CONSERVATION INTERNATIONAL
Fiji

Australian Government
Department of Foreign Affairs and Trade

BLUE CARBON IN FIJI:
DRIVERS OF DEFORESTATION AND DEGRADATION AND CAUSES OF LOSS IN MANGROVES

Conservation International – Fiji
2024

CONSERVATION INTERNATIONAL Fiji

Australian Government
Department of Foreign Affairs and Trade

BLUE CARBON IN FIJI:
DRIVERS OF DEFORESTATION AND DEGRADATION AND CAUSES OF LOSS IN MANGROVES

Conservation International – Fiji
2024

Authors
Adam Bouché – Conservation International
Nikheel Sharma – Conservation International
Clint Cameron – Blue Carbon Fiji Project Technical Consultant
Aliti Vunisea – Socioeconomic, Cultural, and Gender Consultant
Ulai Baya – Environmental Law and Policy Consultant
Isaac Rounds – Conservation International
Bridget Kennedy – Conservation International, Asia-Pacific
Senilolia Tuiwawa – Conservation International

Editor
Nikheel Sharma and Adam Bouche

Layout and Design
Filipe Waqairagata

Disclaimer
This report may include the views or recommendations of authors and third parties and does not necessarily reflect the views of the Australian Government, Fiji Government and Conservation International, or indicate a commitment to a particular course of action.

Citation: Conservation International (2024). Fiji Blue Carbon Project: Drivers of Deforestation and Degradation and Causes of Loss in Mangroves. Conservation International, Suva, Fiji. 100 pp.

ISBN: 978-982-98166-8-9

To Obtain a copy of this publication, please contact:

Conservation International – Fiji Program, 375 Waimanu Road, Suva.
Telephone: +679 3314593
Email: cifijigeneral@conservation.org

EXECUTIVE SUMMARY

Mangroves are ecosystems of critical importance for Fiji due to their role in supporting biodiversity, capturing and storing carbon, and providing food and livelihoods to communities. In order to protect and restore important mangrove areas in Fiji, Conservation International is working closely with the Government of Fiji to develop an analysis of drivers of mangrove loss and potential project opportunities in partnership with the World Wildlife Fund (WWF), and the Fiji Locally Managed Marine Area Network (FLMMA) and with the support of the Australian Government, Department of Foreign Affairs and Trade (DFAT). The present report advances this work by providing an analysis of drivers of mangrove deforestation and degradation (DoDD) and other causes of mangrove loss in Fiji. It advances the feasibility study for a Fiji Blue Carbon project that aims to produce carbon credits through restoration activities. It includes the selection of a pilot site for this project, description of next steps for understanding threats to mangroves across Fiji, and development of strategies for addressing threats to and restoring mangroves. This study evaluated DoDD in three of the largest areas of mangroves on Viti Levu, Fiji's largest island: (1) Ba Delta and Yanuca Island (Ba Province); (2) Navitilevu Bay (Ra Province); and (3) Rewa Delta (Rewa and Tailevu Provinces). In addition to informing the feasibility and design of the proposed blue carbon project, these sites also serve as case studies and representative examples of mangrove degradation and deforestation prominent across Fiji.

Information was gathered through literature reviews, stakeholder consultations and interviews, socioeconomic surveys, spatial analysis of satellite and drone imagery, field data collection, and workshops. Findings were then synthesized using a theory of change approach to analyse threats facing mangroves at each site. Factors that apply broadly to mangrove DoDD across Fiji were addressed, including national legal and policy factors as well as social, economic, cultural, traditional, and governance factors.

Drivers of mangrove deforestation and degradation and the degree of loss due to tropical cyclones varied geographically. Therefore, in addition to an evaluation of national-scale drivers of deforestation and degradation, each site was assessed independently. Significant anthropogenic direct threats to mangroves include wood harvest, primarily for firewood, encroachment of settlements and harvest of wood for building materials, dredging waste disposal, and land reclamation for various purposes.

In terms of damage from recent tropical cyclones, Navitilevu Bay and the Ba Delta experienced considerable damage to taller trees from repeated storms. Navitilevu Bay experienced the worst damage of the three sites studied; widespread defoliation, windthrow, and snapped trees resulted from the storms, and there were significant areas where little-to-no recovery has occurred since Cyclone Winston (2016). Affected areas in Ba Delta have mostly recovered, except for Yanuca Island, an important area for crab harvest, which has a persistent dead patch with very slow recovery. Rewa Delta, in contrast, appeared to have recovered nearly all of mangroves damaged by tropical cyclones.

At a national scale, the legal and policy landscape related to mangroves is complex. There is no single law

or policy that governs the use and management of mangroves, and the authority over mangroves is split across multiple ministries. Across Fiji, laws permit several activities that degrade and deforest mangroves. Where illegal destruction occurs, government often lacks the resources and tools needed to address such issues.

Many of the underlying causes of deforestation and degradation in mangroves across these sites include factors that are relevant at a national scale. These include population growth and demographic shifts from rural to urban areas resulting in expansion of urban and peri-urban settlements into mangrove areas; economic need, subsistence livelihoods, and dependence on mangrove resources, exacerbated by the COVID-19 pandemic and responses; lack of clear governance and conflicting use rights; loss of traditional knowledge and management practices; and lack of monitoring and enforcement of existing laws and regulations.

This report serves as a foundational analysis and contribution to better document and understand the drivers of mangrove deforestation and degradation in Fiji, providing critical information for future conservation, restoration, and blue carbon trading that will be undertaken by and in partnership with the Government of Fiji. The carbon storage and sequestration benefits of mangroves can be measured using globally acceptable standards, such as the Plan Vivo Standard, which enables the potential for generation of carbon credits through a project. At a site-level, the DoDD analysis informed the feasibility of developing a mangrove forest carbon offset project in Fiji and demonstrated that Navitilevu Bay in Ra Province shows the greatest potential as a pilot blue carbon pilot site due to extensive cyclone damage, lack of recovery, and the relationships and community interest developed through stakeholder engagement. Project activities at this site would be categorized as afforestation, reforestation, or restoration (ARR), and project activities would include augmented or assisted recovery. The potential restoration area at this site is at least 40 ha, and if successfully executed, would contribute to the Fiji National Climate Finance Strategy (2022) and Fiji mitigation priorities, including the 30-million trees program.

In general, this is a qualitative description of DoDD, and further work is required to quantify and rank each driver in terms of its impact on the quantity of mangrove cover change and different indices of mangrove ecosystem health. A results chain with specific strategies to address critical threats will be necessary for well-designed projects to be implemented and achieve their goals. Additional data is also needed, both at the site and national scales. At the site scale, water-level loggers and additional field data collection will aid in the design of a restoration plan that can facilitate the recovery of degraded mangrove ecosystem. This pilot project will also serve as a learning experience from which lessons can be applied across scale at mangrove sites throughout the country. There is also a need for a comprehensive, historical assessment of mangrove extent, loss, and recovery (particularly following tropical cyclones) at a national scale using remote sensing tools due to the wide range of estimates currently available; this need will begin to be addressed in future work planned through this project. For restoration interventions, the greenhouse gas (GHG) benefits of carbon sequestration from assisted regeneration efforts must be compared to those produced by natural recovery post-disturbance. For crediting of potential avoided deforestation or degradation activities, historic trends must be analysed across sites. In partnership with the Government of Fiji, CI is currently performing additional analyses to map mangrove change at the sites considered for this project to address this need, but a comprehensive national effort is also required to facilitate future work.

TABLE OF ANNEXES

LIST OF CONTENTS

GLOSSARY

General Terms	
Blue Carbon	Blue carbon refers to carbon stored within the blue carbon ecosystems, namely the mangroves, salt marshes, and seagrasses ecosystems.
Deforestation	Direct human conversion of forest to non-forest land cover and transformation of forest to another land use on a long-term or permanent basis (UNFCCC, 2001; Schoene et al., 2007).
Forest Degradation	Human-induced reduction of forest canopy cover and/or stocking, provided that the canopy cover stays above the canopy cover threshold required for the forest definition (Schoene et al., 2007). May also refer to changes to forest structure and function that lower the long-term capacity of a forest to provide services or other benefits.
Improved Forest Management	Activities that result in improved structure and/or increased function of forest ecosystems in terms of ecological health and/or benefits and services provided, including carbon storage and sequestration. Also called "Enhanced Forest Management."
Mangroves	Forest ecosystems dominated by trees and shrubs in coastal intertidal zones, often at the confluence of freshwater and saltwater systems.
Qoliqoli	Traditional fishing grounds of the indigenous i-Taukei people of Fiji
Restoration	Regeneration of mangrove, via planting or replanting mechanisms, in an area where they previously existed.
Tropical Cyclone	Low pressure systems that form over warm tropical waters. They typically form when the sea-surface temperature is above 26.5°C. (Commonwealth of Australia, Bureau of Meteorology, 2023).
Theory of Change	Causal conceptual model that depicts assumptions about how actions taken can help to achieve results in terms of mangrove conservation, restoration, and broader ecological, climate, and human well-being goals and objectives. ToC can be expressed in descriptive or narrative text, using visual tools such as concept maps and diagrams, or in other forms.
Action	"A general term used to refer to the work of conservation [or restoration] teams. This includes strategies, activities, and tasks," (CMP, 2020).
Activity	"A specific action or set of tasks undertaken by project staff and/or partners to reach one or more objectives. Sometimes called an action, response, or strategic action. (See relationship to strategies.)" (CMP, 2020).

Agent	Person, group, organization, or entity responsible for and associated with a direct threat or action. Also called an "actor," (CMP, 2020).
Critical Threat	Direct threats that are, after analysis, prioritized as the most important to address, due to their impact, prevalence, etc. (CMP, 2020).
Direct Driver	Synonym for "direct threat," (CMP, 2020).
Direct Threat	"Primarily human actions that immediately degrade one or more conservation targets (e.g., logging). They can also be natural phenomena altered by human activities (e.g., increase in extreme storm events due to climate change). Typically tied to one or more stakeholders. (Sometimes referred to as a pressure or source of stress," (CMP, 2020). Compare with underlying cause or indirect threat. In this study, direct threats are actions resulting in mangrove loss, primarily through deforestation or forest degradation or the creation of conditions leading to mangrove loss.
Driver	Either a direct driver (direct threat) or an indirect driver (underlying/root cause).
Factor	"A generic term for an element of a situation model, including direct and indirect threats, and opportunities. It is often advantageous to use this generic term since many factors – for example, tourism – could be both a threat and an opportunity (see also root causes or drivers)," (CMP, 2020).
Goal	"A formal statement detailing a project's desired impact, such as the desired future status of a target," (CMP, 2020)
Intervention	Equivalent to "action."
Objective	"A formal statement detailing a desired outcome of a project, such as reducing a critical threat. A good objective meets the criteria of being specific, measurable, achievable, results-oriented, and time-limited (SMART). If the project is well-conceptualized and -designed, the realization of a project's objectives should lead to the fulfilment of the project's goals and ultimately its vision." Compare to "Goal." (CMP, 2020)
Opportunity	"A factor identified in an analysis of the project situation that potentially has a positive effect on one or more targets, either directly or indirectly. Often an entry point for conservation actions – for example, demand for sustainably harvested timber. In some senses, the opposite of a threat," (CMP, 2020)
Outcome	"The desired future state of a threat or opportunity factor. An objective is a formal statement of the desired outcome. (Synonym for result.)" (CMP, 2020).
Result	"The desired future state of a target or factor. Results include impacts, which are linked to targets and outcomes, which are linked to threats and opportunities," (CMP, 2020).

Results Chain	"Visual diagram of a project's theory of change. A results chain includes core assumptions and the logical sequence linking project strategies to one or more targets. In scientific terms, it lays out hypothesized relationships or theories of change," (CMP, 2020).
Scope	"A situation model (diagram) represents relationships between key factors identified in a situation analysis believed to impact or lead to one or more conservation targets… [links] the conservation targets to threats, opportunities, stakeholders, and key intervention points." Describes, "relationships among the biological environment and the social, economic, political, and institutional systems and associated stakeholders that affect the… targets you want to conserve," or restore," (CMP, 2020).
Situation Model	"A situation model (diagram) represents relationships between key factors identified in a situation analysis believed to impact or lead to one or more conservation targets… [links] the conservation targets to threats, opportunities, stakeholders, and key intervention points." Describes, "relationships among the biological environment and the social, economic, political, and institutional systems and associated stakeholders that affect the… targets you want to conserve," or restore, (CMP, 2020).
Strategy	"A set of activities with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, optimizing opportunities, and limiting constraints. A good strategy meets the criteria of being: linked, focused, feasible, and appropriate. (See also intervention.)" (CMP, 2020).
Stress	"An impaired aspect of a conservation target that results directly or indirectly from human activities. For example, low population size, reduced river flows, increased sedimentation, and lowered groundwater table level. Generally equivalent to a degraded key attribute (e.g., habitat loss)," (CMP, 2020). Also referred to here as a biophysical or environmental factor that is influenced by direct threats.
Target	Also known as a conservation or restoration target: "An element… (species, habitat, or ecological system) at a project site on which a project has chosen to focus. All targets should collectively represent the biodiversity of concern at the site…" (CMP, 2020).
Underlying Cause	"A factor identified in an analysis of the project situation that is a driver of direct threats. Often an entry point for conservation actions," (CMP, 2020). Sometimes called an "indirect driver" or a "root cause". Compare with "direct threat".

ACRONYMS

Acronym	Definition
C&P	Consultation & Participation [Plan]
CI	Conservation International
CI-F	Conservation International - Fiji
CO2	Carbon dioxide (also as CO2e, carbon dioxide equivalent)
DFAT	Australian Government, Department of Foreign Affairs and Trade
DoDD	Drivers of deforestation and degradation
EIA	Environment Impact Assessment
FLMMA	Fiji Locally Managed Marine Area Network
GHG	Greenhouse gas
MoW	Ministry of Waterways
MoE	Ministry of Environment
MoF	Ministry of Forestry
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
REDD	Reducing emissions from deforestation and forest degradation
REDD+	REDD "plus" forest conservation, sustainable management of forests, and the enhancement of forest carbon stocks
TC	Tropical Cyclone
ToC	Theory of Change
UN	United Nations
UNDRIP	United Nations Declaration on the Rights of Indigenous People
UNFCCC	United Nations Framework Convention on Climate Change
WWF	World Wildlife Fund

1. OBJECTIVES

The present report analyses the drivers of mangrove deforestation and degradation and other causes of mangrove loss in Fiji. It also contributes to the feasibility study for a Fiji Blue Carbon Project on Viti Levu. This effort is being led by Conservation International (CI) in Fiji in partnership with the Government of Fiji; Ministry of Forestry (MoF), Ministry of Lands (MoL), Ministry of Waterways (MoW), Ministry of Environment (MoE), Ministry of iTaukei Affairs (MTA), Climate Change Division (CCD), and the World Wildlife Fund for Nature (WWF), with the support from the Australian Government, Department of Foreign Affairs and Trade (DFAT). In previous work supported by DFAT, CI and partners assessed opportunities for developing blue carbon projects in Fiji, including interviews and discussions with communities and stakeholders to understand their roles within Fiji's mangroves; a national analysis of Fijian mangrove coverage; a community structure and carbon stock survey at sites around Viti Levu; a comprehensive site selection assessment; and publication of two peer-reviewed academic papers. Building on this foundation, CI has received additional support from the Australian Government to advance blue carbon project opportunities in Fiji, strengthen mangrove management and restoration actions within three priority sites, support policy and financing pathways to protect Fiji's mangroves in the long-term, and strengthen delivery of nature-based solutions to climate change adaptation. This project aims to strengthen awareness, scientific understanding, and protection of Fiji's coastal blue carbon ecosystems while also developing financing pathways relevant to the carbon and non-carbon values of these ecosystems.

