capacity, and therefore the services they provide to communities. As was found at Navunievu and the four other case study sites (Vusasivo, Korolevu, Naivaka and Raviravi), Lenz (2023), also found that MPAs in Micronesia lack management plans and the pathway to defined

conservation objectives and conservation areas are unevenly distributed, and where MPAs are in place, compliance and enforcement are minimal, all of which limit their effectiveness. To bolster current mangrove planting schemes in local communities to what would be considered an effective and sustainable EbA requires a range of measures, including but not limited to, scale, consideration of ecosystem biodiversity and climate-sensitive species, identification and effective management of climatic and anthropogenic ecosystem threats, strong local governance supported by higher level governance structures, and prioritisation of resource management with a co-management approach that includes all stakeholders. Measures that all aim to produce equitable societal benefits through enhanced ecosystem services (Bertram et al., 2017).

# CHAPTER SEVEN: (Results) Case Study Four – Naivaka Village

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 7.1 Background

Naivaka is the northernmost rural coastal village in Bua Province on Vanua Levu Island (*Figure 7.1*). This village was originally selected as a backup case study site for this research project but through miscommunication, a visit was arranged by the Bua Provincial Office while requesting permission to visit Navunievu Village. The site visit to Naivaka resulted in valuable data that contributed alternative perspectives on some of the themes covered during the group discussions as Naivaka differs from the four other case study sites. Firstly, the community does not have easy access to mangroves. Secondly, they do not have a seawall (although one has been requested), and finally, they have never attempted any nature-based adaptation such as planting mangroves or other coastal vegetation. Naivaka is also the most remote community out of all the case study sites. The *Turaga ni Koro* of Naivaka, Jone Matasere, said he greatly appreciated the effort made to travel to their village as due to their isolation from the rest of Fiji they often '*feel forgotten*' and he was eager to be involved in this research.

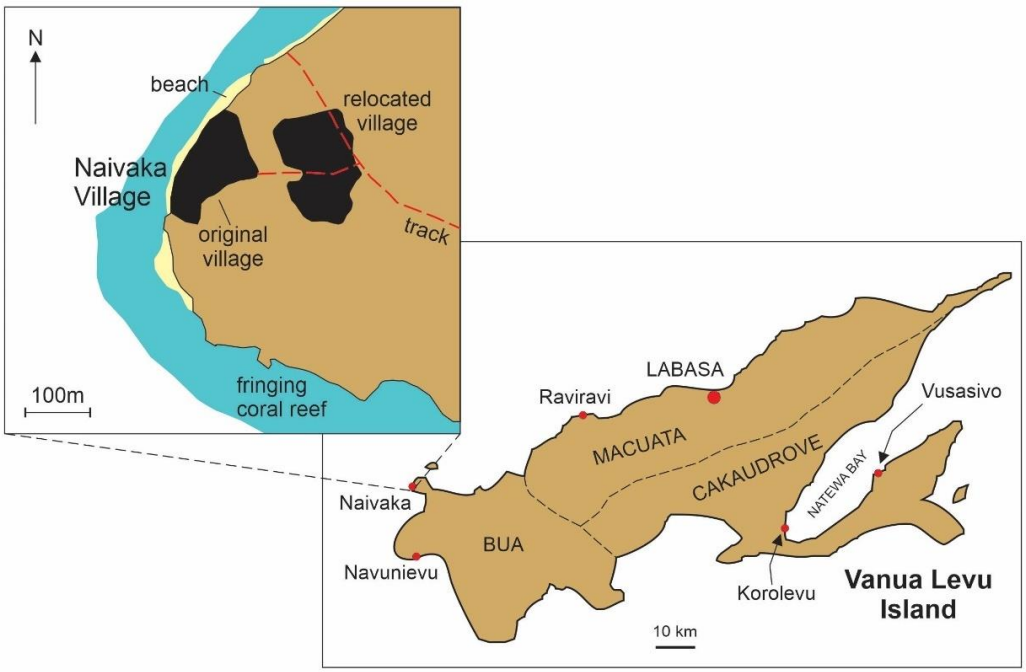



***Figure 7.1*** *Map of Vanua Levu Island showing the location of Naivaka to the north of Bua Province. The inset details Naivaka Village and surrounds, including the unsealed road into the village, the original village site, the partially relocated village, and fringing coral reef.*

The Naivaka Village foreshore curves around the north-western tip of a headland, exposing it to winds from the northwest but also prevailing south-easterly winds. The beach in front of the village consists of course sand and rubble, with sections of the high tide mark covered in low-lying vegetation, mostly *Ipomoea pes-caprae*; minimal larger trees also grow along the backshore (*Figure 7.2a and b*). Naivaka's

closest mangroves are located approximately one kilometre along the coastline to the northeast of the village and there is a fringing reef ranging from 50 – 100 metres offshore that drops off into a deep channel. Across this channel, there is a large patch reef (*Figure 7.2c*).

Access to Naivaka is restricted to boat travel during the wet season (*Figure 7.2d*) but can be possible to access by four-wheel drive during the dry season, although the men mentioned that the road is in disrepair and they expect that at some point in the near future, they will no longer be able to drive to and from the village. Naivaka Village has been partially relocated due to land loss and infrastructure damage caused by coastal erosion with new houses being built at a location that is upland and slightly inland from the original village site (*Figure 7.1*). In July 2022, at the time fieldwork was conducted, the original village site had approximately 26 houses and the relocated site had approximately 23.


***Figure 7.2 (a)*** *Some areas of the beach have minimal vegetation remaining due to clearing, erosion and an encroaching high tide (Source: Author, 2022).* ***(b)*** *Beach Morning Glory (Ipomoea pes-caprae) is a hardy salt-tolerant creeper that exists on some areas of the foreshore at Naivaka (Source: Author, 2022).* ***(c)*** *Spatial imagery showing the distance to the closest mangrove forest and the nearby patch reef (Google, 2018)* ***(d)*** *Travel by boat is the most reliable and convenient way to and from Naivaka (Source: Author, 2022).*

Data were collected during two *talanoa* sessions, separated into men and women, and time was spent observing the foreshore, including the remains of some houses and seawall foundations, the coastal vegetation, as well as snorkelling the shallow waters offshore.

### 7.1.1 Participant details

The data collection carried out at Naivaka Village over two days in July 2022 is outlined in *Table 7.1*.

***Table 7.1*** *Onsite data collection details from Naivaka*

| Group/ Participant | Number of Participants | Age Range | Duration of conversation | Comment |
|---|---|---|---|---|
| Men (recorded) | 14 | 20 – 83 | 3 hours | The conversation was dominated by one man. However, the other participants were asked if they agreed with what was being said or if they had anything to add. They all agreed. |
| Women (recorded) | 19 | 27 – 70 | 2 hours | This group had the largest number of participants out of all *talanoa* sessions and all the women were engaged in the discussion. |
| Unguided | | | 2 hours | Walked the coastline to view the details that had been provided in the group discussions. |

### 7.1.2 General information collected through conversation and observation

The information collected through observation and casual conversation is invaluable in providing context and background information for this research. The Naivaka community members have been requesting assistance from the Government to build a seawall throughout this time. This same gentleman said that there were once houses in the location where they now anchor their boats. Historical data imagery from Google Earth confirms some significant loss of land, at some sections, up to 12 metres. There are two homes visible on the 2008 map (Figure 7.3a) that are no longer in the 2023 map (Figure 7.4c). Unfortunately, 2008 is the earliest available but data from the past 50 years, when most communities have iterated the approximate time that erosion started becoming a cause for concern.


***Figure 7.3*** *Historical Google Earth imagery has allowed a comparison of the foreshore of Naivaka from* ***(a)*** *October, 2008,* ***(b)*** *August, 2019, and* ***(c)*** *November, 2023 (Google, 2018). Loss of land can be noted, as well as houses in Figure 7.4 (a) that are not present in (b) and (c)*

During the observation of the beach, there was evidence of these pre-existing homes that are now located metres below the current high tide range (*Figure 7.4*), along with the foundations of a seawall that,

according to the men of the village, was built circa 1980s but never completed (*Figure 7.5*). During the *talanoa* session, one of the older men stated that he was in primary school when this seawall was started and his father was *Turaga ni Koro* at that time. The Naivaka community members have been requesting assistance from the Government to build a seawall throughout this time. This same gentleman said that there were once houses in the location where they now anchor their boats.

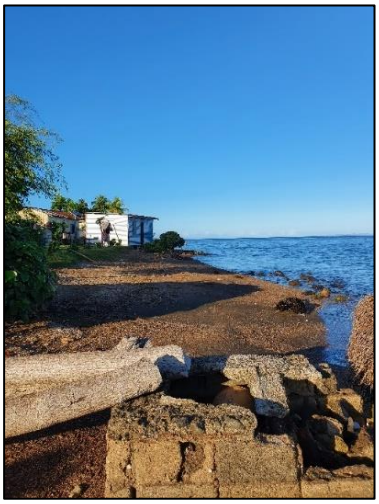


***Figure 7.4*** *Several houses in Naivaka have been damaged by coastal erosion and inundation including this home in the foreground where the kitchen is located below the now high tide mark (Source: Author, 2022).*

***Figure 7.5*** *Remnants of the foundations of a never-completed seawall on the foreshore of Naivaka that was built during the 1980s (Source: Author, 2022).*

Gender roles are of interest for this research as different groups may hold unique and important local ecological knowledge obtained through time spent in that environment (Rabbitt et al., 2022; Singh et al., 2022). In Fiji, women are mostly responsible for food preparation for their families with marine resources as one of the primary sources of protein (Bertana & Blanton, 2022). The women of Naivaka said they are involved in both line fishing and diving, where they are sourcing fish, clams, and beche-de-mer (sea cucumber) for consumption and to sell. Harvesting of sea cucumbers had been banned in Fiji since 2017 but at the time of data collection the ban had been lifted for four months in 2022 to allow communities to boost their income following several cyclone events. While conducting research in Naivaka, a crew of men and women went out by boat to harvest sea cucumbers after dinner one evening and said they would be out for most of the night.

## 7.2 Mangrove Revegetation Project

The community of Naivaka has never planted mangroves or been involved in any other type of revegetation project. One woman from the discussion group said she had some experience with a mangrove project as

she was involved in the first WWF mangrove nursery project in 2004 in her village, Korotubu, a village in Macuata Province, Vanua Levu. The men were adamant that mangroves could not grow in this area and believed it was because they were '*like a passage or a cyclone path'*. They described their beach in resemblance to a sand spit, saying that, *'sometimes sand would pile up at one end of the beach and then at other times it would pile towards the other end*'. If mangroves propagules were planted in such unstable substrate they would have limited chance of survival given (Friess et al., 2022).

## 7.3 Conversation themes based on probing questions

The following section highlights some of the key points arranged into themes that were raised during the *talanoa* sessions in Naivaka.

### 7.3.1 Knowledge and use of mangroves

Although Naivaka Village does not have mangroves directly adjacent to the village, as all the other case study sites do, community members still identified the importance of mangroves and many of the services that mangroves provide. The women identified the provisioning and cultural aspects of mangroves, while the men listed the provisioning, regulating and supporting services provided by mangroves, indicating there were some differences in mangrove usage between genders. The men also stated that they rarely use mangroves because now that they live in modern housing and not a *bure*, they are more likely to source the timber and materials from native trees nearby, suggesting the mens' reflection of mangrove use revolves around timber resources.

When clarifying the difference in mangrove usage between genders, the women stated that: 'The men will mostly go looking for crabs with torches at night around the outskirts of the mangroves, while we go inside the mangroves as we know where the holes are that the crabs are living". The women stated that:

> "*We love mangroves because it is how we get money. Crabs to sell as a source of income for the family."*

Gender was not a key focus of this research but identifying the degree to which women's voices are included in resource management decisions within a community is an important consideration and worthy of future research as women have been identified as key factors in building community resilience, particularly social, economic, and ecological resilience (Singh et al., 2022).

The men and women both identified two species of local mangroves but had variations to the Fijian names. The men referred to the two predominant species as *Dogo vere* and *Dogo kani,* which is the same name

used at Navunievu. The women stated that outside of Naivaka people refer to *Dogo kani* as *Dogo Tu*. The *Rhizophora* sp. that the men referred to as *Dogo vere*, the women called *Dogo dina* but said they have also known it to be called *Tiri*. The women also said that the mangrove they use to tie up crabs with is called *titi*. After the women looked at the mangrove ID cards their discussion continued and they said they may have three different species nearby. This is likely the case, as a hybrid species, *Rhizophora selala*, which they referred to as *titi,* is located on the river banks near Nasau Village. Nasau is the closest village to Naivaka and the landing point for the boats when travelling to and from Naivaka. It is also the public bus departure point for transport to urban centres.

### 7.3.2 Resource Management

As the conversation shifted to resource management, the women were asked about the availability of crabs and fish in their area, to which they replied that compared to 10 or 20 years ago the numbers had decreased and the size of the fish they now catch has decreased, which aligned with the other case study discussions. The women continued talking about crabs, saying that:

> "*We sell the big ones and keep the small ones. The small ones are good to eat*."

When asked if they understood the purpose of the law against taking undersized crabs, they were aware that it was in place to ensure the sustainability of the crab population. The crab project that had been briefly active in Navunievu was explained to the women. It was suggested that a similar type of project may be something for them to consider as over time it would increase their stock of crabs for income and as a food source, although a project like this may be more difficult to monitor when the mangroves are some distance from the village.

The men attributed the reduction in marine resources to commercialisation. They said they were aware of the size restrictions on marine resources, but stated that:

> "*When people are desperate, they cannot worry about the restrictions. They just have to be careful to not get caught*".

Unlike the other case study sites, they said that they sell undersized crabs, although it was not clarified whom they sell to as the other case study sites had said that wholesalers would not buy them. During the same discussion, the men mentioned that the intense harvesting of sea cucumbers that began in the 1980s had a negative impact on their marine resources and that cleaning the sea cucumbers near the beach also contributed to killing the coral and fish, stating:

"*The colourful soft and hard corals that we used to see from here [the shore] are gone and we can only see rocks instead*". According to the men: "*The area of Naivaka was known as a 'hot spot' for beche-de-mer (sea cucumber) and when there were none left in the shallows people started using compressed air to dive for them in deeper waters and a lot of drowning occurred as people did not adhere to the time underwater and the strong currents*".

The men were asked if they knew anything about the ecological significance of sea cucumbers (class Holothuroidea) or *sasalu* in *iTaukei,* but the men said they had no idea what their purpose was. The women were asked the same question and one woman demonstrated an awareness of their ecological importance by saying they '*clean the ocean*'. When the role of these organisms was explained in more detail to both men and women, they said this was all new information.

During the three-month reprieve from the ban on sea cucumber harvesting there was no limit on how many animals that could be taken at any one time, but there are restrictions on size. A 2017 report on the sustainability of the beche-de-mer (sea cucumber) industry in Fiji found that out of 7497 animals measured from a harvest a high percentage were undersized, where one particular species harvested recorded 95% of animals as undersized (Tabunakawai-Vakalalabure et al., 2017). The same report found that some fishers were only receiving between 1 to 5 FJD (0.45 – 2.25 USD) per kilogram for some species (Mangubhai et al., 2017). Therefore, local ecosystems that sustain rural livelihoods were being exploited for very little return. During the time that research was undertaken (July/August 2022), there were complaints that the price that was being paid for a sea cucumber harvest was low. Some community members stated that by the time they got their product to market, it would sometimes be considered inferior, due to heat, unsuitable storage, or difficulty finding timely transport, meaning they received an even lower price. Suva, on the main island, and Labasa, on the second largest island, sometimes a significant distance away, are the main urban centres where people can take their harvest to wholesale outlets in exchange for a cash payment (*Figure 7.6*).

***Figure 7.6*** *A wholesale outlet in Labasa where people are queuing to receive cash for their sea cucumber harvest (Source: Author, 2022).*

The men believed that once they started using torches to go diving at night the coral began to die as they believed this unnatural light caused damage and also led to the disappearance of some fish species, particularly those that '*sleep*' on the reef, as well as many of the larger fish. He stated:

> "*They became scared of the light and they moved further out to sea*". One man said: "*Today when we fish we only catch smaller sized ones and occasionally something that is a suitable size to sell*". In addition to torchlight, the men believed the lights in the village also contributed to '*killing the coral and causing the disappearance of the fish*' as their houses are fitted with solar lights now compared with when they had much dimmer lighting from kerosene lanterns.

The men's perceptions about what has caused their resources to become scarce were of interest and indicate gaps in the TLK being used for resource management. It is likely that diving at night did negatively impact marine resources as fish could be more readily caught in their sleep-like state. Species such as Parrotfish (family Scaridae) are easily taken by hand at night as they rest on the reef but spend daylight hours benefiting marine ecosystems by eating algae that builds up on the coral's surface.

During the *talanoa* session with the men of Naivaka, they were asked if they had any *tabu* areas close by. They responded with obvious frustration, saying that the mangroves to the south of the Naivaka belong to them but they see people from Nasau taking from there, adding:

> "*We cannot stop them as we have traditional links and family ties to Nasau"*. Then said: "*It's part of our culture to share. It was always our culture that people can take for themselves but now they are selling*".

This statement was an indication of some contemporary challenges that communities face when trying to sustainably manage resources that are utilised commercially and by the wider community. The men said their village did have a law against selling octopus for commercial purposes as it is their totem. However, in more recent times they tended to disregard this rule and have seen the negative consequences as there are very few left compared with the number of octopus that were once seen in the area. To exaggerate this fact one man said: *"Before, we could almost see them climb the trees there were so many* [octopus]".

After becoming aware that rural communities have a conservation committee during discussions with Navunievu it was intriguing to find out if this was the same for other communities. When the men of Naivaka were asked if they had a conservation committee, they replied that, "*it was not really functioning at the moment"*. The women were asked about this comment but they did not have anything to add. Given that similar responses had been given at other case study sites indicates that this type of resource monitoring is not appropriate for rural communities, or the system has not been implemented or supported well.

During discussions about the damage seawater causes to their crops, the women said that although their crops get badly damaged, they find that heavy rain somewhat removes the salt and then their crops improve, as though they have used a fertiliser. The men confirmed what the women said, adding that their losses included coconut trees, cassava and taro patches but the salt can also improve the soil. They mentioned that they have been cultivating on the same land as their ancestors and it is likely the soil has become less fertile from overuse but is improved by salt. This point that the same land has been used for generations was interesting as other researchers have noted that crop rotation is a traditional method of ensuring food security in many Pacific Island countries (Nalau, Becken, Schliephack, et al., 2018). The same researchers also noted that these traditional systems were becoming less common due to agricultural land requiring more intensive farming techniques to account for an increasing population as well as pressure on land usage.

To decipher the level of local environmental knowledge held by the women that could be applied to sustainable resource use, the women were asked several questions about different aspects of their local marine environment. During this conversation, they mentioned there was extensive coral damage and dead coral. When asked if they had seen any white coral [evidence of coral bleaching], they said yes but they did not know what it was or the cause. The men said the same in that they had never heard of coral bleaching before but had seen white coral many times. The first mass coral bleaching event was recorded in the year 2000 in Fiji, which was linked to heat stress due to increased ocean temperatures, while several minor events had also been previously noted (Cumming et al., 2002). Other Pacific Island countries had also noted

mass bleaching events on a similar timeline (Bruno et al., 2001). Coral bleaching is a concern as it can reduce coral diversity and negatively impact species richness and abundance, resulting in a decline in ecosystem services provided by the reef (Hughes et al., 2018; Venegas et al., 2019).

As we spoke about the reasons for seawater inundating the village, the women claimed it occurred because they had removed some vegetation. When asked to clarify this they explained that during a visit from the Fiji Minister of Health, they were advised that they need to clean their foreshore by removing their 'untidy vegetation'. The plant they were advised to removed is *Ipomoea pes-caprae*, commonly known as Beach Morning Glory, which is a hardy salt-tolerant fast-growing creeper that is established on many foreshores in the Asia-Pacific region and can assist in stabilising substrate. The women said that after it was removed the flooding and erosion worsened and they later realised that this plant was beneficial for their shoreline. Beach Morning Glory has re-established along some sections of the foreshore (*Figure 7.2 b*). One of the women claimed:

> "*The problems we had were caused by not knowing how to look after the environment when compared with our ancestors*".

Similar remarks were made in the other case study sites that may be an indication of the loss of traditional knowledge, changes in resource use, or a decrease in ecosystem resilience.

### 7.3.3 Traditional and Local Knowledge (TLK)

The women were asked how they had obtained their local knowledge about the mangroves and catching crabs; they said this was through observation of their mothers and grandmothers. When asked if their children come to observe them, they responded, "*No*", and claimed that:

> "*They're occupied with school work and when they finish primary school they go to secondary school away from the village, then university. If they find work or get married, some don't come back*."

Although this was the case, the women believed passing on their knowledge to their children was important and said that they should be teaching them.

The men attributed some lack of respect and loss of culture from the younger generation to '*foreigners*' and outside influence from other sources, like social media or people visiting from other countries which the youth are exposed to when they go to urban centres. They said:

"*Young boys copy haircuts and women dress like Western people, wearing thin straps and pants, which should only be worn by men in Fiji. These little things take away our culture*."

Similar sentiments were noted in each case study community.

### 7.3.4 'Hard' versus 'other' solutions

There was unanimous consent by all community members that Naivaka was in desperate need of a seawall. The women were asked what their expectations of the seawall were and after some discussion amongst themselves they replied: *"We understand it won't be long-term but want it to be installed"*.

The men had hoped that this research was going to assist them towards attaining a seawall. When asked if they had seen a seawall that had provided some success for a village, they said they had not seen any in a village, only in the city. Once it was explained that the type of engineered wall they were referring to is not something that could be built or maintained in a village and they were told of some of the negative impacts that can be caused by a seawall they became indifferent towards the idea. As the option of ecosystem-based adaptation was introduced, the men said they were certain that mangroves would not grow here and also mentioned they had lost many large deep-rooted trees along their foreshore over the years.

There was further talk about other possible solutions that may have fewer negative impacts than a seawall, such as large rocks in groin-type structures running perpendicular to the shore that may help trap sand and could create a habitat for marine animals. It was also mentioned that there is vegetation, other than mangroves, that can stabilise the shoreline, such as Beach Morning Glory and Vetiver grass. We discussed the opportunity to create 'no go' zones on the dune foreshore and it was explained that people walking on the dunes and the coastal vegetation can destabilise and cause damage to these ecosystems. Limiting traffic to four or five access points along the backshore might assist in stabilising the shoreline substrate and increase the vegetation biomass. The men were very receptive to these suggestions and enthusiastic to start implementing them. It was suggested that they seek advice from their appropriate government department as any changes they make to their coastal ecosystem can have unintended consequences and these ideas did not come from a formal impact or site assessment.

### 7.3.5 Understanding of climate change

The women of Naivaka claimed they were all familiar with climate change and attributed it to the more frequent cyclones, heavy rainfall and higher sea levels that they were experiencing. They said they had

gained this knowledge from groups that had visited the village (they did not provide specific details of which groups) but said they could also feel it happening. When asked if they could explain what climate change was, they were not able to. Mr Qera suggested engaging the women in another role play to explain the basic concept of climate change. This was done by allocating some women to take on the role of the sun, earth, and atmosphere and a visual explanation of their interaction, which the women enjoyed.

The men attributed the regular flooding of seawater into the village to climate change. They explained that they could remember when the village would only be inundated very occasionally but it has become more like a monthly occurrence and will happen '*regardless of the weather – even on very calm days*'. They also said that very high tides which should be followed by extreme low tides no longer occur, and now the low tides '*appear like normal tides compared with the past*'.

The explanation of climate change was also visually demonstrated with the men. They said that several NGOs and people from the Provincial Office had visited their village and told them their coastal erosion problem was caused by climate change but no one had ever really explained what it meant, why it happens, or provided any solutions, and they were grateful for this new knowledge. This comment from the men demonstrated the need for change in the way government and non-government organisations communicate with rural communities, such as the use of unfamiliar or Western terminology with an assumption that it is understood. This was also noted in Korolevu when the *Turaga ni Koro* asked for some explanation on some of the terminology in his *Community Plan*.

### 7.3.6 Trust in faith for challenge management

The women said they use prayer to assist in managing some of the challenges that Naivaka is exposed to. They explained that they believe their prayers are answered in many different ways, such as this research and our visit is an indirect way that they know their prayers have been heard. The men said:

> "*We believe we have to do what the bible says. The damage to the resources only occurs because we do not take care and do as the bible has informed us. If we had done as God said, nothing bad would happen*." They followed this with: "*Most of what has happened to us is because we ignore our culture and traditions. We are like people moving around with a lost soul not knowing what to do at the right time. Respect is gone. God gave us a special place for a reason and a special way of living, called culture. Most of the time when we overrule this cultural and traditional way, we are faced with difficulties*".

These comments from both men and women corroborate the other case study sites and other researchers to illustrate how highly Pacific Island communities value and rely on faith to guide their future, indicating the significance of including spiritual values to achieve sustainable climate change adaptation projects (Luetz et al., 2023; Luetz & Nunn, 2020).

### 7.3.7 Impacts of COVID-19

The news of COVID-19 reached Naivaka through radio and television. The men said they had also received a visit from the Minister of Health, who explained the precautions that they needed to take. The women said they followed the advice of no social gatherings, healthy living, and restricted movement out of the village as they were afraid of becoming ill. They said they would still drink '*grog*' (kava) together as it was too far for anyone to come and check on them. The men stated that the main impact on the village was children not going to school and they were not allowed to conduct church services. Food security was not impacted in Naivaka during the lockdown period except for the supplies that they normally purchased from urban areas, such as sugar.

The women were asked why COVID-19 restrictions were easy to abide by but other regulations that involved sustainable resource use were not followed. They discussed this comment for some time then all agreed and understood the point that was being made. That is, abiding by the laws of resource management ensures that marine resources are being used sustainably, and the impacts of not following these laws have negative consequences, as was the case for COVID-19 restrictions.

## 7.4 Looking forward

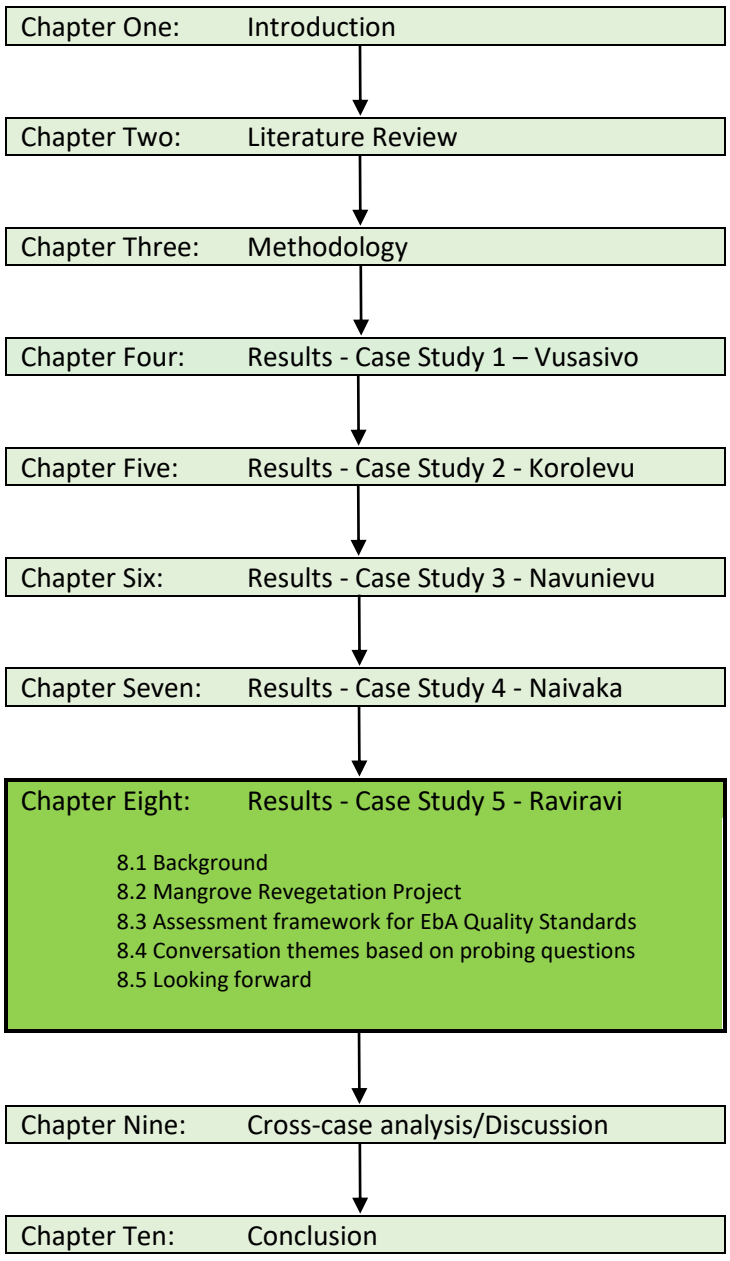
This section provides a brief conclusion to the data collected at this case study site and outlines possible adaptation opportunities for Naivaka. One point of interest is how resolute each community member in Naivaka was about building a seawall. Yet, after a short conversation on the possible negative consequences for their community that may result from a seawall, they quickly changed their minds.

Naivaka villagers also raised concerns about managing their coastal resources and it became apparent through discussions that they would benefit from some assistance establishing MPAs (*tabu* areas), as well as support in monitoring and managing these areas, with assurance that the women are included in these programs. A site assessment to establish whether Naivaka's coastline could be stabilised through groins and assistance in revegetating their coastal vegetation would be beneficial for the sustainability of the community. Further to this, the need for community members to oppose catch size restriction laws indicates alternate livelihood programs may be valuable.

Although outside the scope of this research, because of its location, Naivaka has a history of foreign ocean travellers landing on their shores and the men of Naivaka told some interesting accounts and showed artifacts from these visits. Assistance in recording this history for future generations may help preserve Naivaka's cultural heritage.

# CHAPTER EIGHT: (Results) Case Study Five – Raviravi Village

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 8.1 Background

Raviravi Village was the final community where data were collected for this research. It is a rural coastal village located in the northwest of Macuata Province, Vanua Levu Island (*Figure 8.1*), approximately 55 km by road from the largest urban town of Labasa. Raviravi was chosen as a suitable case study site as they have undertaken coastal ecosystem restoration and management, following decades of mangrove deforestation and subsequent coastal erosion and ecosystem services decline. The community has achieved some success planting mangroves and has undertaken a new mangrove planting project with the assistance of C3 Fiji, a locally based NGO. This new project has experimented with several novel approaches, such as a mangrove nursery and protection of newly planted saplings behind a bamboo barrier, to reduce wave impact.

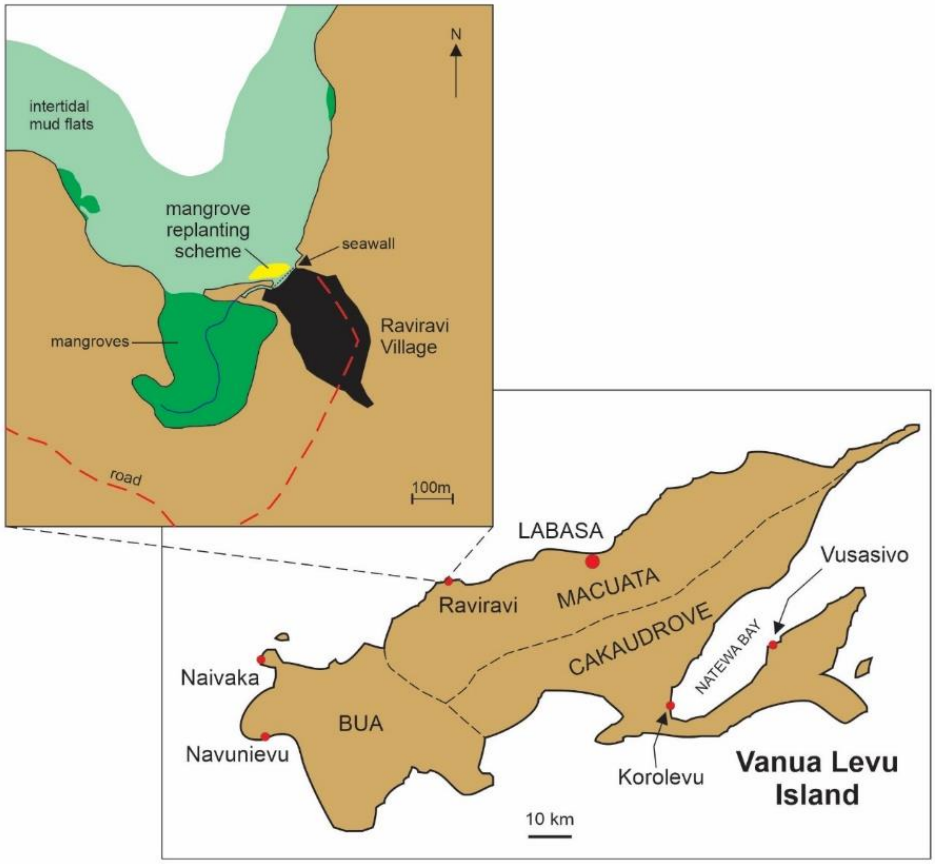



***Figure 8.1*** *Map of Vanua Levu Island showing the location of Raviravi Village in the northwest of Macuata Province. The inset map details the surrounds of Raviravi Village, including the access road from the main road to the village, the natural mangrove forest, the recent seawall built in front of the village, and the location of the mangrove replanting site.*

Data were collected over three days in August 2023 from two focus group discussions, divided into male and female (*Figure 8.2 a*). Additionally, two ecosystem observations were conducted. One was to observe the shoreline, mangrove nursery and mangrove planting site and the second was to view the condition of a local marine ecosystem, and the mangroves on a nearby island. During the time spent at Raviravi, a one-on-one interview was conducted with Mr Qera to gain further insight into the projects and background of C3 Fiji and the initiatives and goals of the organisation, as well as to learn from his experience working with rural Fijian communities.

Raviravi Village sits in a north-northeast facing bay and therefore is not exposed to the south-easterly trade winds, suggesting that prevailing winds are probably not the primary cause of coastal erosion. The intertidal zone of the bay in which Raviravi is located is mostly a coarse sand and mud substrate, although there are some areas where this finer material has been eroded and a rocky substrate remains (*Figure 8.2 b*). There is a stream located near the village but the women mentioned this stream has changed course over the years, likely as the coastal vegetation was removed. Raviravi has approximately five hectares of natural mangrove forest remaining to the east, adjacent to the village. The men of the village mentioned that copra processing was intensive around the 1970s at Raviravi and that green mangrove trees were cut down to fuel the copra dryers. Today, mangrove timber is still used as firewood for cooking, but the men indicated that only dead trees are used. There are nearby patch reefs several kilometres offshore and a ribbon reef approximately 20 kilometres offshore that runs adjacent to the north-eastern Vanua Levu coastline. There are also several uninhabited islands almost entirely composed of mangroves within 10 – 15 kilometres of Raviravi.

Raviravi Village is an approximately four-hectare grassy clearing less than one metre above sea level. It was subject to severe coastal erosion and regular flooding from seawater during high tides and storm surges up until September 2020, when a seawall was constructed by the Ministry of Waterways and Environment, Fiji. This seawall was badly damaged shortly after completion by TC Yasa in December 2020 and seawater inundated most of the village, while the seawall required repairs. Despite being damaged, the seawall has reduced the coastal erosion that has been claiming land from the village for several decades, and Raviravi no longer experiences regular flooding that has previously caused the loss of homes and other infrastructure, including a shop (which the community members referred to as a cooperative store). The women of the village explained that there was once a vegetated island just offshore from the village, which they described as, "*A long strip of sand with trees growing on it*". All that remains of this island is a small pile of rocks approximately 50 metres offshore from the seawall (*Figure 8.2 c*). The women mentioned that they would grow some crops on this island and believed it was also an ancestral burial site as they recall

seeing headstones on the island when they were children. They estimated that it had almost completely eroded by the late 1990s. The women were asked if any trees were ever cut down from the island and they said, yes, most likely for firewood. The men had a similar description of the island but said it was quite wide and contained large trees that were never cut down, but which fell as the island eroded. The men said they grew root crops there and confirmed the island had an old burial site in the centre. Ancestral burial grounds cement a strong connection to place and in some cases can create barriers to relocation as a form of climate change adaptation (Yee et al., 2022).

The village leader at Raviravi is female which is uncommon in Fiji. It is believed she expressed interest in the position and received a majority vote from the community to be appointed. At the time data collection occurred here, August 2022, Raviravi consisted of approximately 35 households, most of which maintain semi-subsistence livelihoods, selling marine resources and excess produce at local markets.


***Figure 8.2 (a)*** *The talanoa session with the women of Raviravi, including the Marama ni Koro and Maleli Qera, the translator and research assistant was held in the Marama ni Koro's home.* ***(b)*** *The foreshore to the east of Raviravi Village has had much of the finer substrate eroded exposing small rocks underneath. This area would benefit from reestablishing mangroves to assist in accreting and trapping sediment and reducing further erosion.* ***(c)*** *The remnants of a nearshore island from Raviravi Village eroded by the late 1990s (Source: Author, 2022).*

### 8.1.1 Participant details

Table 8.1 outlines the data collection carried out at Raviravi over three days in August 2022.

***Table 8.1*** *Onsite data collection details from Raviravi.*

| Group/Participant | Number of Participants | Age Range | Duration of session | Comment |
|---|---|---|---|---|
| Men (recorded) | 10 | 22 – 86 | 2 hours 35 mins | The older men were very engaged in the conversation. |
| Women (recorded) | 12 | 30 - 75 | 2 hours 15 mins | Some women left to remove washing from their lines when it started raining and did not return. |
| Maleli Qera | 1 | 52 | 1 hour 75 mins | Conducted a one-on-one interview with Mr Qera while in Raviravi Village. This was due to his knowledge on Raviravi's projects and on his experience implementing projects in Pacific Island communities. |
| Site observation (not recorded) | Research team only | | 2 hours | Observational walk of the mangrove planting site, tidal flat and adjacent coastal ecosystems. |
| Site observation (not recorded) | 2 women and 1 man | | 3 hours | Observation of a nearby mangrove island and snorkelling at a local reef with two women who collected sea cucumbers and clams. |

### 8.1.2 General information collected through conversation and observation

Data collected through both formal and informal conversations and site observations are included in this section. Conversations revealed that with external assistance, Raviravi has created several alternative livelihood options such as a small village convenience store with the aid of C3 Fiji (*Figure 8.3a*) and a pearl farming and jewellery-making project through the University of the Sunshine Coast. The store was operated by the *Marama ni Koro*, while the pearl research project involved teaching several younger female community members skills in business startup and operation. This training included basic finance literacy as well as growing, harvesting and preparing pearls, and the art of macrame to create the jewellery. The project also provided the funding to purchase a boat (*Figure 8.3b*) and to build a workshop and outlet to create and sell their products (*Figure 8.3c*). At the time of data collection, both the convenience store and the jewellery store had minimal stock. The women involved in the pearl project said they hoped to draw a wage from the business in the future. The first stock of pearls was lost during TC Yasa in 2020, with the women estimating the dollar value to be in the tens of thousands. The women said this loss initially left

them despondent and limited their motivation to continue with the project but they had recently laid out the new lines of shells, which required regular checking and maintenance. The women said they were lacking macrame supplies and they are not available to buy them in Fiji, which has limited the work they can do. In addition to TC Yasa destroying the pearl stocks, it also caused irreparable damage to five homes in the village (*Figure 8.3d*). The communal effort required for post-cyclone recovery may be a further reason for the delay in restarting the pearl project. The same women involved in the pearl project training applied their new business skills to another small business venture and had purchased a refrigerator that is powered by solar panels in the village, where they store soft drinks to sell to community members for a small profit. The challenges that these women have overcome to build alternate sustainable livelihoods have been adverse and support the findings from other researchers that without ongoing support, such projects are often unsustainable (McNamara et al., 2020).


***Figure 8.3 (a)*** *The village convenience store was established with the assistance of C3 Fiji as an alternate livelihood project.* ***(b)*** *The boat that was purchased by the University of the Sunshine Coast to seed and check the pearl shells.* ***(c)*** *A sample of the jewellery created by the women involved in the pearl research project and the workshop and outlet in the village to sell their products.* ***(d)*** *Remnants of a home damaged by TC Yasa in 2020 (Source: Author, 2022).*

During the one-on-one interview with Mr Qera, he identified continuous monitoring of projects by the organising agency as the key to the sustainability of a project. He said that even once the project timeline had ended, the C3 Fiji policy is to remain in contact and support the community until they are certain the project is sustainable under the governance of the village. The benefit of having local organisations developing adaptation projects means that this ongoing support can be provided. Mr Qera also revealed that many of the communities he has connections with have complained about failed projects, where a donor agency has implemented a project and then has no follow-up contact with the community. Some communities he mentioned said that their projects were not even completed before the donor agency had abandoned the village.

Mr Qera stated that for reforestation projects, C3 staff will monitor tree height alongside the community until the trees are fully established. In the villages where shops are set up, C3 monitor the accounts, reports and bank statements monthly and will question the relevant community members if they notice any discrepancies. Mr Qera said: "*At one village we found they were using supplies from the shop for their family and friends without payment, so C3 was required to change the shopkeeper*". Community members are also recruited and trained to monitor and report back to C3, but this arrangement does not always work, according to Mr Qera.

An additional challenge identified at Raviravi Village is the poor quality of drinking water. The water coming from the taps in the village is a brownish colour and contains high levels of sediment, an issue that the *Marama ni Koro* is trying to address. Several women mentioned they overcome the problem with the drinking water by filling containers and letting the sediment settle before drinking but this is not a suitable solution as the water may contain other contaminants. Access to clean water has been identified as a concern for many communities throughout the Pacific Islands (Lal et al., 2020).

## 8.2 Mangrove Revegetation Project

Mangrove planting was initiated at Raviravi in 2018 under the recommendation of World Wide Fund for Nature, who commented on this project in a news report (WWF 2019), and with the support of C3 Fiji and staff from the Provincial Office. Trees from this initial planting range in height from 60 – 120 centimetres. The exact number of propagules planted or their survival rate was not able to be determined during discussions with community members but it was mentioned that they had noticed sand accretion in the location of these young mangroves (*Figure 8.4 a & b*). It is interesting to note that despite the mangrove planting and encouragement by WWF to use natural solutions to stop the flooding from seawater, a seawall was built anyway, less than two years into the mangrove planting project. After the seawall was built, several

more recent plantings have taken place as '*whole community*' projects in Raviravi. The women described their planting technique, saying they picked mangrove propagules from nearby trees as well as collecting them from the foreshore and plant them into a hole dug using a metal rod or spade. They also uprooted saplings from the undergrowth of the nearby mangrove forest to the east of the village and replanted them towards the front of the village in the location of the rehabilitation site but realised that the plant survival rate was poor so did not continue with this method.


***Figure 8.4 (a)*** *The young mangrove saplings from the initial mangrove planting project in 2018 by C3.* ***(b)*** *Accretion of sand in the location of the 2018 mangrove saplings.* ***(c)*** *The mangrove nursery in Raviravi which was part of the mangrove project initiated by C3 Fiji (Source: Author, 2022).*

C3 Fiji provides long-term support for their chosen communities. Further assistance was provided to Raviravi through the establishment of two plant nurseries – one for mangroves (*Figure 8.4 c*) and the other for native forest trees. The nurseries were also a revenue-raising project as C3 provided the supplies but they intend to buy back each healthy sapling from Raviravi as well as pay community members to do the planting of the saplings.

This payment served as an incentive for community members to monitor and care for the plants in the nursery after C3's departure. The premise is that introducing a well-established mangrove sapling grown in a nursery may have an increased survival rate compared to directly planting a propagule into the substrate. However, there is limited evidence supporting this notion, particularly within a Pacific Islands context. The existing research demonstrates varied results, influenced by factors such as the species planted and the specific conditions during the first few months of establishment (Elster, 2000; Kodikara et al., 2017).

During conversations with the men, they noted that the propagules in the nursery grew faster than those planted on the intertidal flats. Upon viewing the mangrove nursery, it was noticed that half of the samplings were missing. Mr Qera, who was involved in setting up the nursery enquired where these saplings were. The *Marama ni Koro* advised that they had been planted, and it was then determined that there had been a miscommunication between another C3 staff member and a village elder who had been under the impression that they should go ahead with planting. This miscommunication provides lessons for donor organisations, that even without a language barrier, as in the case of C3 Fiji, there needs to be a clear project plan developed and communicated with the community members overseeing the project to ensure sustainable outcomes are achieved and both donor and community are working towards the same goal.

The recently planted saplings from the nursery have been protected with a bamboo fence (*Figure 8.5 a & b*). The women mentioned this bamboo fence was part of the Kiwa Initiative. This initiative is a multi-donor program funded by the European Union, France, Canada, Australia and New Zealand and in partnership with several Pacific Island-based support organizations and IUCN (International Union for Conservation of Nature). They aim to strengthen the ecosystem, community and economic resilience in the Pacific Islands against the impact of climate change by protecting, sustainably managing and restoring biodiversity. The Kiwa Initiative is currently providing funding and a two-year commitment for several of C3 Fiji's projects. A Kiwa Initiative staff member came to view the mangrove planting site at Raviravi and said it was likely the mangrove saplings they planted would not survive due to the wave intensity in the location where they have been planted and suggested trying a bamboo fence as they had seen some success from this type of structure in mangrove rehabilitation projects in Malaysia. It was questioned what might happen to the bamboo in the case of a cyclone. The men of the village said the bamboo fence was temporary and once the mangroves were established and large enough to withstand some wave intensity the bamboo would be removed.

During the site observation of the propagules that had been planted to the northwest of the fenced-off area at Raviravi, it was noted that a significant number had not survived (*Figure 8.5 c*). The limited survival rate may be attributed to the specific species planted in this location, with a high number of *Bruguiera*. This particular mangrove species is more likely to survive when planted in close proximity to the shoreline, at or above the tidal range. Ellison (2020) emphasises that most mangrove species are challenged if planted below mean sea level (MSL), primarily due to oxygen-level stress for the establishing roots. While *Rhizophora stylosa* exhibit greater tolerance to prolonged inundation, planting below MSL still falls outside its optimal survival range. Offering community members guidance on estimating MSL and selecting the

ideal planting location and species could prove invaluable for project success as they undertake autonomous/semi-autonomous adaptation efforts.

Additionally, Ellison (2020) explains that identifying the MSL is something that is easy to do and does not require technical equipment. By determining the time that is midway between high tide and low tide for the daytime tide, and marking the water's edge with sticks at this time. Propagules planted inland of this line of sticks are more likely to survive. Once the trees have established, they will raise the ground level through accumulation of sediment. *Figure 8.5d* shows the water height at mid to high tide at Raviravi and all of the planted propagules and seedlings are underwater, indicating they have a reduced chance of survival.

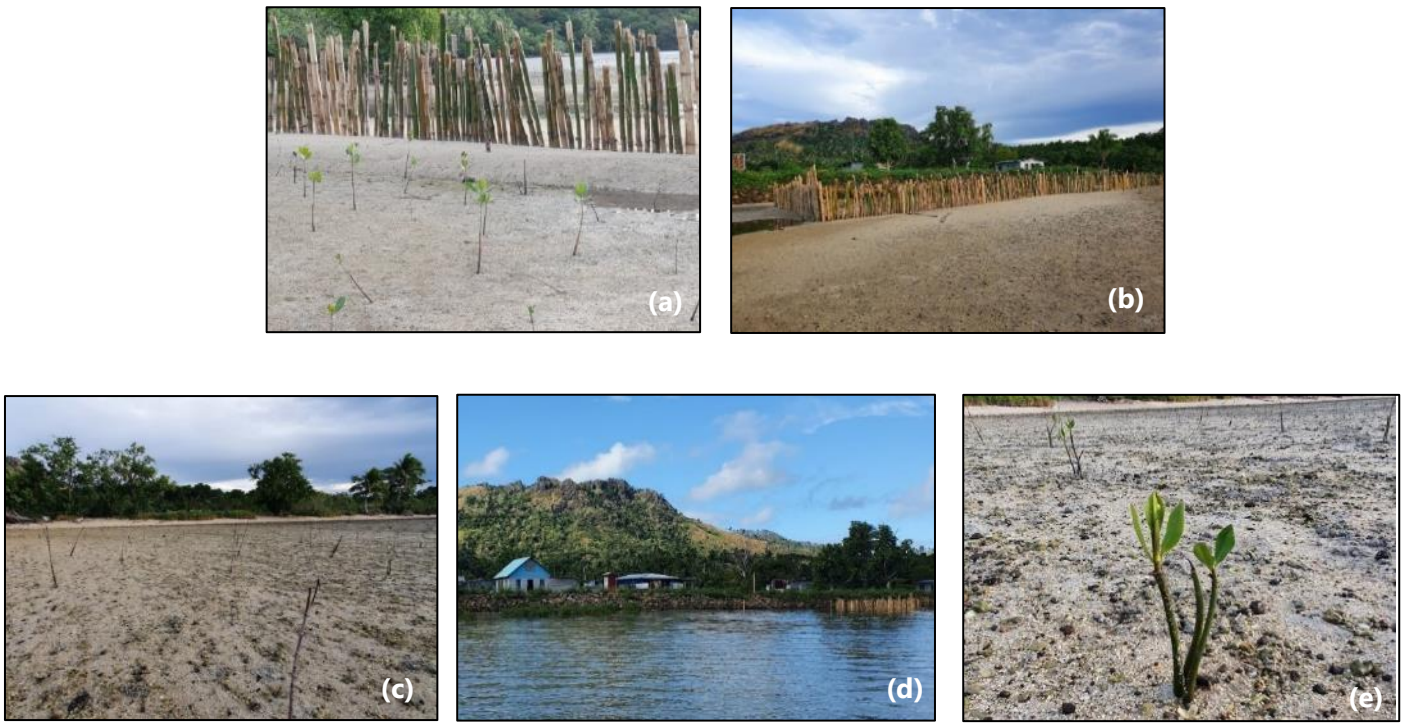



***Figure 8.5 (a)*** *and* ***(b)*** *Saplings grown in the nursery in Raviravi have been planted with the protection of a bamboo fence to protect the young plants from waves.* ***(c)*** *Many of the propagules planted on the intertidal flats in front of the seawall at Raviravi have not survived.* ***(d)*** *The intertidal zone at Raviravi is flat and remains inundated with water for long periods during the mid to high tide, which may impact the survival of mangrove seedlings.* ***(e)*** *Community members trialled planting three propagules together instead of one and have found this to be more successful (Source: Author, 2022).*

During the discussion with the women, they were asked if there was a monitoring system in place for the new mangrove seedlings. They replied, '*yes*', and said they look for dead ones and replace them as required. Details on how communities monitor such programs may be useful for assessing the likelihood of success for ecosystem-based adaptation projects. The *Marama ni Koro* said she has a logbook of all the activities carried out in the village. This data collection, which includes the dates of the mangrove planting, was implemented as part of the training led by C3 Fiji, where community members were told the importance of maintaining records, including recording and identifying any problems that arise and solutions

attempted. Additional useful data would be to record the number and species of propagules planted, and the percentage and which species did or did not survive. Weather records, including rainfall, during the first few months of planting would also be advantageous as different weather conditions have been shown to have a high impact on seedling and sapling survival. Additional data records that may be useful is whether the propagule was picked from a tree or collected from the foreshore as underdevelopment or the time since the propagule fell from the tree will impact survival (Elster, 2000).

It was noted that some of the mangrove propagules planted outside of the bamboo barrier had been done so in sets of three (*Figure 8.5 e*), similar to the way Vusasivo planted in sets of five (Section 4.2). The men were asked why they were planted this way and they replied that they believed it would increase the chance of at least one plant surviving. They were asked how they came up with this idea in which they stated that they had experimented and noticed that when only one was planted, very few survived, but when three were planted together, many of the propagules seemed to sprout their first leaves.

Further research on the success rate of mangrove planting involving mostly *Rhizophora* (97%) as well as a small percentage of *Bruguiera* (and other species), which were the two species planted at each case study site, found 36 out of 67 planting sites had no surviving mangroves (Kodikara et al., 2017). Ellison (2020) suggests increasing the elevation of the planting site to above MSL and protecting the seedlings from wave action, as was done at Raviravi may be a way to increase the success rate of plant survival. Recognising that globally, mangrove planting projects have had limited success is not intended to suggest that mangrove planting should not be done, but that it is more complex than it appears. Pacific Island adaptation projects must become more sustainable as the impacts of climate change and pressures on ecosystems become more severe. For this to happen, further research on coastal ecosystem restoration within a rural community context is required. By making further research localised, providing communities with the tools to collect, analyse, and share data, and plan and implement culturally-appropriate projects based on this data may increase the likelihood of community support and project sustainability.

## 8.3 Assessment framework for EbA quality standards

Using the three core elements: people, nature, and climate change adaptation *Tables 8.2, 8.3 and 8.4* provide an analysis of Raviravi's mangrove project rankings in accordance with the FEBA EbA assessment framework (Bertram et al., 2017).

### **Criterion 1.** Reduced social and environmental vulnerabilities

Criteria 1 and 2 are listed under Element A – *Helping people to adapt*. Raviravi ranged between strong and weak for Criterion 1 Quality Standards (*Table 8.2*), although all are ranked with 'somewhat confident' or 'requires further research' due to the lack access to the data that may have been collected by the donors and the extent to which a vulnerability or climate risk assessment was carried out by the donors before commencing the project. C3 collects data to assess a community prior to implementing any projects but this data was not made available. The slightly higher rating for Criterion 1 compared to the other case study communities was due to their support through C3 Fiji, the KIWA Initiative, and the Provincial Office, who are all local agencies that consulted and worked alongside the community to support the adaptation process.

### **Criterion 2.** Generates societal benefits in the context of climate change adaptation

Societal benefits were rated strong or very strong (*Table 8.2*) although 'requiring further research' or 'somewhat confident' as the standard was unable to be fully assessed based on the available data. The high ratings (Quality Standard 2.3 and 2.4) are based on the number of beneficiaries in community and the economic feasibility and advantages compared to other adaptation options. The mangrove project has economic and other benefits over a seawall or relocation but the rating is based on the project being sustainable and scaled up, along with the implementation of a MPA that included the new mangroves, existing mangroves and nearby reef, which would provide monetary and non-monetary benefits for all community members.

### **Criterion 3.** Maintains or improves ecosystem health

All quality indicators in Criterion 3, within Element B - Making active use of biodiversity and ecosystem services, were ranked very weak except Quality Standard 3.5, which was due to the stakeholder involvement (*Table 8.3*). The current scale and lack of protected areas were the reason for the low rankings as this criterion considers the extent to which human pressure is removed from the ecosystem through alternate livelihoods and the sustainable use of resources. Although this has been attempted, it has not yet been achieved in Raviravi.

### **Criterion 4.** Is supported by policies at multiple levels

Criterion 4 assesses how the EbA project is supported by policies at multiple levels. Rankings for this ranged from weak to strong, although Quality Standard 4.4 was with 'somewhat confident'. Improving or implementing a strong governance framework may assist in the management and upscaling of Vusasivo's

project, which was a need identified during the group discussions with Raviravi and other case study communities (*Table 8.4*).

### **Criterion 5.** Supports equitable governance and enhances capacities

Criterion 5 focuses on the project's community and gender inclusivity. Given that both focus groups confirmed that the entire village was involved in the mangrove project and participated in the training provided by C3, the village headperson is a female, both men and women are involved in the alternative livelihood projects established in the community, and the level of Indigenous knowledge representation, quality standards in Criterion 5 have mostly been ranked between very strong and strong (*Table 8.5*).

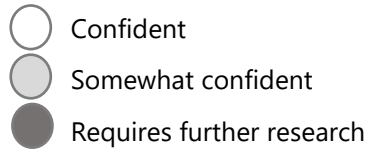



***Table 8.2*** *Assesses Element A of the Assessment Framework for EbA Quality Standards – Helping people to adapt with regard to Raviravi's mangrove project.*

| Qualification Criteria | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 – 6) | Strong (6 – 4) | Weak (4 – 2) | Very weak (2 – 0) | |
| #1. Reduced social and environmental vulnerabilities | **1.1** Use of climate information | Yes, short-, medium-, and long-term | | | Very limited or not at all | • Extent of information about future climate change used<br>• Quality of climate data sources |
| | **1.2** Use of local and traditional knowledge | Yes | | | Very limited or not at all | • Extent and relevance of local resources consulted (individuals, communities, NGOs)<br>• Participation of affected natural resource users during the planning process<br>• Quality of consultation process |
| | **1.3** Taking into account findings of vulnerability assessment (VA) | Yes, clearly integrating findings of climate change vulnerability assessments | | | Very limited or not at all | • Extent to which information from VA is being considered<br>• Consideration of climate risk reduction potential<br>• Extent to which ecosystem services are assessed by the VA |
| | **1.4** Vulnerability reduction at the appropriate scale | Land/seascape scale or larger | | | Local-scale | • n or % of the population with reduced vulnerability<br>• Effects from different scales of ecosystems are considered |
| #2. Generates societal benefits in the context of climate change | **2.1** Quantity & quality of societal benefits compared to other adaptation options | Very high | Would likely be the case in appropriate scale. | | Comparable | • Quantity of monetary & non-monetary benefits provided (e.g. income, resource access, reduced risks)<br>• Quantity and quality of provisioning ecosystem services (e.g. water, food, fibre), regulating ES (e.g. erosion prevention, extreme event buffering, climate regulation) as well as supporting and cultural ES<br>• Extent of physical asset damage or destruction avoided (e.g. Saved Wealth index)<br>• Extent of avoided deaths and injuries (e.g. Saved Health index) |
| | **2.2** Timescale of societal benefits demonstrated | Short-, medium, and long-term | | | Short- and/or medium-term | • Sustainability of provided benefits<br>• Estimated or projected benefits |
| | **2.3** Economic feasibility and advantages compared to other adaptation options | Very high | | | Low | • Positive economic and non-economic assessments (taking into account a quantification of ecosystem services benefits) |

| | | | | | |
|---|---|---|---|---|---|
| | **2.4** Number of beneficiaries | High | | Low | • n or % of benefitting people |
| | **2.5** Distribution of benefits | Fair and transparent | | Distribution questionable | • Distribution of benefits within and between different groups |

Confident
Somewhat confident
Requires further research

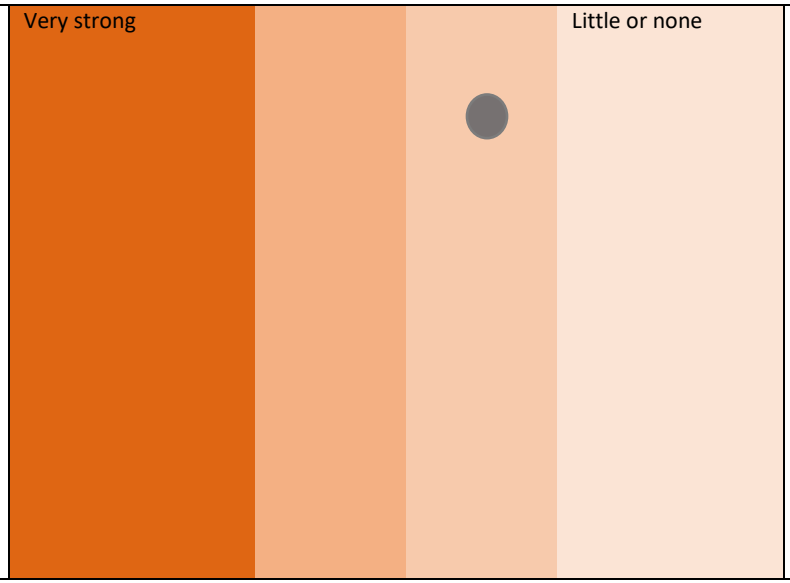
***Table 8.3*** *Assesses Element B of the Assessment Framework for EbA Quality Standards – Making active use of biodiversity and ecosystem services with regard to Navunievu's mangrove project.*

| Qualification Criteria | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8 - 6) | Strong (6 - 4) | Weak (4 - 2) | Very weak (2 - 0) | |
| #3. Restores, maintains or improves ecosystem health | **3.1** Appropriate scale of management | Land/seascape scale or larger | | | Small scale | • Size of the area (e.g. in ha) under management |
| | **3.2** Prioritisation of key ecosystem services within management | Yes, clear | | | Very low | • n of indicator species (e.g. IUCN Red list) showing the quality of ecosystem and its services<br>• Valuation of n ecosystem services (esp. supporting, regulating and cultural) over time |
| | **3.3** Monitoring of ecosystem services health and stability | Yes | | | No | • Results of IUCN Red List of Ecosystems categories and criteria<br>• Results of ecosystem risk assessments |
| | **3.4** Protection and management area coverage/diversification of land use | High coverage | | | Very little coverage | • Size or % of protected area<br>• Size or % of restored area<br>• Size or % of sustainably managed area<br>• Size or % of different land use systems |
| | **3.5** Level of co-management (government, communities, private sector) | Very high | | | Limited | • n of (community) management plans<br>• n of stakeholders engaged in management<br>• Level of cooperation between government, local stakeholders and private sector |

Confident
Somewhat confident
Requires further research

***Table 8.4*** *Assesses Element C of the Assessment Framework for EbA Quality Standards – Part of an overall adaptation strategy with regard to Raviravi's mangrove project.*

| Qualification Criteria | Quality Standards | Continuum of EbA quality | | | | Example indicators |
|---|---|---|---|---|---|---|
| | | Very strong (8-6) | Strong (6-4) | Weak (4 - 2) | Very weak (2 - 0) | |
| #4. Is supported by policies at multiple levels | **4.1** Compatibility with policy and legal frameworks and policy support | Very high | | | Limited | • n of direct links between EbA measure with policies and legal frameworks<br>• Quality and type of policies that support the implementation of the EbA measure as well as its replication and upscaling<br>• n of political decision-makers engaged in the process |
| | **4.2** Multi-actor and multi-sector engagement (communities, civil society, private sector) | Very high, with different actors/sectors | | | Limited | • Level or % of civil society engagement in policy discussions<br>• Level or % of private sector engagement in policy discussions<br>• n of sectors involved<br>• n or % of people participating in activities |
| | **5.1** Accountability and group representation | Clearly demonstrated (up and down) at the relevant scale | | | Very little demonstrated, with decisions made externally | • Level of accountability and transparency<br>• Level or % of civil society engagement in governance<br>• Level or % of private sector engagement in governance<br>• n or % of people participating in awareness raising or training sessions |
| | **5.2** Consideration of gender balance and empowerment | Explicit part of the proposal | | | None | • Gender balance within each benefiting group |
| | **5.3** Status of Indigenous and local knowledge and institutions | Respected or incorporated | | | Not respected or incorporated | • n or % of indigenous or local people represented in the governance structure |

| | | | | |
|---|---|---|---|---|
| #5. Supports equitable governance and enhances capacities | **5.4** Long-term capacity to ensure sustainable governance | Very strong  Little or none | | • n or % of individuals in a group of beneficiaries directly involved in governance framework |

## 8.4 Conversation themes based on probing questions

As was done in each case study site, *talanoa* sessions were held for both men and women separately using a probing guide to steer the conversation and ensure comparable data were collected.

### 8.4.1 Knowledge and use of mangroves

Both the men and women of Raviravi expressed a clear understanding of the ecological, economic and cultural value of mangroves. One woman said:

> "*They are a sanctuary for biodiversity, can bring back species that have been lost and provide holes for crabs. They are a buffer for strong waves and can protect the seawall and the village.*" Another stated that: "*Mangroves are nesting sites for birds and habitat for small marine animals, a source of income, medicine, salusalu, like garlands, firewood, paint, which is like a varnish, and for the dye to make tapa, but this is not done here. I also remember that they reduce carbon dioxide in the atmosphere.*" The men repeated this information, but added that: "*Mangroves are a source of income and food and also act as a filtration system for debris"*.

Both groups claimed to have received this knowledge through observation and knowledge passed down from elders, as well as through training done with C3 Fiji and WWF. Raviravi community members informed that they had also received 'awareness training' on mangroves from the conservation officer of the Macuata Provincial Office and the Ministry of Forestry. The men mentioned that the formal training sessions they had done provided them with some completely new knowledge, indicating that other rural communities may also benefit from similar training and complement their traditional knowledge to enhance the sustainable management of coastal resources.

When the women were asked about the number and type of mangrove species, they had in their local area they identified two different species, *Dogo Tu* (holding up the *Bruguiera* mangrove identification card) and *Tiri*. One of the women referred to *Tiri* as *Dogo Dina*. When the men were asked the same question, they replied *Dogo Tu* and *Dogo Dina*. The women were asked if they could show the *Tiri* species using the mangrove identification cards. They stated that from their training with C3, they understand that there are different species of *Tiri* and *Tiri* is a general term. Several women said they could tell the difference between the *Tiri* and *Bruguiera* propagules and that *Tiri* had been planted for the mangrove project, while others said that both species had been planted. The men also said they were aware of the different seedlings and that *Dogo Tu* is not suitable to be planted on the tidal flats and should be planted further inland once the

other mangroves had grown. Mangrove knowledge in Raviravi was superior in comparison to the other case study sites.

### 8.4.2 Resource Management

In conversations concerning the availability of marine resources, the women conveyed that only four individuals from the village go crabbing, and their expeditions are not a daily occurrence. As a consequence, they have noticed there is a plentiful supply of crabs. Their primary activities include fishing or gathering sea cucumber, octopus, or clams as these items fetch a better, yet their supply is seasonal.

The women mentioned that they have noticed a decrease in the size and the number of fish they catch particularly of some species and that they will often need to stay out for longer than they used to. When asked the reason for the smaller catch sizes, they mentioned both climate change and water quality. One woman mentioned that Raviravi was not far from the mouth of the Dreketi River, the deepest river in Fiji (*Figure 8.6*). The women mentioned that there is logging and farmlands that use pesticides upstream on this river and they believe this also impacts the water quality of their coastal ecosystems and marine resources. The women said that following heavy rain they notice the water clarity is reduced as large amounts of sediment flow from the river mouth.


***Figure 8.6*** *A spatial image showing the mouth of the Dreketi River, located approximately 12 km away from Raviravi. During the group discussions, it was mentioned that following heavy rainfall large amounts of sediment flow from the river and create turbidity around the reef and fishing zones (Google , 2018).*

During the session with the men, they mentioned that they noticed crabs and some fish species are becoming more plentiful and they no longer have to travel as far to collect them, but in general, they have noticed a decrease in the size and number of most fish throughout the last several decades. The men attributed this decline to changes in fishing laws. They said that before the newly assigned *qoliqoli* (fishing ground) Raviravi had one of the largest fishing areas in the province. Now the fishing grounds are divided into districts and therefore many villages have access to the same fishing site, making it more difficult to manage. There are three fish wardens in Raviravi but the men said these people did not have the resources to monitor the fishing area and they had seen large boats coming to fish in their *qoliqoli*. During the same discussion, the men said they had reserved a section of the outer reef to try and increase the fish and coral found there but the reservation was not respected by other users of the *qoliqoli*. The women reiterated what the men had said about poachers and the difficulty in managing *tabu* areas. The women said they do not have any *tabu* areas in place currently and they have never had a *tabu* on the mangroves, only reefs. The men advised that when formal MPAs are initiated by the Ministry of Fisheries (MoF), they are more likely to be enforced but the main concern for MoF is that people have the appropriate fishing licence. Due to the men's obvious frustration, this conversation continued for some time. They also mentioned that they had seen poachers around the mangroves and had woken many times to small fish on their foreshore and said that when people come to poach, they only take the larger fish caught in the nets and dump the smaller fish, which often wash onto the beach. According to Criterion 4 of the EbA Framework (Bertram et al., 2017), an EbA needs to be integrated into existing policy frameworks for it to become sustainable and scalable. For this support to occur, communities may require support implementing and managing MPAs set aside for stock replenishment. Without multi-sectoral support, interventions will remain short-term and limited in their effectiveness. Mr Qera mentioned that it was the intention to implement a MPA as part of the C3 mangrove replanting project. It was not determined why this still had not been done four years into the project.

The men mentioned that following the training and implementation of the project with C3 they had changed the way they manage the natural mangrove forest adjacent to the village. Prior to their training they would regularly clear the undergrowth and remove any new mangroves encroaching into the village as the new saplings were considered untidy and the mangroves were thought to attract mosquitoes. The mangrove clearing task was assigned to a Raviravi community member during the 'village clean-up' days. Clearing of mangroves in the Pacific Islands for similar reasons has also been noted by other researchers (Greenhalgh et al., 2018; Nunn & Campbell, 2020). The men said that as they were carrying out this duty,

they had not considered that they were having a negative impact on the environment but since this practice has been stopped, they have noticed positive changes in the health of the forest and crab population.

As discussions about marine resources continued, the women were asked about size restrictions on certain species, such as crabs and fish, and if undersised stock was returned. They replied, laughing: "*Back to the pot, not to the sea*". The women said they had done the training on catch sizes several years ago and a measuring device had been provided to the village. They recalled from the training session that the size regulations were to ensure the population could regenerate and acknowledged that disregard for these laws would result in a decrease in the size and number of species. The women were asked if they also take spawning crabs. They said these would also be sold or consumed but then added that they rarely see spawning crabs in this area. Although not disagreed with at the time, this comment is questionable. Many species of crab, including those most commonly found in Fiji spawn once per year, usually in early spring. A female crab will only mate and lay eggs once in its lifetime. Some species of crab lay up to 20,000 eggs of which only several will survive to adulthood as most are eaten by fish and other marine organisms. The removal of female crabs before they have spawned not only impacts future crab populations but also decreases the food source for local fish species and impacts the marine ecosystem.

The women of Raviravi were informed about the 'crab fattening' project initiated at Navunievu. It was clarified that female crabs may only need to remain in the cage for one to two weeks, serving as a method to ensure spawning crabs can release their eggs before being consumed or sold and this approach aims to promote a more sustainable utilisation of marine resources without compromising income. As the conversation shifted towards the ban on harvesting sea cucumbers, concerns were raised about the inadequacy in implementing and communicating such restrictions to communities, causing frustration among those affected. It was highlighted that the ban of certain species not only results in a loss of income but can also feel like punitive measures for a community when the rationale behind the ban is not clearly explained.

When determining the variation in roles between men and women in Raviravi, the women mentioned that they all fish but the women mostly stay on the tidal flats close to shore, while the men fish by boat some distance away. The men mentioned that they will all catch crabs in the mangroves but it is predominantly the role of women. The women stated that if men are in the mangroves, it is more often during high tide with a spear to catch fish. These gender specific role descriptions align with the other case study sites (excluding Naivaka) and other research findings (Pearson et al., 2019).

While inspecting the mangrove planting site and foreshore of Raviravi, several observations were noted that may negatively impact the coastal ecosystem and ecological restoration projects. A freshly dug waste pit was located just several metres from the high tide mark, as well as buried waste around the high tide mark that had been exposed by tidal or water movement (*Figure 8.7 a & b*). As sea levels continue to rise, the contents of these former pits, many of which contain plastics and other non-biodegradable materials, will continue to be exposed and their contents entering the marine environment. Assisting communities to dispose of this type of rubbish is essential for the health of the marine ecosystem they are trying to restore and which they rely on for their livelihoods. Remnants of the plastic lines used to secure the pearl shells for the Pearl Research Project were found throughout the foreshore vegetation, including tangled in branches of mangrove trees (*Figure 8.7 c*). The use of biodegradable products should be prioritised by donors when working in communities that cannot readily dispose of such items. This also includes the plastic bags provided by C3 Fiji to grow the mangrove seedlings in the nursery. A more appropriate alternative might be to pay the women of Raviravi or another village to weave baskets from *Pandanus* fronds, or similar, that could be planted directly into the intertidal flats and would eventually decompose as the mangrove sapling became established and would also provide revenue for those making the baskets. A pig was tied to a well-established tree on the foreshore of the village (*Figure 8.7 d*). In the animal's search for food, it had substantially loosened the sand around the tree roots so that the tree's survival would likely be compromised in an extreme weather event.


***Figure 8.7 (a)*** *A freshly-dug waste pit located within metres of the high tide mark at Raviravi.* ***(b)*** *Previously buried waste, exposed on the backshore at Raviravi. This will increasingly occur as the sea level rises.* ***(c)*** *Remnants of the cyclone-damaged Pearl Project lines tangled in the mangroves at Raviravi.* ***(d)*** *A pig tied up on the foreshore of Raviravi is likely to decrease the chance of survival for one of the last remaining trees on the foreshore during an extreme weather event as the substrate has been removed from around the roots (Source, Author, 2022).*

### 8.4.3 Traditional and Local Knowledge (TLK)

When discussing how knowledge is passed down to the next generation, the men of Raviravi said that their children should know more than them as they not only receive all the knowledge from their elders but they receive knowledge from their school education. The men said they pass down knowledge to the children by speaking with them but also involving them in community activities, such as mangrove planting. In relation to the mangroves, the men said:

> "*We have never received any of this type of information that the children had been given about mangroves but this generation of children now understand the importance of mangroves*."

This comment from the men is similar to the other case study sites but does not align with what other researchers have found regarding knowledge of mangroves (Pearson et al., 2020), although it could be interpreted that the men were referring to Western or scientific knowledge that they had learnt, not local Indigenous knowledge. The concept of peripherality was discussed, where the men mentioned that although children in Suva may also learn about mangroves in school, they do not get the hands-on experience that someone growing up in a village has access to, indicating the local ecological knowledge of rural communities is superior to those living in urban environments. Due to the rain disruption during the women's interview, TEK and passing down knowledge was not discussed. Yet while in the village, women were observed in traditional practices of weaving and broom-making (*Figure 8.8*).

***Figure 8.8*** *A women from Raviravi Village making traditional Fijian broom from coconut palm leaves, but also has leaves drying in the background, which are used for mat or basket weaving (Source: Author, 2022).*

### 8.4.4 'Hard' versus 'other' solutions

The seawall built at Raviravi in 2020 by the Ministry of Waterways & Environment (*Figure 8.9 a & b*) was the first engineered structure built in Raviravi to stabilise the shoreline and protect the village against flooding. During discussions with the women, they claimed that seawater had been entering the village every high tide and would reach the second row of houses – something that they estimated had been occurring since the small island in the bay in front of the village had disappeared around the 1990s. This new seawall had only been completed three months when TC Yasa made landfall over Vanua Levu. The intensity of the waves dislodged the rocks from the top section of the seawall and into the village. The damage to the seawall has since been repaired but during the cyclone, the women mentioned that seawater completely inundated their village. There was extensive damage to backyard garden crops that the women had been growing around their homes, which an NGO had assisted in establishing. These gardens contained a large variety of vegetables, such as tomatoes, that the women would use and sell at the markets. The women did not go into detail about why the gardens had not been re-established but it is assumed they felt a similar feeling of discouragement as they had when the Pearl Project was damaged by the same cyclone. Some of the women had re-established gardens further away from the village but this creates additional challenges to managing gardens close to the home, such as an increased time commitment and accessibility to travel to the garden and return with the produce, particularly for those caring for young children.