The proposal submitted by Conservation International (CI) and accepted by the Australian Government, Department of Foreign Affairs and Trade (DFAT) included objectives for the development of the Fiji Blue Carbon Project. The present report contributes to the following objectives:

Objective 1.1: Complete detailed assessment of the agents and drivers of deforestation and degradation, as well as mangrove loss. Steps for completing this objective, detailed in this report, include:

- *1.1.1 Review of existing information of drivers of mangrove deforestation and forest degradation.*
- *1.1.2 Mapping and spatial analysis using drone and satellite imagery.*
- *1.1.3 Data collection about DoDD via community interviews, socioeconomic surveys, and workshops.*
- *1.1.4 Ground truthing through site visits to validate the information collected.*

The first objective of this report is to provide a coherent picture of the drivers of deforestation, degradation, and mangrove loss (DoDD), including direct drivers, underlying causes, and associated agent(s), in mangroves in Fiji. This objective was achieved by conducting a national-scale assessment of historic drivers of mangrove loss; social, cultural, and economic factors influencing mangroves; and law and policy related

to mangroves. An in-depth DoDD evaluation was then conducted in three significant mangrove areas on Viti Levu: (1) the Ba Delta and Yanuca Island (Ba Province); (2) Navitilevu Bay (Ra Province); and (3) the Rewa Delta (Rewa and Tailevu Province). These sites were used as proxies to understand the dynamics of mangrove loss across Fiji. To achieve this objective, information was first collected through literature reviews and diverse data collection and analysis methods, including community interviews and consultations, socioeconomic surveys, spatial analysis of satellite and drone imagery, and workshops. This information was then synthesized using a theory of change approach. Situation models were produced to describe the present state of DoDD. This analysis also forms the basis for additionality arguments and baseline scenarios, which are key elements of a certified carbon project. The results of this section are important components of the technical documentation required for the certification process, including the Project Information Note (PIN) and Project Design Document (PDD) to be developed during subsequent stages of this project.

The second objective of this report is to advance the study of the feasibility of a Fiji Blue Carbon project, including the selection of pilot sites, next steps, and development of a strategy for the project. For this objective, the situation models were used to identify barriers and opportunities and create a results chain with a description of preliminary strategies and project activities to be implemented under the Fiji Blue Carbon Project. In addition, spatial analysis and fieldwork were conducted to assess potential blue carbon sites and the carbon, community, and biodiversity benefits that could be delivered by such a project.

2. CONTEXT

2.1 Geographic and Social Context

According to the 2017 Population and Housing Census, the total population of Fiji has reached 884,887 people, but the annual rate of growth has declined since 1986 due to low birth rates and migration (Fiji Bureau of Statistics, 2017). Of the total population, 55.9%, or 494,252 people lived in urban areas in 2017, and Ba Province alone housed 28% of the population, with 36.7% growth since 2007 (Fiji Bureau of Statistics, 2017). The two main ethnicities in Fiji are the *iTaukei* and Fijians of Indian descent, with *iTaukei* mostly belonging to various Christian denominations, while the latter groups share diverse traditions originating from Christian, Hindu, Muslim, and Sikh traditions (ADB, 2015) along with indigenous practices.

Administratively, the country is divided into Northern, Eastern, Central and Western divisions, which are governed by a commissioner for the coordination of governmental activities at their respective regions (Rahman & Singh, 2011). Each of the 14 provinces is made up of a group of sub-units called *Tikina* (akin to district level). Each *Tikina* comprises several villages. The *Tikina* and *Yasana* boundaries were drawn up during the colonial era, largely for administrative purposes. However, most of these clusters are based on traditional socio-political ties. The *iTaukei* Affairs Board, constituted under the *iTaukei* Affairs Act (Cap. 120), governs all matters concerning the administration of *iTaukei* affairs, including *iTaukei* custom services. Each village has a headman called the *Turaga ni Koro*, who is the link between Provincial Office and the villagers. However, each village also has the *Liuliu ni Yavusa* of chiefly status, as are the *Liuliu ni Tikina* (*Tikina* chief) and *Liuliu ni Yasana* (Provincial chief). Provincial Council meetings are held twice a year. There are also district (*Tikina*) meetings held within the year.

Within indigenous *iTaukei* communities, ownership and access to land, among other resources, are determined by an individual's relation to a *mataqali*, or a clan, and households are generally able to request an access from the clan (Becker, 2017). However, there are regional differences in the mechanism by which the clan hierarchies operate. For example, the access to fishing rights in a *solevu* is determined by a membership to *yavusa* (tribes) a larger social unit consisting of number of *mataqali*s - rather than an individual relation to a *Mataqali* group (Becker, 2017). *Vanua* (land) has an important communal importance that is attached to the hierarchies of *yavusa* and to the branches of *mataqali* below these tribal groups. *Mataqali*s have various social ranks, such as chief of villages (*Turaga*), the traditionally priestly class (*Bete*), and warriors (*Bati*).

Understanding the ethnic composition and hierarchies within and between communities is important especially in the context of disasters and climate, as they will invariably influence the social cohesion and community response and shape the efforts to enhance community resilience. Traditional designations also determine differences in how clans in a community use mangrove and related fisheries resources. In terms of gender equality, there remain traditional and cultural barriers to full inclusion of women in decision-making processes at the community, district, and provincial levels. In some instances, however, there is matrilineal land heritage in Fiji, which ensures inclusion of women in decision-making processes.

There are differences in the status of women within the *iTaukei* and Indo-Fijian groups, but male-dominated hierarchies are common and prevalent in the society regardless of ethnicity (Chattier, 2015). Furthermore, inadequate sexual and health education (resulting in increased teenage pregnancies), combined with traditional perceptions about woman's role in a household, also affect the education and employment conditions of women and girls (ADB, 2015). As a result, only 46% of women are employed or are looking for work. The issue is more severe among Fijian Women of Indian descent, of whom only 37% are engaged in the labour force (ADB, 2015). Women are also dominantly engaged in the informal fisheries sector in Fiji, resulting in their not being enumerated or included in official employment statistics. Commitments for gender equality are not well mainstreamed into institutional structures, planning, and budgeting; even though the constitution guarantees equality, cultural norms, the social environment, and the lack of capacity to enforce legislature obstruct the achievement of gender-equality at the grass-root levels (Vunisea, 2016).

2.1 Mangroves in Fiji

Overview

Fiji is home to the third most extensive stands of mangroves in the Pacific Island region, including over 44,000 ha of mangroves estimated across the two main islands of Viti Levu and Vanua Levu (IUCN, 2016). The largest mangroves stands are in the Rewa and Ba deltas, located on opposite ends on the island of Viti Levu, followed by the Labasa delta on the island of Vanua Levu. These together make up more than 80% of Fiji's mangroves. Mangrove forests are unique assemblages of trees and shrubs that can be found at the intersection of freshwater and saltwater systems. They are found mostly along banks and deltas of major rivers in the intertidal zone, and they do not necessarily follow distinctive zonation patterns regarding dominant tree species (Tuiwawa *et al.* 2013). There are seven mangrove tree species in Fiji, with one mangrove hybrid that occurs sporadically throughout the islands, including several mangrove associates. In most instances, the seaward edge has the *Rhizophora* forest, which comprises of *Rhizophora stylosa* ("*tiri*"), *Rhizophora samoense* ("*tiri*") and *Rhizophora x selala* ("*selala*"). Moving inland from the *Rhizophora* forest is the *Bruguiera* forest, dominated by *Bruguiera gymnorrhiza* ("*dogo*"). Moving further inland from the *Bruguiera* forest is the "mixed forest," composed of a mixture of *Rhizophora* species and *Bruguiera* species with interspersed *Xylocarpus granatum*, *Excoecaria agallocha* and *Lumnitzera littorea* (Tuiwawa *et al.,* 2013).

Human Perceptions and Uses

In Fiji, the perception of mangroves varies depending on the stakeholder. Some people consider mangroves a wasteland of little value, while others see them as areas of economic value for development, fisheries, or other purposes. To rural and semi-urban mangrove and coastal communities, including stakeholders in the environment and conservation space, mangroves are critical ecosystems and must be sustained well into the future because of the resources they provide and have been providing for many generations. Mangroves in Fiji are a critical component of livelihood and social-economic resources for multiple stakeholders. Coastal communities as one of the primary consumers and beneficiaries of mangrove resources, as they rely on mangroves as a primary source of livelihood and sustenance. Mangroves are a critical source of natural resources that offer a broad range of social and economic benefits especially to those communities that live close to them. Mangroves contribute significantly to the well-being of residing communities. In addition, mangroves also provide food security and coastal protection, and a natural solution for regulating carbon emission into the atmosphere.

For Fiji, anthropogenic mangrove loss, also known as deforestation, has been the result of conversion of mangrove areas to other uses, pollution, increased human population in mangrove areas (especially in urban areas nearby mangrove forest), increased demand for development, poverty and inequality, poor governance, inadequate management, infrastructure, and economic pressure (Pillai, 1985; Watling 2013). The impact of these actions on the integrity of mangroves is high, threatening livelihood sources; resource access, sustainability, and stability; food security; and the capacity of mangroves to mitigate the destructive impacts of natural disasters (Pillai 1985; Tuiwawa *et al.* 2013).

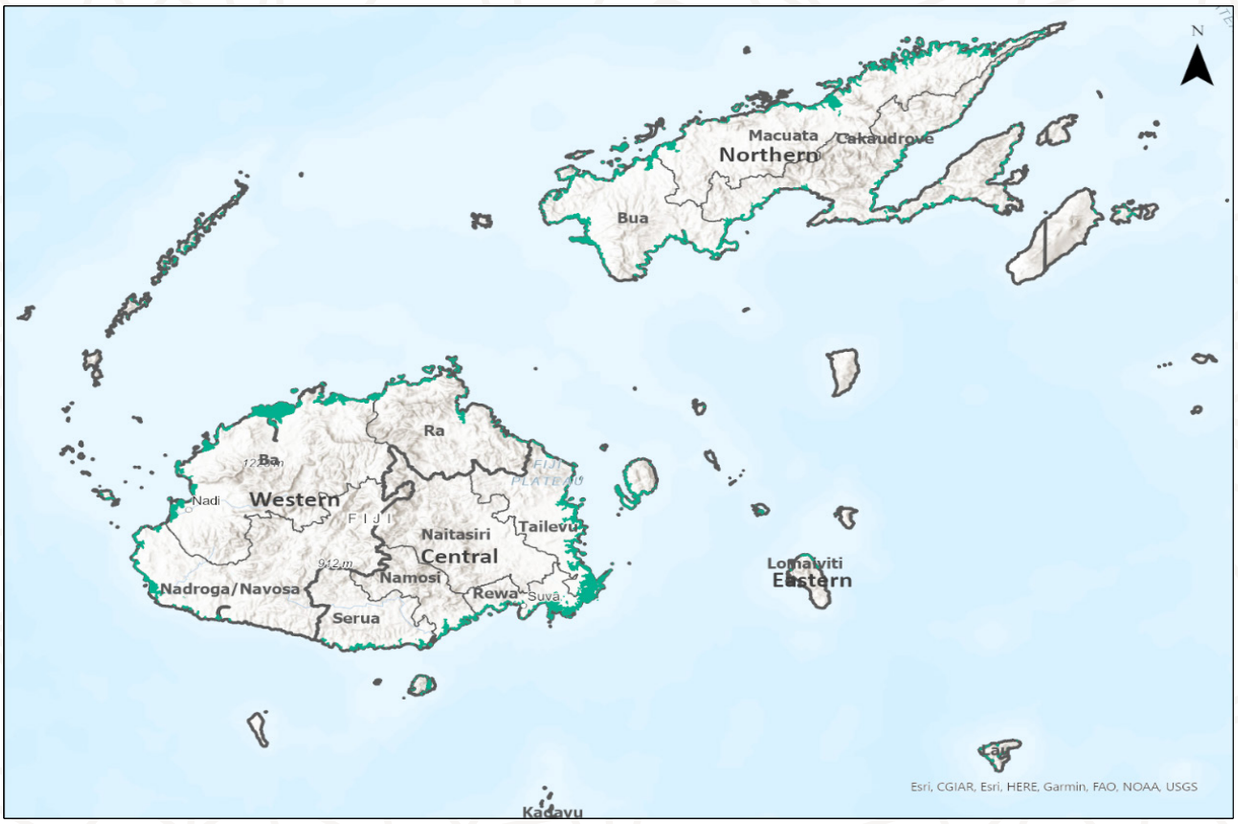


Figure 1. Approximate location and extent of mangroves on Viti Levu, Vanua Levu, and nearby islands as of 2016 is shown in turquoise. Source: IUCN 2016.

Cultural and Traditional Significance

Mangroves are an important aspect of communal living, especially for communities that have resided in the same locations over many generations. The connection between people and mangroves often represents cultural heritages and historical alliances. This is often associated with social and cultural empowerment that gives communities an inherent sense of communal rights and obligation. Such practices are reflected in the operations of traditional authorities in managing daily activities and communicating social norms and practices. In some instances, the involvement of external institutions (e.g., indigenous co-operation groups, councils of elders, customary laws, and mediators) may be required to assist traditional authorities in mobilizing collective actions to maintain community infrastructure and other cultural norms. These issues may be expressed in the form of resolving social disputes, enforcement of standard behaviour and accepted cultural norms, or ensuring community solidarity and mutual assistance. Non-conformities with traditional values, practices, and behaviours can be interpreted as lack of awareness or understanding as well as the influences of development resulting from modernization.

Within mangrove areas, there are existing cultural and traditional sites that lie buried within the forests and swamps of surveyed deltas. These can be centuries-old sites with histories often documented and stored in the Fiji Museum or in the oracles of tradition spoken amongst villagers and community members. Sites can be identified as old house mounds, ancestral burial grounds, or old village sites, including taboo sites that often are left alone out of reverence and enforced with traditional management structures as by-laws within community settings.

Mangroves can also connect people and communities by providing diverse resources. In some communities, the utility of these resources is considered an important part of their culture and tradition that has existed for many generations (Pillai, 1985; Lal, 1990a; Lal, 1990b). It is not surprising that there are also sentimental and cultural associations with mangroves that relate to their value as providing important resources. These benefits are both tangible and intangible, including the supply of food, timber and building materials,

firewood, medicine, shelter, protection from tidal waves and storm surges, and erosion control, among many others.

Economic Significance

Mangroves are an important source of livelihoods and economic benefits for many stakeholders. According to a recent study across the Ba and Rewa deltas (Avtar *et al.,* 2021), up to 45% of community members visit mangroves on a day-to-day basis for their livelihoods, including both subsistence use and commercial sale of wood, fish, crabs and a diversity of fishes and other crustaceans. In addition to commodities sourced from mangroves, food crops planted in mangrove communities are also constant sources of economic value. Typical examples of food crops are breadfruit or "*bele*" (*Abelmoschus manihot*), taro or *"dalo"* and taro leaf or "*rourou*" (*Colocasia esculenta*), *"duruka"* (*Saccharum edule*), tapioca or cassava (*Manihot esculenta*), sweet potato or *"kumala"* (*Ipomoea batatas*), and ferns or *"ota"* (*Diplazium esculenta*). Some of the more common fruiting trees include mango (*Mangifera indica*), lemon (*Citrus limon*), pawpaw (*Carica papaya*) and "*ivi"* (*Inocarpus fagifer*).