There is one drainage point in the seawall that allows water to drain from the village back to the sea (*Figure 8.9 c*) which seemed inadequate. The women said that the idea to build the seawall was a community decision and since it had been completed, they no longer experience regular flooding in the village. Both men and women described the design of the seawall as a pilot project for Fiji, which is a similar design to the wall currently being built in Navunievu. According to the men, the seawall has proved successful, except for the one incident where a cyclone damaged the seawall soon after construction and lead to the village flooding. The fact that seawalls often cause flooding in villages was discussed with the men, who mentioned that the two natural streams that flowed on either side of the village likely prevented this from occurring at Raviravi. This suggests that if the design of a seawall accounts for other local environmental factors, such as existing natural waterways, it may reduce the likelihood of unintended negative consequences, such as those other villages have encountered (Piggott-McKellar, Nunn, et al., 2020).

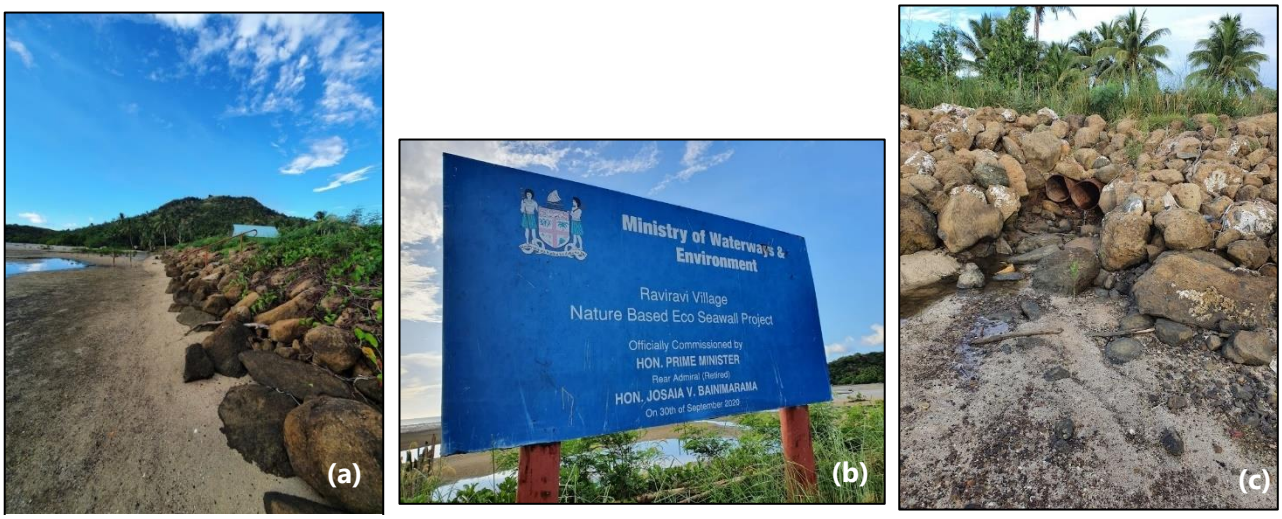



***Figure 8.9 (a)*** *The rock seawall that runs the length of the Raviravi coastline, built to reduce erosion and flooding during high tides.* ***(b)*** *At the staircase entrance to the beach over the sea there is a sign acknowledging the completion of the project, which included the Prime Minister of the time attending the opening ceremony.* ***(c)*** *The drainage point built in the seawall at Raviravi is an improvement in the design at Vusasivo, due to the larger sized pipes and location slightly higher location on the wall (Source: Author, 2022).*

### 8.4.5 Understanding of climate change

Both the men and women attributed some of their challenges climate change to, such as the number of fish they catch, coastal erosion, and sea-level rise, but their level of knowledge about the causes of climate change was not determined as the topic was not discussed in great detail.

### 8.4.6 Trust in faith for challenge management

The men of Raviravi believed that praying to God for help may provide assistance to manage the changes they are going through. They were referring to environmental changes, and the changes to their coastline as this comment followed after discussions of the small island disappearing and a conversation about climate change and sea-level rise. One elder said:

> "*We believe in what the bible says that when God created the universe, everything was perfect. The changes that have happened are because of our actions. If we go back and try to protect everything that God created everything will revert back naturally.*" They said this belief is a motivation for changing their behaviour.

During discussions with the women about the reliance they place on their faith to overcome problems, they stated: "*Nothing is impossible with God*." Expanding on this, they were asked how they believe God can assist with problems such as climate change, coastal erosion and sea-level rise. The women replied:

*"The Holy Spirit inspires individuals. We believe that praying, fasting and serving God can help inspire people to come and help us. For example, we have been asking and praying for a seawall for a long time, even the elders that are now gone were asking and begging for a seawall. Now in God's time, he has inspired people to help to be part of building the seawall. That's how we connect our beliefs. It inspired the Government, inspired the Ministry of Waterways, inspired the donors who gave the money. Everybody is touched because God allows it, because we have been praying."*

These comments demonstrate how critical it is to incorporate spirituality into conversations between community members and donors when planning adaptation projects, as secular messages will often conflict with a community's spiritual worldview (Nunn, 2017).

### 8.4.7 Impacts of COVID-19

During the *talanoa* session with the men, they shared that their awareness of COVID-19 initially came through radio broadcasts, followed by a personal visit from the Minister of Health. This visit included instructions of handwashing, social gathering restrictions, and advice on what to do if they become ill, along with the importance and directive to get vaccinated. When asked about the effectiveness of the authorities' communication regarding COVID-19 and vaccinations, the men indicated that the messages were very clear. They noted that compliance with vaccination mandates was reinforced by the consequence of being excluded from essential public services, including public transport, school, and hospitals, for those that did not comply. Furthermore, the men highlighted that once travel restrictions eased, bus drivers were mandated to verify vaccination cards before allowing individuals to board the bus. This led to a discussion about the reasons COVID-related regulations were followed so readily, while others, such as those related to resource management were overlooked. In alignment with the other case study sites, the response from the Raviravi community members was that the consequences of not being vaccinated would cause great inconvenience, as it would prohibit being able to go to the supermarket or the bank. The regulations were enforced by the police, in contrast to laws on resource management, where enforcement is mostly at the community level. The men stated:

"*There are laws and consequences but no one to monitor*", "*We take anything we like from the ocean and people can poach and no one will monitor*".

The men agreed that if regulations for resource management were similar to COVID-19 restrictions, there would be more compliance and attributed the reason for the difference in law enforcement was because COVID-19 restrictions and vaccination orders were from a global perspective, coming from World Health

Organisation, while fisheries laws were at a national level. In their separate conversation, the women agreed and stated that: "*everyone complied with COVID-19 restrictions because we were afraid of the $200 penalty*", which is the cost of the fine if found not abiding to the local enforcement of movement restriction during COVID-19. To unpack this statement, the women were also asked about the difference between complying with the COVID-19 restrictions and taking undersized marine resources, where they stated that it was because there are no penalties, and also mentioned that it was the same for poaching. They did not have the resources to enforce any restrictions imposed with a MPA and there are no consequences for people poaching in their area.

Additional impacts of COVID-19 identified by the women of Raviravi replicated what was said in all the other case study sites, that children were reluctant to return to school once they reopened after COVID-19-related movement restrictions. The women also found some other restrictions challenging, such as no church services, community work, or social gatherings, which included not being able to attend funerals.

The women said their diet was not severely impacted as they have the ocean and farms to source their food from but mentioned that they found it difficult selling items, such as fish they had caught, as there were fewer buyers. Items they wanted to purchase, like sugar, salt and soap were more expensive and difficult to access as only one person could leave the village for supplies and this person needed to be vaccinated. If they questioned the price of these items, they were told it is the COVID-19 price, an indication of supply chain issues which was also noted globally (Davila et al., 2021; Elliott et al., 2020).

## 8.5 Looking forward

This section summarises key points made by the community members of Raviravi in relation to opportunities and challenges for sustainable adaptation, with a focus on EbA. Raviravi had been fortunate to be chosen for several pilot projects which have the ability to provide them with an alternative source of income away from their marine resources. One successful harvest of pearls from the pearl project would yield a substantial return in terms of village income and would allow the women managing the project to draw a wage and provide revenue to reinvest and grow the business. The convenience store also provides one family from the village a source of income, while providing the rest of the community the convenience of not having to travel to town to purchase essential supplies. The seawall design piloted in Raviravi is superior to the design of many other seawalls in Fiji and has provided the village with some relief from seawater flooding and has stabilised the coastal erosion, while the mangrove and native tree nursery project is a source of income and once these trees are planted and become established ecosystems, they

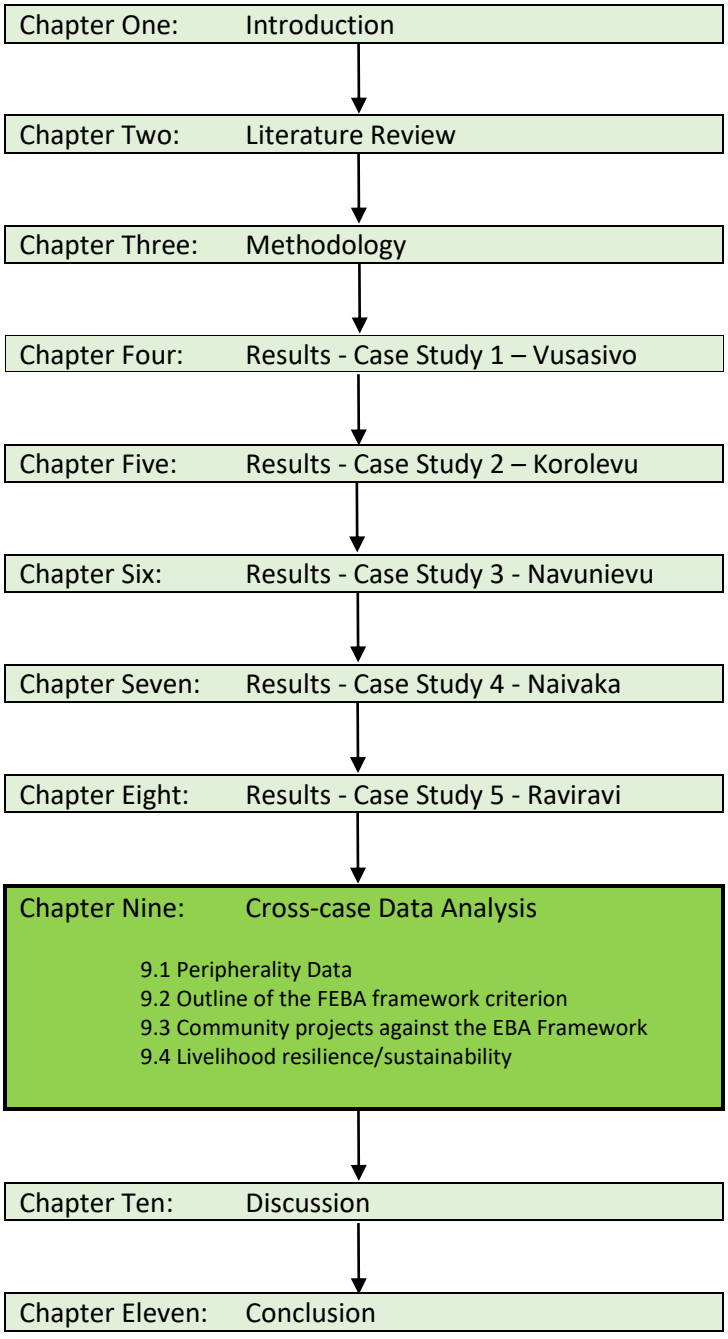
will increase food security for the community and likely provide some protection from extreme weather events.

When applying the assessment framework for EbA quality standards the most apparent reason why Raviravi's mangrove project may not be successful is the elevation below mean sea level where the propagules were planted, the lack of project monitoring in place, and the scale of the project. The challenges that have been identified in Raviravi were mirrored in the other case study sites and provide the foundation for finding solutions to more sustainable adaptation in rural Pacific Island communities.

In the ensuing discussion section, a cross-case analysis is presented, comparing the challenges, opportunities and themes arising from the data collected from each case study site. This community comparison seeks to identify commonalities among rural Pacific Island communities, while highlighting the unique circumstances inherent to each community. It underscores the notion that adaptation strategies cannot be uniformly applied, emphasising the findings from previous research the unsuitability of adopting a 'one-size-fits-all' approach in the context of diverse communities (IPCC, 2022b).

# CHAPTER NINE: Cross-case Data Analysis

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



This chapter commences with a summary of peripherality data collected during discussions with members of the community and through general observations. Following this is an outline of the five EbA Assessment Framework criteria that exist within the three Framework Elements (Bertram et al., 2017). The four case study communities that had undertaken mangrove reforestation (Vusasivo, Korolevu, Navunievu, and Raviravi) had their project rated based on its alignment with the quality standards that are encompassed within each criterion, presented in the results chapters (4 – 8) for each case study. The mean of these quality standard ratings was calculated and graphed to provide a visual representation of each community's project and is presented in this chapter (*Section 9.2)*, followed by the consolidation of case study data using the mean value of each EbA Framework element. These results are graphically illustrated, which provides a visual insight into the potential correlation between projects. While similarities are evident among these case study communities, a recurring theme throughout the results chapters is the unique attributes that characterise each community. This includes their specific goals, aspirations, variations in social structure, and the extent of preserved TLK, factors that may facilitate or inhibit sustainable adaptation. Naivaka was not included in this analysis as they have not undertaken any type of nature-based solution.

Additional findings that have been extracted from the data encompass the resilience and sustainability of a rural coastal community with regard to livelihood (Section 9.3). Extracting these data involved a qualitative estimate of each community's sources for nutritional requirements and income streams, which is graphically represented, along with an outline of the relevance of this data to sustainable EbA.

## 9.1 Peripherality Data

*Table 9.1* and *9.2* summarise peripherality data that was collected during site visits. Peripherality is a geographical-based measure that helps explain how a community may be more autonomous as the facilities readily available in urban centres are less utilised due to time/cost/effort to travel (Korovulavula et al., 2019; Nunn & Kumar, 2019). Indices used to calculate peripherality are related to geographical location/isolation, population and employment, and tradition and global awareness (Nunn, Joseph, et al., 2019) and can be used as a possible indicator of a community's autonomous coping capacity and their level of risk and resilience to the impacts of climate change (Nunn & Kumar, 2019); something that is often difficult to measure (Medina Hidalgo et al., 2021).

***Table 9.1*** *Basic geographic peripherality data of the five case study communities for this research project. These data were collected through observation, community conversations, and information provided by Maleli Qera, the local research assistant/interpreter. Peripherality data can assist in providing insight into a community's autonomous coping or adaptive capacity.*

| Case Study Sites | Vusasivo | Korolevu | Navunievu | Naivaka | Raviravi |
|---|---|---|---|---|---|
| **Basic Geographical Data** | | | | | |
| **Number of households** | 70 | 6 (original village);<br>9 (relocated village) | 36 (original village);<br>6 (relocated village) | 26 (original village);<br>23 (relocated site) | 24 (5 destroyed in TC Yasa) |
| **Village access to and from the nearest town by:** | | | | | |
| • Motor vehicle | 4WD only | In the new village only | High clearance vehicle, 4WD in wet conditions | Limited, 4WD in dry season only | High clearance vehicle, 4WD in wet conditions |
| • Bus (return fare from the closest bus stop) | FD$22 | FJ$7 | FJ$7 | FJ$24 (from Nasau) | FJ$5.60 to Labasa;<br>FJ$2.60 to Seaqaqa (not avail in very wet conditions) |
| • Boat | No | Raft | Yes | Yes | No |
| • On foot access | No | No | No | No | No |
| • Distance from the nearest town | 80 km | 28.5 km | 38.4 km | 115 km | 55 km |
| **Nearest medical facility** | In the village | 2 km | 10 km | 23 km | 27 km |
| **Nearest primary school** | In the village | 4 km | 2 km | In the village | 11 km (rough terrain) |
| **Nearest secondary school** | 40 km | 4 km | 10 km | 23 km | 25 km* |
| **Mobile phone access** | Very limited | Very limited | Good | No | Very limited |
| **Internet access** | At the school | No | Limited | Only at the school | No |

***Table 9.2*** *A comparative summary of the impacts of climate change and adaptation options that have been implemented by the case study community. These data were collected through observation and discussions with community members.*

| Case Study Sites | Vusasivo | Korolevu | Navunievu | Naivaka | Raviravi |
|---|---|---|---|---|---|
| **Local Ecosystems** | | | | | |
| Mangroves cleared | Yes | Yes | Yes | No | Yes |
| Village experiences regular flooding | Yes | Yes | Yes | Yes | Yes |
| Is currently experiencing coastal erosion | No | No | Yes | Yes | No |
| Noted decline in coastal resources | Yes | No | Yes | Yes | Yes |
| **Adaptation Approaches** | | | | | |
| Mangrove replanting | Yes | Yes | Yes | No | Yes |
| Seawall (functional) | Yes | No | Under construction | No | Yes |
| Previous seawalls | Yes | No | Yes | Never completed | No |
| External funding provided for projects | Yes | Yes | Yes | Not determined | Yes |
| Relocation underway | Being considered | Yes | Yes | Yes | No |
| **Culture** | | | | | |
| Trust in faith for challenge management | N/A | N/A | Yes | Yes | Yes |
| Trust in science for challenge management | Yes | Yes | Yes | Yes | Yes |
| Mangroves used for cultural practices | Yes | Yes | Yes | Not to the same level as other villages | Yes |
| **Livelihood** | | | | | |
| Mangroves important for income generation | Yes | Yes | Yes | Not to the same level as other villages | Yes |
| Alternate livelihoods in place | No | Yes, but price and stock are in decline | No | No | Yes |

## 9.2 Outline of the FEBA (2017) Framework Elements and Criteria

The Assessment Framework for EbA Quality Standards was outlined in detail in Chapter 3. The following section provides a brief overview of each of the five criteria within the three elements that the case study community projects were rated on. This was done by averaging out the accumulative ranking score of the mangrove planting projects and then graphed in this section.

### Element A – EbA helps people adapt to climate change

*Criterion 1. Reduces social and environmental vulnerabilities* is premised on the expectation that EbA must address current and future climate change and climate variability. A climate vulnerability, hazard, and risk assessment for people, as well as the benefits resulting from the increased ecosystem services assessment form the basis of this criterion. The use of the best existing scientific data combined with TLK and the results from the vulnerability assessment form the foundation of the EbA project. The measures via which EbA reduces climate vulnerability for people needs to be at least done on a local scale, although an ecosystem scale is superior.

*Criterion 2. Generates societal benefits in the context of climate change adaptation* assures that an EbA will provide equitable and fair societal benefits and reduce the vulnerability of people through the use of biodiversity and ecosystem services. It addresses the needs of people, particularly those whose livelihoods depend on or use natural resources and who are vulnerable to the impacts of climate change. Examples of how EbA can increase the resilience of people to climate change are by enhancing food security, risk reduction, and provision of fresh water and medicine, as well as by generating additional benefits that are important for sustainable development including carbon sequestration and habitat provision. The need for EbA to distribute short-, medium-, and long-term benefits will ensure projects support adaptive capacities.

### Element B - EbA makes active use of biodiversity and ecosystem services

*Criterion 3. Restores maintains or improves ecosystem health* is aimed at ensuring the EbA approach will restore, maintain and improve ecosystems to a scale that addresses the impacts posed by climate change and other anthropogenic activity. Additionally, climate change and other threats can alter ecosystem composition and structure, therefore, this criterion focuses on ensuring that the health and stability of ecosystem services are maintained, improved, and monitored. It supports the diversification of land and marine resource use by considering livelihood options and may include the introduction of climate-adapted species better suited to a changing climate, provided there is no risk of these species becoming invasive or detrimental to native species.

### Element C – EbA is part of an overall adaptation strategy

*Criterion 4. Is supported by policies at multiple levels* and mandates that EbA operates at local, national, and regional levels, and at multiple geographic scales. The approach becomes integral to policies and frameworks aimed at sustainable development, agriculture, land use, poverty reduction, natural resource management, climate change adaptation, and disaster risk reduction.

*Criterion 5. Supports equitable governance and enhances capacities* ensures EbA enhances governance of natural resources with respect to the use of biodiversity and ecosystem services. This is achieved by following a community-centred approach that is marked by gender inclusivity, transparency, empowerment, and accountability. It provides ownership to the people tasked with managing the ecosystem, who are the ones using and benefiting from the ecosystem.

## 9.3 Community projects against the EbA framework

The mangrove planting projects at Vusasivo, Korolevu, Navunievu, and Raviravi were analysed against the FEBA (2017) framework. This section provides a review and a mean ranking based on each community project against each of the qualification criteria of the framework.

### Qualification Criterion 1

Data analysis of each community's mangrove planting project for Qualification Criterion 1 of the EbA Framework is shown in *Figure 9.1*. This criterion assesses whether a project reduces social and environmental vulnerabilities and if the project addresses current and future climate change and climate variability, as well as whether the project plan was based on an assessment of the community's climate vulnerability, and associated hazards and risks. It is likely that the three case study communities with a seawall (Vusasivo, Navunievu, and Raviravi) were assessed by the donor organisations on their climate change vulnerability as part of the seawall project plans but these data were not evident or disclosed at the time of data collection for this research. Vusasivo community members stated they were involved in conversations as part of their vulnerability assessment before their seawall construction, but were never provided with these results. The ability to assess climate change vulnerability in accordance with this Criterion requires access to locally-relevant climate data and an understanding of how climate change may impact the local environment and the community under future climate scenarios. This site-specific knowledge ensures that a project can be planned accordingly. An example of this may be planting in a location that accounts for future sea-level rise, using a planting technique that protects juvenile plants, or considering species that are more resilient to higher temperatures, longer periods of tidal inundation (more saline-tolerant), or seasonal changes in precipitation.

Although only achieving a mean score of 4/8, Raviravi was rated the highest for this qualification based on their incorporation of TLK, their multi-pronged approach to their project, which included various methods of planting mangroves to improve survival rate. Additionally, the protective barrier that had been placed around the planted propagules demonstrated that the community members were aware of the potential climate hazards on juvenile plants. The other three case study communities received a similarly low rating of 2 – 3 out of 8 for varying reasons. That is, it is not likely that the current scale of Vusasivo's mangrove project will address the community's climate change vulnerability. While Korolevu had achieved good results in the early stages of their mangrove planting project, it was not addressing the main issues that were impacting the community's well-being, and Navunievu did not have an active nature-based project but was rated on their level of understanding of their vulnerability to climate change, their local ecological knowledge, and the fact that they had initiated mangrove planting although the saplings had been destroyed with the construction of the new seawall.

Developing, implementing, monitoring and evaluating an EbA project is complex and the challenge is increased as many projects are implemented on degraded ecosystems, meaning the baseline from which the project begins is low and it is often (uncritically) presumed that the area will support the species that previously existed there (Nalau, Becken, & Mackey, 2018). In such cases, the local ecological knowledge required for project implementation may need input from a broader range of expertise, indicating that strategic investments and partnerships that can provide localised data based on future climate scenarios while still welcoming the traditional knowledge from the local community may increase the sustainability of a project (Rahman et al., 2023; Roberts et al., 2012).

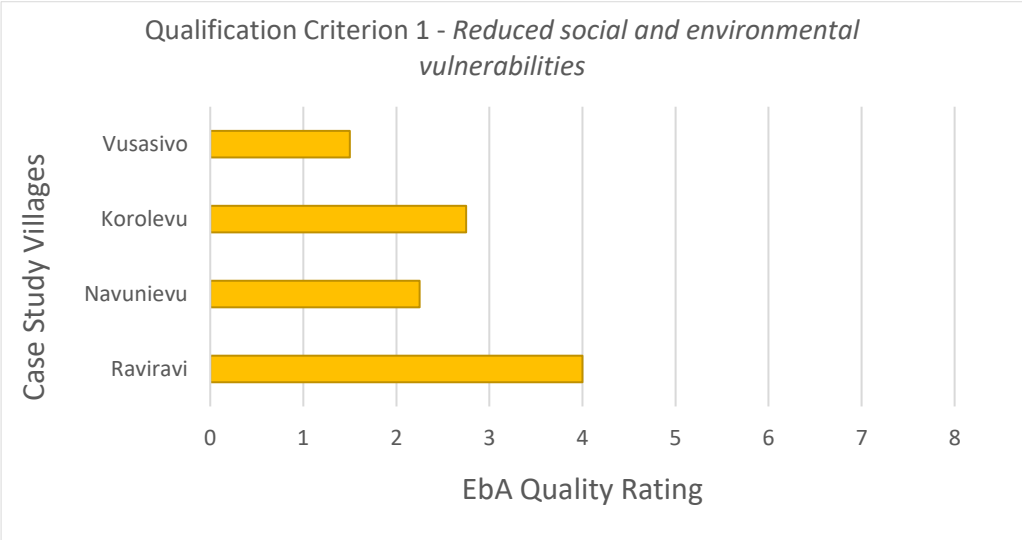



***Figure 9.1*** *Assessment rating of EbA quality using the FEBA (2017) framework for qualification criterion 1 for each case study community based on qualitative interviews and observational data results.*

## Qualification Criterion 2

According to the framework, Qualification Criterion 2 can be achieved by addressing the needs of people, thereby reducing vulnerabilities or increasing climate change resilience through the use of biodiversity and ecosystem services. The three communities (Vusasivo, Korolevu, and Raviravi) that had active mangrove projects all attained around 5/8 for this criterion based on the projections of equally distributed benefits that would be generated by the ecosystem services provided by the mangroves once fully established (*Figure 9.2*).

This qualification was assessed on the assumptions that each project would have continued community support and that community members could continue to plant and improve their monitoring of the mangroves, as the assessment is based on the long-term benefits derived from a biodiverse ecosystem. The framework states that for an EbA to support adaptive capacity, it should also provide short- and medium-term benefits. Each community that had initiated mangrove planting stated that they had already noticed some positive changes in their coastal resources even after just a few months, which may be attributed to the community taking more care of the area where the planting had occurred. Community projects, such as those at Vusasivo, Korolevu, and Raviravi may incentivise autonomous adaptive capacity as self-initiating a project can provide a sense of accomplishment while bringing community members together, enhancing local creativity and capability while drawing out and grounding local knowledge (McNamara et al., 2022). Supporting community decisions, filling knowledge gaps, and providing funding or training workshops may increase the short- to medium-term outcomes of community EbA projects, and potentially reduce a vulnerability mindset which can hinder adaptive capacity (Kelman, 2020).

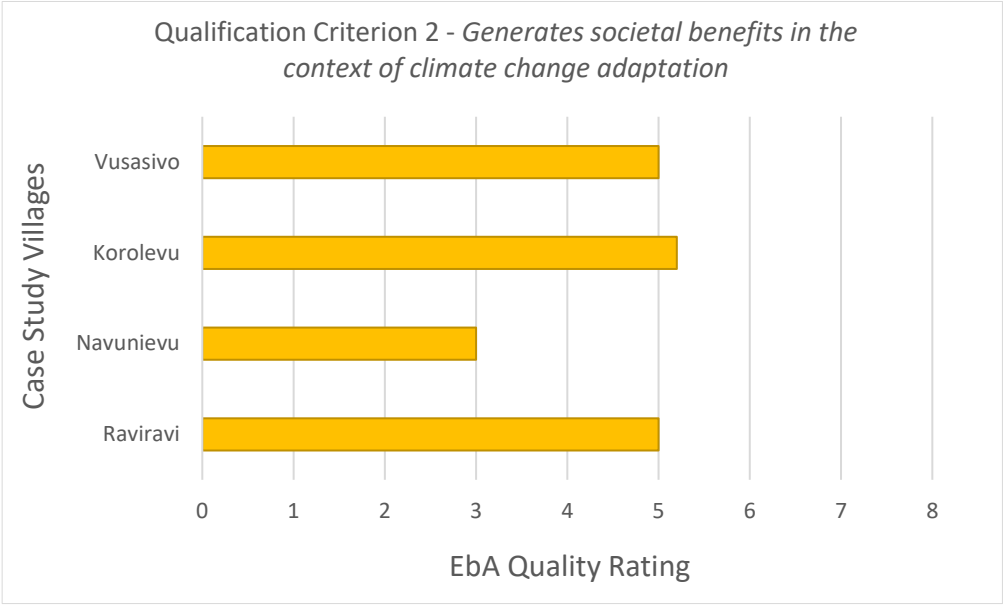



***Figure 9.2*** *Assessment rating of EbA quality using the FEBA (2017) framework for qualification criterion 2 for each case study community based on qualitative interviews and observational data results.*

## Qualification Criterion 3

In addition to the application of TLK, Qualification Criterion 3 of the EbA Assessment Framework evaluates the scale at which a project restores, maintains or improves ecosystem health, and accounts for the impacts of climate change and the reduction of non-climate stressors on the site. Although each case study community had demonstrated the application of their traditional and local knowledge to implement their planting project, they were still given a low rating for not achieving other criteria *(Figure 9.3)*. Korolevu and Raviravi were rated higher than the other two communities due to the scale of their projects, and novel planting approaches respectively, as well as the increased level of external support for both communities. None of the case study sites had considered the suitability of the area they planted in, such as the duration of tidal inundation, the existence of adequate substrate, or whether the species planted were suitable as pioneer species. Planting sites were chosen based on where the community was hoping to reduce erosion. Each case study site, except Korolevu, was not at a scale (area or species diversity) that could be considered ecosystem restoration (SERA, 2018), and none of the case study sites had the area placed under protection from non-climate stressors (e.g. harvesting of fish and shellfish), such as the introduction of a *tabu* zone, although each community mentioned they intended to do this. Mr Qera mentioned that Raviravi's planting project, which had been supported by C3, was supposed to include the implementation of an MPA as part of the plan, but this still had not been done several years into the project.

Removing non-climate stressors from an ecosystem that is used as a primary source of food and income may provide challenges, therefore rural communities may gain from assistance in working through a cost-benefit analysis to demonstrate the long-term advantages of strict resource management practices. Discussions with the participants revealed that resource management was one of the biggest challenges for such their community. Each community had several systems in place, such as allocated fish wardens, a conservation committee, and community members who had attended training on marine resource management, yet these programs had not achieved their intended goals. Community members stated that the main challenges in resource management were changes in traditional fishing areas, lack of respect for *tabu* zones, the requirement of income, and limited law enforcement on catch regulations. Other pertinent researchers have noted that the role of community fish warden never eventuated to the extent that it was originally planned, which was a paid position provided with boats and equipment that could be used for patrols (Fache & Breckwoldt, 2018). The same research also mentioned that many communities do not have fish wardens as it can be difficult to find someone willing to take on the role because it can challenge or impact their social relationships within the local villages. That is, younger men or women willing to take on this role would find it difficult, or are unable to address an elder Aunt, Uncle or Chief due to family laws and customs in Fiji. Although not specifically mentioned, this barrier was most likely one of the reasons that the fish warden's role had not been successful in the case study communities.


***Figure 9.3*** *Assessment rating of EbA auality using the FEBA (2017) framework for qualification criterion 3 for each case study community based on qualitative interviews and observational data results.*

## Qualification Criterion 4

Qualification Criterion 4 of the framework assesses whether an EbA project is supported by policies at multiple levels, including local, national, and regional. Criterion 4 is incorporated into Element C which states that EbA needs to be part of an overall adaptation strategy. An EbA that meets this criterion presumes that it is integrated into existing policy which allows for projects to be sustainable and scalable rather than short-term or stand-alone (Bertram et al., 2017). The framework also states that when an EbA operates at multiple levels with a multi-sectoral approach, it can work at multiple geographic scales and can become part of the strategy that targets sustainable agriculture and land use, poverty reduction, natural resource management, climate change adaptation, and disaster risk reduction. Both case studies 1 and 2 (Vusasivo and Korolevu) were assigned a score of 2/8 (*Figure 9.4*) due to the partial relocation of the village - a minimal element of this criterion. Case study 3 (Navunievu) could not be rated as their project was disrupted with the construction of the seawall, while case study 4 (Raviravi) was rated the highest as they met several of the key criteria, such as their multi-sectoral approach and the integration of their project as a part of a broader adaptation plan that included attempting the removal of climate and non-climate stressors from the project area. This included planting saplings from a nursery instead of propagules, protecting young plants using a bamboo fence, and some focus on alternate sources of income other than their marine resources.


***Figure 9.4*** *Assessment rating of EbA quality using the FEBA (2017) framework for qualification criterion 4 for each case study community based on qualitative interviews and observational data results.*

## Qualification Criterion 5

The final criterion, also incorporated into Element C, provides the means to assess whether an EbA project supports equitable governance and enhances capacities. This criterion highlights the need for a community-centred, participatory, and gender-sensitive approach to the governance of natural resources with respect to biodiversity and ecosystem services. It also states that the project should support participation at the local level and the benefits should be shared equitably amongst the stakeholders. Those benefiting from the project should have ownership and be responsible and accountable for ecosystem management with checks in place to ensure that the ecosystem services are being renewed from the project and are used sustainably. Strong local governance should be embedded into higher-level governance structures, such as local and national Fiji Government departments, which can facilitate local action through pertinent policies and support structures. Criterion 5 also recognises that human well-being and resilience cannot be provided by ecosystem health alone, particularly when the ecosystem may be impacted by climate change. Therefore, an EbA needs to be integrated into a wider adaptation strategy and be complemented by other adaptation options, such as raised vegetable gardens, planting salt/drought tolerant species, and possibly a longer-term plan to relocate further inland and upland.

Again, Raviravi (case study 5) was rated most highly for Criterion 5 (*Figure 9.5*) based on the accountability, group representation and gender balance, and the local governance and external support structure of their project. Case studies 1 and 2 (Vusasivo and Korolevu) were rated slightly lower based on their group representation and gender balance, and strength of local governance respectively. A rating was given to Navunievu owing to their strong commitment towards implementing a project in the near future. However, this result may be inflated should their project no go ahead. Ongoing research into each of these community projects would be beneficial and would allow monitoring of the community commitment and project success, and would build on knowledge that could be valuable for the broader rural Pacific Islands community looking at similar projects.

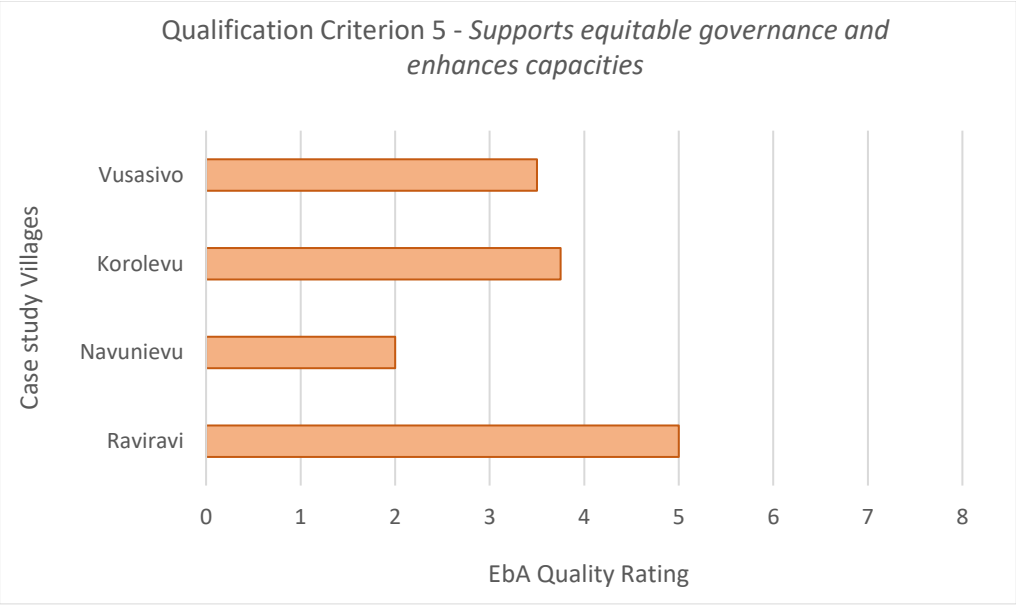



***Figure 9.5*** *Assessment rating of EbA quality using the FEBA (2017) framework for qualification criterion 5 for each case study community based on qualitative interviews and observational data results.*

Data from each community project were combined to show a comparison of how each was rated on the three core elements of the EbA Framework (*Figure 9.6*). Although each community identified similar challenges during the group discussion, this graph shows more clearly that each community has strengths and areas where they may benefit from additional (external) support in their EbA project. These results continue to validate that a one-size-fits-all approach is not suitable for community adaptation as it does not account for the local environment or the level of resilience and traditional knowledge, or the social structure within a particular community.

It can be noted from *Figure 9.6* that Raviravi has a higher rating than the other case studies for Element A and C. This result can be attributed to their engagement with the locally-based NGO, C3 Fiji, as well as the additional support that the community gained as part of the Kiwa Initiative, which provided clear project goals and timelines that assisted the project in maintaining momentum. The low ratings of the other communities can mostly be attributed to the limited scale, monitoring and evaluation of their projects, the absence of a plan to reduce the non-climate stressors from the project area, and the project not accounting for future climate change.