With economic development, especially in the tourism industry, there is an open mindset within communities who are now interested in venturing into the eco-tourism markets and other similar business schemes whereby they could produce additional capital from available mangrove resources. At present, eco-tourism in mangroves is limited, though there is potential for eco-tourism to become a more significant economic factor in mangroves. If such activities are developed, appropriate management and ethics will be required to ensure that tourism is practiced sustainably and provides net benefits and minimal harms to the mangrove ecosystems and communities.

Environmental and Climatic Significance

While still an emerging topic in terms of climate change and carbon, mangroves play a significant role in helping to mitigate and adapt to the impacts of climate change. Given Fiji's large expanses of mangroves, it is important to consider the benefits they provide in terms of carbon sequestration and storage as well as the threats that they face.

In addition to serving as a buffer against sea level rise and storm surges for vulnerable communities, mangroves are highly effective carbon sinks. On an area-specific comparative basis, mangroves not only store carbon in above- and below-ground biomass at quantities rivalling some terrestrial forests, but they also store far more carbon in soils than any other ecosystem. The anoxic characteristics of sedimentary deposits within undisturbed blue carbon habitats means carbon is locked away at timescales that are orders of magnitude greater than terrestrial ecosystems (Nellemann *et al.* 2009). The saline conditions of healthy mangroves are also believed to have the advantage of emitting negligible amounts of other GHGs, such as methane (CH_4) and nitrous oxide (N_20) (Crooks *et al.* 2011), which are substantially more potent GHGs than CO_2.

In Fiji, as in much of the world, there is a growing interest in coastal ecosystems such as mangroves for their "blue carbon" potential, both for the climate benefits they present as well as the financial benefits of carbon crediting mechanisms, when feasible. An awareness of the role of mangroves for climate regulation among diverse stakeholders has become evident through stakeholder consultation workshops conducted under previous blue carbon initiatives in Fiji as well as currently funded, ongoing projects. In recognising the importance of mangroves for climate change mitigation and adaption, as well as the potential of blue carbon projects to support the management of mangroves, the Government of Fiji has identified the need to reverse ongoing mangrove losses, conserve and sustainably manage mangroves, and account for the ecosystem service values of mangroves in national climate strategies and mechanisms (Cameron *et al.* 2021). As evidence of this, Fiji has developed a Mangrove Management Plan developed under the 2013 Mangrove Ecosystems for Climate Change Adaptation and Livelihoods Project, although this plan has yet to be formally implemented.

As large, continuous coastal ecosystems with high carbon storage potential, mangrove forests are crucial to Fiji's blue carbon capture projects. Central to the feasibility of such projects is the ability to protect and

sustainably manage healthy coastal mangroves and restore areas where mangroves have been lost or deforested. These mangroves, in turn, can provide benefits to people, such as food, livelihoods, recreation, storm and flood protection, and a nursery for fisheries, among other benefits. Yet, despite their clear importance, mangroves are vulnerable to both natural and human-induced impacts, such as urbanization, squatter settlements, unplanned development, solid and liquid waste pollution runoff, and invasive species (SPREP, Regional Wetlands Action Plan, 2011-2014).

2.3 Legal and Policy Context for Mangroves in Fiji

Though Fiji does have a mangrove management plan from 1985/1986 that was reviewed in 2013, Fiji does not have one legislation specifically for mangroves nor does it have a specific wetlands policy. As such, there is no single government body or institution that is dedicated to governing mangroves. Therefore, the legal framework for mangrove ecosystem uses and management is provided through the intersecting coverage of laws, sectorial policies, and regulations of activities. The legal and policy framework for mangroves ownership, governance, customary use rights, and sustainable management is thus the result of the converging interplay of major legislation, such as the Fisheries Act 1942 (Cap 158), Environment Management Act (2005), Forest Bill (2016), *iTaukei* Land Act (Cap 133), and State Lands Act (Cap 132). There are additional national laws and regulations relating to resource use that also affect mangroves, as discussed below. Overall, Fiji's legislative framework is complemented by its international obligations owed under the various international instruments to which Fiji is a signatory. A detailed discussion of all national laws pertaining to mangrove ecosystems, including access, development, management, land tenure, planning, and conservation, is provided in *Annex II: Legal analysis of DoDD of mangroves*.

In addition to domestic laws and policies, Fiji is a signatory to several binding international instruments, treaties, and agreements that influence future actions relating to forests, wetlands, ecosystem protection, biodiversity, and conservation. There has been consistent growth in the number and coverage of these and other instruments governing environmental issues. This proliferation of treaty-making has arisen from a global recognition that many environmental problems are transboundary in nature and are beyond the capability of countries to address when acting alone. Nations have successfully negotiated treaties to address species loss and climate change, for example, wherein global standards and measures are agreed which parties then adopt and apply domestically. Key agreements to which Fiji is party include the United Nations (UN) Convention of Biological Diversity and the UN Framework Convention on Climate Change (UNFCCC). The influence of such international treaties on domestic law and policy related to mangroves is discussed in full in *Annex II: Legal analysis of DoDD of mangroves*.

Mangroves in Fiji are owned by the Fiji government. There are at least three government agencies responsible for matters relating to mangroves under various principal legal frameworks that oversee their use and management. The three ministries primarily responsible for mangrove protection are the Ministry of Forestry, Ministry of Environment and the Ministry of Lands and Mineral Resources. While all intertidal and submerged lands, including mangroves, are owned by the State, it must be noted that indigenous *iTaukei* communities have customary rights to access and use resources in these intertidal areas under the Fisheries Act of 1942. According to the act, all *iTaukei* communities have access rights to all traditional fishing grounds. These rights are held exclusively by the *Yavusa* or the chief of traditional clans in a village setting (Tuiwawa, 2022).

The legal structures in place in Fiji influence ownership of land and carbon rights, the latter being required for the development and implementation of a blue carbon project. As a former colony, Fiji's current legal system is sourced from the laws of England. Laws relating to property ownership and dealings became formal laws of the land through the doctrines of adoption and reception and were translated to the local context after the Cession of 1874. In Fiji being a common-law country, it is generally accepted through the inference arising from the application of common law principles that ownership of forest carbon rights lies with the owners of the land, through the nexus of landowners, forest trees (mangroves), and sequestered forest carbon. Under this interpretation, a forest plantation owner who is not the landowner does not own rights to carbon sequestered from the plantation forest unless there is a prior existing consent agreement from the landowner to this effect. Despite the absence of specific legislation, Fiji does have relevant

legislation that will assist with the implementation of blue carbon, such as those addressing sustainable forest management, biodiversity, and special land use conditions affecting mangroves and mangrove ecosystems.

2.4 Sites Assessed as Proxies and for Potential Inclusion in a Fiji Blue Carbon Project

In this study, three sites on the island of Viti Levu were evaluated in terms of the agents, drivers, and causes of mangrove deforestation, degradation, and loss (Figure 2. Sites assessed for inclusion in a Fiji Blue Carbon Project, outlined in red.) and used as proxies to understand the broader threats to mangroves in Fiji. This evaluation process supports Fiji in identifying pathways for financing mangroves and coastal ecosystems, including through the development of a blue carbon pilot project. The three sites studied represent some of the largest areas of mangroves within Fiji and include the Ba Delta (Ba Province, Western Division), the Rewa Delta (Rewa and Tailevu Provinces, Central Division), and Navitilevu Bay (Ra Province, Western Division). This study draws on the recommendations provided to DFAT in the document 'Fiji Blue Carbon Site Selection Report' (Conservation International, 2020). Site visits and satellite image analysis conducted in October and November 2022 suggest that Navitilevu Bay in Ra Province has the greatest potential for development of a blue carbon project pilot. Of the three sites, it has the most extensive cyclone damage, with large areas without natural recovery, presenting an opportunity to develop an augmented or assisted restoration project (Section 4.3, Section 5).

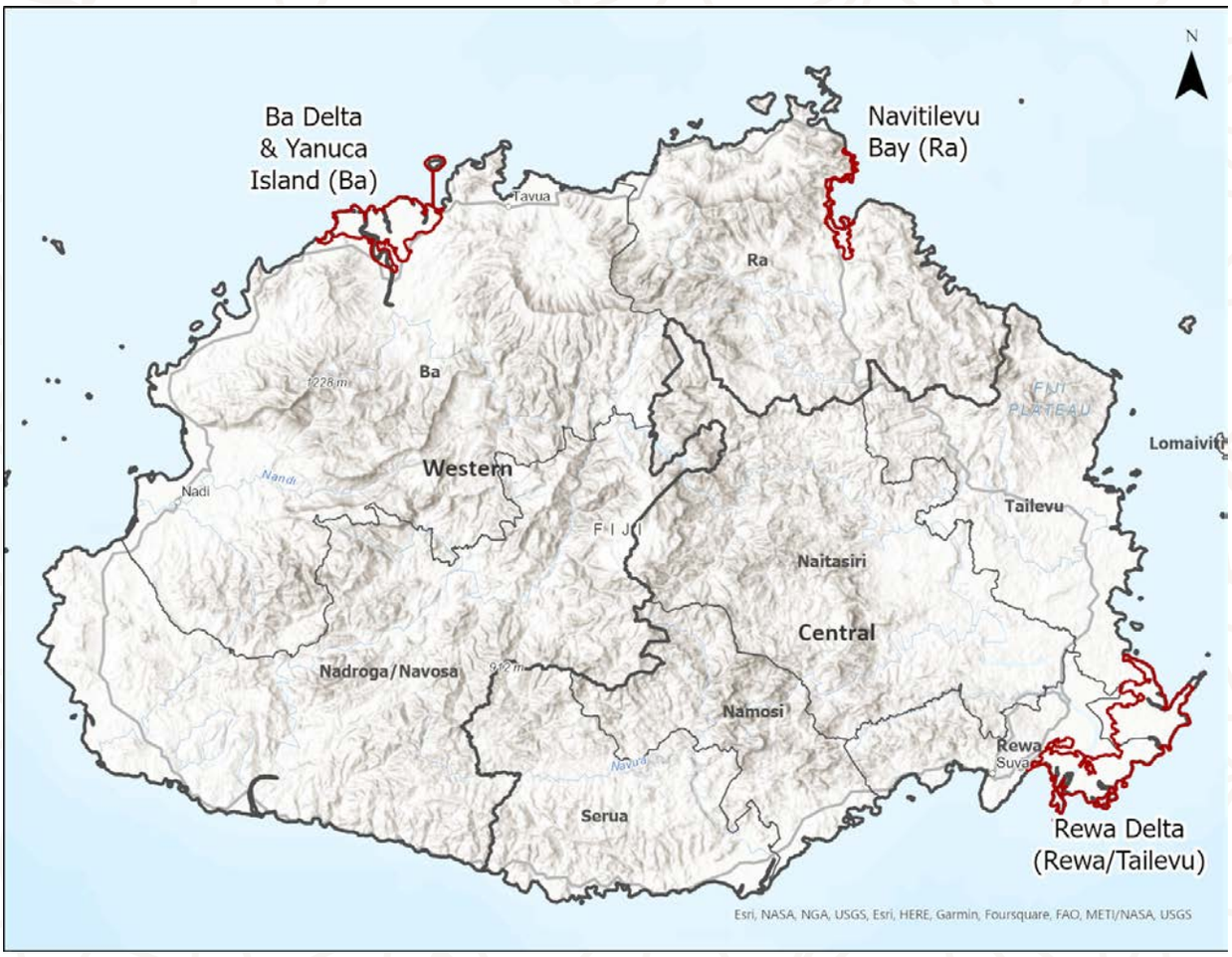


Figure 2. Sites assessed for inclusion in a Fiji Blue Carbon Project, outlined in red.

2.5 Previous Assessments of Mangrove Deforestation, Degradation, and Loss

Mangrove cover change in Fiji for the period 2001-2018 was previously assessed during Phase 1 of the Blue Carbon project based on large-scale forest change detection datasets, with results published in the journal *Environmental Challenges* (Cameron *et al*. 2021). Key findings included an estimate of mangrove loss across Fiji at 1,135 hectares over the period 2001-2018, representing a decrease of 1.7% in mangrove cover at an average annual loss rate of 0.11% (Table 1. Summary of mangrove extent, mangrove coverage loss and drivers of loss for selected provinces in Fiji 2001-2018. The unsurvey Bua Province of Vanua Levu accounts for an additional ~223.7 ha of loss due to tropical cyclones. N/A = not applicable). Based on this study, provinces exhibiting the highest mangrove losses are Ra (315.3 ha, 12.2%), Ba (343.5 ha, 2.6%) and Bua (Vanua Levu, 223.7 ha, 2.3%). In contrast, regions with significant mangrove cover but minimal loss included Cakaudrove and Macuata on the southeast and northeast coasts of Vanua Levu (0.7% and 0.3% loss of cover between 2001 and 2018, respectively) and Rewa, Nadroga-Navosa, and Serua on the southeast, western, and southern coasts of Viti Levu (0.8%, 0.6%, and 0.3% coverage loss between 2001 and 2018, respectively). However, results from this study require further validation, as the scale of loss is almost double that reported in Worthington and Spalding (2019) of 637 ha, likely due to differences in data sources and the lack of national mangrove cover assessment for Fiji.

In this study, mangrove cover change was attributed to a variety of causes. This included anthropogenic causes that act as direct threats to mangroves and result in deforestation and forest degradation as well as natural causes of mangrove loss such as tropical cyclones (TC), which are exacerbated by climate change. Interpretation of annual mangrove cover loss with corresponding satellite imagery data reveals that approximately 77% of loss (~870 ha) can be directly attributed to the successive impacts of TCs Gene (Category 3, January 2008), Mick (Category 2, December 2009), Evan (Category 4, December 2012), and Winston (Category 5, February 2016. Figure 2), with mangrove loss largely concentrated in the Ra, Ba, and Bua Provinces (Table 1, Figure 3). After TCs, the next most significant drivers of coverage loss were the conversion of mangroves for tourism development and coastal reclamation (~120 ha) followed by the disposal of dredging spoil in the Ba and Rewa Deltas (~33 ha). The remaining 112 ha of loss was attributable to smaller scale conversion for industrial estates, squatter housing, agriculture, and construction of sugarcane tram lines as well as harvest for both fuelwood and construction materials, all of which were previously recognized drivers of mangrove loss in Fiji (MoE 2018).

Table 1. Summary of mangrove extent, mangrove coverage loss and drivers of loss for selected provinces in Fiji 2001-2018. The unsurvey Bua Province of Vanua Levu accounts for an additional ~223.7 ha of loss due to tropical cyclones. N/A = not applicable

Province	Mangrove extent 2018 (ha)	Mangrove loss 2001-2018 (ha)	% loss (per annum)	Drivers of mangrove loss and estimated extent (ha) and proportion (%)			
				TCs	Tourism development	Dredge disposal	Other
Ba	13,066	343.5	2.6 (0.16)	~210 (61%)	~120 (35%)	~13.5 (4%)	N/A
Nadroga-Navosa	2,599	16.2	0.6 (0.04)	~16.2 (100%)	N/A	N/A	N/A
Rewa and Tailevu	11,005.6	105	0.9 (0.1)	~61.1 (58%)	N/A	~18.9 (18%)	~25.1 (24%)
Ra	2,271.8	315.2	12.2 (0.76)	~307.7 (98%)	N/A	N/A	~7.5 (2%)
Fiji total	**65,243**	**1,135**	**1.7 (0.11)**	**~870 (77%)**	**~150 (13%)**	**~32.4 (3%)**	**~82.6 (7%)**

Several other studies were reviewed to assess mangrove cover change and DoDD in Fijian mangroves, covered in depth in *Annex I*.

More in-depth, site level studies to assess the feasibility of blue carbon intervention projects were undertaken in the Ba Delta and Yanuca island (Ba Province), Navitilevu Bay (Ra Province), and the Rewa Delta (Rewa and Tailevu Provinces) in March 2019 and November 2022. Key findings from these site-level assessments in relation to DoDD and the feasibility of developing blue carbon intervention projects are discussed in the following sections.

3. APPROACH AND METHODOLOGY

3.1 Literature Reviews

As a first step in identifying and describing mangrove deforestation, degradation, and loss, information was collected in a series of thematic literature reviews. Literature reviews considered peer-reviewed scientific literature as well as grey literature, including reports produced by governments and non-governmental organizations (NGOs). Literature reviews covered the following topics, with a report produced for each and included as an annex to this document.

- Published studies relating to drivers of deforestation and forest degradation in Fijian mangroves (Annex I)
- Tropical cyclone impacts on mangroves in Fiji (Annex I)
- Legal and policy context for mangroves in Fiji (e.g., management, use, conservation, governance, regulations, etc.) (Annex II)
- Socio-economic influences on mangrove use, deforestation, and degradation (Annex III)
- Culture, gender, and traditional influences on mangrove use, deforestation, and degradation (Annex IV)

3.2 Stakeholder Engagement and Socio-economic Data Collection

A diverse set of methods and activities were conducted to carry out stakeholder engagement and data collection related to community uses of mangroves and their connection to DoDD.

Stakeholder Consultation

A Stakeholder Consultation and Participation (C&P) Plan was developed to ensure that consultations with stakeholders were carried out effectively and well-documented. This plan also ensured stakeholder input into the programme. Stakeholder engagement and consultation was conducted in consideration of the geographic, cultural, traditional ethnic, social, economic, political, gender, indigenous, traditional, and hierarchical divisions within Fijian society. This process was led by Aliti Vunisea, a consultant with extensive training and experience in stakeholder engagement in the local context. All outreach processes considered the traditional hierarchies, protocols, and customs in indigenous Fijian *iTaukei* communities.

Emphasis was placed on inclusive participation, including a focus on gender inclusion and disenfranchised community members (women, elderly, informal settlers, and youth). Social safeguards were established and followed during this process, and feedback and grievance mechanisms were also implemented. The plan served to:

- enhance awareness and understanding on mangrove degradation and deforestation issues;
- inform relevant stakeholders of mangrove uses, regulations, conservation management plans;
- ensure relevant stakeholders contributed to the development of mangrove management plans, activities, and programs;
- ensure full and active participation of all communities in Fiji, considering gender, ethnicity, special needs, marginalization, and informal settlement; and
- contribute towards national development priorities on social inclusiveness, transparency, and mangrove governance.

In addition, social safeguard principles were established and followed in order to employ best practices when engaging and consulting stakeholders.

1. **Ensure inclusivity:** Full and effective participation of all relevant stakeholders, especially marginalized groups.
2. **Apply Free, Prior, & Informed Consent (FPIC) principles:** Support informed decision-making by all concerned stakeholders.
3. **Promote transparency**: Ensure information and processes are well understood, credible and open to scrutiny.
4. **Integrated approach**: Promote the participation and involvement of various sectors and agencies at all levels.
5. **Promote ownership**: Ensure effective involvement of participating stakeholders and strengthen the feedback mechanism process.
6. **Respect for culture and tradition**: Recognize the importance of cultural and traditional values in project implementation.
7. **Gender inclusivity**: Ensure gender issues and concerns are addressed at all levels of the consultation and participation processes.
8. **Capacity development of resource persons and groups**: Strengthen the capacities of community facilitators and organizations to implement the C&P Plan.

In partnership with WWF and the Ministry of Forestry, CI undertook stakeholder engagement and data collection to assess the drivers of mangrove loss and degradation within the three key mangrove sites targeted in this study: the Ba Delta, Rewa Delta, and Navitilevu Bay. Village and community sites were selected based on the extent of mangrove areas in their vicinity, the degree of perceived or potential threats to mangrove health, presence of biodiversity hotspots, history of mangrove extraction, and planned or ongoing restoration efforts. These sites are listed in Table 2. Sites for stakeholder engagement and data collection. and displayed in Figure 3, Figure 4, and Figure 5.

Table 2. Sites for stakeholder engagement and data collection.

Site	Province	Villages
Ba Delta	Ba	Namoli, Sasa, Sorokoba, Votua, Nawaqarua, Natutu, Tavualevu, Natanuku
Rewa Delta	Rewa	Naivilaca, Narocake, Matanimoli, Nasilai, Muanaicake, Muanaira Laucala, Kinoya Koro
	Tailevu	Dravo, Daku, Naivakacau, Natila, Waicoka
Navitilevu Bay	Ra	Nanukuloa, Nareseilagi, Barotu Matawailevu, Navuniivi

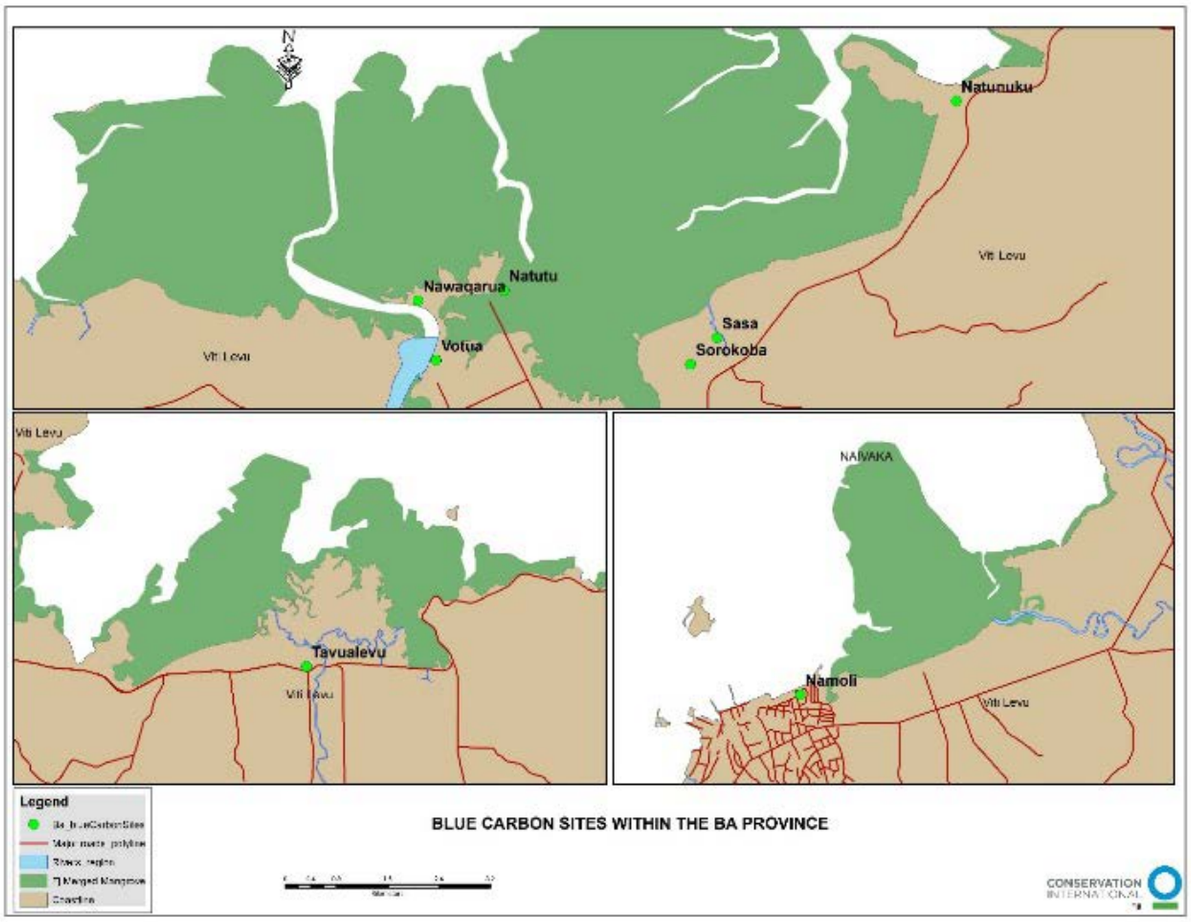


Figure 3. Sites for stakeholder engagement and data collection in Ba province.

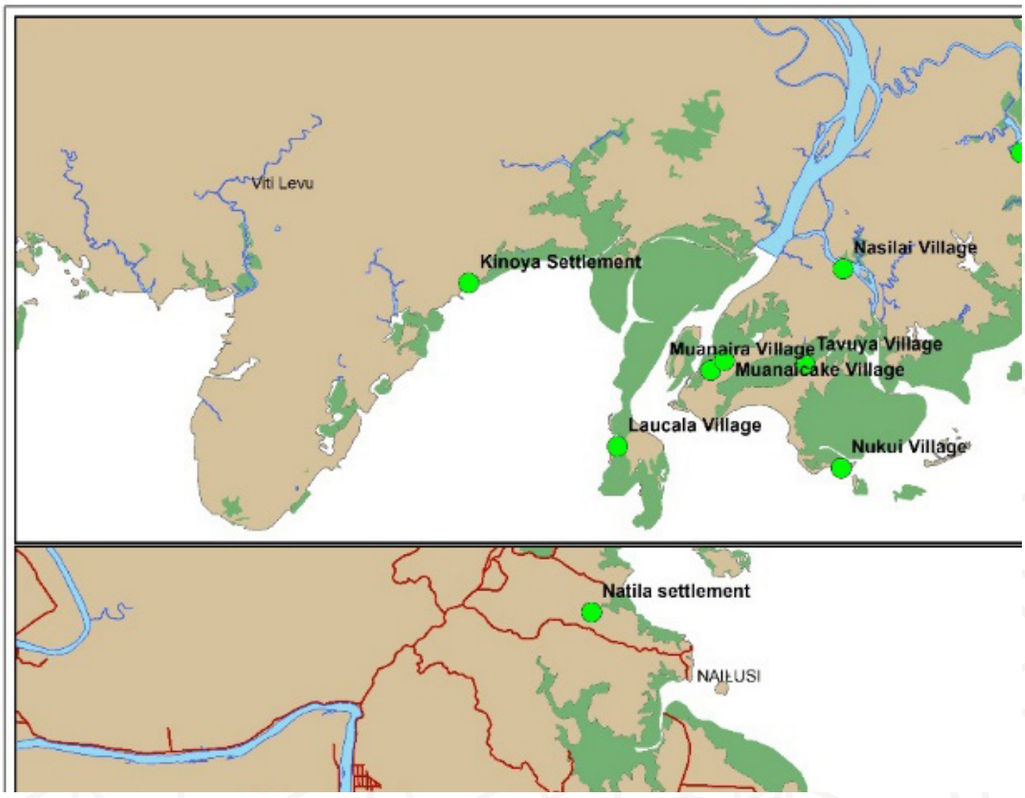


Figure 4. Sites for stakeholder engagement and data collection in Ra province near Navitilevu Bay.

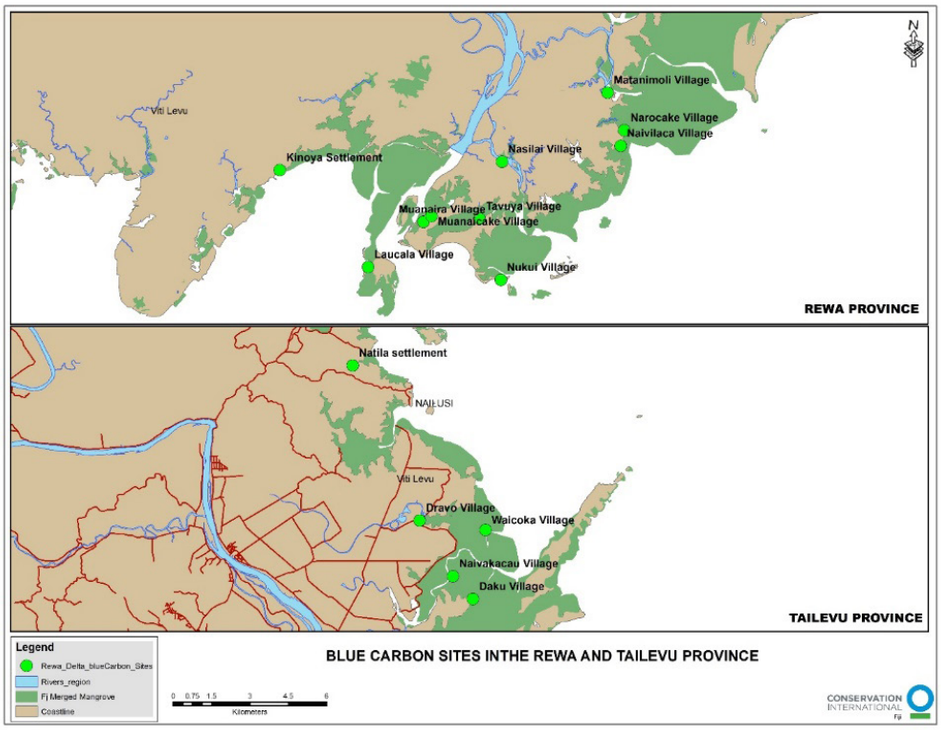


Figure 5. Sites for stakeholder engagement and data collection in Rewa and Tailevu provinces.

Data collection and engagement methods

In addition to the objectives related to stakeholder engagement and consultation described above, data collection and stakeholder consultations provided information necessary to assess DoDD, serving the following objectives:

1. Analyse the social and cultural demands that place pressure on mangroves, including traditional structures; norms; laws; and the needs of communities, vulnerable and marginalised groups.
2. Assess the role of local communities in deforestation and mangrove degradation and their degree of dependency on mangrove resources for livelihoods.
3. Identify community-level economic activities and associated incentives proven and/or with potential to support mangrove conservation, sustainable management of mangroves, and mangrove carbon stock enhancement.
4. Analyse the influence of current land tenure structures and formal and informal land access arrangements in supporting mangrove conservation and sustainable management of mangroves.
5. Assess the effectiveness of current community management regimes in supporting mangrove conservation, and the sustainable management of mangroves.
6. Identify the main social and cultural issues that serve as either barriers or opportunities for mangrove restoration.

Methods of data collection and stakeholder engagement included the following:

1. **Key people/key informant interviews** were held with men, women, and youth leaders at the community level.