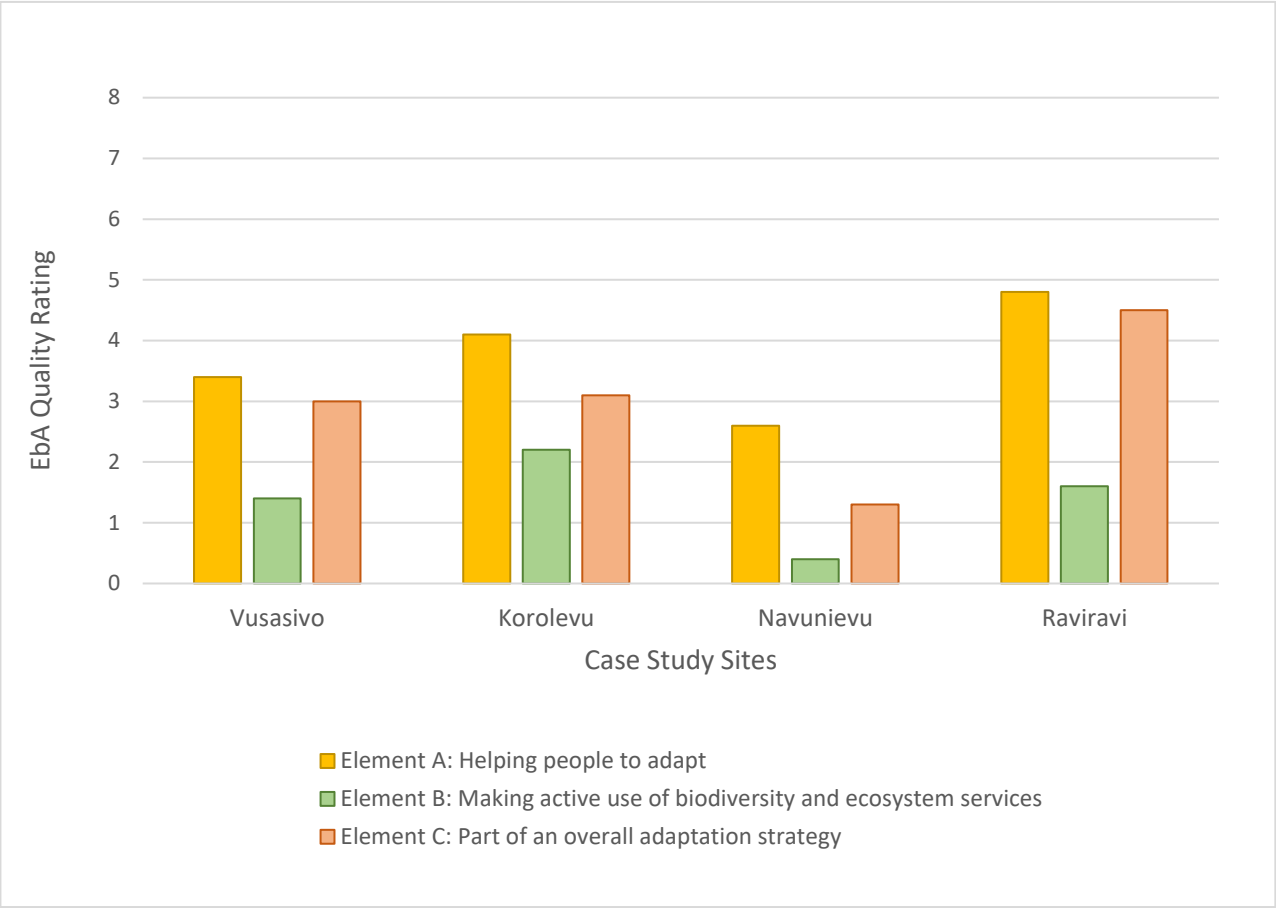



***Figure 9.6*** *A case study comparison of the mangrove planting projects based on the FEBA (2017) assessment framework for EbA quality standards.*

Data represented in *Figure 9.6* also indicates areas where the EbA projects could be improved to increase the likelihood of their sustainability. Overall, Elements B and C appear to present the greatest challenges to rural communities. The shortfall in achieving Element B may be due to the heavy reliance on ecosystem services for daily use. Therefore, without alternative sources of food or income in place, communities need to maintain daily life using the ES they are accustomed to. The difficulty in achieving Element C appears to come from a lack of a supportive governance structure, and that the scale at which climate change may impact their community and the local ecosystems is not adequately understood. Additionally, the mangrove projects were not part of an overall adaptation strategy, for although three of the villages had seawalls and all had started partial relocation, the adaptation projects did not appear to be synchronised, but were more like several stand-alone reactive projects. This reactive approach has been previously noted (Nunn et al., 2020). Other researchers also noted that without purposeful, aligned methods of adaptation, communities may independently adapt to the changing climatic conditions, but this may have significant

adverse ecological, social, and economic impacts that can be avoided by anticipatory, planned adaptation (Prasad et al.,2022).

The case study community of Naivaka has been largely omitted from this cross-case analysis chapter as they have never undertaken any nature-based solution. Yet, they did provide valuable comparative data and insight into rural community adaptive capacity. This community has faced significant shoreline erosion resulting in the loss of many homes yet they had never explored whether this damage could be managed through any form of EbA and had opted for a seawall as their first preference and relocation of new homes after the request for a seawall was not fulfilled. The Naivaka community members claimed that mangroves had never grown on their foreshore and would not grow if planted there, which is very likely the case due to the exposure and dynamic nature of the coastline. It is presumed this is also the reason why donors or government agencies avoided constructing a seawall because it would likely be short-lived. During discussions with the women of Naivaka, it became evident that they saw a connection between vegetation being removed from their foreshore and increasing erosion. They mentioned that they removed some coastal vegetation on advice from the Minister of Health, which led to increased erosion. As a result, they attempted to restore this vegetation. Both the men and women expressed concern about the condition of their adjacent reef but did not associate the degradation of their reef with coastal erosion. While mangroves are unlikely to survive at Naivaka, there are other opportunities for EbA that could enhance ecosystem services and adaptive capacity for this community, such as other species of coastal vegetation that are inherently found in similar environments (dune vegetation). During discussions with the men of Naivaka, the idea of placing large rocks near the village foreshore was proposed as a possible option as an alternative to a seawall. It was suggested that this option may provide habitat and encourage marine life back to the foreshore as well as offering some protection from larger waves.

This section provides a data analysis of the four case study community mangrove planting projects against the FEBA (2017) EbA Quality Standards Assessment Framework and a review of the Naivaka results. To date, there are limited data available on autonomous adaptation projects initiated by rural Pacific Island communities (Nalau, Becken, & Mackey, 2018). It is important to share data on such projects as it may assist in developing policies that support these projects and may expedite other community projects (Klöck et al., 2022). The following section is an analysis of data collected from the group interviews, based on themes derived from the sustainable livelihood framework (SLF) (*Figure 3.2*) (Natarajan et al., 2022). The SLF anticipates outcomes such as increased income and well-being, reduced vulnerability, improved food security, and increased sustainability of natural resource use, all of which align with the outcomes of a sustainable EbA.

## 9.4 Livelihood resilience/sustainability

EbA is premised on helping people adapt to climate change through the use of ecosystem services. A sustainable EbA project requires the restoration, management and improvement of local ecosystems, in addition to reducing or removing the non-climate stressors. One major challenge identified by all of the case study communities was sustainable resource management. Local marine ecosystems provide income and a food source for local (subsistence-oriented) communities but community members noted that the size and number of marine species available have decreased in recent decades. Additionally, other ecosystem services provided by the local coastal ecosystems, such as protection from ocean waves and a stable shoreline, have declined, undermining the current way of life for Pacific Islands people (IPCC, 2022b; Meriwether et al., 2018). One way to reduce non-climate stressors from an ecosystem and increase community resilience may be to diversify where communities source their food and income, such that disruption to one or more sources will not threaten food security. Based on qualitative observational and conversational data collected from the case study communities, *Figures 9.7 and 9.8* break down where rural coastal Fijian communities source their food and obtain their income.

Although there may be some variation depending on the geographical location of the village, the five case studies are a general representation of rural coastal communities in Fiji. Based on qualitative data, the case study communities reveal that over 50% of their food and income is sourced from nearby marine ecosystems, which include mangroves (*Figures 9.7 and 9.8*). Many households have their own fruit trees and vegetable gardens located within the village, referred to in *Figure 9.7* as local gardens, where a limited amount of fresh produce is grown. Villages also have gardens or farms usually located within walking distance from their village, referred to as upland gardens/farms. Men from the village will often spend the day working at the farm, where they grow produce that is used by the community but also sold at local markets to provide a source of income. Most villages usually have a number of livestock that are eaten on special occasions, and chickens free-ranging around the village provide a further source of protein. Other nutrients are sourced from imported and store-bought goods, such as flour, salt, sugar, tinned fish, noodles and rice.

In many Pacific Island communities, including Fiji and the case study communities, changes in diet have occurred due to shifts in political and economic structures (Medina Hidalgo et al., 2020). Further to this, food sources or income streams can become disrupted by unforeseen events, such as extreme weather or an imposed ban (sea cucumber) (Purcell et al., 2018). For rural community members, this disruption may mean they have to travel further out to sea or substitute fresh foods obtained locally with lower-nutrient

foods purchased from urban centres. Diversification of food and income sources is more likely to provide food security and increase community resilience, particularly when certain ecosystems are being degraded or impacted by multiple stressors. These disruptions can increase economic pressures on households as well as have negative impacts on physical health and well-being, such as potentially increasing the incidence of non-communicable diseases, such as obesity and diabetes (Horsey et al., 2019; Marrero & Mattei, 2022; Medina Hidalgo et al., 2020).

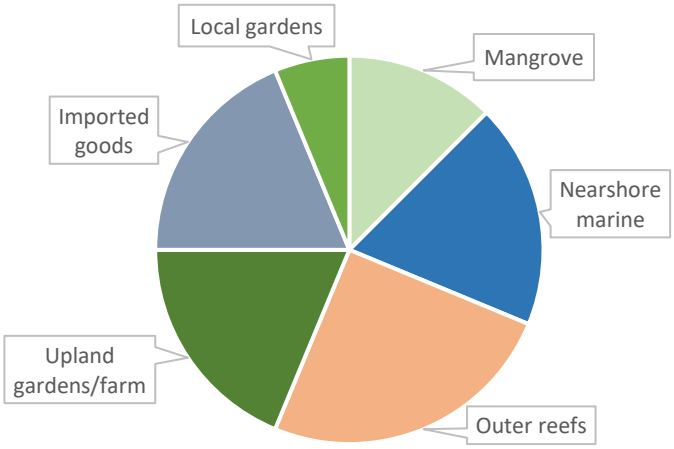



***Figure 9.7*** *A breakdown of where coastal rural communities in Fiji source their food based on observation and information provided during community discussions.*

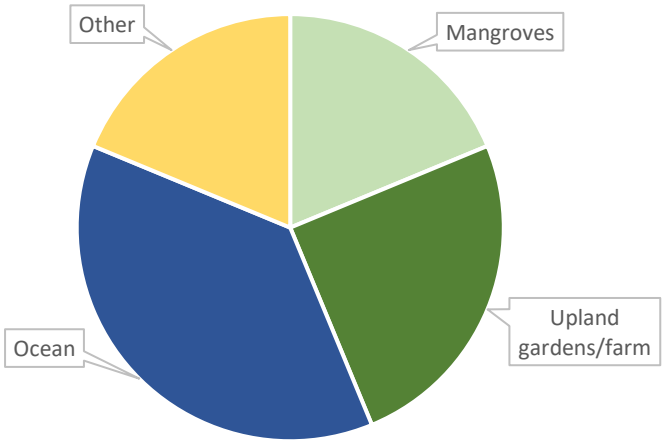



***Figure 9.8*** *A breakdown of where coastal rural communities in Fiji source their income based on observation and information provided during community discussions.*

Additionally, many communities now practice less food preservation and storage than they once did, further increasing food insecurity, particularly in the event of a natural disaster (Pickering et al., 2023). These changes in food systems have occurred over the decades since colonisation for a number of reasons, including the reduction of crop diversity to make way for export crops like copra, as well as famine foods being replaced due to the provision of disaster relief following natural disasters (Campbell, 2015). Further to this, international trade agreements mean refined imported foods like rice and flour products are often cheaper and easier to store than locally produced traditional foods, such as cassava and taro (Pickering et al., 2023). The high consumption of foods made from wheat flour was noted at each case study community, though some more than others. The limited availability of fresh fruit was also noted in some case study communities, which may be partly attributed to the time of year that the data collection took place or the fruit trees were damaged during TC Yasa in late 2020 and TC Ana in early 2021. Although these weather events occurred almost 18 months prior to data collection, there was still noticeable evidence of cyclone damage in each community.

Pickering et al. (2023) recommend EbA as a potential way forward to restoring food security because healthy ecosystems can enhance agricultural productivity and climate and disaster risk resilience. Implementing EbA at scale would require behavioural change to break the cycle of unsustainable resource use and the reliance on local ecosystems as a primary income stream. Each case study community in this study revealed that practices, such as taking undersized fish and crabs, was considered the norm, and suggested that strict regulations with appropriate law enforcement would be required to achieve a change in behaviour, recognising that COVID-19 restrictions worked well when managed in this manner.

Understanding how communities utilise their local ecosystems is an important aspect to the planning of a sustainable EbA because an ecosystem that is already degraded and is not being sustainably managed will likely limit the outcome potential of an EbA project. Nalau, Becken and Mackey (2018) identified a number of EbA constraints that impact project outcomes, including financial, governance, social, and cultural aspects, as well as significant knowledge gaps. Enabling EbA through mainstreaming into policy and improving project outcomes requires these EbA-specific constraints to be overcome. Suggestions for beginning this process may include documenting of EbA case studies, improving the co-development of projects with local communities, refining the monitoring and evaluation procedures, and understanding ecosystems under a changing climate.

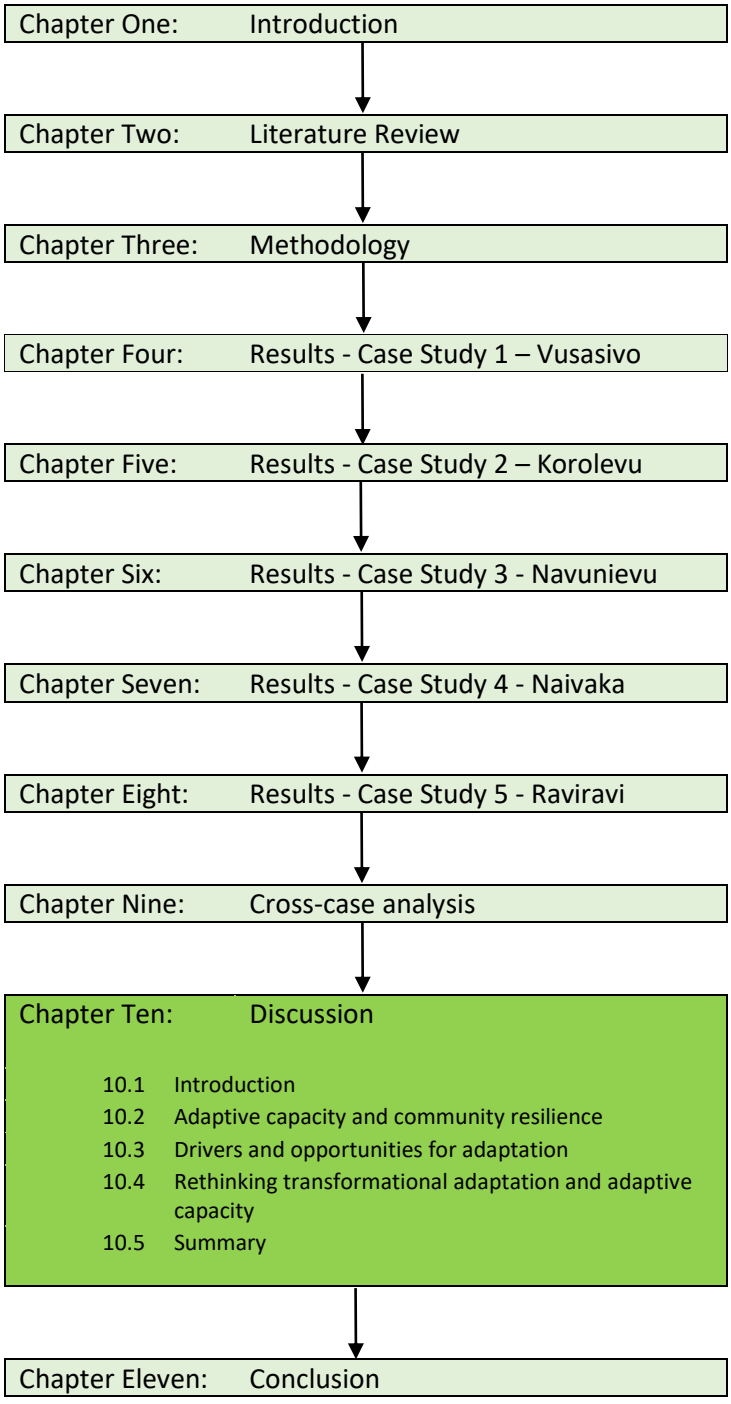
In this chapter, the five EbA Assessment Framework criteria encompassed within the three FEBA (2017) Framework Elements were outlined. Community projects were compared based on their mean ratings for

each qualification criteria of the framework *(Figures 9.1 - 9.5),* followed by a synthesis of case study data using the mean value of each EbA Framework element (*Figure 9.6*). This cross-case analysis aimed to find similar attributes or challenges between projects that may assist in ways to better support other rural communities in similar projects. Furthermore, qualitative data pertaining to sustainable EbA, such as the sources for nutritional requirements and income streams *(Figures 9.7 and 9.8)* concluded this chapter.

The following chapter provides a discussion of the factors that underpin a sustainable EbA project in a rural community context. The five case study communities serve as examples to highlight the opportunities or challenges in this context. This discussion encompasses a range of factors that may contribute to or impact the sustainability of each community project, taking into account each community's resilience and adaptive capacity to climate change. Chapter 10 concludes with a section on rethinking transformational adaptation and adaptive capacity that includes mainstreaming EbA, the resourcefulness of the Pacific Island people, and lessons from the COVID-19 pandemic.

# CHAPTER TEN: Discussion

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



## 10.1 Introduction

This thesis explores opportunities for ecosystem-based adaptation (EbA) to climate change in rural Pacific Island communities arising from the premise of using services provided by ecosystems to sustain culture, food security, and livelihoods. Five coastal rural Fijian subsistence-oriented communities, that are representative of coastal Pacific Island communities, were examined in relation to their perspectives on climate variability, climate change, and coastal ecosystem management strategies. Additionally, the autonomous adaptive capacity and resilience of these communities was explored by identifying strengths or challenges that facilitate or hinder the ability to adapt to climate change. It has been recognised that limited information is available on EbA efforts initiated by Pacific Island communities (Mcleod et al., 2019). This research begins to fill this knowledge gap, which could be used to assist policy and decision-makers to make better-informed decisions regarding climate change adaptation and coastal ecosystem management that may benefit and support coastal Pacific Island people and their livelihoods. Supporting community decisions, filling local knowledge gaps, and providing funding or training workshops may increase the short- to medium-term outcomes of community EbA projects, and potentially reduce a vulnerability mindset which can hinder adaptive capacity (Kelman, 2020).

The five case study results were presented in Chapters 4 to 8 in chronological order of the data collection carried out during July and August 2022. Chapter 9 provided a cross-case analysis as well as identifying the relevance of findings to sustainable EbA initiatives. This discussion chapter (Chapter 10) outlines the factors that contribute to a sustainable EbA project in a rural community context, including the challenges of contemporary resource management and the importance of TLK in EbA according to the data. The discussion continues around the inclusion of faith in the planning of EbA projects as this is not specifically incorporated in the current EbA Framework, yet is considered an essential component of project sustainability in spiritually-focused communities (Luetz et al., 2023). Finally, the chapter concludes with a section on moving forward and rethinking transformational adaptation and adaptive capacity.

## 10.2 Adaptive capacity and community resilience

Adaptive capacity refers to a system's inherent ability to positively respond to change (Whitney et al., 2017). The adaptive capacity of a community is determined by their socioeconomic characteristics, where enhancement of adaptive capacity represents practical means of coping with change and is a necessary condition for reducing vulnerability (Smith et al., 2003). This research into EbA in rural Fijian communities was equally concerned with the social adaptive capacity (community) and ecological adaptive capacity (local environment) in relation to the impacts of climate change, as together these systems are essential

for livelihood sustainability within a Pacific Island community context (R. R. Prasad et al., 2022). Social adaptive capacity is dependent on factors such as TLK, supportive governance, and livelihood diversity and flexibility (Whitney et al., 2017). Additionally, community resilience is dependent on the capacity of ecological systems to provide ecosystem services (ES), which are threatened by climate-related impacts and other anthropogenic pressures (IPCC, 2022c). In contrast, an ecosystem's resilience to disturbances, or adaptive capacity, depends on factors such as ecological and genetic diversity but is also influenced by human factors, like monitoring and conservation efforts (Whitney et al., 2017). These same researchers found significant gaps when looking at the social-ecological assessments of adaptive capacity but suggest policy and action should be geared towards preventing the loss of ecological adaptive capacity and building social adaptive capacity concurrently.

Adaptive capacity is not often prioritised in adaptation planning meaning that local knowledge, livelihood opportunities, and social capital are not integrated into decisions that affect resource management, risk mitigation, and resilience building (Wongbusarakum et al., 2021). Assessing a community's adaptive capacity through a risk assessment in the initial EbA planning phase can determine the entry points and guide EbA options. Risk assessments evaluate a community's hazards and exposure, and the vulnerability of social-ecological systems (GIZ, 2018).

The case study communities demonstrated varying degrees of adaptive capacity through the ways they overcame or managed the challenges of their degraded ecosystems and coastal erosion issues, their reliance on external assistance to reduce their exposure to flooding and storm surges, and some loss of traditional knowledge. The communities that pursued the mangrove planting projects (Vusasivo, Korolevu, Navunievu, and Raviravi) demonstrate a high degree of adaptive capacity, although none of these projects were self-initiated, and all had originated through some training or interaction with Fiji Government officials or NGOs. It has been suggested that a dependency on external aid can hinder autonomous adaptive capacity (Nunn & McNamara, 2019). All five case study communities had begun autonomous relocation demonstrating the willingness or ability to undergo social change when required (adaptive capacity).

As an example of the factors that contribute to or against adaptive capacity, Korolevu has access to a healthy coastal ecosystem (*Figure 9.3*), does not have an eroding shoreline, and does not have any artificial adaptation structures built on their coastline that could potentially become maladaptive. Additionally, during the group discussions, Korolevu demonstrated a high level of understanding of the need to ensure key ecosystems are well-managed to support future livelihoods. As well as planting mangroves, they

revealed plans to reforest their nearby hillsides and had the option to relocate the remainder of the village, should the need arise. These are all factors that positively contribute to adaptive capacity. Korolevu also had a number of contributing factors that reduced their adaptive capacity as they had some serious challenges that impacted the daily lives of the community members, including regular flooding from the river, no running water and difficulty accessing the village via the river crossing, an income stream that was losing value, and a reliance on faith as the solution to their challenges (*Figure 9.1*).

As a second example, Raviravi was rated with the highest level of adaptive capacity compared to the other four case study communities (*Figure 9.6*), due to their multiple projects in place. It is difficult to assess how Raviravi would be positioned if this funding and assistance had not been provided. In some cases, communities become the recipients of project funding by actively seeking donors, as mentioned by C3 Fiji, which may be considered a form of adaptive capacity as communities recognise the need for and seek the assistance required. This assistance may increase dependency on external aid but if projects are successful and supported by community members, it may also reduce their vulnerability to the impacts of climate change. It may be possible that seeking external assistance can impact autonomous adaptive capacity as communities may wait for assistance rather than implement changes on their own. An example of this is Navunievu asking for 19 years, or Naivaka for over 30 years, for the short-term solution of a seawall to be built. Perhaps the delay in the seawall funding stimulated community action as they self-initiated their partial relocation when they believed the seawall might never eventuate. Additional research into the drivers and barriers of autonomous adaptive capacity may be beneficial as the impacts of climate change are likely to increase for rural Pacific Island communities and there are limited data available in this context.

In the context of EbA planning, it is not only the adaptive capacity of the community that needs to be considered but also that of the ecosystem. A recent study in the Micronesian group of Pacific Islands revealed an extensive gap in the research pertaining to the adaptive capacity of ecosystems in the region, both in the context of climatic and non-climatic drivers (Lenz, 2023). This same research indicated that both climatic and non-climatic drivers needed to be assessed and addressed to enhance an ecosystem's adaptive capacity, and therefore the services they provide to communities. As was found at the five case study sites, Lenz (2023), also found that MPAs in Micronesia lack management plans and pathways that lead to defined conservation objectives, conservation areas are unevenly distributed, and where MPAs are in place, compliance and enforcement are minimal, all of which limit their effectiveness. To bolster current mangrove planting schemes in local communities to enhance ecosystem adaptive capacity and to a level that would be considered an effective and sustainable EbA requires a range of measures, including but not limited to scale: consideration of ecosystem biodiversity and climate-sensitive species, identification and

effective management of climatic and anthropogenic ecosystem threats, strong local governance supported by higher level governance structures, and prioritisation of resource management with a co-management approach that includes representatives of all stakeholders - measures that aim to produce equitable societal benefits through enhanced ecosystem services (Bertram et al., 2017).

### 10.2.1 Traditional and Local Knowledge (TLK) and EbA

Loss of traditional knowledge has been identified as a potential threat to the sustainable management of resources in the Pacific Islands (Kitolelei et al., 2021). Each case study community noted a loss of TLK, with the male elders expressing the greatest concern for the loss as well as uncertainty about how to restore lost knowledge. Some of the challenges noted by the community members regarding TLK were a lack of interest, or that their children were often too busy to learn this knowledge, as well as changes in environmental conditions that made it more difficult to make the predictions they once could. Cultural perspectives offer valuable insight into localised impacts and responses to climate change (Walshe et al., 2018) and are therefore essential for a sustainable EbA. As Westoby et al. (2021) note, locally-led adaptation (LLA) can be a culturally beneficial way of filling knowledge gaps in communities with fragmented TLK. *Figures 9.1 and 9.2* show that LLA proved advantageous for Raviravi with ongoing support from the local NGO, C3 Fiji. Increasing the capacity of small, localised NGOs such as C3 may prove a more economical investment than injecting funding into short-term projects, such as seawalls. Further research into how communities can be supported in revitalising or preserving traditional knowledge may be advantageous in ensuring the longevity of EbA projects.

### 10.2.2 Awareness of global scientific knowledge

The four case study communities all expressed the importance of their mangrove project and a general understanding of the benefits for their community if project outcomes were achieved. Yet simultaneously, each community also demonstrated a limited understanding of anthropogenic climate change, the complexity of ecosystem linkages, or how to restore or manage a severely degraded ecosystem. Science-based knowledge historically dismisses Indigenous knowledge systems as inferior, but understanding knowledge systems in different cultural contexts is considered an important step towards a sustainable EbA (Reyes-García et al., 2019). Some researchers have found that traditional knowledge gaps may not necessarily be due to a lack of knowledge but may be indicative of knowledge-action gaps where there is a failure to translate TLK into action (Pilbeam et al., 2019). Such knowledge-action gaps may undermine the level of urgency required for climate change adaptation, particularly for EbA, where visible outcomes are often longer-term. The Fijian culture is renowned for its relaxed nature and its concept of time differs

from that of Western ideologies of time (Eräsaari, 2018). Each community saw their project as a priority but perhaps the sense of urgency is within the context of 'Fiji time', an idea that may be beneficial to consider in EbA project planning in Fiji, which will ensure a project's momentum fits within cultural norms but still progresses at a rate that can maximise community benefits (Sahin et al., 2021; Terton & Dazé, 2018).

Something noted during the fieldwork for this research and also by others conducting research in the Pacific Islands is that community members have the notion that those with global scientific knowledge or qualifications are the 'experts' (Pilbeam et al., 2019). The same authors quote a local NGO employee, who states that they have to work hard to get some community members to share local knowledge as community members do not see its value. Such attitudes may have developed following continued negative deficit-framing messages, which portray Pacific Island people as vulnerable and weak, therefore hindering autonomous adaptive capacity and increasing reliance on external assistance (McNamara et al., 2022; Westoby et al., 2019). The idea of 'Western' knowledge as superior was suggested a number of times throughout the group discussions in several communities, particularly by the women's groups. Another example of this occurred at the commencement of the group discussion with the women of Waitabu. Upon hearing that the discussion was about planting mangroves, they stated, "*The mangroves were planted by the youth so there might not be any information that we can assist with*." Once the women were reassured that their knowledge and contributions were valuable and that they held the knowledge we were looking for, they began to speak more freely. This mindset is something that may need to be considered when planning an EbA project with local community members, ensuring they are made aware of how valuable their local knowledge is to the success of the project.

### 10.2.3 Challenges with contemporary resource management

Sustainable resource management has allowed people in the Pacific Islands to thrive for millennia, even on smaller islands with limited resources (Nunn & Campbell, 2020). Although EbA is primarily aimed at reducing climate change impacts, resource management was identified as a major challenge during every group discussion. With this challenge identified, many of the group discussions were focused on topics in relation to coastal resource management because the sustainability of an EbA project relies on protecting, managing, and monitoring local ecosystems. Other researchers have also noted coastal and marine resource management as a big challenge in the Pacific Islands and something that needs to be addressed to increase adaptive capacity (P. Chand et al., 2023).

Historically in Fiji, marine resources have been used for largely subsistence purposes. The commodification of these marine resources to global markets, along with an increasing demand for cash, poaching within

*qoliqoli* (traditional fishing grounds), and the undermining of respect for traditional management systems (*tabu* areas and bans on totem species) has impacted the supply of coastal resources for local communities (Long, 2018; Rantes et al., 2021). Each community revealed slightly different challenges in resource management. During the discussions at Navunievu and Raviravi, it was said that undersized and spawning crabs are readily taken although they had been trained not to do so. The main reason for doing this was because they wanted to sell the legal-sized animals as they needed the income, therefore keeping the undersized crabs to eat allowed them to have crab meat in their diet. The community members who were doing this could explain the reason that size restrictions were in place and understood what the long-term impacts of removing juvenile crabs would have on crab populations, but they said that they did it because there was no enforcement. Examples of comments by community members verifying some community concerns about resource management are:

> *"At night…we used to see fish sleeping on the reef edge but now if we try and get them [fish] we can't. When fish became commercialised, after the corals were killed and the fish were scared away, they moved to deeper parts of the oceans so it's hard to get big ones [fish]. If you had watched them [fishermen] come back from fishing last night you would only see small-sized fish. Even for people who line-fish, they only come back with the small ones" (Male elder, Naivaka).*
>
> *"We understand that what you get out of the sea [needs] a certain length or measurement to be purchased. We know that fisheries enforce this but when people are desperate, they will take the small ones to sell as well. We take the restricted sizes to sell but it's just as long as we don't get caught" (Younger male, Naivaka).*

The men in Naivaka and Raviravi said they found it impossible to monitor their local fishing grounds for poachers as they do not have the equipment and, if the poachers are from nearby, they often have a family connection that makes enforcement difficult. Where the topic was raised, each group mentioned that their conservation committee was largely inactive or had minimal momentum, possibly due to limited guidance or support in committee goals or the community having greater priorities. Similar findings have been noted by other researchers (Fache & Breckwoldt, 2018). For Pacific Island countries to mainstream ecosystem management and EbA will require strengthening the level of coordination and collaboration between local and higher-level governance. One community member from Navunievu stated that checks done by the Department of Fisheries were mostly concerning whether people selling to markets held a current fishing licence. If law enforcement priorities are better aligned with the goals of sustainable resource management, stakeholders may become more compliant and sustainable resource use may improve.

Remling and Veitayaki (2016) found that projects that had community involvement were more likely to be successful, based on their study on Gau Island, Fiji. Therefore, ensuring inclusivity and equitably distributed benefits among community members may provide the incentive to abide by the size regulation laws. During the discussion with the women of Tacilevu, it was stated that the COVID-19 restrictions positively impacted their marine resources and there was a noticeable increase in the crab populations following almost 12 months of limited trading. If messages of this visible evidence of increasing marine resources through limited harvesting could be more widely disseminated, it may motivate communities to adhere to *tabu* area and size restriction laws as they could see the longer-term economic benefits of the restriction.

The community discussions revealed that many fishing practices utilised today differ from those used in the past, therefore it could be argued that traditional resource management practices may become less relevant when contemporary fishing practices are used, such as for commercial purposes, large nets, diving for fish using compressed air tanks, or motorised vessels over canoe-style. Research into fisheries management in Fiji found that it may be necessary to go beyond a community-level of understanding of the drivers of fishing practices and look at the individual household practices as a way to effectively manage small-scale fisheries (Dacks et al., 2018), an approach which could be extended to other marine resources, such as crabs and sea cucumbers.

### 10.2.4 Merging TLK and global scientific knowledge for a sustainable EbA project

The recognition of co-existing knowledge systems and the role they play in biodiversity conservation and ecosystem management is becoming increasingly acknowledged (McElwee et al., 2020; Parsons et al., 2017). Yet equitable knowledge integration is still an area of ongoing research, as existing models of integration do not challenge Western ideologies and often 'cherry-pick' aspects of traditional knowledge to suit a project (Nalau, Becken, Schliephack, et al., 2018).

The EbA Assessment Framework used as a guide to evaluate each community's mangrove project has a quality standard (1.2) that considers the extent to which TLK was used for the project, and to what extent the local resource users were consulted in the planning process. Most communities were rated as strong to very strong for this quality standard, as the projects assessed for this research, although not initiated by, were mostly designed and implemented by the communities themselves, giving the projects strong community support and relevance. Yet the absence of global scientific knowledge also resulted in some very low scores in some criteria, such as in Quality Standards 1.1 - Use of climate information, and 1.3 - Taking into account findings of vulnerability assessment, both of which incorporate limited integration of TLK. If blending knowledge leads to a more robust EbA, it may be beneficial where possible, to have

reference to both knowledge systems integrated into all EbA framework quality standards. That is, Quality Standard 1.1 may be more locally appropriate as 'Use of historical local climate knowledge and Western science climate projections'. Similarly, Quality Standard 1.3 refers to a vulnerability assessment, which is largely a Western concept. This standard refers to who and what is vulnerable to climate change and could be culturally translated to a concept that community members can identify and conduct themselves through localised training. A model of how knowledge systems may be integrated during each phase of an EbA project, which may lead to an increase in project relevance and community support is suggested *(Figure 10.1)*.

A study aimed at identifying factors that increase the risk of project non-completion in the Pacific Islands found that projects where EbA was combined with hard-engineered structures, such as a seawall, had a significantly lower probability of completion compared to projects where EbA alone was used (Hasan et al., 2021). These researchers suggested this may be because combining approaches could be mutually exclusive and the two approaches may be incompatible, culturally, institutionally, logistically, or physically. This claim is relevant to this research and may be worthy of further investigation as two of the five case study sites (Vusasivo and Raviravi) had a recent seawall built, and one site (Navunievu) had a seawall under construction, which may impede an EbA project. Another case study site (Naivaka) had preferenced a seawall over any EbA.

It was noted in Samoa that local stakeholders often preference engineered solutions over EbA and also that a government stakeholder had mentioned a disconnect between the concept of climate change and traditional knowledge systems (Nalau, Becken, Schliephack, et al., 2018). The same researchers pointed out that TLK can be held by particular individuals rather than communities, and this could be gender-based, suggesting a critical assessment of what is meant by 'traditional' and 'local' knowledge is needed to avoid biases and exclusions. The underlying message is that blending knowledge is not straightforward but worthy of ongoing investigation as it may increase community participation and support for EbA projects (Meriwether et al., 2018).