2. **Household surveys (socio-economic and livelihoods questionnaires)** were conducted to collect information about livelihoods, mangrove uses, and mangrove DoDD at the household level. These surveys allowed for collection of sex-disaggregated data on resource use, sources of livelihoods, and dependence on mangroves. They also helped to provide quantitative data, including estimates of the frequency, quantity, and use of wood and other non-timber forest products harvested from mangroves. Surveys were conducted in communities near Navitilevu Bay in Ra Province and across

the Rewa Delta in Rewa and Tailevu Provinces, with a total of 417 respondents (Table 3). A copy of the questionnaire is provided in *Appendix 1: Socio-economic Survey Questionnaire*.

Table 3. Summary of the number of socio-economic survey respondents by Province, Tikina, and Koro (village/town).

Province	Tikina	Koro	# Respondents
Ba	Nailaga	Votua	37
		Nawaqarua	35
	Vitogo	Namoli	23
	Bulu	Natunuku	26
		Sasa	26
		Sorokoba	31
	Tavua	Tavualevu	64
	Votua	Natutu	20
	Total		262
Ra	Nalawa	Matawailevu	14
	Navitilevu	Navitilevu	16
	Saivou	Barotu	13
		Naiserelagi	12
		Nanukuloa	12
	Total		**67**
Rewa	Noco	Matanimoli	35
		Naivilaca	47
		Narocake	4
	Rewa	Nasilai	24
		Nukui	27
		Tavuya	28
	Settlement	Kinoya	30
	Vutia	Laucala	2
		Muanaicake	24
		Muanaira	30
	Total		**251**
Tailevu	Bau	Natila	17
		Waicoka	27
	Buretu	Daku	40
	Dravo	Dravo	15
	Total		**99**
All	**Total**		**680**

3. **Stakeholder mapping exercise:** This activity was employed to identify government agencies, non-governmental organizations (NGOs), civil society organizations (CSOs), private sector

actors, and community groups that use or rely on mangroves for their livelihoods; partners that work on development or management in mangrove areas; and government agencies that work in mangrove and coastal areas. These exercises were also used to identify and assess the stakeholders that have access to, mandates over, and interest in mangrove areas in Fiji. In addition, stakeholder mapping was used to identify agencies, groups, or individuals to interview at community and national level. Mapping exercises will continue to be conducted by CI at different scales. At the province level, such exercises will be used to identify key actors engage in each province. At the community level, these exercises will be used so that people can produce a visual aid depicting the actors who having an interest in, access to, and authority over mangroves.

4. **Resource mapping:** This activity was used to identify the mangrove resources present in the *tikina*, as identified by stakeholders, and identify real and perceived changes to mangroves and their use over time. This activity included creating a physical "social map" with stakeholders that did the following:
    - identify the main subsistence and commercial resources-which of these are related to mangroves;
    - identify the location of selling outlets and markets for mangrove products;
    - identify the most important mangroves areas (remaining) and changes to mangrove extent over time;
    - identify and describe causes of mangrove loss;
    - provide a species ranking for both subsistence and commercial uses; and
    - identify problems, including a discussion of the agents and drivers of mangrove deforestation and degradation based on the maps.

5. **Problem-solution trees:** This activity was used to identify underlying causes of mangrove deforestation and degradation and potential interventions that could provide solutions and improve mangrove management and health. This session expanded upon information produced in a problem analysis exercise. In this activity, people identified the main direct threats to mangrove removal, discussed underlying/root cause, and proposed potential activities to address each. The impacts and multiplier effects of problems were then identified by tracing the impacts of various mangrove-use activities. Such activities allow people to see problems constructively and, by tracing causes and impacts, apply the same approach to other community issues. Because the activity uses a diagram that represents the shape of a tree, it serves as a metaphor to explain the interconnected nature of direct threats and underlying causes.

3.3 Imagery and Spatial Analysis

As part of the study of agents and drivers of deforestation, degradation, and causes of mangrove loss, CI analysed high-resolution imagery collected by drones and satellites for each site in order to detect and quantify changes in mangrove state and cover over time. A time series of high-resolution, multispectral, optical satellite imagery was purchased for each of the three priority sites (Table 4. High-resolution satellite imagery purchased to analyse mangrove cover change over time across sites.). Images covered the range 2007-2022 and were chosen to cover key dates related to the timing of tropical cyclones that impacted Viti Levu; this range of dates was also chosen to reflect recent changes to mangrove cover and identify the agents and drivers of mangrove loss that are relevant at present. The images were corrected and orthorectified by the provider to improve feature and pixel alignment between images across years. Using the three visible bands (red, green, blue), the near-infrared band, and the panchromatic band, higher resolution pansharpened images were produced; a cloud masking and mosaicking process was also applied to these images to fill in data gaps.

Table 4. High-resolution satellite imagery purchased to analyse mangrove cover change over time across sites.

Site	Period	Dates	Sensor(s)/ Satellite(s)	Resolution (m)	# Bands
Ba Delta & Yanuca Island	2007	2007-12-11	IKONOS	1.0	4
	2010	2010-08-11	WorldView-2 (WV2)	0.5	8
	2013	2013-01-24, 2013-02-12	WV2, GeoEye-1 (for cloud patch)	0.5	8
	2017	2016-12-04, 2016-10-23	Pleiades	0.5	4
	2022	2022-04-21	WV2	0.5	8
Rewa Delta	2010	2010-01-04, 2010-01-31	WV2, Quickbird	0.5	4
	2013	2013-06-02, 2013-06-02	Pleiades	0.5	4
	2017	2017-06-09, 2017-06-09	WV3, WV	0.5	8
	2022	2022-08-02, 2022-06-09, 2022-06-04	WV3, GeoEye-1 (Cloud patch)	0.5	4
Navitilevu Bay	2007	2007-12-10	KSO2	1.0	4
	2010	2010-08-25	WV2	0.5	8
	2013	2013-05-13	WV2	0.5	8
	2017	2017-01-20	WV2	0.5	8
	2022	2022-06-09	WV3	0.3	8

In coordination with CI, the Fiji Ministry of Forestry collected ultra-high resolution drone imagery (~3 cm) for key areas of the Navitilevu Bay and Ba Delta during the third quarter of 2022. These images include red, green, blue, and near-infrared bands as well as a digital surface model.

Images from multiple years were overlaid and compared. Visual inspection of satellite and drone imagery was used to:

- identify areas with mangrove deforestation and/or degradation (e.g., mangrove clearing, tree cutting, etc.);
- identify areas damaged by tropical cyclones;
- identify areas with and without recovery from tropical cyclones;
- identify potential hydrological changes or impediments in mangroves;
- identify and evaluate site suitability for restoration activities; and
- identify and evaluate site suitability for avoided deforestation/degradation and improved management activities.

Spatial analysis of satellite and drone imagery was also performed using GIS (Geographic Information System) and remote sensing techniques. Spectral indices were used to separate mangroves areas from non-mangrove areas and detect changes to mangrove health. ArcGIS Pro software was used to calculate the normalized difference vegetation index (NDVI), a spectral index that uses surface reflectance of the red and near-infrared bands to produce an indicator of vegetation presence and vigour. By overlaying NDVI images

for multiple years and applying a pixel-by-pixel subtraction, changes in NDVI (dNDVI) were calculated and used to detect, map, and quantify, disturbance from natural or human causes. Visual inspection was used to identify thresholds in dNDVI that represented potential disturbances, confirm the accuracy of these change detections, and discard artifacts caused by image misalignment, differences between sensors and image collection conditions (e.g., sun angle and shadows, image collection angle, etc.). By thresholding and reclassifying dNDVI images, areas of mangrove loss, deforestation, degradation, recovery, and lack of recovery were delimited and quantified. In summary, spatial analysis allowed for the following:

- map and quantify areas with mangrove deforestation and/or degradation (e.g., mangrove clearing, tree cutting, etc.);
- map and quantify areas damaged by tropical cyclones;
- map and quantify areas where mangroves have and have not recovered from tropical cyclones; and
- identify the size and location of areas with potential for inclusion in the Fiji Blue Carbon project.

3.4 Field Validation

In November 2022, a team conducted site visits to Navitilevu Bay and Yanuca Islands to evaluate conditions and collect additional data as well as validate the causes and drivers of deforestation, degradation, and loss. This fieldwork included several components, listed below.

- Collection of evidence and discussion with communities to understand mangrove uses and validate reported drivers of deforestation and degradation (clearing of mangroves; harvest of trees, bark, and other mangrove resources; clearing and replacement of mangroves for other land uses; disposal of waste; disposal of dredging spoils, etc.).
- Measurement of biomass plots to evaluate biomass carbon stocks in cyclone-damaged sites with and without post-cyclone recovery to assess potential carbon sequestration in biomass under different restoration scenarios.
- Establishment of sediment pins to assess changes to soil/sediment depth due to compaction and erosion.
- Development of hypotheses for lack of recovery in cyclone-damaged sites, including observations of water levels at high tide, mid tide, and low tide; assessment of propagule dispersal potential due to hydrologic connectivity and physical barriers (dense walls of seedlings and saplings along edges of cyclone-damaged patches, coarse woody debris); salinity measurements; and
- Assessment and discussion of potential approaches for restoration between the team and local community leaders, including establishment of mangrove nurseries and the removal of woody debris to improve hydrologic flow regimes.

3.5 Theory of Change Approach

A theory of change (ToC) approach was applied to synthesize the data collected on agents and drivers of deforestation and produce a preliminary conceptual model for project development for each site. This study used the approach provided by the *Open Standards for the Practice of Conservation v.4.0* (also referred to as *Open Standards*), a document that serves as a guide to design and implement conservation practices and provides a set of principles and best practices to do so (CMP, 2020). The *Open Standards* provide a five-step management cycle that includes a process to develop a theory of change.

In the context of this DoDD study, a ToC is a causal conceptual model that depicts assumptions about how actions taken can help to achieve results in terms of mangrove conservation, restoration, and broader ecological, climate, and human well-being goals and objectives. A ToC can be expressed using descriptive or narrative text, visual tools such as concept maps and diagrams, or in other forms. Different approaches to developing theory of change can use distinct terminology or define commonly used terms in diverse ways. For clarity and consistency, key definitions for terms as used in this report are provided in Table 5. Key terminology and definitions related to theory of change. Modified from the Open Standards for the Practice of Conservation.. Many of these are taken directly from the *Conservation Standards* document, but some adjustments have been made.

Table 5. Key terminology and definitions related to theory of change. Modified from the Open Standards for the Practice of Conservation.

SITUATION MODEL	
"A situation model (diagram) represents relationships between key factors identified in a situation analysis believed to impact or lead to one or more conservation targets… [links] the conservation targets to threats, opportunities, stakeholders, and key intervention points." Describes, "relationships among the biological environment and the social, economic, political, and institutional systems and associated stakeholders that affect the… targets you want to conserve," or restore (CMP, 2020).	
Key Term	**Definition**
Direct Threat	"Primarily human actions that immediately degrade one or more conservation targets (e.g., logging). They can also be natural phenomena altered by human activities (e.g., increase in extreme storm events due to climate change). Typically tied to one or more stakeholders. (Sometimes referred to as a pressure or source of stress," (CMP, 2020). Compare with underlying cause or indirect threat. In this study, direct threats are actions resulting in mangrove loss, primarily through deforestation or forest degradation or the creation of conditions leading to mangrove loss.
Critical Threat	"Direct threats prioritized as the most important to address," (CMP, 2020).
Underlying Cause	"A factor identified in an analysis of the project situation that is a driver of direct threats. Often an entry point for conservation actions," (CMP, 2020). (Sometimes called an "indirect driver" or a "root cause". Compare with "direct threat".)
Driver	Synonym for "underlying cause" or "indirect threat".
Stress	"An impaired aspect of a conservation target that results directly or indirectly from human activities. For example, low population size, reduced river flows, increased sedimentation, and lowered groundwater table level. Generally equivalent to a degraded key attribute (e.g., habitat loss)." (CMP, 2020). Also referred to here as a biophysical or environmental factor that is influenced by direct threats.
Opportunity	"A factor identified in an analysis of the project situation that potentially has a positive effect on one or more targets, either directly or indirectly. Often an entry point for conservation actions – for example, demand for sustainably harvested timber. (In some senses, the opposite of a threat.)" (CMP, 2020).

Factor	"A generic term for an element of a situation model, including direct and indirect threats, and opportunities. It is often advantageous to use this generic term since many factors – for example, tourism – could be both a threat and an opportunity. (See also root causes or drivers)," (CMP, 2020).
Agent	Person, group, organization, or entity responsible for and associated with a direct threat or action. Also called an "actor."

RESULTS CHAIN	
"Visual diagram of a project's theory of change. A results chain includes core assumptions and the logical sequence linking project strategies to one or more targets. In scientific terms, it lays out hypothesized relationships or theories of change," (CMP, 2020)	
Key Term	**Definition**
Goal	"A formal statement detailing a project's desired impact, such as the desired future status of a target. A good goal meets the criteria of being specific, measurable, achievable, results-oriented, and time-limited (SMART)."
Objective	"A formal statement detailing a desired outcome of a project, such as reducing a critical threat. A good objective meets the criteria of being specific, measurable, achievable, results-oriented, and time-limited (SMART). If the project is well-conceptualized and -designed, the realization of a project's objectives should lead to the fulfilment of the project's goals and ultimately its vision." Compare to goal.
Vision	"A description of the desired state or ultimate condition that a project is working to achieve," (CMP, 2020).
Scope	"The broad geographic or thematic focus of a project," (CMP, 2020).
Target	Conservation/restoration target: "An element… (species, habitat, or ecological system) at a project site on which a project has chosen to focus. All targets should collectively represent the biodiversity of concern at the site…" (CMP, 2020). Human well-being target: "…those components of human well-being affected by the status of conservation [or restoration] targets. All human well-being targets at a site should collectively represent the array of human well-being needs dependent on the conservation [or restoration] targets," (modified from CMP, 2020 to include restoration).
Strategy	"A set of activities with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, optimizing opportunities, and limiting constraints. A good strategy meets the criteria of being linked, focused, feasible, and appropriate. (See also intervention.)" (CMP, 2020).
Activity	"A specific action or set of tasks undertaken by project staff and/or partners to reach one or more objectives. Sometimes called an action, response, or strategic action. (See relationship to strategies.)" (CMP, 2020).
Result	"The desired future state of a target or factor. Results include impacts, which are linked to targets and outcomes, which are linked to threats and opportunities," (CMP, 2020).
Outcome	"The desired future state of a threat or opportunity factor. An objective is a formal statement of the desired outcome. (Synonym for result.)" (CMP, 2020).

To produce the ToC, the information collected was synthesized into a situation model for each site, a diagram describing the present status of the system, including direct threats to mangroves and the underlying causes

behind them (Figure 6. Example of a simplified situation model with the basic components. Modified from CMP (2020)., Figure 7. Example of how a situation model (top) can be used to produce an initial results chain (bottom). Modified from CMP (2020).). The situation models describe relationships between the ecosystem and the social, economic, political, and institutional systems, as well as stakeholders. Based on the situation model, stakeholder engagement, and discussion within the project team, preliminary strategies were developed to describe how interventions via project activities could address issues impacting mangroves in the Fiji Blue Carbon project; these will form the basis of the results chain to complete the ToC for sites where conservation and restoration interventions will be carried out.

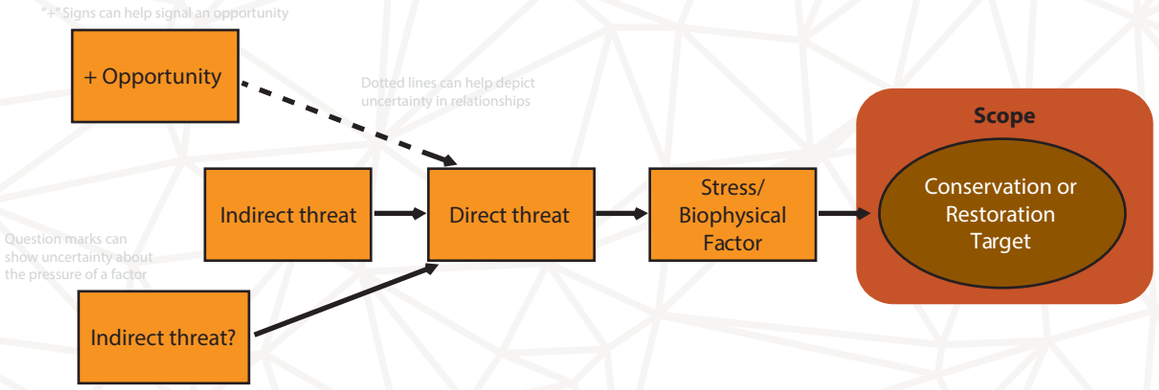


Figure 6. Example of a simplified situation model with the basic components. Modified from CMP (2020).

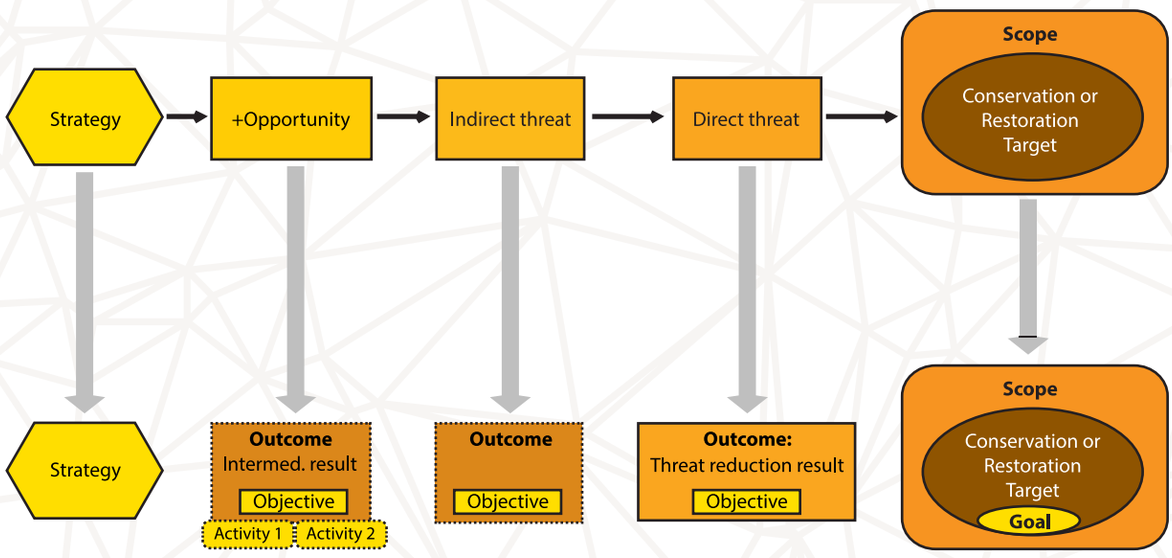


Figure 7. Example of how a situation model (top) can be used to produce an initial results chain (bottom). Modified from CMP (2020).

4. ANALYSIS OF AGENTS, DRIVERS, AND CAUSES OF MANGROVE DEFORESTATION, DEGRADATION, AND LOSS

This report is centred on the analysis of agents and drivers of deforestation and degradation (DoDD) and causes of loss in mangroves in Fiji. This analysis was based on a synthesis of results from literature reviews, spatial and remote sensing analysis of satellite and drone imagery, socioeconomic data, and discussions with communities and other stakeholders. Factors that apply broadly to mangrove DoDD across Fiji are addressed, including national legal and policy factors (Section 4.1) and social, economic, cultural, traditional, and governance factors (Section 4.2). Mangrove loss due to DoDD and tropical cyclones was analysed on a site-by-site basis in recognition of geographic variation in drivers as well as environmental, social, economic, and ecological conditions (Section 4.3). In general, this is a qualitative description of DoDD, and future work will quantify and rank each driver in terms of its impact on the quantity of mangrove cover change and different indices of mangrove ecosystem health.

4.1 Legal and Policy Factors Related to Drivers of Mangrove Deforestation and Degradation in Fiji

A legal and policy analysis was conducted through a literature review that evaluated all existing and proposed laws, policies, and regulations pertaining to mangroves in Fiji and assessed their influence on drivers of mangrove deforestation and degradation. This analysis included both national laws and international conventions to which Fiji is a party (Table 6. Implications of laws and policies in Fiji for agents and drivers of mangrove deforestation and degradation. The full assessment was conducted by Ulai Baya and is provided in *Annex II: Legal analysis of DoDD of mangroves*.

It can be deduced from the analysis of policies, laws, and regulations that mangrove forest ecosystem protection and sustainable management is a complex project. This complexity is, in part, the result of a lack of custodianship under a single legislation or coherent national policy approach in Fiji. Mangroves are currently sharing legal coverage under at least six pieces of legislation, which may entail overlapping and potentially conflicting responsibilities between different government agencies. How these responsibilities are shared among government agencies and their determined accompanied weighting remains unclear. The multiple, overlapping mandates and the resulting lack of clarity as to the entities responsible for managing mangroves leads to an overall lack of governance over mangroves. The lack of awareness within and among agencies – and among the public – regarding responsibility for and authority over mangrove ecosystems and resources is reflected in the lack of enforcement of such laws and lack of monitoring. This creates conditions that facilitate deforestation and degradation.

Most laws and regulations of Fiji governing the environment and natural resources reflect the thinking and paradigm of the time related to their origin. Therefore, it is not logical to premise protection of resources such as mangrove forests under the intersection of old pieces of law that have seen minor change to adapt to the improved scientific understanding, aspirations, values, and challenges of the present moment. An example is the preponderance on climate change, with laws embracing the protection and management of new properties, such as carbon rights.

Overall, ancillary terrestrial laws and regulations highlight a worrying trend where little thought is given to environmental sustainability. Support in terms of instruments and general capacity to manage resources is therefore negligible. Limitations relate to the absence of resource and/or environmental management capacity, poor governance provisions, and, to an extent, questionable policy concerns within the statutes. The Roads Act illustrates that sourcing and dumping of source materials in building of roads is allowed from adjacent property, meaning mangrove forest on coastal roads construction is legally convenient.

To manage resources and the environment, a common deficiency is the lack of any active management

tools. Overall, none of the statutes discussed manifest an awareness of the necessity of managing resources or protecting environmental values from degradation. Where objectives of laws are not itemized and management tools or instruments are not available, almost all the statutes highlight actions that are permissible on the one hand and those that are not permissible on the other, the latter categorized as constituting an offense. In this context, the correspondent or complementary requirements to manage resources are not readily identified.

In terms of wider issues relating to governance, most statutes worryingly marginalize stakeholders and the wider public interest in the environment. These legislations generally lack avenues for public involvement in decision-making; even those directly affected by decisions have no formal grievance redress mechanisms thus having few rights of redress. It is noteworthy that provisions exist in statutes purporting to empower the Minister to compulsorily acquire land for a range of uses, which appear to transcend the authority provided under the *State Acquisition of Lands Act*.

Another striking feature of some of the natural resource legislation discussed is the ability of the Minister to set aside the relevant act at his or her discretion. Procedurally, laws enacted by Parliament empower a Minister to rule, yet laws that may be under the discretion of the Minister that can be considered not to apply is quite perplexing. Another similar example is the power of the Minister to redefine enacted terminology by changing the statutory definitions in some laws. Some statutes also contain clauses stating the laws do not apply to the State. Provisions of this type are inherent in several of Fiji's natural resources laws and need to be reviewed.

Two acts do present a more enlightened and inclusive process for protecting both public and private interests regarding natural resources. The *Land Conservation and Improvement Act* and the *Drainage Act* emerge as better conceived and constructed, notwithstanding other limitations within the legislations per se. It is important to note that significant, new legislation to update natural resources policy and improve environmental protection in Fiji exists, both in enacted and draft form, such as the proposed *Management of Mangrove Regulation* enabled under the *Environment Management Act (2005)* and the *Forest Bill No 13 (2016*) to supersede the *Forest Decree (Act) of 1992*. Much of this law is premised on intents of international treaties and reflects a high degree of fidelity to those conventions.

International laws and treaties to which Fiji is a party are also relevant in considering the legal and policy context for mangroves. Ozone depletion, endangered and protected species, and climate change are the subjects of recent local laws directly implementing international laws. Also, laws such as maritime pollution and fisheries management, and sustainable development contain an international dimension, although, with marine pollution, the nexus is much less direct than is the case for the enacted ozone and endangered species laws. In addition, the fisheries and sustainable development legislation addresses a wide range of issues of a domestic character and perhaps signifies the shifting of government policy toward the environment and natural resources in Fiji.

There is a possibility that Fiji will soon sign and ratify the *UN Declaration on the Rights of Indigenous People* (UNDRIP), become bound by it, and transmute the application of its provisions into local laws. While the argument that Fiji is already an indigenous nation is respected, Fiji's current legal position will not obligate it to observe Article 45 of UNDRIP, regarding diminishing and extinguishing existing indigenous rights. Under this Article, a signatory party State is precluded from weakening existing institutions regarding Indigenous people. In the context of mangroves and mangrove ecosystem protection, this may apply to existing institutions and governance relating to rights to customary use; rights to customary fishing grounds; proper valuation of indigenous values to property rights to compensate takings; and control over land, its tenure, and its management.

A description of the implications of specific laws and policies for the agents and drivers of mangrove deforestation and degradation in Fiji is provided in Table 6. Implications of laws and policies in Fiji for agents and drivers of mangrove deforestation and degradation..

Table 6. Implications of laws and policies in Fiji for agents and drivers of mangrove deforestation and degradation.

Question	Law/ Policy	Assessment
Do existing laws or policies create conditions or incentives for legal or illegal deforestation or degradation?	*Policies*	*Policies observed are sectorial in approach and therefore are not harmonized with regards to environment protection and sustainable development.* *Delay in substantial progress of the Mangrove Policy may point to the lack of awareness of its importance and political will.* *No clear lead agency with responsibility can be singled out, given the sectorial approach.* *Adequate resourcing and capacity issues* *Housing Policy highlights as a policy measure the provision of tenure and the formalization of informal settlements on State lands thus linking to a probable increase in mangrove use on coastal settlements near major cities.*
	Drainage Act (Chap. 143) 1961	*Considerable capacity for the government to intervene in the use of private land exists under the Drainage Act. The provisions relating to the process attempt to put in place a transparent regime but are very understated concerning issues such as the appointment of the CA, the role of the Minister, and appeal provisions. A major problem is that only landowners within a proposed drainage area may object to the area's designation. That said, the Act, depending on the approved aspect of its program, has the potential to either affect hydrology with deleterious impact on mangroves or, on the other hand, allow for the restoration and maintenance of mangrove forests through enhanced engineering designs.*
	Sewerage Act (Cap 128) 1965	*Section 5: Council may enter and survey lands, bore, dig, and cut, get, or remove materials for sewerage works, as long as it is done with minimal damage. This can allow for undesirable land use to be planned and consolidated into sewerage area. There is no link between provision to declare an area and provisions exerting regulatory control.*
	Fiji Roads Act (1914)	*Section 7: Power to Permanent Secretary or any officers to enter any land.* *Section 10: Power to throw rubbish upon adjacent lands of such earth, rubbish, or materials it shall or may be necessary to remove from the place of works.* *Section 8: Power to take materials as required on or near such public roads for the use of officers, workmen, This, inversely, could also allow for extraction of material from mangrove area for road use.* *This is of concern, especially regarding road construction along the coasts of major islands to mangrove ecosystem management and conservation.*
	Irrigation Act (Cap 144A) 1974	*The Irrigation Act is an instrument designed to optimize agricultural production; environmental conservation and its needs are not mentioned Indeed, under the legislation farmers can be compelled to remove vegetation from their land, a policy that has contributed to comparative, massive environmental degradation in many countries. Little support for protecting the environment is found in the legislation.* *The policy's intention is unambiguous, however, with the Commissioner having almost invasive powers to direct landholders in the use of those farms included in an irrigation area. In this regard, the capacity of the Commissioner to exercise powers and then retrospectively seek approval is an illogical statutory provision. From both environmental and public policy perspectives, the Irrigation Act needs rigorous review for want of more contemporary legislation. Perhaps this review could include measures relating to control of direct discharge that impacts mangroves.*
	Forest Decree (1992)	*Under Section 6, Minister may declare forest reserve or nature reserve on un-alienated State lands, land leased to the State, or un-alienated iTaukei lands. Case of un-alienated iTaukei land requires the consent of the Trustee in TLTB (iTaukei Lands Trust Board).* *Forest reserves per section 7(1) shall be managed as permanent forests, and under section 7(2) nature reserves to be managed for the exclusive purpose of permanent preservation of their environment, including flora and fauna, soil, and water.* *Despite the text, the protection provided under the Forest Decree is not permanent protection. The Minister may, upon advisement of Forestry Board, rescind by declaration any forest reserve or nature reserve to whole or part of an area and it shall cease to be a forest or nature reserve, respectively.*
	Environment Management Act (2005)	*Section 3(2)(a) application and purpose of this Act are to apply principles of sustainable use and development. Section 3(a) alludes to the preservation of the coastal environment, margins of wetlands, lakes, and rivers.* *Absence of comprehensive regional and national land use plans.* *Limited protection and enforcement for conservation, especially in native forest areas. EIA process is not mandatory for every development. Monitoring of EIA conditions on leases often requires extensive land-owning unit (LoU) input*
	Fiji Forest Policy (2007)	*In the 21st Century, the forest policy environment continues to change with increased emphasis on sustainable forest management, climate change, and globalization.* *Promotes policies that encourage sustainable forest management and support government strategic planning for sustainable development of Fiji* *Ensured ecosystem stability through conservation of forest biodiversity, water catchment, and fertility.* *Contingent upon [Forest Bill 2016] still in its Parliamentary passage. Protracted progression can lead to institutional weaknesses and entrenched bureaucratic processes given extended transitory expectations.* *Absence of detailed forest management and harvesting plans.*