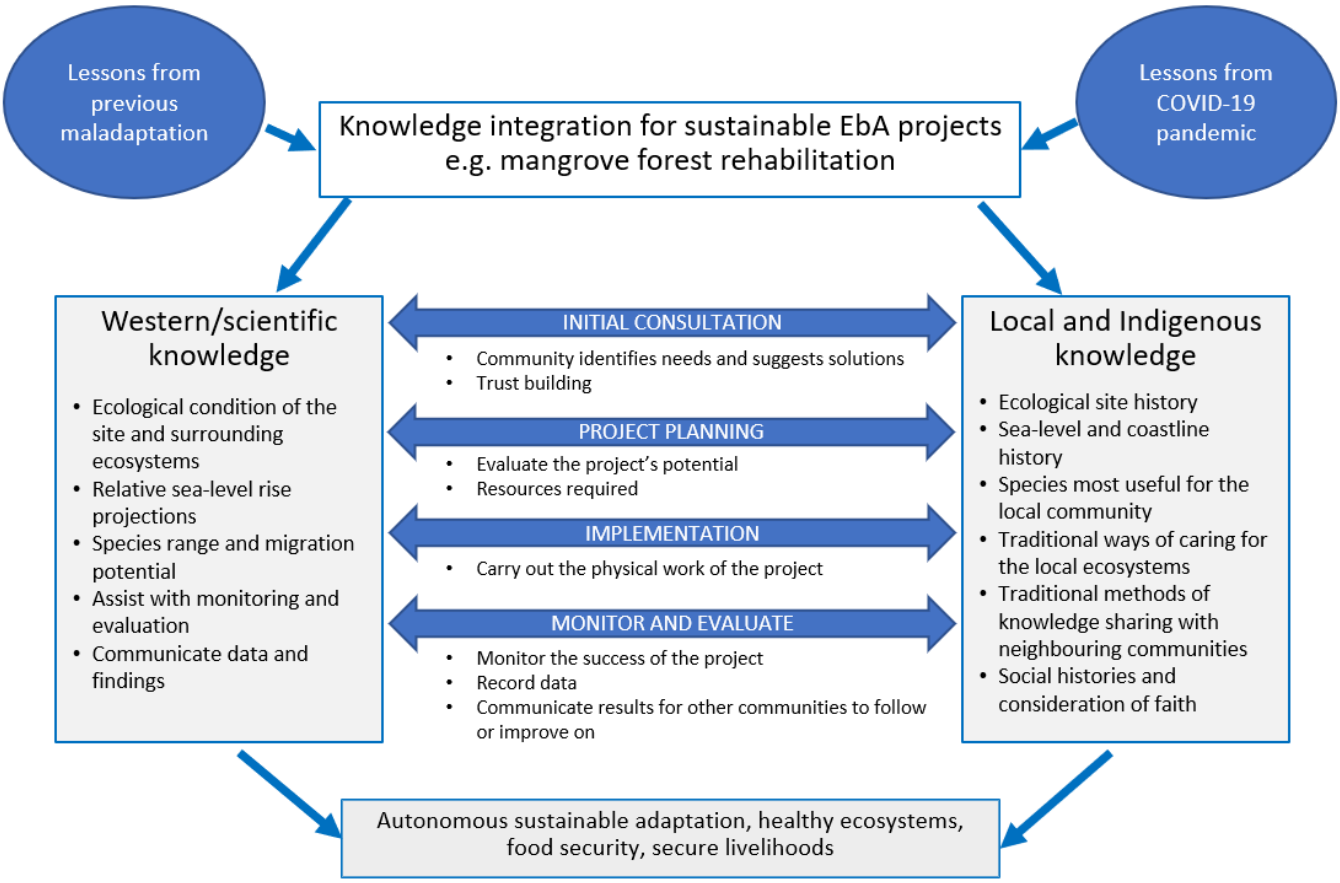



***Figure 10.1*** *A model demonstrating how knowledge systems could be integrated at each phase of an EbA project to increase community support and project sustainability.*

### 10.2.5 A role for faith in EbA projects

Incorporating and aligning EbA projects with a community's faith has been recognised as critical and highly undervalued by a number of researchers (Luetz & Nunn, 2023; Oakes & Oakes, 2019). Its importance was also made evident during community discussion sessions for this research through comments such as:

> *"During [Tropical Cyclone] Yasa, all the mangroves were inundated and the waves came in but it did not affect us very badly. It didn't take away the houses because of how well we serve God. The water was high in the mangroves but it was the power of the faith, and God protecting us. We tried to gauge the height of the water. It was like up to the roofs of the houses but then the village is saved because we have faith in God" (Younger male, Navunievu).*

One critique of the EbA Assessment Framework used to benchmark each community's EbA project is its secular nature, specifically the omission of faith or community belief systems being mentioned. An outcome of this research is that it may be beneficial to acknowledge faith into EbA planning in faith-based

contexts. This inclusion could be developed through an additional set of Qualification Criteria into the FEBA framework that rated a project on cultural appropriateness that accounts for a community's belief system. Some researchers have noted that communities believe in forms of supernatural punishment. For example, people who poach in *tabu* areas will be cursed and come to their demise (Fache & Breckwoldt, 2018). Such beliefs may be difficult to appreciate from a secular mindset but need to be considered in order to create culturally appropriate community-supported projects in certain contexts.

## 10.3 Drivers and opportunities for adaptation

Although financial donors play an important role in climate change adaptation for Pacific Island communities, they should be enablers rather than drivers of adaptation initiatives (Westoby et al., 2021). These same researchers propose a number of mutually reinforcing drivers of locally-led adaptation, such as the value of tacit local knowledge and coping mechanisms. These drivers may lead to opportunities for culturally appropriate methods of adaptation and rather than having negative impacts on communities, will enhance local livelihoods *(*Magnan et al.*,* 2016*;* Piggott-McKellar*,* Nunn*,* et al.*,* 2020*)*.

### 10.3.1 Drivers of adaptation

Climate change adaptation in the Pacific Islands can be driven by external forces or autonomously from within the local community. Identifying the drivers of adaptation as part of the EbA process may provide insight into a community's adaptive capacity and the likelihood of project sustainability.

#### *10.3.1.1 Externally-driven*

The seawall projects noted in the case study communities provide examples of externally-driven projects. These newly constructed seawalls may appear to align with community objectives and community members will often drive the decision to build a seawall, which in the short-term will limit erosion and seawater flooding in the village, as well as provide a feeling of assurance for community members. Yet, although a seawall can be requested by the community, they largely exclude community priorities, override TLK, are based on secular or Western contexts, and often leave communities in the same situation or worse shortly after project completion (IPCC, 2022b; Nunn et al., 2021). The seawall built at Vusasivo was part of the Coastal Community Adaptation Project (C-CAP) delivered by USAID in 2015: two other nearby villages, Korotasere and Karoko, also located in Cakaudrove Province had the same type of rock-mattress revetment structure built. Research into the outcomes of these other seawalls reveal that they were largely considered maladaptive because the communities suffered unexpected negative impacts and no follow-up solutions were ever offered/provided by the donor (Piggott-McKellar, et al., 2020).

Seawalls and similar structures are not just short-term and maladaptive but may also be detrimental to the initiation or momentum of an EbA project. After a seawall has been constructed, the feeling of comfort and peace of mind may diminish the urgency of EbA planning. In cases where a seawall may be deemed the best short-term option, it should be part of a broader hybrid solution that includes an ecosystem-based approach that can strengthen social-ecological resilience through enhancing ecosystem services. Conversely, relying solely on EbA is not likely to provide all the solutions to the impacts of climate change on degraded ecosystems, and adaptation may need a multi-pronged approach (Nalau, Becken, & Mackey, 2018). This may be the inclusion of a long-term relocation plan or alternative livelihood options to reduce the reliance on local ecosystems.

#### *10.3.1.2 Autonomous/community-driven*

In contrast to externally-driven adaptation, community-driven adaptation is more likely to reduce reliance and increase resilience to the impacts of climate change by aligning local contextual factors of both the environment and the community into a project (Piggott-McKellar, et al., 2020). The community-driven projects were undertaken in three of the research case study communities (Vusasivo, Korolevu, and Raviravi), even though community members were uncertain whether their project would succeed and they faced setbacks, such as large numbers of mangrove seedlings not surviving. The drivers for beginning their projects were all similar, such as regular flooding from seawater, concern for their future in their current location, and the suggestion from the Ministry of Fisheries and Forestry that they begin planting mangroves, as well as short visits from a number of NGOs to initiate planting. Raviravi was the only community that had received more formal training from C3 Fiji regarding the ecological importance of mangroves and how restoring mangroves might support the community. Further research into the long-term success of these case study community projects may be beneficial, offering insights for other communities and policymakers on project initiation or enhancement, including assessing whether the external support enriched project outcomes, or not.

Naivaka provided an interesting comparative case study site as coastal erosion had impacted their infrastructure and claimed land, but they had not attempted any in-situ adaptation projects, except for the partial construction of the foundations of a seawall, as well as an incremental relocation of their village. Naivaka is the most isolated of the case study communities and is almost impossible to access by road. Based on discussions with elders, the Naivaka community had sought aid to construct a seawall for close to three decades but received no support for this or any other adaptation projects. The limited attempt at adaptation in Naivaka may be interpreted as a lack of autonomous adaptive capacity. Alternatively, their limited adaptation efforts could be attributed to their deep-rooted connection to cultural heritage and

traditional methods of adaptation, which involved retreating inland and upland as their ancestors once did (Nunn & Carson, 2015). This ambiguity may be something that could be better understood through spending more time with this community.

Additionally, the Provincial Office had instructed Naivaka to tidy up the village, which included removing vegetation that was vital to stabilising the shoreline. The women from Naivaka stated that coastal erosion became much worse once this vegetation was removed. Poor advice was also evident in Raviravi, where a gentleman mentioned that they had only recently stopped clearing the mangrove regrowth and undergrowth of the forest adjacent to the village following the information session provided by C3 Fiji in 2018. These instances underscore how misguidance can lead to poor decision-making by community leaders, hindering autonomous adaptive capacity and increasing climate change vulnerability.

### 10.3.2 Opportunities for EbA

The IPCC Sixth Assessment Report chapter on Small Islands summarised three in-situ adaptation options, namely engineered and nature-based options (NbS), incremental autonomous relocation, and external-sponsored relocation (Mycoo et al., 2022). Of the case study communities involved in this research, all five had begun incremental adaptation and all had made attempts at in-situ adaptation, although Naivaka had not tried any NbS and had given up with their attempt at building their seawall. While the long-term future of low-lying communities may be relocation, if sustainable methods of adaptation can be implemented soon, there may be the opportunity for communities to remain in their current location longer and continue with slow incremental relocation. The opposite is also true in that if low-lying communities continue on their current path of unsustainable resource use, reliance on externally-built engineered adaptation, and small-scale coastal restoration, adaptation options may become limited to externally-sponsored relocation.

The relocation of an entire village or community is considered transformational adaptation which, according to the IPCC (2022b), is in contrast to incremental adaptation and refers to fundamental societal changes due to climate change, disaster risk reduction, and sustainable development that occur once all other options have been exhausted. Transformation in a socio-ecological systems context is described as a profound change of a system when the existing ecological, social, or economic conditions are no longer tenable or are undesirable (REF – Pelling 2015 Adaptation to climate change from resilience to transformation). The IPCC report aligns with the Fiji Government's Planned Relocation Guidelines, but these guidelines additionally recognise the conservation of traditions and cultural identities as an important consideration for relocation (Government of Fiji, 2018). Transformational adaptation may differ for many countries, but in the context of the mountainous Pacific Island countries, like Fiji, it may be the relocation

of a coastal village to a more inland and upland location. For some countries and villages, this type of adaptation may not be possible or may be resisted for reasons such as land tenure and changes in employment opportunities and customary livelihoods (McMichael & Katonivualiku, 2020; Nunn et al., 2021).

Researchers have noted that women, particularly in some patriarchal Pacific Island cultures, can be excluded from adaptation decisions, including village relocation (Bertana & Blanton, 2022). Fijian women have an intimate knowledge of mangrove ecosystems, therefore, including them in EbA projects would prove beneficial. This inclusion may also involve providing women with opportunities to manage or oversee EbA projects, such as mangrove planting. The FEBA Assessment Framework Quality Standard 5.2 suggests using gender balance within each benefiting group as a quality indicator (Bertram et al., 2017). As a result of this research, it has been noted that gender equity could be further embedded into the framework so that a gender balance is achieved throughout every phase of an EBA project, including planning, implementation, monitoring, and evaluation.

## 10.4 Rethinking transformational adaptation and adaptive capacity

Contemporary literature refers to managed retreat as a form of transformational adaptation that will become increasingly necessary under current sea-level projections and while maladaptation persists (Aiken & Mabon, 2023). While relocation, driven by both environmental and social factors, is well-established in Pacific Island cultural history, it is often an unwanted change in contemporary rural communities. Rethinking transformational adaptation by re-establishing and strengthening traditional management systems may prolong the inevitable necessity to relocate (Nunn & Campbell, 2020).

Rural Pacific Island livelihoods depend on the natural environment, and traditional management systems have been established for millennia (Nunn & Campbell, 2020), but today an increase in resource commodification, forest clearing, impacts from climate change, and changing rural population densities may mean that traditional practices need to be repositioned to consider these compounding pressures. Ecosystem-based adaptation (EbA) is suggested as a culturally appropriate method of climate change adaptation as it aligns with traditional methods of resource management (Ojea, 2015). In the Pacific Islands, it was common practice to observe ecosystems and limit resource use if they became scarce by placing a *tabu* on a particular area (Raisele & Lagi, 2023; Singh et al., 2022). Although the case study communities referred to this practice as part of their everyday management of resources, none of these communities had this system in place. EbA emphasises managing resource use, so rethinking transformational adaptation as big lifestyle changes that involve behavioural change, including stricter laws around

traditional management practices and ecosystem restoration may become more appealing if it reduces the necessity to relocate.

Due to the degraded ecosystems that were the cause of many of the challenges identified by the case study communities, engaging communities that are willing to undergo behavioural change as part of their EbA may increase the likelihood that projects will be able to enhance ecosystem services for future generations. As a result of this research, six knowledge gaps have been identified and recommendations for further research have been provided that may improve EbA outcomes. They are discussed below in no particular order; all appear of equal importance for a sustainable future for Pacific Island livelihoods.

### 10.4.1 Mainstreaming EbA

The idea of mainstreaming EbA refers to the idea of incorporating nature-based approaches into all climate change adaptation policy, budgeting, implementation, and monitoring processes at all levels (national, sectorial, and sub-national), as well as development planning, disaster risk reduction, human health and well-being, and biodiversity conservation (Ilieva & Ament, 2019). A suggested framework for mainstreaming EbA is presented *(Figure 10.2)*. The cyclic nature of this framework incorporates monitoring and evaluating EbA projects, as well as learning from project outcomes and adjusting as required. Specifically, prioritising EbA mainstreaming efforts in the Pacific Islands would mean EbA becomes the first response to climate change adaptation or is incorporated into all other adaptation options, including built structures. One barrier identified in mainstreaming EbA is the difficulty in measuring the cost benefits of the outcomes of an EbA project (Terton & Dazé, 2018). The idea of mainstreaming EbA is a change of mindset at all levels, from community members, local leaders, government, NGOs and bilateral/international donors and funders in development strategies, policies, and actions, (GIZ et al., 2020).

Mangrove planting is an ideal entry point for coastal Pacific Island community EbA projects because the ecosystem services mangroves provide are integral to the Pacific Island way of life and the intimate knowledge and connection that community members invariably have of/with these ecosystems. Additionally, there is minimal cost or equipment required and, in many cases, mangrove ecosystems once existed in the location in which communities are replanting them. In cases of severe ecosystem degradation, such as erosion of substrate, the focus may need to start with rebuilding the health of surrounding ecosystems (reef, nearby mangroves, upstream ecosystems) which might assist in replenishing the coastal nutrient supply.

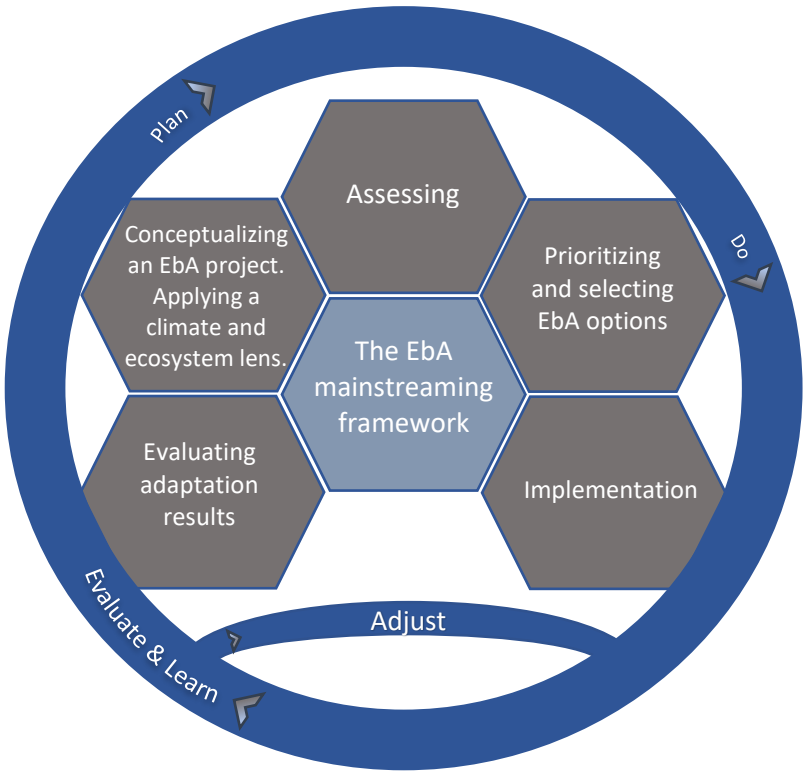



***Figure 10.2*** *The suggested steps to mainstreaming EbA so it is implemented into all development strategies, policies and actions (modified from GIZ, 2022).*

### 10.4.2 EbA as a long-term approach

EbA is a long-term adaptation option and it may take up to 25 years before communities obtain significant benefits from projects such as planting mangroves (Nunn, 2009). While EbA may not yield immediate benefits to communities, it is likely to surpass the effectiveness of building a seawall, as the benefits of EbA grow exponentially over time with the establishment of the ecosystem. A seawall will deteriorate somewhere between two years for those built using local materials to perhaps five to ten years for more engineered newer designs, and may never achieve what it was designed for (Nunn et al., 2021). Yet the longer EbA is delayed, the harder it may become to re-establish ecosystem services, since many ecosystems are already degraded and may be close to their tipping point, where a minimal disturbance may result in irreversible or hard-to-reverse changes in ecosystem functions (Laurance et al., 2011; Pandit et al., 2021). Where the tipping point has been reached, planted mangrove seedlings will not likely survive.

In addition to prioritising EbA, precision in planning, monitoring, and evaluating projects is also desirable as it avoids time being wasted (Ilieva & Ament, 2019). Monitoring and evaluating (M & E) of EbA projects is described by EbA planners as a process of adaptive management. A simplified model of monitoring and evaluating an EbA project in the cyclic nature of adaptive management is shown in *Figure 10.3*, where

following planning and implementing a project requires checking or reviewing whether the output goals are being achieved. Based on the outcome of the checking phase, adjustments may need to be made (GIZ et al., 2020; Holling & Walters, 1978)

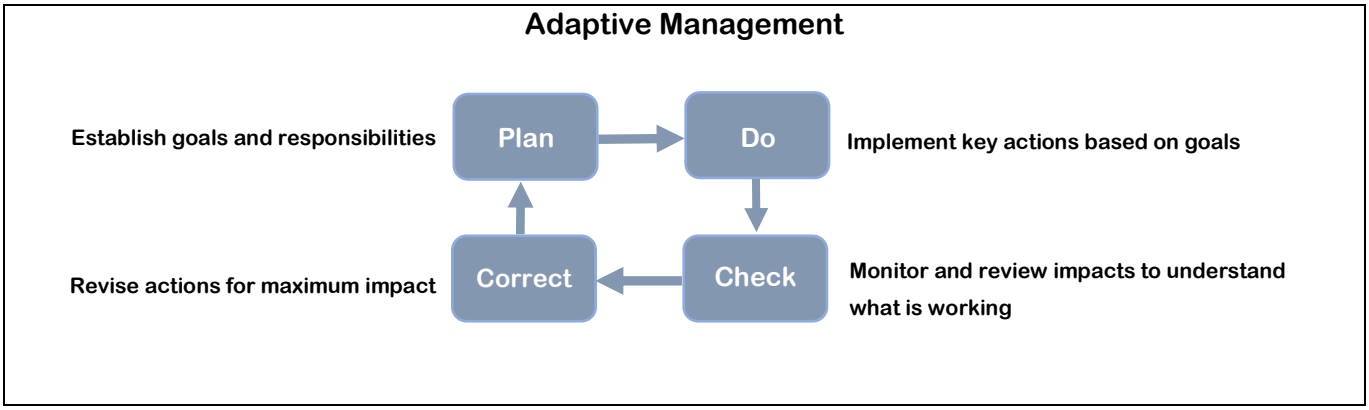



***Figure 10.3*** *A model outlining the key elements of adaptive management of EbA projects (Holling & Walters, 1978).*

In the course of discussions with the case study communities, an absence of planning, monitoring, and evaluation of their mangrove planting projects was evident. This absence may be attributed to limited knowledge and expertise among community members on how to implement or formalise these processes. Facilitating collaboration with communities to develop an adaptive management strategy that is suitable and sustainable for rural communities is achievable and may ensure the long-term support and success of their EbA projects. An example of how this could be achieved within this context may be working with community members to firstly establish and record the baseline or initial condition of the ecosystem before the commencement of any project activities. Secondly, to develop specific and measurable targets that can be used to assess whether a project is reaching its objectives, as well as indicators to measure these targets. The targets act as the benchmark to demonstrate the level of success achieved by the project. Indicators can be qualitative or quantitative, and process-based or results-based. For example, a process-based indicator can measure inputs and outputs, while a results-based indicator measures outcomes and impacts (GIZ et al., 2020). A simplistic example of the baseline, process-based indicators, and targets may be that 20 established mangroves trees are remaining in the reforestation area; 500 mangrove hypocotyl will be planted by a certain date; with an 80% survival rate of the seedlings, checked and recorded at three-month intervals, as well as recording details of the non-surviving seedlings. It would be beneficial for community members to undergo training to carry out these checks to ensure data consistency. A description of what each development stage may look like could be provided, along with a range of options to try if milestones are not met, which will allow visibility as to whether or not the EbA actions are helping towards climate change adaptation.

Two of the case study communities (Korolevu and Raviravi) claimed that their project was successful, quoting the number of seedlings planted by a particular date. While these data are important, it would be beneficial to work with communities to develop measurable data on how effective the project is at delivering outcomes, such as reducing erosion, sediment accretion, or number of days that seawater enters the village. Measuring these outcomes is more challenging as there is often a lack of baseline data against which adaptation effectiveness can be determined, as well as a prolonged period between adaptation implementation and delivery of beneficial outcomes (Jackson et al., 2021). The lack of obvious outcomes may be a drawback of EbA as short-term projects with visible outcomes are more likely to receive community support for the duration of the project (Hasan et al., 2021). The lengthy duration of an EbA is a further reason why it may be beneficial for communities to undertake ownership and control of the project, as donor-funded projects rarely have funding available for the length of time it will take to achieve measurable outcomes of a mangrove planting project.

During their research into reasons for project incompletion, Hasan et al. (2021) found that longer-term projects are more likely to reach completion when they are co-funded or receive an in-kind contribution from other donors, project partners, or recipient countries. In the context of EbA, it is difficult to allocate a completion point to a project because the assigned ecosystems will ideally undergo decades of M & E, and therefore will be incorporated into a local community's policies. Raviravi provides an example of a project that maintained momentum through multiple donors and in-kind contributions compared to the other two self-funded, self-managed mangrove projects in Vusasivo and Korolevu. Agence Française de Développement, the second organisation to assist Raviravi as part of the Kiwa Initiate, conducted an evaluation of the outcomes of the mangrove planting project. They offered recommendations on how to improve their results, including the bamboo protection around the young mangrove saplings to increase the survival rate. This input appeared to re-motivate the community's motivation for the project.

### 10.4.3 EbA as part of an overarching adaptation strategy

The restoration of degraded ecosystems is an essential component of EbA, but it is not likely that ecosystem restoration alone will address all issues related to climate change (Nalau, Becken, & Mackey, 2018). An EbA should therefore be part of a larger plan to adapt to climate change which means it should be integrated into all development policies and plans relating to environmental and resource management.

In the context of the case study communities, none of the mangrove projects were seen by community residents as integrated within a larger climate change adaptation strategy. An example of a mangrove planting project as part of an overarching adaptation plan may be a quarterly evaluation of the crab

population in the adjoining mangrove ecosystem; the monitoring of stock levels would determine if a *tabu* should be placed in the area. Concurrent projects that have similar overarching goals (for example, marine resource management) could be implemented alongside mangrove forest regeneration, such as establishing alternative livelihood programs and waste management programs. Research on the completion of climate change adaptation projects found that complex, or larger multi-disciplinary projects had a low likelihood of completion. Smaller projects with a singular, clear and consistent focus on adaptation had the highest completion rates, although completion is not a guarantee for sustained adaptation success (Hasan et al., 2021). The same research indicated that projects which combined an ecosystem-based approach and an engineered-based approach had a significantly reduced probability of completion than an EbA alone. This reduction was attributed to the idea that different approaches may be incompatible or that the engineered structure may inhibit the effectiveness of the EbA. This last point is interesting to note and worthy of further investigation in relation to the case study communities as Vusasivo, Navunievu, and Raviravi had recently undertaken or intended to undertake mangrove planting. Yet, it raises the possibility that mangrove planting may have been prioritised had these communities not recently built seawalls.

It has been suggested that the most effective way to restore or rehabilitate a mangrove forest is by removing stressors, encouraging natural regeneration, and then planting only when natural regeneration does not meet the anticipated growth rate goals (Lewis et al., 2019). Adequate natural forest regeneration may occur in healthy mangrove forests through the use of traditional methods of resource management, such as the establishment of a *tabu* area that is respected under traditional laws, which may negate the necessity for intentional planting. If planting mangroves is required, some training for community members may be beneficial as the case study communities revealed that this is not something with which they had any prior experience. Some points that were not considered among the case study community projects were planting the naturally occurring pioneer species first, leaving adequate spacing between seedlings, and which time of year to plant. Imbert et al. (2000) suggest planting is ideal during the wet season, yet, in Fiji, plant survival may be more likely during winter months when there is less chance of severe tropical storms. Failure to consider these details may decrease the survival rate of seedlings, and further research as well as publishing EbA methods and outcomes may be beneficial for future projects.

One key component that is helpful to consider when planning for EbA is how climate change will impact ecosystems, including mangroves, in the Pacific Islands region. The ways in which an increase in global temperatures will impact mangroves is an area of ongoing research, although the IPCC (2022c) report states with high confidence that there are observed impacts of climate change on ecosystem structure,

species range shifts, and changes in phenology on small islands. Findings indicated that climate change may potentially have both positive and negative impacts on mangrove ecosystems. For example, increased rainfall and atmospheric carbon dioxide levels may increase vegetation biomass but will likely decrease areal extent. Decreased precipitation and changes in climatic oscillations will likely limit plant growth and ecosystem area, while sea-level rise and an increase in cyclone activity associated with climate change are expected to have a large-scale negative impact on mangrove forest ecosystems.

### 10.4.4 Ingenuity, adaptability, resilience, creativity, and novel approaches

People in the Pacific Islands demonstrate examples of ingenuity, adaptability, resilience, and creativity through their customary and time-honoured ways of coping with socio-ecological changes, such as variations in sea level, extreme weather events, and societal changes brought about by globalisation (Nunn, Nakoro, et al., 2019). Rural communities, in particular, are accustomed at utilising the resources they have available. For example, when community members had noted that mangrove seedling survival rates were low, they experimented by planting three seedlings together (*Figure 10.4 a*). Additionally, traditional methods of resource utilisation to make provisions for daily needs, such as brooms, baskets, and nets are still common practice throughout the Pacific Islands, (*Figure 10.4 b*).

***Figure 10.4*** *Drawing on a history of ingenuity, adaptability, and resilience of Pacific Island people may provide lessons for sustainable livelihoods. (a) Community members tried planting three mangrove seedlings together to improve the survival rate of the plants. (b) A woman from Raviravi making a broom from local materials to use in the village and to sell at the local markets (Source: Author, 2022).*

To cope with the novel ecosystems that may emerge under a changing climate, creativity and resourcefulness may be required. Understanding how ecosystems may respond to climate change has been identified as a knowledge gap and a potential barrier to EbA in the Pacific Islands (Nalau, Becken, & Mackey, 2018). The case study community members indicated that the ecosystem functions of today differed from what their ancestors had experienced and managed, demonstrating a need for innovative approaches to adaptation. Using nature as a means of climate change adaptation is still relatively new as a formal concept and although Pacific Island people have been managing local ecosystems since inhabiting the region (Nalau, Becken, Schliephack, et al., 2018; Nunn & Kumar, 2022), the multiple stressors on particular ecosystems may demand a modified approach from traditional practices. Adaptation projects and methods may be novel and somewhat experimental, and a method used in one ecosystem or community may not work in another (Lenz, 2023), but through knowledge synthesis, successful EbA options should be achievable.

Different mangrove planting techniques have been experimented with during the recent history of mangrove rehabilitation, achieving varying degrees of success (Lovelock et al., 2022; Riley & Kent, 1999), but there is limited data available on the type of restoration/afforestation/reforestation projects being conducted in Pacific Island case study communities. Monitoring, evaluating, and communicating the short, medium-, and longer-term outcomes of these types of projects will provide valuable lessons for other communities aspiring to undertake similar-scale EbA projects. Additionally, the development of planting guides specific to Fiji, similar to those that have been developed for other projects (Asian Development Bank, 2018; Melana et al., 2000) would be beneficial given some of the challenges that were mentioned in the discussion groups .

As part of their mangrove replanting project, C3 Fiji was trialling a mangrove nursery at Raviravi Village (*Figure 10.5*) to see if the plants had a higher survival rate, but the results are so far inconclusive. The nursery implementation could be improved to reduce the environmental impacts by shifting from planting plastic bags to biodegradable bags, such as hessian. These plastic bags are designed for reuse but in the absence of proper storage and as they degrade over time, these will likely enter the marine ecosystem ultimately having negative environmental impacts. Using a natural, biodegradable material would be preferable as it could be planted with the sapling and would break down over time as the mangrove tree became established, without having adverse impacts on the environment.

Adopting biodegradable planting bags may also increase the survival rate of the sapling as it would limit the likelihood of damaging or disturbing the roots that may occur when removing the sapling from the

plastic bags for planting. This new system would also increase nutrient availability to the juvenile plants as some of the areas in which the communities are planting are highly degraded and lacking substrate, such as the foreshores of Vusasivo, where they were planting mangrove seedlings into pebbles. A substitute to hessian material may be planting bags woven from pandanus leaves or similar, that members of the community could make as part of an alternative livelihood program, being paid by the donor agency for their product as an alternative to purchasing the plastic bags. Utilising local materials not only enables communities to independently implement these projects with minimal cost or need for external equipment, eliminating the need for external assistance.

***Figure 10.5*** *Raviravi's mangrove nursery, located near the shoreline within the existing mangrove forest adjacent to the village. It consisted of two sectioned-off areas made from locally sourced materials, each approximately 400 x 150 cm and potentially holding approximately 300 saplings. The premise is the mangroves are exposed to similar climatic conditions as the planting location but are sheltered from strong wind and waves during their most vulnerable stage (Source: Author, 2022).*

### 10.4.5 Lessons from the pandemic for sustainable EbA

Comments during the group discussions revealed that there were potentially some lessons that could be learned based on the community's response to COVID-19. On numerous occasions, it was mentioned that regulations relating to COVID-19 throughout 2020 and 2021, such as movement restrictions and vaccinations were strictly enforced and observed, while regulations that involved resource management

were commonly disregarded. These comments became a key focus of this research because sustainable resource management is deemed essential for the success of an EbA project with the protection and support of biodiversity conservation increasing the likelihood of climate resilience within ecosystems (Lo & Rawluk, 2023). The variation in compliance with COVID-19 regulations and resource-use was attributed to the communication methods, repercussions for non-compliance, and the level at which the regulations were enforced. Both unsustainable resource use and COVID-19 have the potential to cause a health crisis, yet people from the case study communities could see the potential negative impact of COVID-19 and admitted a fear of becoming ill, but could not rationalise the long-term health impacts of unsustainable resource use.

Posters were used as one way to disseminate messages about COVID-19 to the broader Fijian community (*Figure 10.6*) and similar methods have been used to explain the importance of marine resource management (*Figure 10.7*). Although both forms of the printed media were in a similar style, written using the *iTaukei* language and depicting Fijian people, the rules relating to COVID-19 were also announced via radio and by the Ministry of Health through visits to each village as well as visits from nurses to administer vaccines.


***Figure 10.6*** *Examples of posters disseminating illness prevention messages in Fiji during COVID-19 (Source: Plan International, 2020).*

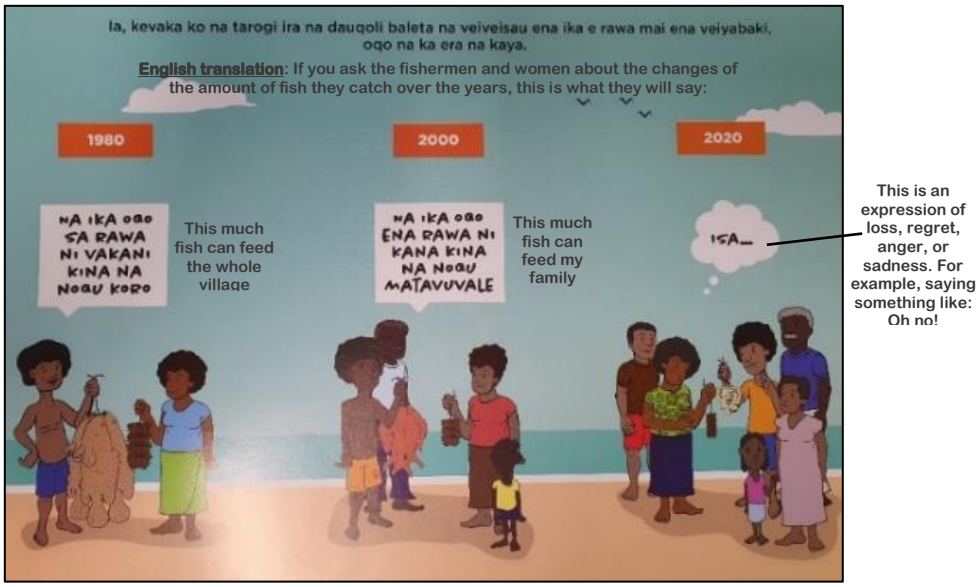



***Figure 10.7*** *Section from a booklet produced by the Ministry of Fisheries Fiji and funded by a suite of external organisations, including European Union which includes an English translation (Printed 2022).*

All case study communities, except Naivaka, advised that throughout the movement restriction period, they had regular unannounced police visits to check on compliance with the regulations in place, such as no social gatherings or church services. Community members said they were afraid of being fined for breaking COVID-19 restrictions, which were strictly enforced, and therefore they complied. Yet the regulations on marine resources, predominantly managed by the local communities and overseen by the Ministry of Fisheries, are not consistently enforced by any higher authority, therefore the community members did not feel the same level of obligation to comply. Noncompliance was likely driven by the necessity for food or income rather than a deliberate intention to do wrong. Additionally, authorities do not effectively communicate or enforce the issue of illegal harvesting of coastal resources, leading to uncertainty about the impact it can have on local ecosystem biodiversity.

These findings reveal that current resource management practices need modernisation that accounts for degraded ecosystems, commercialisation of resources, and changes in social structure. Additionally, further engagement and enforcement from local authorities may be beneficial in helping communities sustainably manage their resources. Resource restrictions could also be communicated more effectively, as community members said they felt as though they were being punished whenever a restriction was placed on a resource, such as the five-year ban on sea cucumber harvesting. Such a ban can place enormous financial pressure on communities or households relying on the income from these commodities, therefore creating alternative sources of income would be beneficial where this resource is a key source of income. Further to

this, rural communities feel they have the ownership rights of their local ecosystems and the resources within just as their ancestors did, so receiving an outside directive for a nationwide ban on a resource can be received with some contempt. If clear explanations accompanied the announcements for resource bans, and communication channels were open where those most impacted could work through their concerns, the bans may be better received and understood that they are put in place for the overall benefit of each community.

### 10.4.6 Using 'Economies of scale'

After discussions with community members and observation of the mangrove planting sites, it became clear that encouraging an increase in project scale and mindset may be of value. Community members called their projects 'mangrove planting', yet it may be beneficial to refer to them as 'creating ecosystems' given what they were trying to achieve. The FEBA (2017) framework does not provide an exact measurement at which a project should be scaled as this could vary substantially between ecosystems, regions, and level of vulnerability. It does suggest that projects need to be at a scale that addresses the challenges and accommodates for the impacts of climate change. That is, the project establishes stability, resilience, and connectivity of ecosystems as part of the broader landscape, and part of the EbA assessment measures of the area (ha) under management. The mangrove planting areas at Vusasivo and Raviravi both span less than one hectare. Their current management plans for these projects do not take into consideration or attempt to reduce the human impacts on connected ecosystems, such as the natural mangrove forest, upstream of the rivers that feed sediment and nutrients to the mangroves, or the adjacent reef, but in doing so the mangrove planting may have an increased chance of success.

Lovelock et al. (2022) suggest that there are pros and cons of both larger and smaller-scale projects. There have been some very large-scale projects of up to thousands of hectares that have been successful but this outcome was achieved only through strong government support and the projects targeted ecosystems that were not overly degraded. There have also been many large projects that have failed for contrary reasons: lack of support and inappropriate biophysical conditions. The same researchers found that small-scale projects often succeed as they have simple governance structures, the opportunity for experimentation, and usually long-term support from community members and stakeholders. Yet small-scale projects may not deliver the ecosystem services or biodiversity benefits anticipated by the community. The ecosystem services are a critical reason why communities are undertaking these projects, therefore guidance on an appropriate scale of a project and/or management area would be beneficial to

ensure communities receive the expected outcomes. It is unlikely a project would be supported by the community if they are not observing any benefits.

If increasing adaptive capacity requires effective coastal resource management, then upskilling communities in areas of marine biology and ecology and the anticipated climate change impacts on key ecosystems, which includes strengthening and integrating local and traditional knowledge may prove valuable (P. Chand et al., 2023). Upscaling environmental education to include EbA in school-based curricula may improve resource management and diminish the dominance of hard-engineered structures (like seawalls) in the Pacific Islands. Recent research by Rahma et al. (2023) has led to the development of a new theoretical framework for school ecosystem-based disaster risk education. Using a similar framework model may be useful in integrating EbA into the Fiji school curriculum and higher-level education.