	Fiji REDD+ Policy (2011)	*Offers an additional excellent opportunity for Fiji to conserve its forest and at the same time benefit from the continued environmental services of standing forests including benefits through the conservation of its forest biodiversity.* *Recognizes that a significant proportion of Fiji's greenhouse emission is likely to arise from forest sector emissions.*
	Fiji's Constitution (2013)	*Section 40(1) -Every person has the right to a clean and healthy environment, which includes the right to have the natural world protected for the benefit of the present and future generations through legislative and other measures.* *Possible reversal- Section 40(2) a law or an administrative action taken under a law may limit or may authorize the limitation of the rights set out in this section.*
Are there laws and policies that do or do not allow for mining in mangroves? Under what circumstances?	*Mining Act (Chap 146) 1966*	*The Ministry of Lands and Mineral Resources and Environment (MLMRE) is Fiji's main government agency that implements the country's mineral development policies under the Mining Act. Exploration licenses are granted for gold, base materials, bauxite, limestone/marble, aggregate, and petroleum resources in the country. The Minister may declare ANY area, not exceeding 250 ha, government protection areas for mining and then grant mining tenements there over –section 5(1).* *The Minister may by order prohibit or restrict prospecting for any specified mineral throughout Fiji and by the same or by a subsequent order grant the exclusive right to prospect for any mineral so specified to such a person as may be named in the order and the provision for this section –section 4. Any reserved forest is closed to mining except with the consent of the Conservator of Forest under section 5(h)*
	Quarries Act and Quarries Regulation [Chap. 147]	*Act applies to the excavation of minerals (not covered by the Mining Act such as rock, earth, clay, sand, or other common mineral substances as declared by the Minister under section 2 (f) of the Mining Act. Such quarrying could be or become a significant cause of mangrove ecosystem degradation. This is authorized by the Minister of Lands and Mineral Resources or when extraction occurs on iTaukei Lands by a license issued by TLTB by agreement with Min of Lands and Mineral Resources. Land under section 2, as defined by the act includes water and land covered by water. This definition may have implied application on mangroves given the possibility of quarrying in areas close to mangroves.*
Do law and policy allow for land reclamation in mangroves? Under what circumstances?	*Reclamation of Mangroves*	*The Lands Department is responsible for issuing a development lease for any activity relating to mangroves foreshore reclamation in general. Historically, most of the reclamation has recently been initiated through government agencies, primarily for agriculture and infrastructure development. The process does so only after mandatory institutional consultations have taken place between the various government departments represented on the Mangrove Management Committee. The Lands Department receives the development proposal, obtains relevant information about the customary fishing rights owners from iTaukei Fisheries Commission and forwards it to an independent arbitrator who then determines the value of potential loss of fishing rights because of reclamation. The recompense amount (which is a one-off payment) is then determined by customary right holders and developers and on information about productivity in the area on information provided by a government agency such as Fisheries Department.* *The basis of valuation methodology for recompense amount is questionable given it does not consider special indigenous values and connection to fishing grounds.* *The process of final payment is preceded by a waiver of fishing rights form signed off by the registered owners of the fishing rights despite having no assessment of what is been waived nor the elements of the proposed taking being valued.*
Do law and policy allow for waste disposal (mining or otherwise) in mangroves? Under what circumstances?	*Waste disposal under Roads Act (Chap 175)*	*Chap 175 provides broad powers to the government. The rights of adjoining land users yield to the State. Workers may forcibly extract materials from any proximate land to a public road for roadworks. (Sections 7 and 8). Excavated material and roadwork debris may be dumped on lands adjacent to roadworks-section 10.*
Do law and policy allow for the conversion of mangroves or land uses that are possible drivers of deforestation and degradation? For what purposes or under what circumstances?	*Forest Decree (1992)*	*Section 7 - Minister may upon advisement from Forestry Board rescind by declaration any forest reserve or nature reserve to whole or part of an area and it shall cease to be a forest or nature reserve, respectively. This may include, for example, the prioritization of commercial interest, e.g., tourism development.*
	State Lands Act (Chap 132)	*Leases for state lands ae generally unexceptional. Special conditions apply to the leasing of foreshore land or soil 'under waters of Fiji' to protect public access to the coast. Before awarding a lease over coastal areas, the application must be advertised, and any objections considered by the Minister. see section 21. Regulations (R) under section 41, of State Lands Act created 9 categories of leases: Agricultural, residential, dairying, tramway, quarry, and special purposes (R7)* *Leases for farming and quarrying may run for 30 periods, while other categories can extend for 99 years.* *Farming leases impose minimum conditions to conserve soil and vegetation (R7 and 14)* *Annual leases can be issued to graze livestock, extract building material, cultivate crops and reside with attached conditions to recognize soil erosion and vegetation but this is not reflected in other types of licenses (see Regulations 35-39)*
Do law and policy allow for harvest of flora and fauna from mangroves? For what purposes or under what circumstances?	*Fiji Constitution (2013)*	*Recognizes the traditional right of access to marine resources, but only guarantees the right of compensation or payment of royalties for infringement of these rights for mining operations.*
	Forest Decree (1992)	*Part V- Saving of Customary Rights-Section 21(1)(a)(i) the exercise of any native rights established by custom to hunt, fish, or collect fruits and vegetables growing wild is allowed. Section 21(1)(a) (ii) Cutting or removal by any iTaukei in accordance with iTaukei custom of forest produce which may be necessary for the permanent abode for himself or for his family but harvest for commercial use is not permitted*

Which people and/or entities, if any, have the legal rights to convert or extract wood from mangroves?	*Forest Decree (1992)*	*Part V- Saving of Customary Rights-Section 21(1)(a)(i) the exercise of any native rights on itaukei reserve, established by custom to hunt, fish, or collect fruits and vegetables growing wild. The application of this provision is broad and beyond but including mangroves, to cover, collection of fruits and wild fruits and vegetables.* *Section 21(1)(a) (ii) Cutting or removal by any iTaukei in accordance with iTaukei custom of a forest produce which may be necessary for the permanent abode for himself or for his family.*
	Forest Bill No 13 (2016)	*Section 30 saved provisions and legal force of section 21 of Forest Decree (1992) re; usufruct rights of any iTaukei to hunt and collect flora and fauna. There may be an internal application of these to iTaukei communities who are not registered fishing rights owners to the coastal areas and may enter into some form of traditional arrangement with registered fishing rights owners. There is an outstanding question regarding monitoring re: volume and limiting harvest amount and frequency in a particular place.*
	State Lands Act (Chap. 132)	*Individuals or private entities can apply for a foreshore and coastal leases. Special conditions will apply to leasing of the foreshore land or soil 'under waters of Fiji.'to protect public access to the coast. Before awarding a lease over coastal areas, the application must be advertised, and any objections must be considered by the Minister. see section 21. Regulations, under section 41, of State Lands Act created 9 categories of leases; Agricultural, residential, dairying, tramway, quarry, and special purposes (R7)*
Are laws and policies designed with the intention of conserving/ protecting mangroves? If they are, are they effective? Are they enforced?	*All laws and policies*	*There is currently no formalized national policy and/or specific legal framework for mangrove use and updated mangrove resource management in place for Fiji. Mangroves as a forest resource are directly and indirectly covered in the existing policies. Few provide good coverage of mangroves as in the forest policy, mangrove management plans and National Biodiversity Strategic Action Plan (NBSAP).* *The subsisting deficiency in enforcement and monitoring of the existing policies, laws and regulations is of relevance and is an ongoing concern for mangrove use and management contributing to the continuing destruction of mangrove resources. This, in particular, in peri-urban and urban areas at the cost of development. The fragmentation of current policies and implementation procedures will require a synoptic review and a possible harmonization, consolidation, or a separate stand-alone mangrove policy framework to be explored that is specific to the ecosystem it serves.*

4.2 Social, Economic, Cultural, Traditional, and Governance Factors as Drivers of Mangrove Deforestation and Degradation in Fiji

A full analysis of socioeconomic, cultural, traditional, and gender factors on mangroves was prepared by Aliti Vunisea and can be found in *Annex III. Review of Socio-Economic Influences on Mangrove Use, Deforestation, and Degradation* and *Annex IV. Literature Review of Culture, Gender, and Traditional Influences on Mangrove Use, Deforestation, and Degradation*.

Direct Threats Causing Deforestation and Degradation

Traditional Uses of Mangroves

Coastal communities in Fiji have used mangrove resources for generations. As in other Pacific Island countries, mangroves are recognised as significant resources with respect to the traditional lifestyles of indigenous peoples, providing resources such as fuelwood, construction materials, food, herbal medicines, natural dyes, ceremonial commodities (such as flowers for garlands/traditional necklaces), and the gathering of crabs and fish (Lal, 1990a; Lal, 1990b). Apart from harvesting the mangrove trees, villagers also collect non-timber forest products from the mixed mangrove-associated vegetation, such as *"ivi"* (*Inocarpus fagifer*), coconuts (*Cocos nucifera*), "*vutu"* (*Barringtonia edulis*), and *"dawa"* (*Pometia pinnata*). Pandanus leaves are processed and woven into mats and fans for cultural purposes such as weddings and funerals (Dayal *et al.*, 2022). These products can be used directly, gifted, or sold in markets for additional income. Indian Fijians also employ mangroves for tradition uses, including use of mangrove wood for cremation due to characteristics such as slow burning and providing a good heat source due to its density. However, the impact of these activities in terms of CO_2 emissions may be negligible compared with conventional logging and fuelwood, given the relative infrequency of this traditional use.

Traditional uses of mangroves continue in coastal communities, and, depending on the ways in which these resources are managed, traditional uses can act as direct threats to mangroves. Given rising costs of living and lack of livelihood alternatives in the delta areas of the main islands, present conditions suggest the possibility that traditional uses for both commercial and subsistence purposes could become a driver of deforestation and degradation. Traditional use arrangements also exist in areas where there are *"qoliqoli cokovata,"* traditional fishing grounds of the indigenous *i-Taukei* people of Fiji. Such areas are present in

Ra Province and in Rewa, where people within a larger *yavusa* comprising several villages have access to *qoliqoli* areas; in such cases, those that live outside of the coastal villages that directly access mangroves have the same access rights and can use mangrove resources at will without seeking permission from those that are living in coastal communities. Whether traditional mangrove uses act as direct threats to mangroves likely varies depending on the community and mangrove area, since sustainable and traditional management practices can be found in many mangroves throughout Fiji. Furthermore, the amount of trees and vegetation removed for traditional purposes is relatively small compared to other drivers, such as harvest for firewood, and, therefore, traditional mangrove uses are not necessarily drivers of deforestation or degradation across all contexts.

Tourism and Development

Though not a direct threat to all mangroves in Fiji, large-scale mangrove conversion for tourism has caused significant mangrove deforestation in some areas of Fiji, including Denarau, Vulani (Sabeto River), and Saweni (Nadi Bay) (SPREP, 2014). The continuation of large-scale tourism development rapidly changes the landscape, especially when mangroves are cleared for land reclamation. Development of port facilities on delicate coastal ecosystems in Fiji is also increasing, with large areas of mangrove being filled in for this purpose (UNCCD National Focal Point, 2007).

Unsustainable development has also been found to impact the environment and increase flood risk in and around some of the luxury tourist resorts. One of these is the island of Denarau, where five-star establishments have mushroomed during the last decades. Natural mangrove forests acting as buffer zones were removed during the construction phases, which also affected livelihoods of locals as fish disappeared from the area. The loss of buffer zones has permanently damaged the local communities and is now repelling tourism in some areas due to the frequent flooding in the area, with an estimated loss reported in millions.

Dredging and Disposal of Dredging Spoils

There had been substantial but undocumented losses of mangroves from dredging and the subsequent disposal of spoil in mangrove areas (SPREP, 2014). Dredging is pursued for a variety of purposes, including to maintain navigability of rivers and streams, maintain discharge capacity, and avoid major flooding. Despite introduction of the Environmental Management Act (2015), EIAs, and detailed environmental guidelines for dredging, there have still been problems with disposal of dredging spoils (SPREP, 2014). When dredging spoil is placed in mangroves, it alters the hydrodynamic regime and can affect mangroves in a variety of ways. It often kills all mangrove trees, transforming the area to a terrestrial habitat unsuitable for mangrove restoration (Watling, 2021). In certain circumstances where the hydrology is only slightly altered, small areas of disposal do experience mangrove regeneration, but younger patches of mangroves do not necessarily provide the same ecological, climate, and community benefits of the original forest that they are replacing.

Conversion of Mangroves in Urban and Peri-Urban Settings

In the 2013 Mangrove Management Plan, the loss of urban and peri-urban mangroves remained the single most conspicuous and contentious mangrove issue to the public (Watling, 2013). The drivers associated with mangrove conversion in these settings include multiple types of direct threats. An estimated 112 ha loss of mangroves had been attributed to small-scale conversion for industrial estates and squatter housing (MoE, 2018; Cameron *et al.*, 2021). Examples were the major mangrove conversions for industrial purposes in Rokobili (Suva Harbour), Saru & Namoli (Lautoka), and Vakamasuasua (Labasa) (SPREP, 2014). Small-scale conversion for industrial activities as well as small scale development (including extraction activities), logging, and unregulated residential settlements ("squatter housing") all act as direct threats causing mangrove deforestation and degradation at the margins of urban and peri-urban settings. Small-scale developments have long resulted in the loss of mangroves and continue to do so today (Lal, 1983; Thaman et al., 2003). While extraction is often localised and small-scale in this setting, there are concerns that an influx of people, mostly young families, migrating from inland rural areas to coastal or urban will drive

demand for construction materials to build new houses (Conservation International, 2018). Additionally, mangrove forests face threats of direct clearance to create land for domestic dwellings, tourism amenities, and for large-scale infrastructure such as roads and bridges (Agrawal *et al.*, 2003; Nunn, 2013; Cameron *et al.*, 2021).

Conversion of Mangroves for Agriculture and Aquaculture

Conversion of mangroves for agriculture and aquaculture has served as a direct threat to mangroves historically, but these pose less of a threat today. In the early 1970s, late 1990s, and early 2000s, at least 300 ha (3 km^2) of mangroves were converted to large scale agriculture schemes in Raviravi (Ba Province) for sugar cane, Dreketi (Macuata Province) for rice, and Waidamu (Rewa Province) for agriculture (SPREP, 2014). Before that, the Colonial Sugar Refining Company (CSR) converted about 2,300 ha (23 km^2) in the Labasa delta for agriculture use (Lal, 1983; Watling, 2021; Cameron 2020). Other factors related to agriculture and aquaculture, including ponds, sewerage, pesticide runoff, animal waste, introduced species, logging, and bioprospecting, also act as direct threats to mangroves, and some of these continue today.

Underlying Causes of Deforestation and Degradation

Demographic Changes, Migration, and Settlement Patterns

Generally, there is a lack of defined policy for land-use planning, including for the development of new settlements in anticipation of migration and population growth. The lack of defined policy in urban and peri-urban reclamation results in unplanned, piece-meal development and incremental loss of urban mangroves and related increased squatting in mangrove areas (Watling, 2013). In addition to conversion of mangroves and use of mangrove wood for informal settlements, there are concerns that an influx of people, mostly young families, migrating from inland rural areas to coastal and urban areas (e.g., for economic opportunity) will continue to drive mangrove deforestation and degradation; this could lead to continued expansion of settlements into mangroves in urban and peri-urban areas and/or increased demand for construction materials to build new houses, which could be filled by wood harvested in mangroves and result in degradation or even deforestation (Conservation International, 2018).

COVID-19 Pandemic

The COVID-19 pandemic and government responses have influenced patterns of settlement and the distribution of the population with implications for DoDD. During the first two years of the pandemic, the government implemented a policy of establishing borders and containment areas that limited access to markets and urban centres and prevented people from selling goods. In addition, small canteens in villages were closed. These changes resulted in lost income and economic issues across Fiji, including in communities near mangroves. Consultations with communities suggested that people increasingly relied on locally available resources to survive, including farming and fishing, and extraction of other resources, like firewood, from mangroves. These economic impacts also left some people unable to afford rent payments. As a result, they lost stable, formal housing and built or expanded informal squatter settlements, often at urban margins, which, in some areas, include mangroves. This trend would have exacerbated pre-existing issues around informal settlement in urban and peri-urban settings, driven in part by people migrating from rural to urban areas for economic opportunity.