It became evident through interviews and observations of the case study communities that one way to encourage larger-scale thinking may be to broaden the project to multiple communities working together to achieve sustainable ecosystem management. This locally-led rather than community-based approach, has been noted by other researchers (Westoby et al., 2019) as possibly more beneficial as it can fill knowledge gaps, broaden the skill base, and ensure all local communities benefit from the services of a rich, diverse ecosystem. It would also ensure that communities were working together to sustainably manage local ecosystems and may reduce the likelihood of poaching by neighbouring communities. A comment by the *Turaga ni koro* of Korolevu confirms this last point when he said:

> *"It is important to keep the mangroves because the beche-de-mer is a commodity that is open for two months. If you look out there [offshore] you will see lights. Those are outsiders. They come to collect from around the mangroves. They are benefiting from what we are doing. There's a lot [sea cucumbers] out there because of the mangroves" (Turaga ni koro of Korolevu).*

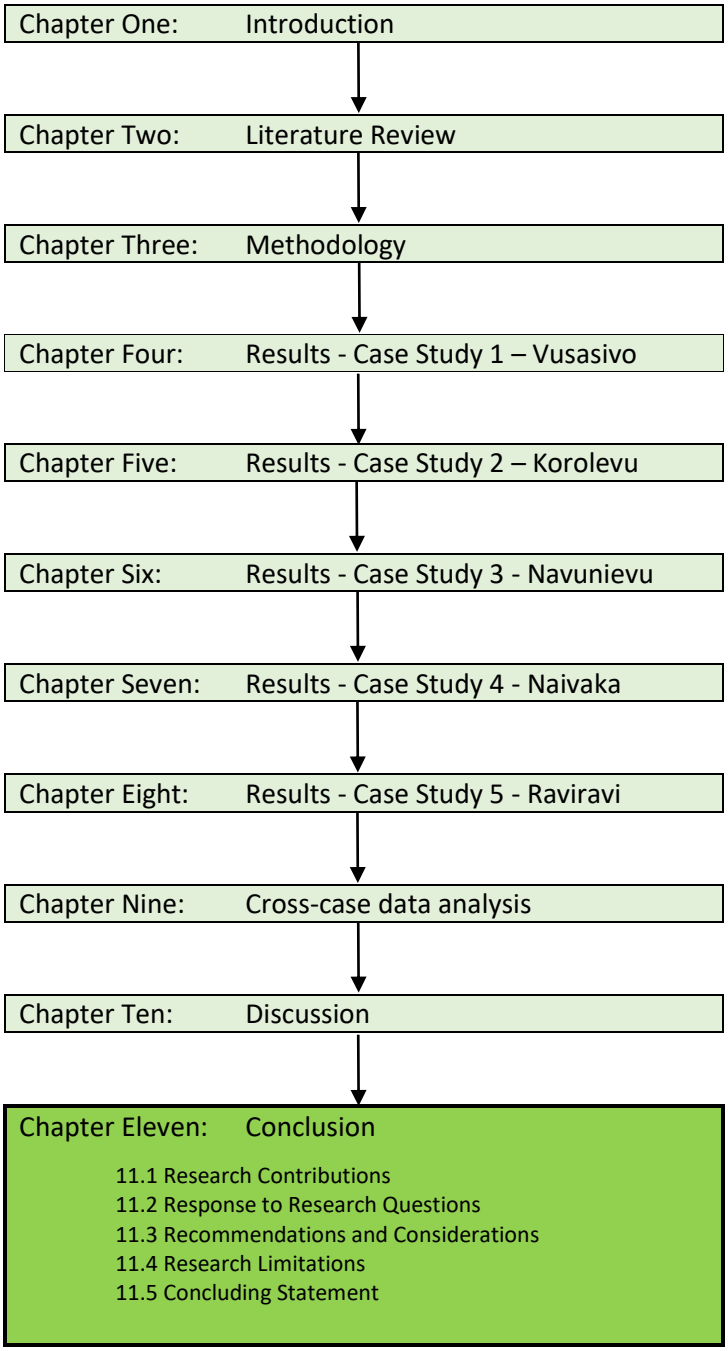
## 10.5 Summary

This chapter has provided insights into the interpretation and relevance of the results extracted from the qualitative data collected at the five case study communities for this project. Possible enablers and barriers that contribute to adaptive capacity and community resilience were identified, including TLK, resource management, and faith, and their application to sustainable EbA. The opportunities and drivers of adaptation, followed by a section on rethinking transformational adaptation were then outlined. Mainstreaming EbA, consideration of the long-term characteristics of EbA, as well as the inclusion of EbA into a broader adaptation strategy, lessons from the pandemic, and project scale populated the final section on transformational adaptation.

The following chapter (Chapter 11) concludes this thesis by offering a summary of the findings from this research, as well as any research limitations identified throughout the project. Recommendations and considerations for future research are then outlined, followed by a concluding statement of the entire project.

# CHAPTER ELEVEN: Conclusion

***Thesis Guide*** *- The highlighted section indicates where the reader is within the document.*



This concluding chapter provides a synthesis of the outcomes from this research, which explored opportunities for Ecosystem-based Adaptation (EbA) in coastal Pacific Island communities. The research was initiated by identifying significant knowledge gaps within the context, application, and outcomes of autonomous community-based EbA projects in the Pacific Islands. The disproportionate impacts of climate change on Pacific Island communities, in addition to the decline in ecosystem services, and the dependence of subsistence-based livelihoods on local resources make the findings of this research critical for policy-makers and non-government organisations when planning and implementing climate change adaptation and resource management strategies.

To date, most formalised funded climate change adaptation strategies in the Pacific Islands have emerged from a Western perspective or top-down approach, often failing to achieve their intended outcomes, and in some instances, have even increased vulnerability. Through this exploratory research approach, the *talanoa*-style discussions in the five case study communities provided valuable insight into what culturally appropriate sustainable adaptation encompasses from a Pacific Island perspective. These group discussions, as well as ecological observations of the mangrove planting sites, provided answers to the three key research questions. Additionally, data collection in each community exposed some of the major challenges facing Pacific Island communities and how these challenges can hinder autonomous adaptive capacity.

The following section highlights some of the key findings from this research, outlined as the research contributions, followed by a response to the three research questions. Subsequently, recommendations and considerations for future research, the research limitations, and a concluding statement complete this thesis.

## 11.1 Research contributions

This section emphasises the significance of this research within the academic literature on climate change adaptation in coastal Pacific Island communities. The primary objective was to explore and highlight the importance of prioritising EbA as part of an effective adaptation strategy.

The exploratory approach of this research was well-suited to navigating the cultural nuances of Pacific Island communities, providing valuable insights into the challenges and opportunities for implementing EbA and resource management faced by these communities. Through direct conversations with those most impacted by climate change and sea-level rise, this research has begun to fill a crucial knowledge gap on how Pacific Island communities might best be supported in ecosystem restoration projects.

Aligning the case study community mangrove planting projects with the EbA framework offered practical insights into enhancing these initiatives. The research concludes that nature-based solutions, such as EbA, represent an optimal approach to adaptation for Pacific Island coastal communities coping with rising sea level. EbA is not only cost-effective but is also more sustainable than hard structures like seawalls. Additionally, EbA enhances ecosystem productivity, resulting in food security and increased income for rural communities.

EbA alone is not likely to repair severely degraded ecosystems or address the long-term challenges of sea-level rise. Therefore, relocation remains inevitable for low-lying coastal communities, but will be a long and difficult process that will communities will require substantial support. EbA can be included as part of the overarching strategy of transformative adaptation. Despite its limitations, EbA projects can offer communities empowerment and autonomy, reducing the sense of vulnerability that comes with not being in control of their own future (Baleinakorodawa & Boege, 2024)

In an era of increasingly unstable climatic conditions, the findings from this research are crucial in addressing the impacts and challenges faced by Pacific Island communities. Delaying action may limit available options for ecosystem rehabilitation as ecosystems reach their tipping point.

## 11.2 Response to research questions

This section provides a summarised response to the three research questions.

1. *How does the community utilise their local mangrove ecosystem and what is the community's understanding of the impacts of climate change on food security and coastal ecosystem services?*

Conversations with community members reveal that the conservation of mangroves is vital to the sustainability of the community, due to the role of mangroves in many aspects of local livelihoods. Yet, it was evident that the community's management and replanting efforts did not align with traditional practices. Providing education and training in mangrove planting and rehabilitation could benefit not only these communities but Pacific Island communities more broadly.

While community members had heard of climate change, their understanding of its scale and likely impact on their community and ecosystems was limited. Many expressed a preference for hard protective structures, like seawalls, indicating a need for knowledge sharing about other seawall projects in similar settings and their potential unintended consequences. Most community members cited urban locations when asked about examples of successful seawalls.

Given the projected sea level over the next several decades and beyond, it is unlikely that the case-study coastal communities can remain in their current locations. Although all except Vusasivo had started relocating to higher ground, relocation did not appear to be a community priority nor was there a concrete plan as to when a full relocation might occur, suggesting uncertainty regarding the impacts of climate change and sea-level rise. Supporting communities in relocation, coastal ecosystem regeneration, and alternative livelihood projects may offer superior benefits for livelihood sustainability, including protection, food security, and income.

2. *What climate change adaptation strategies have been implemented in the community, to what extent was external assistance provided, and if so, did the planning incorporate traditional and local knowledge? Did the strategy achieve the desired outcome?*

This second research question was intended to gain an understanding of the climate change adaptation strategies that had been implemented within the community, along with the degree of external assistance provided, as well as assess the community's involvement in the planning and decision-making process. This information is of critical importance, serving as a foundational understanding for a possible roadmap to achieve sustainable adaptation in rural Pacific Island communities. Learning from previous initiatives helps prevent the repetition of mistakes and facilitates the documentation and streamlining of successful strategies for other communities. Aligning project success with community input and support not only offers evidence of previous scholarly endeavours but also lays the groundwork for best practices in the implementation of ecosystem-based adaptation projects in rural communities.

During this research, it was found that three of the five case study communities had seawalls, and the fourth community had been requesting a seawall for nearly two decades. The construction of these seawalls was predominantly driven by external agencies, with minimal consultation from the community in the design process. While these seawalls are a significant improvement in design compared to those constructed in previous decades, they failed to achieve the expectations of the community. This indicates a lack of communication and community consultation during the seawall projects. For instance, the community members of Vusasivo expected the seawall to stop seawater from flooding their village, while it is likely meant to contribute towards this it is also constructed to reduce coastal erosion. The women of the village wanted the height of the seawall raised because the village was still regularly flooded with seawater.

In the case of mangrove reforestation, four out of the five case study communities had engaged in planting mangroves These projects received varying degrees of external input and success, as detailed in Chapters

4 to 8. The communities drew on their TLK of mangrove ecosystems to guide these reforestation efforts. However, replanting cleared sites presented a challenge, as it was an unfamiliar practice for Pacific Island communities. This explains why each community sought assistance and training for this process. Considering the long-term nature of EbA initiatives and the data collection only providing a 'snap-shot', it is difficult to predict the long-term outcome of the projects. The reforestation efforts undertaken by the communities have so far yielded only limited success, with many of the seedlings failing.

3. *How did COVID-19 impact the community, and are there any lessons that can be drawn from the management of COVID-19 to improve the outcomes of climate change adaptation and resource management in rural Pacific Island communities?*

This research began during an unprecedented time in recent human history, as the COVID-19 virus was declared a global pandemic, profoundly impacting human health and disrupting social norms, supply chains, food security, and income. Although this event led to disruptions in this research, it was also considered as an opportunity to investigate the significance of the pandemic on rural communities compared to urban centres, drawing on possible lessons from subsistence-based lifestyles, with an aim to improving global emergency preparedness, particularly in the context of climate change adaptation and resource management.

In summary, it was found that the impact of supply chain disruptions, which were prevalent in many urban areas, had minimal effects on rural communities. These communities demonstrated resilience and adaptability, primarily due to their ability to source a significant portion of their food locally, from their gardens and the ocean. As a result, they perceived their supply of food was plentiful during the pandemic, in contrast to the literature claiming significant challenges faced by urban residents.

Through the discussions with the case study communities, valuable lessons in sustainable resource management were uncovered from their experiences during COVID-19. Notably, effective communication of information about the pandemic and the enforcement of regulations ensured that directions were followed. These insights were promising as they may be used to address the current challenges of resource management that was noted by the communities.

## 11.3 Recommendations and Considerations

The examination of this topic through exploratory research, conducted in a way that respects Pacific Island epistemologies, has contributed to the significant knowledge gaps in ecosystem-based adaptation in rural

Pacific Island communities. This section outlines ten recommendations and considerations based on the research findings.

### 11.3.1 Adaptive capacity

Traditional knowledge, supportive governance, and livelihood diversity and flexibility are pivotal in driving adaptive capacity (Janif et al., 2016; Whitney et al., 2017). The participant case study communities demonstrated varying degrees of these attributes, which directly impact their ability to autonomously adapt. Going forward, the first recommendation emerging from this research is how crucial it is to prioritise climate change adaptation strategies that align with the above principles, such as EbA. Village relocation may also align with these traits, while the construction of a seawall does not.

### 11.3.2 Stakeholder inclusion and community participation

While the five case study communities disclosed similar challenges, they also mentioned challenges that were unique to their respective villages. These insights highlight the significance of implementing a personalised approach to address the distinct needs of each community. An individualised approach will likely increase the long-term viability and support within the community. In addition, apart from tailoring adaptation strategies, it is important to provide communities with a clear understanding of the project and a realistic view of the outcomes. For example, the 'crab fattening' project in Navunievu had the potential to benefit the community but was only active for 12 months. This short duration could be attributed to the community's limited understanding of the project's purpose or potential outcomes. This lack of understanding was evident as each time the project was mentioned by the four different discussion groups there were inconsistencies in explaining the project's design and intention. Had the project been more clearly explained, or if the community had been involved in its design and trained to use the crab cages for their intended purpose, they might have recognised the benefits and subsequently resumed the project following TC Yasa.

Additionally, small-scale projects, such as the mangrove planting implemented by three of the case study communities, might fall short of delivering the ecosystem services or biodiversity benefits anticipated by the communities. Consequently, to maintain community support throughout restoration projects, it may be necessary to provide guidance on project scale and areas under management, as well as establishing realistic timelines. This is essential to prevent the loss of community interest in cases where the desired results are not achieved or progress is slow or disrupted.

### 11.3.3 Knowledge integration

Given that knowledge integration has not been done well to date (Meriwether et al., 2018), and owing to the crucial role of traditional and local knowledge in sustainable EbA, further research into effectively bringing global and local knowledge together for methods of adaptation is another recommendation emerging from this research. This research revealed that the restoration of severely degraded coastal ecosystems may be beyond the scope of traditional and local knowledge, as was noted in each case study community. In such instances, knowledge integration may be of particular importance to maximise the success of a restoration project. Projects carried out on severely degraded ecosystems will also be likely to require intensive monitoring and evaluation, which is another area of support that would benefit rural communities. It should also be noted that global scientific knowledge does not hold all the answers to restoring severely degraded ecosystems or those that have reached a tipping point (Chandra et al., 2023; Crameri & Ellison, 2022).

Additionally, this research revealed that communities need to understand the value of their site-based knowledge and how important it is to the successful outcomes of a project. On several occasions, it was noted, particularly by the women, that they believed they did not have any information to contribute.

### 11.3.4 Gender equity

In a Pacific Island context, the inclusion of women's voices and knowledge would be ideal when planning and implementing EbA using mangroves, given their intricate knowledge of these ecosystems. The FEBA Assessment Framework Quality Standard 5.2 suggests using gender balance within each benefiting group as a quality indicator. As a result of this research, it has been noted that gender equity could be further embedded into the framework so that gender balance is achieved throughout each phase of an EBA project, including planning, implementation, monitoring, and evaluation. This form of stakeholder inclusion will likely contribute to project success. Therefore, it may be beneficial to offer the women the opportunity to manage or oversee EbA projects, but this may require a shift in social norms and in some Pacific Island countries, may not be well received. The model that was developed as part of this project *(Figure 10.1)*, demonstrates how knowledge systems could be integrated at each phase of an EbA project to increase community support and project sustainability.

### 11.3.5 Ecosystem resilience

Ecosystem resilience is impacted by anthropogenic pressures (Lenz, 2023). Given that rural communities rely on the local ecosystem for their daily provisions, reducing anthropogenic pressures should be

prioritised as part of any adaptation project. This consideration will increase the likelihood of sustainable livelihoods and autonomy for the community, preventing reliance on external aid (Dornan et al., 2017). This leads to the following recommendations.

### 11.3.6 Contemporary resource management

Challenges with contemporary resource management emerged as a significant concern among the five case study communities and were mainly attributed to a lack of respect for *tabu* areas and insufficient resources for effective monitoring. In recognition of the crucial role of sustainable resource management in the long-term success of an EbA project (Ilieva & Ament, 2019), it became evident during this research that there is a need for increased support, training, and resource allocation for contemporary resource management. Such support would ideally be integrated with local and regional policy frameworks to ensure its effectiveness. Additionally, placing a higher priority on EbA over alternative adaptation options, like seawalls, would ensure resource management and the delivery of ecosystem services are embedded into the project's objectives. Choosing EbA options would also ensure that communities have the knowledge and resources to monitor and evaluate ecosystem changes and respond to, or change management practices, as required. In cases where communities have a decline in the traditional and local knowledge required to manage resources, it is incumbent upon local leaders and national policymakers to facilitate the revival of traditional practices.

In healthy mangrove forests there is a natural forest regeneration that occurs (Lewis et al., 2019). The use of traditional methods of resource management, such as the introduction of *tabu* areas that are respected under traditional laws, may negate the necessity for intentional planting. The observed decline in respect for these traditional practices raises the question of why this is occurring and therefore suggested as an area worthy of further investigation.

Discussions with community members revealed insights into the possibility of drawing upon the communication strategies and regulatory and enforcement measures implemented during the COVID-19 pandemic as proving beneficial in sustainable management practices. Leveraging these lessons may foster a culture of compliance and a newfound respect for regulations of local resources through impartial enforcement. Additionally, research into fisheries management in Fiji revealed that achieving effective management of small-scale fisheries might require going beyond community-level factors influencing fishing practices. Instead, it suggests investigating individual household practices as a means to enhance the management of fish species (Dacks et al., 2018). This could be extended to other marine resources, such as crabs and sea cucumber management practices.

### 11.3.7 Transformative thinking

Small-scale projects, exemplified by the efforts of three of the five case study communities (Vusasivo, Navunievu, and Raviravi), may fall short of delivering the anticipated ecosystem services or biodiversity benefits to the community. To ensure continued community support for restoration projects, it may be necessary to provide guidance regarding the scale of projects and areas under management, as well as the establishment of realistic timelines. This is essential to prevent a decline in community interest in cases where the desired outcomes are not achieved. Addressing the issue of scale may be facilitated by instilling a change in mindset as part of the training process. Instead of simply viewing the project as planting mangroves, as the communities referred to them, a shift towards a broader perspective of 'ecosystem restoration' could be encouraged.

### 11.3.8 Stakeholder inclusion and localised training and education in climate change and EbA

While the five case study communities disclosed similar challenges, they also mentioned challenges that were unique to their respective villages. These insights highlight the significance of implementing a personalised approach to address the distinct needs of each community. An individualised approach will likely increase the long-term viability and support within the community. In addition, apart from tailoring adaptation strategies, it is important to provide communities with a clear understanding of the project. For example, the 'crab fattening' project in Navunievu, that had the potential to benefit the community, but was only active for 12 months. This short duration could be attributed to the community's limited understanding of the project's purpose or potential outcomes. This lack of understanding was evident as each time the project was mentioned by the different discussion groups there were inconsistencies in explaining the project's design and intention. Had the project been clearly explained within a cultural context, or if the community had been involved in its design and trained to use the crab cages for their intended purpose, they might have recognised the benefits and subsequently resumed the project following TC Yasa.

The Government of the Republic of Fiji (2018) released materials outlining the opportunity for local-level stakeholders to engage in project monitoring and evaluation sessions. The actual implementation of this initiative remains unclear. Notably, discussions with the various communities underscored the significance of training and education in mangrove rehabilitation arose as a prominent feature of the group discussions in each community. Choosing an appropriate revegetation site and species to plant are critical to seedling survival (Lovelock et al., 2022), yet communities did not rate these details as high importance. Rubaiyat et al. (2023) contribute valuable insights on managing mangrove ecosystems in Viti Levu Island, offering pertinent information on species selection, baseline data for assessing mangrove ecosystems, and

culturally appropriate management of mangroves with a focus on reducing anthropogenic disturbances. Disseminating the findings of such research down to the community level could prove beneficial. Where education and training are provided to communities, it must be appropriate for rural communities. S. Chand et al. (2023) suggest shorter, face-to-face, hands-on training would be far more appropriate for community members over full-time courses or qualification certificates.

### 11.3.9 Inclusion of faith

Recognising the pivotal role of belief systems within a Pacific Island context, the planning and implantation of EbA projects through a faith-based approach hold the potential to significantly enhance community awareness, understanding, and engagement in a project. A faith-based approach involves taking into account the deeply-rooted belief systems within these communities, even when these beliefs may not align with global scientific knowledge. Collaborating with local churches and spiritual leaders may be effective in disseminating messages regarding climate change and the importance of sustainable resource management. Despite the significance of integrating faith into these initiatives being highlighted by other researchers, it remains overlooked by externally funded projects (Luetz & Nunn, 2023), Therefore, this justifies the recommendation for improving how faith inclusion can be incorporated into EbA approaches.

### 11.3.10 EbA as a long-term approach and part of an overarching adaptation strategy

It is important to acknowledge that this research offers only a snapshot in time, given that EbA initiatives are long-term endeavours. To enhance the effectiveness of these small-scale initiatives, it would be beneficial to designate specific sites for continuous monitoring and long-term evaluation. By doing so, we could assess the success of these projects, address any shortcomings, and ensure resources are not being wasted on futile endeavours. Furthermore, it would also be valuable to conduct a comparative analysis to determine whether the externally supported projects achieved better outcomes than community-initiated projects.

The final and possibly most significant recommendation emerging from this research is that the implementation of an ecosystem-based adaptation needs to be part of an overarching strategy to address the long-term impacts of climate change. While EbA initiatives may increase food security, provide income for a community, and offer some protection from storm surges and cyclones, it is important to recognise that current sea level projections indicate that many low-lying coastal areas are at risk of inundation. This risk necessitates long-term planning, with concurrent efforts directed towards assisting with the relocation of many coastal communities across the Pacific Islands.

## 11.4 Research limitations

Limitations to this research can be partially attributed to the COVID-19 pandemic, which led to extended border closures and delays in data collection. This research may have benefited from three consecutive visits to the case study sites. The first field trip would have ideally been exploratory, followed by fieldwork that would have allowed for an assessment of the projects over time, while a final field trip would have provided the means to disseminate these findings in person to the participating communities. Instead, only one field trip was possible and time with each village was limited, yet did not impact the overall outcomes of the research and likely provided opportunities for future research.

## 11.5 Concluding Statement

In conclusion, this research underscores the resilience and adaptive capacity of rural Fijian communities in effectively managing the challenges posed by climate change. However, this support must be tailored to the specific needs of communities, remain non-secular, and address the challenges of contemporary resource management. A promising approach to alleviate the anthropogenic pressure of coastal and marine resources is the implementation of alternate livelihood programs, which can reduce rural communities' reliance on these ecosystems. Additionally, offering further support and training in ecosystem restoration would be beneficial because the case study communities for this research demonstrated a limited understanding of the planning, scale, monitoring, and evaluation required to execute sustainable EbA projects.

# References


Aiken, G. T., & Mabon, L. (2023). Where next for Managed Retreat: Bringing in History, Community, and under-researched places. *Area*. https://doi.org/10.1111/area.12890

Albert, J. A., & Schwarz, A.-M. (2013). *Mangrove management in Solomon Islands: case studies from Malaita Province* [Policy Brief AAS-2013-14]. https://hdl.handle.net/20.500.12348/822

Allen, J., & Duke, N. (2006). Bruguiera gymnorrhiza: large-leafed mangrove. *In: Traditional Trees of Pacific Islands: Their Culture, Environment, and Use. Permanent Agriculture Resources (PAR)*, 139-152.

Alongi, D. M. (2002). Present state and future of the world's mangrove forests. *Environmental Conservation*, *29*(3), 331-349.

Andrew, N. L., Bright, P., de la Rua, L., Teoh, S. J., & Vickers, M. (2019). Coastal proximity of populations in 22 Pacific Island Countries and Territories. *PLoS ONE*, *14*(9), e0223249-e0223249. https://doi.org/10.1371/journal.pone.0223249

Asian Development Bank. (2018). *Community-based Mangrove Planting Handbook for Papua New Guinea* https://doi.org/10.22617/TIM189796-2

Atkinson, S. C., Jupiter, S. D., Adams, V. M., Ingram, J. C., Narayan, S., Klein, C. J., & Possingham, H. P. (2016). Prioritising mangrove ecosystem services results in spatially variable management priorities. *PLoS ONE*, *11*(3), e0151992.

Baleinakorodawa, P., & Boege, V. (2024). *Climate Change-Induced Community Relocation in Fiji: Challenges and Ways Forward*.

Barbour, P., & McGregor, A. (2019). The Fiji agricultural sector. *Pacific Economic Bulletin*, *13*(2), 64-81.

Barnett, J., & McMichael, C. (2018). The effects of climate change on the geography and timing of human mobility. *Population and Environment*, *39*(4), 339-356. https://doi.org/10.1007/s11111-018-0295-5

Barnuevo, A., Asaeda, T., Sanjaya, K., Kanesaka, Y., & Fortes, M. (2017). Drawbacks of mangrove rehabilitation schemes: Lessons learned from the large-scale mangrove plantations. *Estuarine, Coastal and Shelf Science*, *198*, 432-437. https://doi.org/10.1016/j.ecss.2017.02.015

Becker, M., Karpytchev, M., & Hu, A. (2023). Increased exposure of coastal cities to sea-level rise due to internal climate variability. *Nature Climate Change*, *13*(4), 367-374. https://doi.org/10.1038/s41558-023-01603-w

Bedford, R., Bedford, C., Wall, J., & Young, M. (2018). Managed temporary labour migration of Pacific islanders to Australia and New Zealand in the early twenty-first century. *Population, Migration and Settlement in Australia and the Asia-Pacific*, 211-232. https://doi.org/doi.org/10.4324/9781315147543

Begum, A., Lempert, R. R., Ali, E., Benjaminsen, T. A., Bernauer, T., Cramer, W., Cui, X., Mach, K., Nagy, G., Stenseth, N. C., Sukumar, R., & Wester, P. (2022). Point of Departure and Key Concepts. In *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)].* (pp. 121-196). https://doi.org/doi:10.1017/9781009325844.003

Bergstrand, K., Mayer, B., Brumback, B., & Zhang, Y. (2015). Assessing the relationship between social vulnerability and community resilience to hazards. *Social indicators research*, *122*, 391-409. https://doi.org/10.1007/s11205-014-0698-3

Bertana, A., & Blanton, N. (2022). Climate change adaptation, gender, and mainstreaming: the role of gender in Fiji's relocation initiative. *Climate and Development*, 1-9. https://doi.org/10.1080/17565529.2022.2055524

Bertram, M., Barrow, E., Blackwood, K., Rizvi, A. R., Reid, H., & von Scheliha-Dawid, S. (2017). *Making Ecosystem-based Adaptation Effective: A Framework for Defining Qualification Criteria and Quality Standards, Friends of Ecosystem-based Adaptation, (FEBA technical paper developed for UNFCCC-SBSTA 46),* . https://www.iied.org/sites/default/files/pdfs/migrate/G04167.pdf

Bhattarai, B., & Giri, C. P. (2011). Assessment of mangrove forests in the Pacific region using Landsat imagery. *Journal of Applied Remote Sensing*, *5*(1), 053509.

Blankespoor, B., Dasgupta, S., & Lange, G.-M. (2017). Mangroves as a protection from storm surges in a changing climate. *Ambio*, *46*(4), 478-491. https://doi.org/10.1007/s13280-016-0838-x

Borah Hazarika, O., & Das, S. (2021). Paid and unpaid work during the Covid-19 pandemic: a study of the gendered division of domestic responsibilities during lockdown. *Journal of Gender Studies*, *30*(4), 429-439. https://doi.org/10.1080/09589236.2020.1863202

Bosco, F. J., & Herman, T. (2010). The SAGE Handbook of Qualitative Geography. In. SAGE Publications Ltd. https://doi.org/10.4135/9780857021090

Botzen, W., Duijndam, S., & van Beukering, P. (2021). Lessons for climate policy from behavioral biases towards COVID-19 and climate change risks. *World Development*, *137*, 105214-105214. https://doi.org/10.1016/j.worlddev.2020.105214

Bruno, J., Siddon, C., Witman, J., Colin, P., & Toscano, M. (2001). El Niño related coral bleaching in Palau, Western Caroline Islands. *Journal of the International Society for Reef Studies*, *20*(2), 127-136. https://doi.org/10.1007/s003380100151

Bryant, M. A., Bryant, D. B., Provost, L. A., Hurst, N., McHugh, M., Wargula, A., & Tomiczek, T. (2022). *Wave Attenuation of Coastal Mangroves at a Near-Prototype Scale*. US Army Corps of Engineers.

Buggy, L., & McNamara, K. E. (2016). The need to reinterpret "community" for climate change adaptation: a case study of Pele Island, Vanuatu. *Climate and Development*, *8*(3), 270-280. https://doi.org/10.1080/17565529.2015.1041445

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 (Basel, Switzerland)*, *14*(15), 3657. https://doi.org/10.3390/rs14153657

Cameron, C., Maharaj, A., Kennedy, B., Tuiwawa, S., Goldwater, N., Soapi, K., & Lovelock, C. (2020). Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. *Environmental Challenges*, *2*, 100018. https://doi.org/10.1016/j.envc.2020.100018

Campbell, A., Kapos, V., Scharlemann, J. P. W., Bubb, P., Chenery, A., Coad, L., Dickson, B., SDoswald, N., Khan, M. S. I., Kershaw, F., & Rashid, M. (2009). *Review of the Literature on the Links Between Biodiversity and Climate Change: Impacts, Adaptation, and Mitigation*.

Campbell, J. (2015). Development, global change and traditional food security in Pacific Island countries. *Regional Environmental Change*, *15*(7), 1313-1324. https://doi.org/10.1007/s10113-014-0697-6

Cavanaugh, K. C., Kellner, J. R., Forde, A. J., Gruner, D. S., Parker, J. D., Rodriguez, W., & Feller, I. C. (2014). Poleward expansion of mangroves is a threshold response to decreased frequency of extreme cold events. *Proceedings of the National Academy of Sciences of the United States of America*, *111*(2), 723. https://doi.org/10.1073/pnas.1315800111

Chand, P., Buliruarua, L.-A., & Morris, C. (2023). Capacity-building for Coastal Climate Change Adaptation and Resilience in the Pacific Islands. *Ocean Yearbook Online*, *37*(1), 37-62. https://doi.org/10.1163/22116001-03701005

Chand, S., Dowdy, A., Bell, S., & Tory, K. J. (2020). A review of South Pacific tropical cyclones: impacts of natural climate variability and climate change. In *Climate Change and Impacts in the Pacific* (pp. 251-273). Springer Climate. https://doi.org/10.1007/978-3-030-32878-8

Chand, S., Power, S., Walsh, K., Holbrook, N., McInnes, K., Tory, K., Ramsay, H., Hoeke, R., & Kiem, A. S. (2023). Climate processes and drivers in the Pacific and global warming: a review for informing Pacific planning agencies. *Climatic Change*, *176*(2), 5. https://doi.org/10.1007/s10584-022-03467-z

Chandra, A., McNamara, K. E., Clissold, R., Tabe, T., & Westoby, R. (2023). Climate-Induced Non-Economic Loss and Damage: Understanding Policy Responses, Challenges, and Future Directions in Pacific Small Island Developing States. *Climate*, *11*(3), 74. https://www.mdpi.com/2225-1154/11/3/74

Cheong, S.-M., Silliman, B., Wong, P. P., Van Wesenbeeck, B., Kim, C.-K., & Guannel, G. (2013). Coastal adaptation with ecological engineering. *Nature Climate Change*, *3*(9), 787-791. https://doi.org/10.1038/NCLIMATE1854

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

Clissold, R., & McNamara, K. E. (2020). Exploring local perspectives on the performance of a community-based adaptation project on Aniwa, Vanuatu. *Climate and Development*, *12*(5), 457-468. https://doi.org/10.1080/17565529.2019.1640656

Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). *Nature-based solutions to address global societal challenges*. International Union for Conservation fo Nature (IUCN). https://doi.org/http://dx.doi.org/10.305/IUCN.CH.2016.13.en

Connell, J. (2021). COVID-19 and tourism in Pacific SIDS: lessons from Fiji, Vanuatu and Samoa? *The Round Table*, *110*(1), 149-158. https://doi.org/10.1080/00358533.2021.1875721

Connell, J., & Taulealo, T. (2021). Island tourism and COVID-19 in Vanuatu and Samoa : an unfolding crisis. *Small States & Territories*, *4 (1)*, 105-124.

Crameri, N. J., & Ellison, J. (2022). Atoll inland and coastal mangrove climate change vulnerability assessment. *Wetlands Ecology Management*, 1-20. https://doi.org/10.1007/s11273-022-09878-0

Cumming, R., Toscano, M., Lovell, E., Carlson, B., Dulvy, N., Hughes, A., Koven, J., Quinn, N., Sykes, H., & Taylor, O. (2002). Mass coral bleaching in the Fiji Islands, 2000. Proceedings of the Ninth International Coral Reef Symposium, Bali, 23-27 October 2000,

Currenti, R., Pearce, T., Salabogi, T., Vuli, L., Salabogi, K., Doran, B., Kitson, R., & Ford, J. (2019). Adaptation to Climate Change in an Interior Pacific Island Village: a Case Study of Nawairuku, Ra, Fiji. *Human Ecology*, *47*(1), 65-80. https://doi.org/10.1007/s10745-019-0049-8

Dacks, R., Ticktin, T., Jupiter, S. D., & Friedlander, A. (2018). Drivers of fishing at the household scale in Fiji. *Ecology and Society*, *23*(1), Article 37. https://doi.org/10.5751/ES-09989-230137

Davila, F., Crimp, S., & Wilkes, B. (2021). A systemic assessment of COVID-19 impacts on Pacific Islands' food systems. *Human Ecology Review*, *26*(1), 5-17. https://doi.org/10.3316/informit.739132722031068

Davis, C. (2016). *Focus groups: Applying communication theory through design, facilitation, and analysis*. Routledge.

De Dominicis, M., Wolf, J., van Hespen, R., Zheng, P., & Hu, Z. (2023). Mangrove forests can be an effective coastal defence in the Pearl River Delta, China. *Communications Earth & Environment*, *4*(1), 13. https://doi.org/10.1038/s43247-022-00672-7

Donatti, C. I., Harvey, C. A., Hole, D., Panfil, S. N., & Schurman, H. (2020). Indicators to measure the climate change adaptation outcomes of ecosystem-based adaptation. *Climatic Change*, *158*(3-4), 413-433. https://doi.org/10.1007/s10584-019-02565-9

Dornan, M., Pryke, J. J. A., & Studies, t. P. P. (2017). Foreign aid to the Pacific: Trends and developments in the twenty-first century. *4*(3), 386-404.

Duke, N. C., Meynecke, J. O., Dittmann, S., Ellison, A. M., Anger, K., Berger, U., Cannicci, S., Diele, K., Ewel, K. C., Field, C. D., Koedam, N., Lee, S. Y., Marchand, C., Nordhaus, I., & Dahdouh-Guebas, F. (2007). A world without mangroves? *Science (New York, N.Y.)*, *317*(5834), 41. https://doi.org/10.1126/science.317.5834.41b

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

Elliott, R. J. R., Schumacher, I., & Withagen, C. (2020). Suggestions for a Covid-19 Post-Pandemic Research Agenda in Environmental Economics. *Environmental and Resource Economics*, *76*(4), 1187-1213. https://doi.org/10.1007/s10640-020-00478-1

Ellison, J. (2000). How South Pacific mangroves may respond to predicted climate change and sea-level rise. In *Climate change in the South Pacific: impacts and responses in Australia, New Zealand, and small island states* (pp. 289-300). Springer.

Ellison, J. (2014). Vulnerability assessment of mangroves to climate change and sea-level rise impacts. *Wetlands Ecology and Management*, *23*(2), 115-137. https://doi.org/10.1007/s11273-014-9397-8

Ellison, J. (2020). Mangrove ecosystem-based adaptation: Advice on improved success. *Journal of the Commonwealth Human Ecology Council*(30), 37-40.

Elster, C. (2000). Reasons for reforestation success and failure with three mangrove species in Colombia. *Forest Ecology and Management*, *131*(1-3), 201-214.

Enari, D., & Viliamu Jameson, L. (2021). Climate Justice: a Pacific Island perspective. *Australian journal of human rights*, *27*(1), 149-160. https://doi.org/10.1080/1323238X.2021.1950905

Eräsaari, M. (2018). Time and the other time: Trajectories of Fiji time. *History and Anthropology*, *29*(4), 407-424.

Eriksson, H., Ride, A., Notere Boso, D., Sukulu, M., Batalofo, M., Siota, F., & Gomese, C. (2020). *Changes and adaptations in village food systems in Solomon Islands: A rapid appraisal during the early stages of the COVID-19 pandemic: WorldFish Program Report*.

Fache, E., & Breckwoldt, A. (2018). Small-scale managed marine areas over time: Developments and challenges in a local Fijian reef fishery. *Journal of environmental management*, *220*, 253-265.

Fache, E., Kon Kam King, J., Riera, L., & Breckwoldt, A. (2022). A sea of connections: Reflections on connectivity from/in Oceania. *Ambio*, 1-9. https://doi.org/10.1007/s13280-022-01789-x

Fache, E., & Pauwels, S. (2020). Tackling coastal "overfishing" in Fiji: advocating for indigenous worldview, knowledge, and values to be the backbone of fisheries management strategies. *Maritime studies*, *19*(1), 41-52. https://doi.org/10.1007/s40152-020-00162-6

Fahey, S., Verstraten, L., & Berry, A. J. (2016). Education for Sustainable Development: Enhancing Climate Change Adaptation Expertise in Developing Countries. *Journal of education for sustainable development*, *10*(1), 54-67. https://doi.org/10.1177/0973408215625534

Farrell, P., Thow, A. M., Wate, J. T., Nonga, N., Vatucawaqa, P., Brewer, T., Sharp, M. K., Farmery, A., Trevena, H., Reeve, E., Eriksson, H., Gonzalez, I., Mulcahy, G., Eurich, J. G., & Andrew, N. L. (2020). COVID-19 and Pacific food system resilience: opportunities to build a robust response. *Food Security*, *12*(4), 783-791. https://doi.org/10.1007/s12571-020-01087-y

Feetham, P., Vaccarino, F., Wibeck, V., & Linnér, B.-O. (2022). Using Talanoa as a Research Method can Facilitate Collaborative Engagement and Understanding between Indigenous and Non-Indigenous Communities. *Qualitative Research*, *0*(0), 1-22. https://doi.org/10.1177/14687941221087863

Ferguson, C. E., Tuxson, T., Mangubhai, S., Jupiter, S., Govan, H., Bonito, V., Alefaio, S., Anjiga, M., Booth, J., Boslogo, T., Boso, D., Brenier, A., Caginitoba, A., Ciriyawa, A., Fahai'ono, J. B., Fox, M., George, A., Eriksson, H., Hughes, A., . . . Waide, M. (2022). Local practices and production confer resilience to rural Pacific food systems during the COVID-19 pandemic. *Marine Policy*, *137*, 104954. https://doi.org/10.1016/j.marpol.2022.104954

Fink, M., Klöck, C., Korovulavula, I., & Nunn, P. D. (2021). Community Participation, Situated Knowledge and Climate Change (Mal-) Adaptation in Rural Island Communities: Evidence from Artificial Shoreline-Protection Structures in Fiji. In S. Moncada, L. Briguglio, H. Bambrick, I. Kelman, C. Iorns, & L. Nurse (Eds.), *Small Island Developing States: Vulnerability and Resilience Under Climate Change* (Vol. 9, pp. 57-79). Springer International Publishing. https://doi.org/10.1007/978-3-030-82774-8_4

Fisichelli, N. A., Schuurman, G. W., & Hoffman, C. H. (2016). Is 'resilience'maladaptive? Towards an accurate lexicon for climate change adaptation. *Environmental Management*, *57*(4), 753-758. https://doi.org/10.1007/s00267-015-0650-6

Ford, J. D., Zavaleta-Cortijo, C., Ainembabazi, T., Anza-Ramirez, C., Arotoma-Rojas, I., Bezerra, J., Chicmana-Zapata, V., Galappaththi, E. K., Hangula, M., & Kazaana, C. (2022). *Interactions between climate and COVID-19*

Forsyth, T. (2013). Community-based adaptation: a review of past and future challenges. *Wiley Interdisciplinary Reviews: Climate Change*, *4*(5), 439-446. https://doi.org/10.1002/wcc.231

Fox-Kemper, B., Hewitt, H. T., Xiao, C., Aðalgeirsdóttir, G., Drijfhout, S. S., Edwards, T. L., Golledge, N. R., Hemer, M., Kopp, R. E., Krinner, G., Mix, A., Notz, D., Nowicki, S., Nurhati, I. S., Ruiz, L., Sallée, J.-B., Slangen, A. B. A., & Yu, Y. (2021). Ocean, Cryosphere and Sea Level Change. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1211–1362). Cambridge University Press. https://doi.org/10.1017/9781009157896.011.

Friess, D. A., Adame, M. F., Adams, J. B., & Lovelock, C. E. (2022). Mangrove forests under climate change in a 2° C world. *Wiley Interdisciplinary Reviews: Climate Change*(e792). https://doi.org/10.1002/wcc.792

Galappaththi, E. K., & Schlingmann, A. (2023). The sustainability assessment of Indigenous and local knowledge-based climate adaptation responses in agricultural and aquatic food systems. *Current Opinion in Environmental Sustainability*, *62*, 101276. https://doi.org/10.1016/j.cosust.2023.101276

Gay, N., van Gemert, C., Merilles, O. E., & Georgel, P. (2022). Pacific island nations face an urgent need for actions and future research on COVID-19. *The Lancet Regional Health–Western Pacific*, *18*. https://doi.org/10.1016/j.lanwpc.2021.100326

Gharbaoui, D., & Blocher, J. (2016). The Reason Land Matters: Relocation as Adaptation to Climate Change in Fiji Islands. In A. Milan, B. Schraven, K. Warner, & N. Cascone (Eds.), *Migration, Risk Management and Climate Change: Evidence and Policy Responses* (pp. 149-173). Springer International Publishing. https://doi.org/10.1007/978-3-319-42922-9_8

Gibson, J., & Bailey, R.-L. (2021). Seasonal Labor Mobility in the Pacific: Past Impacts, Future Prospects. *Asian Development Review*, *38*(1), 1-31. https://doi.org/10.1162/adev_a_00156

Gilman, E., Ellison, J., Duke, N. C., & Field, C. (2008). Threats to mangroves from climate change and adaptation options: a review. *Aquatic Botany*, *89*(2), 237-250. https://doi.org/10.1016/j.aquabot.2007.12.009

Gilman, E., Van Lavieren, H., Ellison, J., Jungblut, V., Wilson, L., Areki, F., Brighouse, G., Bungitak, J., Dus, E., Henry, M., Sauni Jr, I., Kilman, M., Matthews, E., Teariki-Ruatu, N., Tukia, S., & Yuknavage, K. (2006). *Pacific Island Mangroves in a Changing Climate and Rising Sea*. (UNEP Regional Seas Reports and Studies, Issue.

GIZ, EURAC, & UNU-EHS. (2018). *Climate Risk Assessment for Ecosystem-based Adaptation–A guidebook for planners and practitioners*. Bonn, Germany Retrieved from https://www.adaptationcommunity.net/wp-content/uploads/2018/06/giz-eurac-unu-2018-en-guidebook-climate-risk-asessment-eba.pdf

GIZ, UNEP-WCMC, & FEBA. (2020). Guidebook for Monitoring and Evaluating Ecosystem-based Adaptation Interventions. In: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn, Germany.

Glaus, K. B. J., Adrian-Kalchhauser, I., Piovano, S., Appleyard, S. A., Brunnschweiler, J. M., & Rico, C. (2019). Fishing for profit or food? Socio-economic drivers and fishers' attitudes towards sharks in Fiji. *Marine Policy*, *100*, 249-257. https://doi.org/10.1016/j.marpol.2018.11.037

Gleckman, H. (2021). COVAX, A global multistakeholder group that poses political and health risks to developing countries and multilateralism. *Friends of the Earth International*.

Golbuu, Y. (2011). Responses of Palau's coral reefs to disturbances at multiple scales / Yimnang Golbuu. In Y. Golbuu & U. Southern Cross (Eds.): Lismore, N.S.W. : Southern Cross University.

Google. (2018). Google Earth Pro (7.3.3). *Retrieved June, 2023 from https://www.google.com/earth/*.

Google. (2018). Google Earth Pro (7.3.3). Retrieved June, 2024 from https://www.google.com/earth/.

Government of Fiji. (2018). *Planned Relocation Guidelines—a framework to undertake climate change related relocation*. Suva, Fiji Retrieved from https://cop23.com.fj/wp-content/uploads/2018/12/CC-PRG-BOOKLET-22-1.pdf

Government of Fiji & United Nations Development Programme. (N.D.). *Project Document: Implementing a Ridge to Reef approach to Preserve Ecosystem Services, Sequester Carbon, Improve Climate Resilience and Sustain Livelihoods in Fiji,* .

Government of Fiji Ministry of Education National Heritage Culture and Arts. (2008). Education for All: Mid Decade Assessment Report. https://unesdoc.unesco.org/ark:/48223/pf0000221724

Government of the Republic of Fiji. (2018). *Republic of Fiji National Adaptation Plan: A pathway towards climate resilience*. https://www4.unfccc.int/sites/NAPC/Documents/Parties/National%20Adaptation%20Plan_Fiji.pdf

Granderson, A. A. (2017). The Role of Traditional Knowledge in Building Adaptive Capacity for Climate Change: Perspectives from Vanuatu. *Weather, Climate, and Society*, *9*(3), 545-561. https://doi.org/10.1175/WCAS-D-16-0094.1

Greenhalgh, S., Booth, P., Walsh, P., Korovulavula, I., Copeland, L., & Tikoibua, T. (2018). *Mangrove restoration: An overview of the benefits and costs of restoration*. S. Prepared as part of the RESCCUE-SPC Fiji project. Fiji, University of South Pacific—Institute of Applied Sciences.

Guannel, G., Arkema, K., Ruggiero, P., & Verutes, G. (2016). The power of three: coral reefs, seagrasses and mangroves protect coastal regions and increase their resilience. *PLoS ONE*, *11*(7), e0158094. https://doi.org/DOI:10.1371/journal.pone.0158094

Haak, E., & Nakamura, N. (2021). Perceptions of local community members towards foreign aid: A case study of Vava'u, Tonga. *New Zealand Geographer*, *77*(1), 32-41. https://doi.org/10.1111/nzg.12284

Haines-Young, R., & Potschin, M. B. (2018). *Common International Classificaton of Ecosystem Services (CICES)* https://cices.eu/

Hardy, P.-Y., Béné, C., Doyen, L., & Schwarz, A.-M. (2013). Food security versus environment conservation: A case study of Solomon Islands' small-scale fisheries. *Environmental development*, *8*, 38-56. https://doi.org/10.1016/j.envdev.2013.04.009

Hasan, S., Fleming, C. M., Smart, J. C. R., Buckwell, A. J., Folkersen, M. V., & Mackey, B. (2021). Identifying and mitigating risks to completion of small grant climate change adaptation projects: evidence from the Pacific. *Regional Environmental Change*, *21*(2), 55. https://doi.org/10.1007/s10113-021-01781-3

Heyd, T. (2020). Covid-19 and climate change in the times of the Anthropocene. *The Anthropocene Review*, *8*(1), 21-36. https://doi.org/10.1177/2053019620961799

Hickey, F. R. (2006). Traditional marine resource management in Vanuatu: Acknowledging, supporting and strengthening indigenous management systems. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin*, *20*, 11-23.

Hilmi, E., Sari, L. K., Cahyo, T. N., Mahdiana, A., Soedibja, P. H. T., & Sudiana, E. (2022). Survival and growth rates of mangroves planted in vertical and horizontal aquaponic systems in North Jakarta, Indonesia. *Biodiversitas Journal of Biological Diversity*, *23*(2), 687-694. https://doi.org/10.13057/biodiv/d230213

Hobgood, N., Manfredo, J., & Bonaro, C. (2019). *USAID Pacific Islands Coastal Community Adaptation Project Final Report*. https://pdf.usaid.gov/pdf_docs/PA00WKHB.pdf

Hochachka, G. (2020). Unearthing insights for climate change response in the midst of the COVID-19 pandemic. *Global Sustainability*, *3*. https://doi.org/10.1017/sus.2020.27

Holling, C. S., & Walters, C. (1978). Adaptive environmental assessment and management.

Horsey, B., Swanepoel, L., Underhill, S., Aliakbari, J., & Burkhart, S. (2019). Dietary diversity of an adult Solomon Islands population. *Nutrients*, *11*(7), 1622. https://doi.org/10.3390/nu11071622

Hughes, T. P., Kerry, J. T., Baird, A. H., Connolly, S. R., Dietzel, A., Eakin, C. M., Heron, S. F., Hoey, A. S., Hoogenboom, M. O., & Liu, G. (2018). Global warming transforms coral reef assemblages. *Nature*, *556*(7702), 492-496. https://doi.org/https://doi.org/10.1038/s41586-018-0041-2

Huq, N., Renaud, F., & Sebesvari, Z. (2013). Ecosystem based adaptation (EBA) to climate change—integrating actions to sustainable adaptation. Impacts World 2013: International Conference on Climate Change Effects,

Iese, V., Wairiu, M., Hickey, G. M., Ugalde, D., Hinge Salili, D., Walenenea, J., Tabe, T., Keremama, M., Teva, C., Navunicagi, O., Fesaitu, J., Tigona, R., Krishna, D., Sachan, H., Unwin, N., Guell, C., Haynes, E., Veisa, F., Vaike, L., . . . Ward, A. C. (2021). Impacts of COVID-19 on agriculture and food systems in Pacific Island countries (PICs): Evidence from communities in Fiji and Solomon Islands. *Agricultural Systems*, *190*, 103099. https://doi.org/10.1016/j.agsy.2021.103099

Ilieva, L., & Ament, T. (2019). *Emerging lessons for mainstreaming Ecosystem-based Adaptation: Strategic entry points and processes*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. https://www.adaptationcommunity.net/wp-content/uploads/2019/04/giz2019-en-study_Emerging-lessons-for-EbA-mainstreaming_web.pdf

Imbert, D., Rousteau, A., & Scherrer, P. (2000). Ecology of mangrove growth and recovery in the Lesser Antilles: state of knowledge and basis for restoration projects. *Restoration ecology*, *8*(3), 230-236.

IPCC. (2022a). *The Physical Science Basis, Summary for Policymakers* (Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, Issue. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM_final.pdf

IPCC. (2022b). *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*.

IPCC. (2022c). *Impacts, Adaptation and Vulnerability, Summary for Policymakers* (In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Issue.

Ison, S., Hills, J., Morris, C., & Stead, S. M. (2018). Sustainable financing of a national Marine Protected Area network in Fiji. *Ocean & Coastal Management*, *163*, 352-363. https://doi.org/https://doi.org/10.1016/j.ocecoaman.2018.07.011

Jackson, M., Buckwell, A., Sahin, O., Faivre, G., Hadwen, W. L., & Mackey, B. (2021). *Pacific EcoAdapt Phase 1 Final Report*. Griffith University.

Janif, S. Z., Nunn, P. D., Geraghty, P., Aalbersberg, W., Thomas, F. R., & Camailakeba, M. (2016). Value of traditional oral narratives in building climate-change resilience: insights from rural communities in Fiji. *Ecology and Society*, *21*(2). https://doi.org/10.5751/ES-08100-210207

Johnson, J. E., Allain, V., Basel, B., Bell, J. D., Chin, A., Dutra, L. X., Hooper, E., Loubser, D., Lough, J., & Moore, B. R. (2020). Impacts of climate change on marine resources in the Pacific Island region. In *Climate change and impacts in the Pacific* (pp. 359-402).

Jones, H. P., Hole, D. G., & Zavaleta, E. S. (2012). Harnessing nature to help people adapt to climate change. *Nature Climate Change*, *2*(7), 504. https://doi.org/10.1038/nclimate1463

Jones, H. P., Nickel, B., Srebotnjak, T., Turner, W., Gonzalez-Roglich, M., Zavaleta, E., & Hole, D. G. (2020). Global hotspots for coastal ecosystem-based adaptation. *PLoS ONE*, *15*(5), e0233005-e0233005. https://doi.org/10.1371/journal.pone.0233005

Jones, S., McCown, A., Messersmith, M., Andrews, C., & Cormier, L. (2012). Talking Trash. *Ethnoarchaeology*, *4*(2), 147-184. https://doi.org/10.1179/eth.2012.4.2.147

Jupiter, S., Mangubhai, S., & Kingsford, R. T. (2014). Conservation of Biodiversity in the Pacific Islands of Oceania: Challenges and Opportunities. *Pacific Conservation Biology*, *20*, 206-220. https://doi.org/10.1071/PC140206

Karcher, D. B., Fache, E., Breckwoldt, A., Govan, H., Elías Ilosvay, X. E., Kam King, J. K., Riera, L., & Sabinot, C. (2020). Trends in South Pacific fisheries management. *Marine Policy*, *118*, 104021. https://doi.org/10.1016/j.marpol.2020.104021

Kelman, I. (2020). Islands of vulnerability and resilience: Manufactured stereotypes? *Area (London 1969)*, *52*(1), 6-13. https://doi.org/10.1111/area.12457

Kirkby, P., Williams, C., & Huq, S. (2018). Community-based adaptation (CBA): adding conceptual clarity to the approach, and establishing its principles and challenges. *Climate and Development*, *10*(7), 577-589. https://doi.org/10.1080/17565529.2017.1372265

Kitolelei, S., Thaman, R., Veitayaki, J., Breckwoldt, A., & Piovano, S. (2021). Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific [Systematic Review]. *Frontiers in Marine Science*, *8*. https://doi.org/10.3389/fmars.2021.684303

Klenert, D., Funke, F., Mattauch, L., & O'Callaghan, B. (2020). Five Lessons from COVID-19 for Advancing Climate Change Mitigation. *Environmental and Resource Economics*, *76*(4), 751-778. https://doi.org/10.1007/s10640-020-00453-w

Klöck, C., Duvat, V. K., & Nunn, P. D. (2022). Maladaptive diffusion? The spread of hard protection to adapt to coastal erosion and flooding along island coasts in the Pacific and Indian Ocean. *Regional Environmental Change*, *22*(4), 136. https://doi.org/10.1007/s10113-022-01989-x

Klöck, C., & Fink, M. (2019). *Dealing with climate change on small islands: Toward effective and sustainable adaptation*. Universitätsverlag Göttingen.

Kodikara, K. A. S., Mukherjee, N., Jayatissa, L. P., Dahdouh-Guebas, F., & Koedam, N. (2017). Have mangrove restoration projects worked? An in-depth study in Sri Lanka. *Restoration ecology*, *25*(5), 705-716. https://doi.org/10.1111/rec.12492

Korovulavula, I., Nunn, P. D., Kumar, R., & Fong, T. (2019). Peripherality as key to understanding opportunities and needs for effective and sustainable climate-change adaptation: a case study from Viti Levu Island, Fiji. *Climate and Development*, 1-11. https://doi.org/10.1080/17565529.2019.1701972

Koshiba, S., Besebes, M., Soaladaob, K., Isechal, A. L., Victor, S., & Golbuu, Y. (2013). Palau's taro fields and mangroves protect the coral reefs by trapping eroded fine sediment. *Wetlands Ecology and Management*, *21*(3), 157-164. https://doi.org/10.1007/s11273-013-9288-4

Krauss, K. W., McKee, K. L., Lovelock, C. E., Cahoon, D. R., Saintilan, N., Reef, R., & Chen, L. (2014). How mangrove forests adjust to rising sea level. *New Phytol*, *202*(1), 19-34. https://doi.org/10.1111/nph.12605

Kronen, M., Vunisea, A., Magron, F., & McArdle, B. (2010). Socio-economic drivers and indicators for artisanal coastal fisheries in Pacific island countries and territories and their use for fisheries management strategies. *Marine Policy*, *34*(6), 1135-1143. https://doi.org/10.1016/j.marpol.2010.03.013 (Marine Policy)

Kumar, L., Jayasinghe, S., Gopalakrishnan, T., & Nunn, P. D. (2020). Climate Change and the Pacific Islands. In L. Kumar (Ed.), *Climate Change and Impacts in the Pacific* (pp. 1-31). Springer International Publishing. https://doi.org/10.1007/978-3-030-32878-8_1

Lal, A., Lucas, R. M., & Slatyer, A. (2020). Water access as a required public health intervention to fight COVID-19 in the Pacific Islands. *The Lancet Regional Health–Western Pacific*, *1*. https://doi.org/10.1016/j.lanwpc.2020.100006

Lal, P. (2003). Economic valuation of mangroves and decision-making in the Pacific. *Ocean & Coastal Management*, *46*(9-10), 823-844. https://doi.org/10.1016/s0964-5691(03)00062-0

Lal, P. N. (1990). Conservation or conversion of mangroves in Fiji: An ecological economic analysis. *East-West Environment and Policy Institute*(11).

Lam, D. P. M., Hinz, E., Lang, D. J., Tengö, M., von Wehrden, H., & Martín-López, B. (2020). Indigenous and local knowledge in sustainability transformations research: A literature review. *Ecology and Society*, *25*(1), 3. https://doi.org/10.5751/ES-11305-250103

Lata, S., & Nunn, P. D. (2011). Misperceptions of climate-change risk as barriers to climate-change adaptation: a case study from the Rewa Delta, Fiji. *Climatic Change*, *110*(1-2), 169-186. https://doi.org/10.1007/s10584-011-0062-4

Laurance, W. F., Dell, B., Turton, S. M., Lawes, M. J., Hutley, L. B., McCallum, H., Dale, P., Bird, M., Hardy, G., Prideaux, G., Gawne, B., McMahon, C. R., Yu, R., Hero, J.-M., Schwarzkopf, L., Krockenberger, A., Douglas, M., Silvester, E., Mahony, M., . . . Cocklin, C. (2011). The 10 Australian ecosystems most vulnerable to tipping points. *Biological conservation*, *144*(5), 1472-1480. https://doi.org/10.1016/j.biocon.2011.01.016

Leal Filho, W. (2020). Climate Change and the Pacific Region: Some Future Trends. In *Managing Climate Change Adaptation in the Pacific Region* (pp. 313-320). Springer.

Leal Filho, W., Lütz, J. M., Sattler, D. N., & Nunn, P. D. (2020). Coronavirus: COVID-19 Transmission in Pacific Small Island Developing States. *International journal of environmental research and public health*, *17*(15), 5409. https://doi.org/10.3390/ijerph17155409

Lenz, M.-I. (2023). *What conservation strategies support the adaptive capacity of coastal ecosystems in three island states facing a changing climate in Micronesia?* University of Bonn].

Lewis, K. A., McClenachan, G., DeMarco, K., Salerno, J., & Thompson, K. (2023). Perspectives From Coastal Ecosystems Through the Lens of Climate Change. In *Oxford Research Encyclopedia of Climate Science*. https://doi.org/10.1093/acrefore/9780190228620.013.823

Lewis, R. R., Brown, B. M., & Flynn, L. L. (2019). Chapter 24 - Methods and Criteria for Successful Mangrove Forest Rehabilitation. In G. M. E. Perillo, E. Wolanski, D. R. Cahoon, & C. S. Hopkinson (Eds.), *Coastal Wetlands* (pp. 863-887). Elsevier. https://doi.org/10.1016/B978-0-444-63893-9.00024-1

Lo, V. (2016). Synthesis report on experiences with ecosystem-based approaches to climate change adaptation and disaster risk reduction. *Technical Series No.85. Secretariat of the Convention on Biological Diversity, Montreal.*

Lo, V., & Rawluk, A. (2023). *Enhancing Biodiversity Co-Benefits From Nature-Based Solutions, NCAI Technical Report*. International Institute for Sustainable Development.

Long, E. (2018). Marine Protected Areas in Fiji: A Critical Assessment of Community Fisheries Management and Development Plans' as a Mechanism for Formalising customary MPAs, in Particular LMMAs. *Asia Pacific Journal of Environmental Law*, *21*(2), 81-100. (100)

Lovelock, C. E., Barbier, E., & Duarte, C. M. (2022). Tackling the mangrove restoration challenge. *PLoS biology*, *20*(10), e3001836. https://doi.org/10.1371/journal.pbio.3001836

Lovelock, C. E., Cahoon, D. R., Friess, D. A., Guntenspergen, G. R., Krauss, K. W., Reef, R., Rogers, K., Saunders, M. L., Sidik, F., Swales, A., Saintilan, N., Thuyen, L. X., & Triet, T. (2015). The vulnerability of Indo-Pacific mangrove forests to sea-level rise. *Nature*, *526*(7574), 559. https://doi.org/10.1038/nature15538

Luetz, J. M., Nichols, E., de Plessis, K., & Nunn, P. D. (2023). Spirituality and Sustainable Development: A Systematic Word Frequency Analysis and an Agenda for Research in Pacific Island Countries. *Sustainability*, *15*(3), 2201. https://doi.org/10.3390/su15032201

Luetz, J. M., & Nunn, P. D. (2020). Climate Change Adaptation in the Pacific Islands: A Review of Faith-Engaged Approaches and Opportunities. In *Managing Climate Change Adaptation in the Pacific Region* (Leal Filho, Walter ed., pp. 293-311). Springer. https://doi.org/10.1007/978-3-030-40552-6

Luetz, J. M., & Nunn, P. D. (2023). Spirituality and sustainable development: an entangled and neglected relationship. *Sustainability Science*, 1-8. https://doi.org/10.1007/s11625-023-01347-8

Madelyn, E. (2020). What Can COVID-19 Teach Us About Addressing the Climate Crisis? *McGill International Review*.

Magnan, A. K., Schipper, E. L. F., Burkett, M., Bharwani, S., Burton, I., Eriksen, S., Gemenne, F., Schaar, J., & Ziervogel, G. (2016). Addressing the risk of maladaptation to climate change. *WIREs Climate Change*, *7*, 646-665. https://doi.org/10.1002/wcc.409

Makondo, C. C., & Thomas, D. S. G. (2018). Climate change adaptation: Linking indigenous knowledge with western science for effective adaptation. *Environmental Science and Policy*, *88*, 83-91. https://doi.org/10.1016/j.envsci.2018.06.014

Mangubhai, S., Nand, Y., Ram, R., Fox, M., Tabunakawai-Vakalalabure, M., & Vodivodi, T. (2017). *Value-chain analysis of the wild-caught sea cucumber fishery* (Fiji's Sea Cucumber Fishery: Advances in Science for Improved Management, Issue. Wildlife Conservation Society.

Marois, D. E., & Mitsch, W. J. (2015). Coastal protection from tsunamis and cyclones provided by mangrove wetlands–a review. *International Journal of Biodiversity Science, Ecosystem Services & Management*, *11*(1), 71-83. https://doi.org/0.1080/21513732.2014.997292

Marrero, A., & Mattei, J. (2022). Reclaiming traditional, plant-based, climate-resilient food systems in small islands. *The Lancet Planetary Health*, *6*(2), e171-e179. https://doi.org/10.1016/S2542-5196(21)00322-3

Martin, P. C. M., Nunn, P. D., Leon, J., & Tindale, N. (2018). Responding to multiple climate-linked stressors in a remote island context: The example of Yadua Island, Fiji. *Climate Risk Management*, *21*, 7-15. https://doi.org/10.1016/j.crm.2018.04.003

McElwee, P., Fernández-Llamazares, Á., Aumeeruddy-Thomas, Y., Babai, D., Bates, P., Galvin, K., Guèze, M., Liu, J., Molnár, Z., & Ngo, H. T. (2020). Working with Indigenous and local knowledge (ILK) in large-scale ecological assessments: Reviewing the experience of the IPBES Global Assessment. *Journal of Applied Ecology*, *57*(9), 1666-1676. https://doi.org/10.1111/1365-2664.13705

McLeod, E., Arora-Jonsson, S., Masuda, Y. J., Bruton-Adams, M., Emaurois, C. O., Gorong, B., Hudlow, C. J., James, R., Kuhlken, H., Masike-Liri, B., Musrasrik-Carl, E., Otzelberger, A., Relang, K., Reyuw, B. M., Sigrah, B., Stinnett, C., Tellei, J., & Whitford, L. (2018). Raising the voices of Pacific Island women to inform climate adaptation policies. *Marine Policy*, *93*, 178-185. https://doi.org/10.1016/j.marpol.2018.03.011

Mcleod, E., Bruton-Adams, M., Förster, J., Franco, C., Gaines, G., Gorong, B., James, R., Posing-Kulwaum, G., Tara, M., & Terk, E. (2019). Lessons From the Pacific Islands – Adapting to Climate Change by Supporting Social and Ecological Resilience [Perspective]. *Frontiers in Marine Science*, *6*(289). https://doi.org/10.3389/fmars.2019.00289

McLeod, E., & Salm, R. V. (2006). *Managing mangroves for resilience to climate change*. World Conservation Union (IUCN).

McMichael, C., & Katonivualiku, M. (2020). Thick temporalities of planned relocation in Fiji. *Geoforum*, *108*, 286-294. https://doi.org/10.1016/j.geoforum.2019.06.012

McNamara, K. E. (2013). Taking stock of community-based climate-change adaptation projects in the Pacific. *Asia Pacific viewpoint*, *54*(3), 398-405. https://doi.org/10.1111/apv.12033

McNamara, K. E., & Buggy, L. (2017). Community-based climate change adaptation: a review of academic literature. *Local Environment*, *22*(4), 443-460. https://doi.org/10.1080/13549839.2016.1216954

McNamara, K. E., Clissold, R., Piggott-Mckellar, A., Kumar, R., Joseph, E., Warrick, O., & Nunn, P. D. (2020). An assessment of community-based adaptation initiatives in the Pacific Islands. *Nature Climate Change*, *10*(7), 628-639. https://doi.org/10.1038/s41558-020-0813-1

McNamara, K. E., Westoby, R., & Chandra, A. (2021). Exploring climate-driven non-economic loss and damage in the Pacific Islands. *Current Opinion in Environmental Sustainability*, *50*, 1-11. https://doi.org/10.1016/j.cosust.2020.07.004

McNamara, K. E., Westoby, R., & Clissold, R. (2022). Lessons for adaptation pathways in the Pacific Islands. *PLoS Climate*, *1*(2). https://doi.org/10.1371/journal.pclm.0000011

Medina Hidalgo, D. (2021). *Riding the wave: improving climate change adaptation strategies, while supporting food and nutrition security in the Pacific* University of the Sunshine Coast, Queensland].

Medina Hidalgo, D., Nunn, P., & Beazley, H. (2021). Uncovering multilayered vulnerability and resilience in rural villages in the Pacific: a case study of Ono Island, Fiji. *Ecology and Society*, *26*(1), 1-27. https://doi.org/doi.org/10.5751/ES-12197-260126

Medina Hidalgo, D., Witten, I., Nunn, P. D., Burkhart, S., Bogard, J. R., Beazley, H., & Herrero, M. (2020). Sustaining healthy diets in times of change: linking climate hazards, food systems and nutrition security in rural communities of the Fiji Islands. *Regional Environmental Change*, *20*(3), 73. https://doi.org/10.1007/s10113-020-01653-2

Melana, D. M., Atchue, J., Yao, C. E., Edwards, R., Melana, E. E., & Gonzales, H. I. (2000). *Mangrove Management Handbook*. Coastal Resources Management Project, Cebu City, Philippines.

Mercer, J., Kurvits, T., Kelman, I., & Mavrogenis, S. (2014). Ecosystem-Based Adaptation for Food Security in the AIMS SIDS: Integrating External and Local Knowledge. *6*(9), 5566-5597. https://www.mdpi.com/2071-1050/6/9/5566

Meriwether, W., Wilson, A., & Forsyth, C. (2018). Restoring near-shore marine ecosystems to enhance climate security for island ocean states: Aligning international processes and local practices. *Marine Policy*, *93*, 284-294. https://doi.org/10.1016/j.marpol.2018.01.018

Millennium Ecosystem Assessment. (2005). *Ecosystems and Human Well-being: Synthesis*.

Mills-Novoa, M. (2023). What happens after climate change adaptation projects end: A community-based approach to ex-post assessment of adaptation projects. *Global Environmental Change*, *80*, 102655. https://doi.org/10.1016/j.gloenvcha.2023.102655

Mizumoto, K., Kagaya, K., & Chowell, G. (2020). Effect of a wet market on coronavirus disease (COVID-19) transmission dynamics in China, 2019–2020. *International Journal of Infectious Diseases*, *97*, 96-101. https://doi.org/10.1016/j.ijid.2020.05.091

Mohale, H. P., Bhosle, R., Kadam, R., & Narsale, S. (2023). Mangrove restoration: Novel technique to growing new mangrove plants in degraded areas of India. *Trends in Agricultural Science*, *2*(1), 20-32. https://doi.org/10.5281/zenodo.7572010

Movono, A., & Scheyvens, R. (2020). Pacific tourism is desperate for a vaccine and travel freedoms, but the industry must learn from this crisis. *The Conversation*. https://theconversation.com/pacific-tourism-is-desperate-for-a-vaccine-and-travel-freedoms-but-the-industry-must-learn-from-this-crisis-150722

Mycoo, M., Wairiu, M., Campbell, D., Duvat, V., Golbuu, Y., Maharaj, S., Nalau, J., Nunn, P. D., Pinnegar, J., & Warrick, O. (2022). *Small Islands. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)*. https://www.ipcc.ch/report/ar6/wg2/

Nabobo-Baba, U. (2006). *Knowing and learning: An indigenous Fijian approach*. Institute of Pacific Studies, The University of the South Pacific.

Nabobo-Baba, U. (2008). Decolonising Framings in Pacific Research: Indigenous Fijian Vanua Research Framework as an Organic Response. *AlterNative : an international journal of indigenous peoples*, *4*(2), 140-154. https://doi.org/10.1177/117718010800400210

Nagar, S. (2020). NZ needs a plan to help migrant workers pick fruit and veg, or prices will soar and farms go bust. *The Conversation*. https://theconversation.com/nz-needs-a-plan-to-help-migrant-workers-pick-fruit-and-veg-or-prices-will-soar-and-farms-go-bust-150447

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

Nalau, J., Becken, S., Schliephack, J., Parsons, M., Brown, C., & Mackey, B. (2018). The Role of Indigenous and Traditional Knowledge in Ecosystem-based Adaptation: A Review of the Literature and Case Studies from the Pacific Islands. *Weather, Climate, and Society*, *10*(4), 851-865. https://doi.org/10.1175/WCAS-D-180032.s1

Narayan, S., Beck, M. W., Reguero, B. G., Losada, I. J., van Wesenbeeck, B., Pontee, N., Sanchirico, J. N., Carter-Ingram, J., Lange, G.-M., & Burks-Copes, K. A. (2016). The Effectiveness, Costs and Coastal Protection Benefits of Natural and Nature-Based Defences. *PLoS ONE*, *11*(5), e0154735. https://doi.org/10.1371/journal.pone.0154735

Natarajan, N., Newsham, A., Rigg, J., & Suhardiman, D. (2022). A sustainable livelihoods framework for the 21st century. *World Development*, *155*, 105898. https://doi.org/10.1016/j.worlddev.2022.105898

Nhamo, L., & Ndlela, B. (2021). Nexus planning as a pathway towards sustainable environmental and human health post Covid-19. *Environmental research*, *192*(C), 110376. https://doi.org/10.1016/j.envres.2020.110376

Nunn, P. D. (2000). Coastal Changes Over the Past 200 Years Around Ovalau and Moturiki Islands, Fiji: Implications for coastal zone management. *Australian Geographer*, *31*(1), 21-39. https://doi.org/10.1080/00049180093510

Nunn, P. D. (2007). *Climate, environment, and society in the Pacific during the last Millennium*. Elsevier.

Nunn, P. D. (2009). Responding to the challenges of climate change in the Pacific Islands: management and technological imperatives. *Climate Research*, *40*(2-3), 211-231. https://doi.org/10.3354/cr00806

Nunn, P. D. (2012). Na Koronivalu ni Bā: Upland Settlement during the Last Millennium in the Bā River Valley and Vatia Peninsula, Northern Viti Levu Island, Fiji. *Asian Perspectives*, *51*(1), 1-21. http://www.jstor.org/stable/42928791

Nunn, P. D. (2013). The end of the Pacific? Effects of sea level rise on Pacific Island livelihoods. *Singapore journal of tropical geography*, *34*(2), 143-171. https://doi.org/10.1111/sjtg.12021

Nunn, P. D. (2017). Sidelining God: why secular climate projects in the Pacific Islands are failing. *The Conversation*. https://theconversation.com/sidelining-god-why-secular-climate-projects-in-the-pacific-islands-are-failing-77623

Nunn, P. D., Aalbersberg, W., Lata, S., & Gwilliam, M. (2014). Beyond the core: community governance for climate-change adaptation in peripheral parts of Pacific Island Countries. *Regional Environmental Change*, *14*(1), 221-235. https://doi.org/10.1007/s10113-013-0486-7

Nunn, P. D., & Campbell, J. R. (2020). Rediscovering the past to negotiate the future: How knowledge about settlement history on high tropical Pacific Islands might facilitate future relocations. *Environmental development*, *35*. https://doi.org/10.1016/j.envdev.2020.100546

Nunn, P. D., & Carson, M. (2015). Sea-level fall implicated in profound societal change about 2570 cal yr bp (620 bc) in western Pacific island groups. *Geo: Geography and Environment*, *2*(1), 17-32. https://doi.org/10.1002/geo2.3

Nunn, P. D., Hunter-Anderson, R., Carson, M., Thomas, F., Ulm, S., & Rowland, M. (2007). Times of Plenty, Times of Less: Last-Millennium Societal Disruption in the Pacific Basin. *Human Ecology*, *35*(4), 385-401. https://doi.org/10.1007/s10745-006-9090-5

Nunn, P. D., Joseph, E., Korovulavula, I., & Kumar, R. (2019). Peripherality as key to understanding climate-associated risk and resilience for Pacific island communities. *APN Science Bulletin*, *9*(1), 102-105. https://doi.org/10.30852/sb.2019.888

Nunn, P. D., Klöck, C., & Duvat, V. (2021). Seawalls as maladaptations along island coasts. *Ocean and Coastal Management*, *205*. https://doi.org/10.1016/j.ocecoaman.2021.105554

Nunn, P. D., & Kumar, R. (2018). Understanding climate-human interactions in Small Island Developing States (SIDS). *International Journal of Climate Change Strategies and Management*, *10*(2), 245-271. https://doi.org/10.1108/IJCCSM-01-2017-0012

Nunn, P. D., & Kumar, R. (2019). Measuring peripherality as a proxy for autonomous community coping capacity: A case study from Bua Province, Fiji Islands, for improving climate change adaptation. *Social Sciences*, *8*(8), 225. https://doi.org/10.3390/socsci8080225

Nunn, P. D., & Kumar, R. (2022). *Traditional and Local Knowledge for Climate Change and Disaster Management in the Pacific Islands*.

Nunn, P. D., McLean, R., Dean, A., Fong, T., Iese, V., Katonivualiku, M., Klöck, C., Korovulavula, I., Kumar, R., & Tabe, T. (2020). Adaptation to Climate Change: Contemporary Challenges and Perspectives. In L. Kumar (Ed.), *Climate Change and Impacts in the Pacific* (pp. 499-524). Springer International Publishing. https://doi.org/10.1007/978-3-030-32878-8_14

Nunn, P. D., & McNamara, K. E. (2019). Failing adaptation in island contexts: The growing need for transformational change. In C. F. Klöck, Michael (Ed.), *Dealing with climate change on small islands: Towards effective and sustainable adaptation?* (pp. 19). https://doi.org/10.17875/gup2019-1210

Nunn, P. D., Nakoro, E., Tokainavatu, N., McKeown, M., Geraghty, P., Thomas, F. R., Martin, P., Hourigan, B., & Kumar, R. (2019). A Koronivalu kei Bua: Hillforts in Bua Province (Fiji), their Chronology, Associations, and Potential Significance. *Journal of Island and Coastal Archaeology*. https://doi.org/10.1080/15564894.2019.1582119

Nyumba, T., Wilson, K., Derrick, C. J., & Mukherjee, N. (2018). The use of focus group discussion methodology: Insights from two decades of application in conservation. *Methods in Ecology and Evolution*, *9*(1), 20-32. https://doi.org/10.1111/2041-210X.12860

O'Brien, P. A. (2021). Pacific nations grapple with COVID's terrible toll and the desperate need for vaccines. *The Conversation*. https://theconversation.com/pacific-nations-grapple-with-covids-terrible-toll-and-the-desperate-need-for-vaccines

O'Meara, L., Cohen, P., Kafa, R., Wate, J. T., Albert, J., Bogard, J., Bonis-Profumo, G., Burkhart, S., Delisle, A., & Diffey, S. (2023). Pacific food systems The role of fish and other aquatic foods for nutrition and health. *Apia*. https://doi.org/https://doi.org/10.4060/cc5796en

Oakes, R., & Oakes, R. (2019). Culture, climate change and mobility decisions in Pacific Small Island Developing States. *Population and Environment*, *40*(4), 480-503. https://doi.org/10.1007/s11111-019-00321-w

Ojea, E. (2015). Challenges for mainstreaming Ecosystem-based Adaptation into the international climate agenda. *Current Opinion in Environmental Sustainability*, *14*, 41-48. https://doi.org/10.1016/j.cosust.2015.03.006

Olds, A. D., Albert, S., Maxwell, P. S., Pitt, K. A., & Connolly, R. M. (2013). Mangrove-reef connectivity promotes the effectiveness of marine reserves across the western Pacific. *Global Ecology and Biogeography*, *22*(9), 1040-1049. https://doi.org/10.1111/geb.12072

Otieno, F. (2019). The roles of monitoring and evaluation in projects. *Project Management Scientific Journal*, *1*(5), 41-44. https://doi.org/10.15373/22501991

Pacific Community, S. f. D. D. (2023). *Covid-19 Cases in Pacific Island Countries and Territories*. https://sdd.spc.int/dataset/df_covid

Pandit, R., Pörtner, H.-O., Scholes, R. J., Agard, J., Archer, E., Arneth, A., Bai, X., Barnes, D., Burrows, M., & Chan, L. (2021). Scientific outcome of the IPBES-IPCC co-sponsored workshop on biodiversity and climate change.

Parsons, M., Fisher, K., & Nalau, J. (2016). Alternative approaches to co-design: insights from indigenous/academic research collaborations. *Current Opinion in Environmental Sustainability*, *20*, 99-105. https://doi.org/10.1016/j.cosust.2016.07.001

Parsons, M., Nalau, J., & Fisher, K. (2017). Alternative perspectives on sustainability: indigenous knowledge and methodologies. *Challenges in Sustainability*, *5*(1), 7-14. https://doi.org/10.12924/cis2017.05010007

Pearson, J. (2020). *The role of local and Indigenous knowledge in ecosystem-based management and adaptation: a case study of iTaukei communities in Bua Province, Vanua Levu Island, Fiji* The University of Queensland, Australia].

Pearson, J., McNamara, K. E., & Nunn, P. D. (2019). Gender-specific perspectives of mangrove ecosystem services: Case study from Bua Province, Fiji Islands. *Ecosystem Services*, *38*, 100970. https://doi.org/10.1016/j.ecoser.2019.100970

Pearson, J., McNamara, K. E., & Nunn, P. D. (2020). iTaukei Ways of Knowing and Managing Mangroves for Ecosystem-Based Adaptation. In W. Leal Filho (Ed.), *Managing Climate Change Adaptation in the Pacific Region* (pp. 105-127). Springer. https://doi.org/10.1007/978-3-030-40552-6

Pedersen Zari, M., Blaschke, P. M., Jackson, B., Komugabe-Dixson, A., Livesey, C., Loubser, D. I., Martinez-Almoyna Gual, C., Maxwell, D., Rastandeh, A., Renwick, J., Weaver, S., & Archie, K. M. (2020). Devising urban ecosystem-based adaptation (EbA) projects with developing nations: A case study of Port Vila, Vanuatu. *Ocean & Coastal Management*, *184*. https://doi.org/10.1016/j.ocecoaman.2019.105037

Pickering, K., Pearce, T., Manuel, L., Doran, B., & Smith, T. F. (2023). Socio-ecological challenges and food security in the 'salad bowl' of Fiji, Sigatoka Valley. *Regional Environmental Change*, *23*(2), 61. https://doi.org/10.1007/s10113-023-02059-6

Piggott-McKellar, A. E., McNamara, K. E., & Nunn, P. D. (2019). *Climate change forced these Fijian communities to move–and with 80 more at risk, here's what they learned* https://theconversation.com/climate-change-forced-these-fijian-communities-to-move-and-with-80-more-at-risk-heres-what-they-learned-116178

Piggott-McKellar, A. E., McNamara, K. E., & Nunn, P. D. (2020). Who defines "good" climate change adaptation and why it matters: a case study from Abaiang Island, Kiribati. *Regional Environmental Change*, *20*(2). https://doi.org/10.1007/s10113-020-01614-9

Piggott-McKellar, A. E., McNamara, K. E., Nunn, P. D., & Sekinini, S. T. (2019). Moving People in a Changing Climate: Lessons from Two Case Studies in Fiji. *Social Sciences*, *8*(5), 133. https://doi.org/10.3390/socsci8050133

Piggott-McKellar, A. E., McNamara, K. E., Nunn, P. D., & Watson, J. E. M. (2019). What are the barriers to successful community-based climate change adaptation? A review of grey literature. *Local Environment*, *24*(4), 374-390. https://doi.org/10.1080/13549839.2019.1580688

Piggott-McKellar, A. E., Nunn, P. D., McNamara, K. E., & Sekinini, S. T. (2020). Dam (n) Seawalls: A Case of Climate Change Maladaptation in Fiji. In W. Leal Filho (Ed.), *Managing climate change adaptation in the Pacific region* (pp. 69-84). Springer. https://doi.org/10.1007/978-3-030-40552-6

Piggott-McKellar, A. E., Pearson, J., McNamara, K. E., & Nunn, P. D. (2019). A livelihood analysis of resettlement outcomes: Lessons for climate-induced relocations. *Ambio*, 1-16. https://doi.org/10.1007/s13280-019-01289-5

Pilbeam, V., van Kerkhoff, L., & Weir, T. (2019). Conservation Decision-Making in Palau: An Example of the Parallel Working of Scientific and Traditional Ecological Knowledge. *Environmental Management*, *64*(5), 564-579. https://doi.org/10.1007/s00267-019-01213-3

Pill, M. (2020). Planned Relocation from the Impacts of Climate Change in Small Island Developing States: The Intersection Between Adaptation and Loss and Damage. In W. L. Filho (Ed.), *Managing Climate Change Adaptation in the Pacific Region* (pp. 129-149). Springer. https://doi.org/10.1007/978-3-030-40552-6

Pisor, A. C., Basurto, X., Douglass, K. G., Mach, K. J., Ready, E., Tylianakis, J. M., Hazel, A., Kline, M. A., Kramer, K. L., Lansing, J. S., Moritz, M., Smaldino, P. E., Thornton, T. F., & Jones, J. H. (2022). Effective climate change adaptation means supporting community autonomy. *Nature Climate Change*. https://doi.org/10.1038/s41558-022-01303-x

Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. *BMJ*, *320*(7227), 114-116.

Prasad, J. M., Waqa-Sakiti, H., & Iese, V. (2022). An analysis of ecosystem-based adaptations in Pacific Island countries. *Pacific Dynamics: Journal of Interdisciplinary research*, *6*(1). https://doi.org/10.26021/12510

Prasad, R. R., Alam, M. A., & Kundra, S. (2022). Climate Change Adaptation On Small Islands: Towards An Effective And Sustainable Fijian Approach. *Journal of Positive School Psychology*, *6*(7), 5782-5801.

Prince, J., Lalavanua, W., Tamanitoakula, J., Tamata, L., Green, S., Radway, S., Loganimoce, E., Vodivodi, T., Marama, K., Waqainabete, P., Jeremiah, F., Nalasi, D., Naleba, M., Naisilisili, W., Kaloudrau, U., Lagi, L., Logatabua, K., Dautei, R., Tikaram, R., . . . Mangubhai, S. (2021). Spawning potential surveys in Fiji: A new song of change for small-scale fisheries in the Pacific. *Conservation science and practice*, *3*(2), n/a. https://doi.org/10.1111/csp2.273

Purcell, S. W., Lalavanua, W., Cullis, B. R., & Cocks, N. (2018). Small-scale fishing income and fuel consumption: Fiji's artisanal sea cucumber fishery. *ICES Journal of Marine Science*, *75*(5), 1758-1767. https://doi.org/10.1093/icesjms/fsy036

Rabbitt, S., Tibbetts, I. R., Albert, S., & Lilley, I. (2022). Testing a model to assess women's inclusion and participation in community-based resource management in Solomon Islands. *Maritime studies*, *21*(4), 465-483. https://doi.org/10.1007/s40152-022-00282-1

Rahma, A., Mardiatno, D., & Hizbaron, D. R. (2023). Developing a theoretical framework: school ecosystem-based disaster risk education. *International Research in Geographical and Environmental Education*, 1-18. https://doi.org/10.1080/10382046.2023.2214041

Rahman, M. F., Falzon, D., Robinson, S.-a., Kuhl, L., Westoby, R., Omukuti, J., Schipper, E. L. F., McNamara, K. E., Resurrección, B. P., & Mfitumukiza, D. (2023). Locally led adaptation: Promise, pitfalls, and possibilities. *Ambio*, 1-15. https://doi.org/10.1007/s13280-023-01884-7

Raisele, K., & Lagi, R. (2023). Indigenous Knowledge systems' role in addressing sea level rise and dried water source: A Fijian case study. *Pacific Dynamics: Journal of Interdisciplinary research*, *76*(1). https://doi.org/http://dx.doi.org/10.26021/14347

Rantes, J., Nunn, P. D., & Addinsall, C. (2021). Sustainable development at the policy-practice nexus: insights from south West Bay, Malakula Island, Vanuatu. *Agroecology and Sustainable Food Systems*, 1-17. https://doi.org/10.1080/21683565.2021.1979706

Ratuva, S. (2021). COVID 19, communal capital and the moral economy: Pacific Islands responses. *Cultural Dynamics*, *33*(3), 194-197. https://doi.org/10.1177/09213740211014312

Reef, R., Feller, I. C., & Lovelock, C. E. (2010). Nutrition of mangroves. *Tree Physiology*, *30*(9), 1148-1160. https://doi.org/doi:10.1093/treephys/tpq048

Reid, H. (2016). Ecosystem-and community-based adaptation: learning from community-based natural resource management. *Climate and Development*, *8*(1), 4-9. https://doi.org/10.1080/17565529.2015.1034233

Reid, H., Jones, X. H., Porras, I., Hicks, C., Wicander, S., Seddon, N., Kapos, V., Rizvi, A. R., & Roe, D. (2009). Is ecosystem-based adaptation effective? Perceptions and lessons learned from 13 project sites. *IIED Research Report*.

Remling, E., & Veitayaki, J. (2016). Community-based action in Fiji's Gau Island: a model for the Pacific? *International Journal of Climate Change Strategies and Management*, *8*(3), 375-398. https://doi.org/10.1108/IJCCSM-07-2015-0101

Reyes-García, V., Fernández-Llamazares, Á., McElwee, P., Molnár, Z., Öllerer, K., Wilson, S. J., & Brondizio, E. S. (2019). The contributions of Indigenous Peoples and local communities to ecological restoration. *Restoration ecology*, *27*(1), 3-8. https://doi.org/10.1111/rec.12894

Riera-Spiegelhalder, M., Campos-Rodrigues, L., Enseñado, E. M., Dekker-Arlain, J. d., Papadopoulou, O., Arampatzis, S., & Vervoort, K. (2023). Socio-Economic Assessment of Ecosystem-Based and Other Adaptation Strategies in Coastal Areas: A Systematic Review. *Journal of Marine Science and Engineering*, *11*(2), 319. https://www.mdpi.com/2077-1312/11/2/319

Riley, R. W., & Kent, C. P. S. (1999). Riley encased methodology: principles and processes of mangrove habitat creation and restoration. *Mangroves and Salt Marshes*, *3*(4), 207-213.

Rizvi, A. R., Baig, S., & Verdone, M. (2015). Ecosystem Based Adaptation: Knowledge Gaps in Making an Economic Case for Investing in Nature Based Solutions for Climate Change. *Climate Change and Law Collection, IUCN*. https://doi.org/10.1163/9789004322714_CCLC_2015-0019-002

Roberts, D., Boon, R., Diederichs, N., Douwes, E., Govender, N., Mcinnes, A., Mclean, C., O'Donoghue, S., & Spires, M. (2012). Exploring ecosystem-based adaptation in Durban, South Africa: "learning-by-doing" at the local government coal face. *Environment and Urbanization*, *24*(1), 167-195. https://doi.org/10.1177/0956247811431412

Rodrigues, J. G., Conides, A. J., Rivero Rodriguez, S., Raicevich, S., Pita, P., Kleisner, K. M., Pita, C., Lopes, P. F., Alonso Roldáni, V., & Ramos, S. S. (2017). Marine and coastal cultural ecosystem services: knowledge gaps and research priorities. *One Ecosystem 2:e12290*. https://doi.org/10.3897/oneeco.2.e12290

Rolando, F., Marzio, G., Alessandro, L., & Baltasar, M. (2020). COVID-19 and Climate Change: A Tale of Two Global Problems. *Sustainability (Basel, Switzerland)*, *12*(8560), 8560. https://doi.org/10.3390/su12208560

Roos, C. I., Field, J. S., & Dudgeon, J. V. (2016). Anthropogenic Burning, Agricultural Intensification, and Landscape Transformation in Post-Lapita Fiji. *Journal of Ethnobiology*, *36*(3), 535-553, 519. https://doi.org/10.2993/0278-0771-36.3.535

Rubaiyat, A., Rollings, N., Galvin, S., Mitloehner, R., Miah, S., & Boehmer, H. J. (2023). Tree diversity, vegetation structure and management of mangrove systems on Viti Levu, Fiji Islands. *Southern Forests: a Journal of Forest Science*, 1-10. https://doi.org/10.2989/20702620.2023.2218560

Ruiu, M. L., Ragnedda, M., & Ruiu, G. (2020). Similarities and differences in managing the Covid-19 crisis and climate change risk. *Journal of knowledge management*, *24*(10), 2597-2614. https://doi.org/10.1108/JKM-06-2020-0492

Sahin, O., Hadwen, W. L., 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 case study. *Regional Environmental Change*, *21*(4), 90. https://doi.org/10.1007/s10113-021-01809-8

Sakapaji, S. C. (2022). Integrating Local and Indigenous Ecological Knowledge (IEK) Systems into Climate Adaptation Policy for Resilience Building, and Sustainability in Agriculture. *International Journal of Sustainable Development Research*, *8*(1), 9-24. https://doi.org/10.11648/j.ijsdr.20220801.12

Salas, R. N., Shultz, J. M., & Solomon, C. G. (2020). The Climate Crisis and Covid-19 — A Major Threat to the Pandemic Response. *The New England journal of medicine*, *383*(11), e70-e70. https://doi.org/10.1056/NEJMp2022011

Salgado, K., & Martinez, M. (2017). Is ecosystem-based coastal defense a realistic alternative? Exploring the evidence. *Planning and Management*, *21*(6), 837-848. https://doi.org/10.1007/s11852-017-0545-1

Sandilyan, S., & Kathiresan, K. (2012). Mangrove conservation: a global perspective. *Biodiversity and Conservation*, *21*(14), 3523-3542. https://doi.org/10.1007/s10531-012-0388-x

Sayes, S. A. (1984). Changing paths of the land: Early political hierarchies in Cakaudrove, Fiji. *The Journal of Pacific History*, *19*(1), 3-20. https://www.jstor.org/stable/25168537

Scarano, F. R. (2017). Ecosystem-based adaptation to climate change: concept, scalability and a role for conservation science. *Perspectives in Ecology and Conservation*, *15*(2), 65-73. https://doi.org/10.1016/j.pecon.2017.05.003

Scheyvens, R., & Movono, A. (2020). Traditional skills help people on the tourism-deprived Pacific Islands survive the pandemic. *The Conversation*. https://theconversation.com/traditional-skills-help-people-on-the-tourism-deprived-pacific-islands-survive-the-pandemic-148987

Secretariat of the Convention on Biological Diversity. (2009). *Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change.* (Technical Series No. 41, Issue.

Seneviratne, S. I., Zhang, X., Adnan, M., Badi, W., Dereczynski, C., Di Luca, A., Ghosh, S., Iskandar, I., Kossin, J., Lewis, S., Otto, F., Pinto, I., Satoh, M., Vicente-Serrano, S. M., Wehner, M., & Zhou, B. (2021). Weather and Climate Extreme Events in a Changing Climate. In V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J. B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, & B. Zhou (Eds.), *In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1513–1766). Cambridge University Press, Cambridge. https://doi.org/10.1017/9781009157896.013

Sewak, A., Deshpande, S., Rundle-Thiele, S., Zhao, F., & Anibaldi, R. (2021). Community perspectives and engagement in sustainable solid waste management (SWM) in Fiji: A socioecological thematic analysis. *Journal of environmental management*, *298*, 113455. https://doi.org/10.1016/j.jenvman.2021.113455

Shammin, M. R., Haque, A. E., & Faisal, I. M. (2022). A framework for climate resilient community-based adaptation. In A. K. E. Haque, P. Mukhopadhyay, M. Nepal, & M. R. Shammin (Eds.), *Climate change and community resilience* (pp. 11-30). https://doi.org/10.1007/978-981-16-0680-9_2

Sheel, M., McEwen, S., & Davies, S. E. (2022). Brand inequity in access to COVID-19 vaccines. *The Lancet Regional Health - Western Pacific*, *18*, 100366-100366. https://doi.org/10.1016/j.lanwpc.2021.100366

Singh, P., Charan, D., Kaur, M., Railoa, K., & Chand, R. (2020). Place Attachment and Cultural Barriers to Climate Change Induced Relocation: Lessons from Vunisavisavi Village, Vanua Levu, Fiji. In *Managing Climate Change Adaptation in the Pacific Region* (pp. 27-43). Springer.

Singh, P., Tabe, T., & Martin, T. (2022). The role of women in community resilience to climate change: A case study of an Indigenous Fijian community. *Women's Studies International Forum*, *90*, 102550. https://doi.org/10.1016/j.wsif.2021.102550

Sippo, J. Z., Lovelock, C. E., Santos, I. R., Sanders, C. J., & Maher, D. T. (2018). Mangrove mortality in a changing climate: An overview. *Estuarine, Coastal and Shelf Science*, *215*, 241-249.

Smith, J. B., Huq, S., & Klein, R. J. (2003). *Climate change, adaptive capacity and development*. Imperial College Press.

Sovacool, B. K. (2011). Hard and soft paths for climate change adaptation. *Climate policy*, *11*(4), 1177-1183. https://doi.org/10.1080/14693062.2011.579315

Spalding, M., Kainuma, M., & Collins, L. (2010). Mapping Mangroves. In *World Atlas of mangroves* (1 ed., pp. 47-56). Routledge. https://doi.org/10.4324/9781849776608-3

Sreeranga, S., Takagi, H., & Shirai, R. (2021). Community-based portable reefs to promote mangrove vegetation growth: bridging between ecological and engineering principles. *International journal of environmental research and public health*, *18*(2), 590. https://doi.org/10.3390/ijerph18020590

Standards Reference Group SERA. (2018). *National standards for the practice of ecological restoration in Australia* (Restoration ecology, Issue. https://www.seraustralasia.org/

Swaraj, A. (2019). Exploratory research: Purpose and process. *Parisheelan Journal*, *15*(2), 665-670.

Syddall, V. M., Fisher, K., & Thrush, S. (2022). Collaboration a solution for small island developing states to address food security and economic development in the face of climate change. *Ocean & Coastal Management*, *221*, 106132. https://doi.org/https://doi.org/10.1016/j.ocecoaman.2022.106132

Tabunakawai-Vakalalabure, M., Kuridrani, N., Lalavanua, W., Mangubhai, S., & Bertram, I. (2017). *Pre-export sizes of bêche-de-mer in Fiji* (Fiji's Sea Cucumber Fishery: Advances in Science for Improved Management, Issue. W. C. Society.

Tanner, T., Lewis, D., Wrathall, D., Bronen, R., Cradock-Henry, N., Huq, S., Lawless, C., Nawrotzki, R., Prasad, V., & Rahman, M. A. (2015). Livelihood resilience in the face of climate change. *Nature Climate Change*, *5*(1), 23-26. https://doi.org/10.1038/nclimate2431

Taylor, M., McGregor, A., & Dawson, B. (2016). *Vulnerability of Pacific agriculture and forestry to climate change*. Secretariat of the Pacific Community.

Terton, A., & Dazé, A. (2018). ALIVE_Adaptation, Livelihoods and Ecosystems Planning Tool: User Manual. In (Version 1.0 ed.). Canada: International Institute for Sustainable Development & United Nations Environment Programme – International Ecosystem Management Partnership.

Thomas, A. S., Mangubhai, S., Vandervord, C., Fox, M., & Nand, Y. (2019). Impact of Tropical Cyclone Winston on women mud crab fishers in Fiji. *Climate and Development*, *11*(8), 699-709. https://doi.org/10.1080/17565529.2018.1547677

Thornton, P. K., Ericksen, P. J., Herrero, M., & Challinor, A. J. (2014). Climate variability and vulnerability to climate change: a review. *Global Change Biology*, *20*(11), 3313-3328. https://doi.org/10.1111/gcb.12581

Tomlinson, P. B. (2016). *The botany of mangroves*. Cambridge University Press.

Tongco, M. D. C. (2007). Purposive sampling as a tool for informant selection. *Ethnobotany Research and applications*, *5*, 147-158.

Trudinger, H., Crimp, S., & Friedman, R. S. (2023). Food systems in the face of climate change: reviewing the state of research in South Pacific Islands. *Regional Environmental Change*, *23*(1), 45. https://doi.org/10.1007/s10113-023-02040-3

Truong, P. (2000). The global impact of vetiver grass technology on the environment. *Mercury*, *1*(2).

Tui, S., & Fakhruddin, B. (2022). Food for thought: Climate change risk and food (in)security in Tuvalu. *Progress in Disaster Science*, 100255. https://doi.org/10.1016/j.pdisas.2022.100255

UNEP. (2019). *Making EbA an effective part of balanced adaptationstrategies: Introducing the UNEP EbA briefing notes*. https://wedocs.unep.org/bitstream/handle/20.500.11822/28174/EBA1.pdf?sequence=1&isAllowed=y

van der Meulen, F., IJff, S., & van Zetten, R. (2022). Nature-based solutions for coastal adaptation management, concepts and scope, an overview. *Nordic Journal of Botany*, e03290. https://doi.org/10.1111/njb.03290

Van der Stocken, T., Wee, A. K. S., De Ryck, D. J. R., Vanschoenwinkel, B., Friess, D. A., Dahdouh-Guebas, F., Simard, M., Koedam, N., & Webb, E. L. (2019). A general framework for propagule dispersal in mangroves. *Biological Reviews*, *94*(4), 1547-1575. https://doi.org/10.1111/brv.12514

Vasseur, L. (2021). How Ecosystem-Based Adaptation to Climate Change Can Help Coastal Communities through a Participatory Approach. *Sustainability*, *13*(4), 2344. https://www.mdpi.com/2071-1050/13/4/2344

Veitayaki, J., & Holland, E. (2016). Lessons from Lomani Gau Project, Fiji: a local community's response to climate change. *Appropriating Climate Change: Pacific Reception of a Scientific Prophecy*.

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. https://doi.org/10.1007/978-4-431-56481-2_19

Venegas, R. M., Oliver, T., Liu, G., Heron, S. F., Clark, S. J., Pomeroy, N., Young, C., Eakin, C. M., & Brainard, R. E. (2019). The rarity of depth refugia from coral bleaching heat stress in the western and central Pacific Islands. *Scientific Reports*, *9*(1), 1-12. https://doi.org/10.1038/s41598-019-56232-1

Vousdoukas, M. I., Athanasiou, P., Giardino, A., Mentaschi, L., Stocchino, A., Kopp, R. E., Menéndez, P., Beck, M. W., Ranasinghe, R., & Feyen, L. (2023). Small Island Developing States under threat by rising seas even in a 1.5° C warming world. *Nature Sustainability*, 1-13. https://doi.org/10.1038/s41893-023-01230-5

Walsh, K. J. E., McBride, J. L., Klotzbach, P. J., Balachandran, S., Camargo, S. J., Holland, G., Knutson, T. R., Kossin, J. P., Lee, T. C., Sobel, A., & Sugi, M. (2016). Tropical cyclones and climate change. *7*, 65-89. https://doi.org/10.1002/wcc.371

Walshe, R. A., Chang Seng, D., Bumpus, A., & Auffray, J. (2018). Perceptions of adaptation, resilience and climate knowledge in the Pacific: The cases of Samoa, Fiji and Vanuatu. *International Journal of Climate Change Strategies and Management*, *10*(2), 303-322. https://doi.org/10.1108/IJCCSM-03-2017-0060

Walshe, R. A., & Stancioff, C. E. (2018). Small island perspectives on climate change. *Island Studies Journal*, *13*(1), 13-24. https://doi.org/https://doi.org/10.24043/isj.56

Ward, R. D., Friess, D. A., Day, R. H., & Mackenzie, R. A. (2016). Impacts of climate change on mangrove ecosystems: a region by region overview. *Ecosystem Health and Sustainability*, *2*(4), e01211. https://doi.org/doi:10.1002/ehs2.1211

Watters, R. F. (1965). The Development of Agricultural Enterprise in Fiji. *The Journal of the Polynesian Society*, *74*(4), 490-502. https://www.jstor.org/stable/20704333

Weir, T. (2020). Adaptation in Small Islands: Research Themes and Gaps. In *Managing Climate Change Adaptation in the Pacific Region* (pp. 45-68). Springer.

Westoby, R., Clissold, R., McNamara, K. E., Ahmed, I., Resurrección, B. P., Fernando, N., & Huq, S. (2021). Locally led adaptation: drivers for appropriate grassroots initiatives. *Local Environment*, *26*(2), 313-319. https://doi.org/10.1080/13549839.2021.1884669

Westoby, R., McNamara, K. E., Kumar, R., & Nunn, P. D. (2019). From community-based to locally led adaptation: Evidence from Vanuatu [journal article]. *Ambio*. https://doi.org/10.1007/s13280-019-01294-8

Whitney, C. K., Bennett, N. J., Ban, N. C., Allison, E. H., Armitage, D., Blythe, J. L., Burt, J. M., Cheung, W., Finkbeiner, E. M., & Kaplan-Hallam, M. (2017). Adaptive capacity: from assessment to action in coastal social-ecological systems. *Ecology and Society*, *22*(2). https://doi.org/10.5751/ES-09325-220222

Williams, L. (2020). Facebook barter page grows cash-free trade in Fiji and beyond. *Radio New Zealand (RNZ), Pacific, Fiji*. https://www.rnz.co.nz/international/pacific-news/415644/facebook-barter-page-grows-cash-free-trade-in-fiji-and-beyond

Wongbusarakum, S., Gorstein, M., Pomeroy, R., Anderson, C. L., & Mawyer, A. (2021). Mobilizing for change: assessing social adaptive capacity in Micronesian fishing communities. *Marine Policy*, *129*, 104508. https://doi.org/https://doi.org/10.1016/j.marpol.2021.104508

World Bank Group. (2020). *World Bank East Asia and Pacific Economic Update, Spring 2020: Preparedness and Vulnerabilities/Global Reverberations of COVID-19*. (1464815658). The World Bank

World Wide Fund for Nature. (2019, 24 September). *No Holding Back the Tide in Fiji* https://www.arcticwwf.org/newsroom/features/raviravi-and-korovatu-fiji/

Yee, M., Piggott-McKellar, A. E., McMichael, C., & McNamara, K. E. (2022). Climate Change, Voluntary Immobility, and Place-Belongingness: Insights from Togoru, Fiji. *Climate*, *10*(3), 46. https://doi.org/10.3390/cli10030046

Yemoh, V., & Yemoh, M. (2022). COVID-19 Vaccination and Border Restrictions; Evaluation and Outlook on Health and Socio-economic Systems in Pacific Island Countries and Territories. *International Journal of Scientific Research and Engineering Development*, *5*(1), 19-29.

# Appendices

## Appendix A – Human Ethics Approval Letter

20 December 2019

**A/Prof Andrew Crowden**
**Chair, Human Research Ethics Committee**
Tel: +61 7 5430 2823
Email: humanethics@usc.edu.au

Prof Patrick Nunn
Dr Andrew Olds
Ms Melanie Harris

Dear Researchers

**Ethics approval for research project: Opportunities for Ecosystem-Based Adaptation (EbA) to Climate Change on Tropical Islands: An example from the Palau Islands, Northwest Pacific Ocean (S191385)**

This letter is to confirm that the Chair of the USC Human Research Ethics Committee (HREC) has granted ethics approval for this project subject to the standard conditions of approval listed below.

The period of ethics approval is from 20 December 2019 to 20 June 2020.

The ethics approval number for the project is S191385. This number should be quoted in your Research Project Information Sheet and in any written communication with participants.

The USC HREC will review this approval at its next meeting and should there be any variation of the conditions of approval, you will be informed.

If you have any queries or if you require further information, please contact us using the details above.

Yours sincerely

for

**A/Prof Andrew Crowden**
**Chair, Human Research Ethics Committee**

## Appendix B - In country research approval letter


# MINISTRY OF ITAUKEI AFFAIRS

NORTH WING, ITAUKEI TRUST FUND BUILDING COMPLEX
87 QUEEN ELIZABETH DRIVE, SUVA
P.O.BOX 2100, GOVERNMENT BUILDING, SUVA, FIJI

TELEPHONE: (679) 3100 909 FAX: (679) 3300198


**Reference:** MTA – 42/2-3 01 July 2022

Ms Melanie Harris,
University of the Sunshine Coast,
Queensland,
AUSTRALIA.

Dear Ms Harris,

**Re: Ministry of iTaukei Affairs Research Support**

1. Thank you for your letter dated 1 July 2022 on the above.

2. Approval is granted for you to visit Vusaratu village in Cakaudrove province, Qaranivai Point in Macuata province, Navunievu village and Naivaka village in Bua province.

3. It is noted that the purpose of your visit is to identify opportunities for sustainable adaption to reduce the impacts of climate change on the livelihoods of rural coastal Pacific Island people.

4. Please liaise with the following Provincial Council Officials who will facilitate your visit;

   (i) **Cakaudrove Provincial Council Office**
   Roko Tui Cakaudrove, Mr Kaminieli Kasami on mobile no. 9904157 or Senior Roko Tui Cakaudrove, Mr Solomone Vubaya on mobile no. 7121254.

   **Macuata Provincial Council Office**
   Roko Tui Macuata, Mr Kalivati Rabuka on mobile no. 9904161 or Senior Roko Tui Macuata, Mr Maikeli Sauwaqa on mobile no. 9784433.

   **Bua Provincial Council Office**
   Roko Tui Bua, Mr Inoke Tagicakibau on mobile no. 9904156 or Senior Roko Tui Bua, Mr Kalivati Radororo on mobile no. 9476647.

5. I wish you all the best.

Yours sincerely,

Pita Tagicakirewa

**Permanent Secretary for iTaukei Affairs**

## Appendix C - Research Project Information Sheet

# Emerging Opportunities for Post-Pandemic Ecosystem-Based Adaptation (EbA) to Climate Change in the Pacific Islands.

Ethics Approval Number: **S191385**

**Research Team Contact Details**

The research team consists of the Chief Investigator, Professor Patrick Nunn (University of the Sunshine Coast), and Melanie Harris (Student Researcher – University of the Sunshine Coast). Please direct questions to either:

| Chief Investigator | Student Investigator |
|---|---|
| Prof. Patrick Nunn | Ms Melanie Harris |
| Email: pnunn@usc.edu.au | Email: melanie.harris@research.usc.edu.au |

**Project Description**

The purpose of this research project is to identify opportunities for sustainable adaptation to reduce the impacts of climate change on the livelihoods of rural coastal Pacific Island people. This will be done by considering a community's understanding of global climate change and how climate change may have impacted or will impact the local ecosystems, community and livelihoods. The research will also examine what methods may have been attempted by the community to reduce the impacts of climate change, including understanding why these measures were chosen and the result they achieved from them, from a community's perspective. The research is focused on the potential for Ecosystem-based Adaptation (EbA) through mangrove restoration, therefore a health assessment of the local mangrove ecosystem will be undertaken. Villages have been selected as study sites based on their mangrove afforestation projects, or opportunities for such.

The *Turaga ni koro* (village headman) will provide permission on behalf of the local community members to participate in the interviews/focus groups. Participants may be chosen based on their knowledge and/or involvement with the local mangroves, their level of decision-making within the community or to offer the perspective of a particular age/gender group. To assist in contextualizing the data, some general information about the demographics of the community will also be recorded.

**Participation**

If participants are suggested to take part in this research project, they will be invited to attend a focus group and possibly an interview. The process will be very relaxed and informal, taking approximately one hour in a suitable location within the community. The interview/focus groups will be scheduled at a time convenient for the community, therefore will not disrupt any official duties.

Examples of the questions that will be asked during the interview/focus groups are:

1. In what way does your community utilise mangroves?
2. Are mangroves used and managed mainly by men or women in the community?
3. How is knowledge about your mangroves and the local environment passed down to the children in the community?

**With the informed consent of the community, the interview/focus group will be audio recorded.**

Participation in this research project is completely voluntary. If participants do not want to answer a particular question they are not required to do so or if they take part and later change their mind, they are free to withdraw at any time. Your decision to participate (or not) will in no way impact your current or future relationship with the researchers or the University of the Sunshine Coast.

**Consent**

The consent of each participant will be implied by the attendance at the interview/focus group.

The final decision about who will participate in the research will be decided by the Village Headman.

Consent is for the use of the data and information provided during the interviews. All information will be used in a non-identifiable format.

**Risks and Benefits**

There are no anticipated risks beyond normal day-to-day living associated with the participation in this research project.

The results and outcomes of this research may benefit the local community and the Pacific Islands region.

**Privacy, Confidentiality and Results**

Any data collected as a part of this research project will be stored securely as per the University of the Sunshine Coast's Research Data Management policy. All comments and responses will be treated confidentially as required by law.

*Audio recordings will:*

- only be accessed by those listed on this research project.
- be destroyed once the data has been transcribed.

Audio recordings are only for the purpose of accurate data collection and if you would prefer, it is possible to participate without being recorded.

An analysed version of the results of this research project may be presented at external or internal conferences and meetings, or in publications. A summary of the findings of this research will also be distributed to relevant local Community Leaders and Stakeholders.

**Concerns or Complaints**

If you have any concerns or complaints about the way this research project was conducted you can raise them with the Chief Investigator (listed above). If you prefer an independent person, contact the Chairperson of the USC Human Research Ethics Committee: (c/- Office of Research, University of the Sunshine Coast, Maroochydore DC 4558; telephone (07) 5430 2823; email humanethics@usc.edu.au).

As the village headman, I, _____ offer consent on behalf of the community members to participate in the research project detailed above.

_____ *(signature)*

**Thank you for taking part in this important research.**

## Appendix D – Group Discussion Guide

- To start the conversation, I would like to talk about your understanding of the importance of mangroves in general.
- In what ways are mangroves important to your community and how are they used? Is this the same today compared to when you were younger?
- Can you tell me about your local mangroves, how many different types and the mangrove replanting that has been done? (with the exception of Naivaka)
- Are mangroves used mainly by women or men?
- Are there any marine protected areas nearby?
- Can you tell me about the seawall – who's initiative, do you think it has been successful for the village?
- If it hadn't come up in conversation, we tried to extract information about their understanding of climate change.
- How have you learnt all this knowledge about your local environment and is this knowledge passed down to the younger generation?
- Do you rely somewhat on your faith to assist in dealing with the problems we have talked about?
- Did the pandemic have a significant impact of your community? How did you initially hear about it? Did you follow the messages about vaccinations, social distancing and hand washing? Why?

## Appendix E – An example of a mangrove identification card

### *RHIZOPHORA* SPECIES

***Rhizophora stylosa***

Spotted Mangrove
Local Name: Tiri Tabua

Description:

- **This is a medium sized tree ranging from 8-30m in height.**
- **Leaves are about 10cm long and slightly rounded with a small spike at the tip and have a lighter green undersurface covered with brown specs.**
- **Flowers are white** and are wind or insect pollinated.
- **Seeds are long with a bulging cap.**

Flowering and Fruiting: Flowering takes place from February to April whereas fruiting takes place throughout the year.

Uses: Used in building, dye production, firewood.

Habitat: While it is most commonly found on beach fronts or lower tidal reaches it may also extend upstream along estuaries and rivers that remain brackish through most of the year.

Distribution: Very widespread distribution ranging from India to the Pacific. Common throughout the Fiji group.