Complex and Weak Governance and Conflicting Use Rights

Weak governance is a key challenge for mangrove management across the Pacific. This includes a disconnect between formal and traditional management systems; weakening traditional management; lack of awareness of laws, policies, management plans, activities happening in mangroves, and impacts of extraction on mangroves; and limited capacity of government agencies to monitor and enforce laws. In addition, coordination, and participation across sectors such as agriculture, forestry, environment, and fisheries are hindered by the complexity of traditional social structures and unwritten norms (Veitayaki et al., 2017).

As described in the legal and policy analysis, Fijians have customary or traditional unalienable rights of use to the living resources in intertidal areas, such as traditional fishing rights in their customary fishing grounds known as "*qoliqoli,*" yet mangroves are technically under the government's jurisdiction. Therefore, while customary use rights are recognized, there is no user ownership over the resource. This arrangement contributes to the complexity of effective mangrove management in Fiji (MESCAL 2013). Despite having no ownership rights to mangrove or its resources, coastal village communities have considerable independence over the way they use them, and, in general, have been relied upon to be the unpaid custodians of the nation's mangrove resource (Watling, 2013).

Overlapping jurisdiction between traditional rights and state laws can cause confusion, especially where indigenous communities have traditional land use rights that may be perceived as being synonymous with ownership (Veitayaki, 2004). For example, on many occasions, owners of customary fishing areas have confronted fishers and tourist operators they believed were abusing their coastal resources. In some instances, fishing gear has been destroyed and lives threatened as customary owners exert control within their areas. Multiple mandates of government ministries over mangrove areas in Fiji are also an underlying cause to this lack of governance because, with so many different agencies responsible, there is confusion over authority, opening gaps that end up leading to deforestation and degradation.

Loss of Traditional Knowledge

Although classified by some as "non-scientific," traditional knowledge has been accumulated after centuries of extensive trial and error experiences from which people have learned (Veitayaki 2004). Because of their long association with mangroves, communities have a wealth of empirical traditional knowledge on the direct and indirect benefits of mangrove ecosystems. Awareness of community knowledge and utilization patterns of mangrove ecosystems and their services is integral to conservation and management (Thaman et al., 2013). Time-tested indigenous knowledge in Fiji and the Pacific Islands is seriously threatened due to the commercialization of fishing, breakdown of traditional communal leadership and oral knowledge transmission systems, modern education, and movement of the younger generations to urban areas for work and/or study (Veitayaki 2002, Kitoleilei et al., 2021). Centralised management initiatives have not prevented degradation and failed to improve lives (Veitayaki 2008). Where traditional ethnobiological knowledge exists, in-depth systematic traditional knowledge is usually held by a small number of men and women in the community. This knowledge is being lost rapidly and is seriously lacking in the younger generation, urban populations, and among urban-based leaders and policy makers. This loss may be an underlying cause of unsustainable management practices leading to mangrove deforestation and degradation (Thaman et al. 2008).

Lack of Monitoring and Enforcement

While commercial harvesting activities conducted by communities require a license, small-scale subsistence harvesting is not generally monitored by the state (Veitayaki et al., 2017). This results in poorly managed extraction activities conducted by communities and adjacent settlements to gather mangrove wood for funerals (as fuel during cremations), and to produce a red dye used for handicrafts from the coloured mangrove sap (CI, 2020). Lack of monitoring and enforcement also includes the lack of effective implementation of Environmental Impact Assessments (EIA). For example, despite the introduction of Environmental Management Act (2015), EIAs and detailed environmental guidelines for dredging, there have still been problems with disposal of dredging spoils that have caused mortality in mangroves. Though marine reserves have been established with environmental management plans, enforcement is lacking due to lack of resources, lack of skilled labour, and unclear institutional arrangements (ADB, 2013). Legal enforcement mechanisms apparently have not changed attitudes towards mangrove use. Watling (2013) has argued that the Environmental Management Act (2005) and its EIA Regulations (2007) appear to have had no positive impact on sustainable management of the mangrove resource, and instead, poor EIA preparation and review has enabled unsustainable mangrove management.

Economic dependence on mangroves and mangrove resources

In a study on drivers of deforestation and degradation in 2020, one of the main factors revealed was a high rate of unemployment (71% in the Ba delta and 67% in the Rewa Delta). Fishing, crab catching, and firewood collection were primary sources of income, with some secondary activities including livestock rearing and the collection of medicine (Avtar et al, 2021). In many cases, the drive for economic opportunities far outweighs and can undermine the ecological and environmental benefits of mangroves due to immediate economic need and lack of awareness of the importance of mangroves. The demand for adequate ecosystem valuation is critically important for communities and managers to be able to make well-informed decisions.

Proximity of Human Habitation to Mangrove Areas

Where human habitation is close to, or within, the forests, over exploitation of mangrove resources can be evident on a local scale, with degradation occurring due to over harvesting of timber, the presence of non-native or non-mangrove plant species, dumping of domestic waste, and large amounts of plastic waste deposited along river channels and by tides (MoE, 2018; Cameron *et al.,* 2021). This underlying cause is linked to urban expansion of informal settlements into mangrove areas.

Mangrove Loss and Drivers of Mangrove Deforestation and Degradation at Priority Sites

Three sites were selected for detailed analysis as proxies for drivers of mangrove deforestation, degradation, and loss within Fiji. The sites were chosen due to their geographic location (on Viti Levu, Fiji's largest island), size, importance to local communities, and being representative of different mangrove conditions present in the country. In this section, the sites are addressed individually.

Ba Delta and Yanuca Island

Site Description

The Ba Province is in the Western Division in the northwest of Viti Levu. It includes the Ba River Delta (Ba Delta), Fiji's second largest mangrove ecosystem, which covers an area of approximately 5,540 hectares. The Ba Delta can be delineated into two distinct mangrove assemblages; taller vegetation located around river and coastal margins, and scrub or dwarf mangroves which occur in interior or basin regions of the delta. River and coastal margins within the delta exhibit taller *Rhizophora* spp. trees upwards of 20 meters in height and cover an area of approximately 1,530 hectares. These areas sustained significant damage because of TCs Mick (2009) and Evan (2012). The remainder of the Ba Delta (approximately 3,791 hectares), aside from significant areas of mud flats and salt pans, is largely composed of scrub or dwarf Rhizophora spp. mangroves with a canopy height between 2-4 meters.

Yanuca Island, a 110-hectare coral atoll approximately 5 kilometres offshore from the Ba Delta, was also surveyed and considered under the assessment of this site for potential restoration. The entire island is tidally inundated apart from a narrow stretch of terrestrial land abutting the southern coastline and is covered almost exclusively in *Rhizophora* spp. forest. This island is an important area for the harvesting of mud crabs (*Scylla serrata*) by locals, especially women, from nearby villages. Yanuca Island received a direct hit from TC Evan (2012) resulting in the complete destruction of a 17-hectare area of taller *Rhizophora* spp. forest that has not recovered as of the writing of this report (2023).

Mangrove Loss Due to Tropical Cyclones

The largest cause of mangrove cover change in Ba has been the successive impacts from TCs Gene, Mick, Evan, and Winston, which all struck the Ba region within a span of only 8 years. TC Gene formed within the Fijian archipelago and tracked southwest almost directly down the mountainous spine of Vanua Levu before skirting the northern coastline of Viti Levu and hitting Ra and Ba provinces as a Category 1 cyclone

(Australian tropical cyclone intensity scale). Less than a year later, TC Mick initially made landfall at Ba as a Category 2 cyclone before tracking southeast over Viti Levu. Three years later, TC Evan struck Fiji as a Category 4 cyclone with a path that skimmed the northern coastline of Vanua Levu and damaged significant areas of mangroves within Bua before directly hitting Ba (Viti Levu) on a south-southwestern trajectory (Diamond, 2017). TC Winston, a Category 5 event and the most intense in the Southern Hemisphere on record (Diamond, 2017), passed close to Vanua Levu's southern coastline and made landfall at Rakiraki (Ra Province, Viti Levu) at peak intensity, resulting in extensive mangrove loss before tracking west across Viti Levu's northern coastline to the Ba region. These cyclones resulted in the compounding, progressive loss of mangrove coverage across the area (approximately 210 ha), with damage extending from the Ba Delta in the northwest down to the township of Nadi along the west coast of Viti Levu. Mangrove cover loss resulting from tropical cyclone damage within the Ba Delta has been followed by subsequent recovery, with almost complete canopy coverage restored (Figure 8. Top: Close-up on satellite imagery of the Ba Delta showing initial damage from TCs Gene (2008) and Mick (2009) (top left) TC Evan (2012) (top right), and subsequent partial recovery despite the impact of TC Winston (2016) (bottom right). Recent imagery from 2022 (bottom left) shows almost complete recovery of the taller, riverine mangroves (Rhizophora spp). Bottom: Zooming out, this pattern can be observed across Ba Delta mangroves.). Overall, socio-economic survey results indicate that communities perceive net increase in mangroves over the last 5-10 years, perhaps due to recovery after tropical cyclones.

Unlike in the Ba Delta, the devastation wrought on Yanuca Island, initially by TC Evan and exacerbated by subsequent TCs ending with TC Winston, is extensive (Figure 9. Satellite imagery of Yanuca Island showing partial damage inflicted by TC's Gene and Mick (top left) which was then exacerbated by TC Evan and TC Winston (top right and bottom right respectively). The most recent imagery from 2022 (bottom left) shows the lack of any subsequent recovery.). Site visits and satellite imagery have revealed that there has been no regrowth or epicormic branching apparent on the few remaining standing trees, indicating near complete mortality of trees within the cyclone damage zones. While dead tree roots and stumps can be effective at consolidating or holding soils in place in the short- to medium-term (Murray *et al*. 2011), the lack of fine root turnover and leaf litter deposition from living trees precludes the accumulation of new autochthonous soil organic matter to replace lost soil. In addition, satellite imagery shows plumes of black sediment washing out of the mangrove into the surrounding seawater, suggesting that soil carbon is currently and will be continuously lost without intervention (Figure 9. Satellite imagery of Yanuca Island showing partial damage inflicted by TC's Gene and Mick (top left) which was then exacerbated by TC Evan and TC Winston (top right and bottom right respectively). The most recent imagery from 2022 (bottom left) shows the lack of any subsequent recovery.). The lateral displacement of soils combined with the ongoing decomposition of remaining organic matter may lead to soil subsidence and compaction, which could eventually lead to soil elevations no longer suitable for mangrove growth (Asbridge *et al*. 2018; Cahoon *et al*. 2003). However, a site survey conducted in November 2022 revealed evidence of sporadic, advancing regeneration with seedlings and saplings growing where they abut intact fringing mangroves. This shows that edaphic (soil) conditions remain suitable for regeneration and recovery, at least for now. Recruitment of propagules into the interior of the island is most likely restricted by the mass of dead and downed wood which impairs hydrological connectivity within the mangroves and forms a barrier for propagule dispersal and recruitment of new trees.

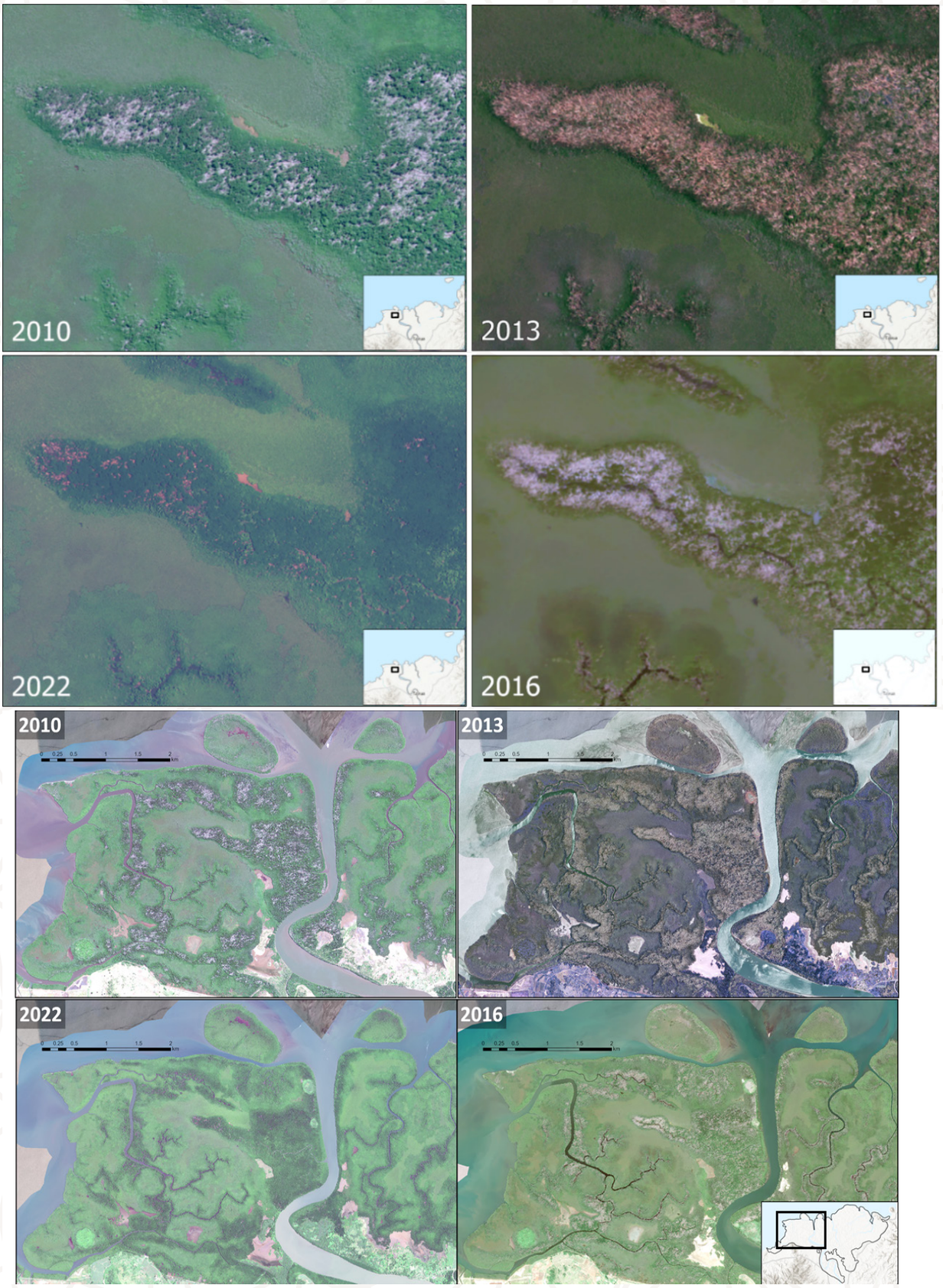


Figure 8. ***Top:*** *Close-up on satellite imagery of the Ba Delta showing initial damage from TCs Gene (2008) and Mick (2009) (top left) TC Evan (2012) (top right), and subsequent partial recovery despite the impact of TC Winston (2016) (bottom right). Recent imagery from 2022 (bottom left) shows almost complete recovery of the taller, riverine mangroves (Rhizophora spp).* ***Bottom:*** *Zooming out, this pattern can be observed across Ba Delta mangroves.*

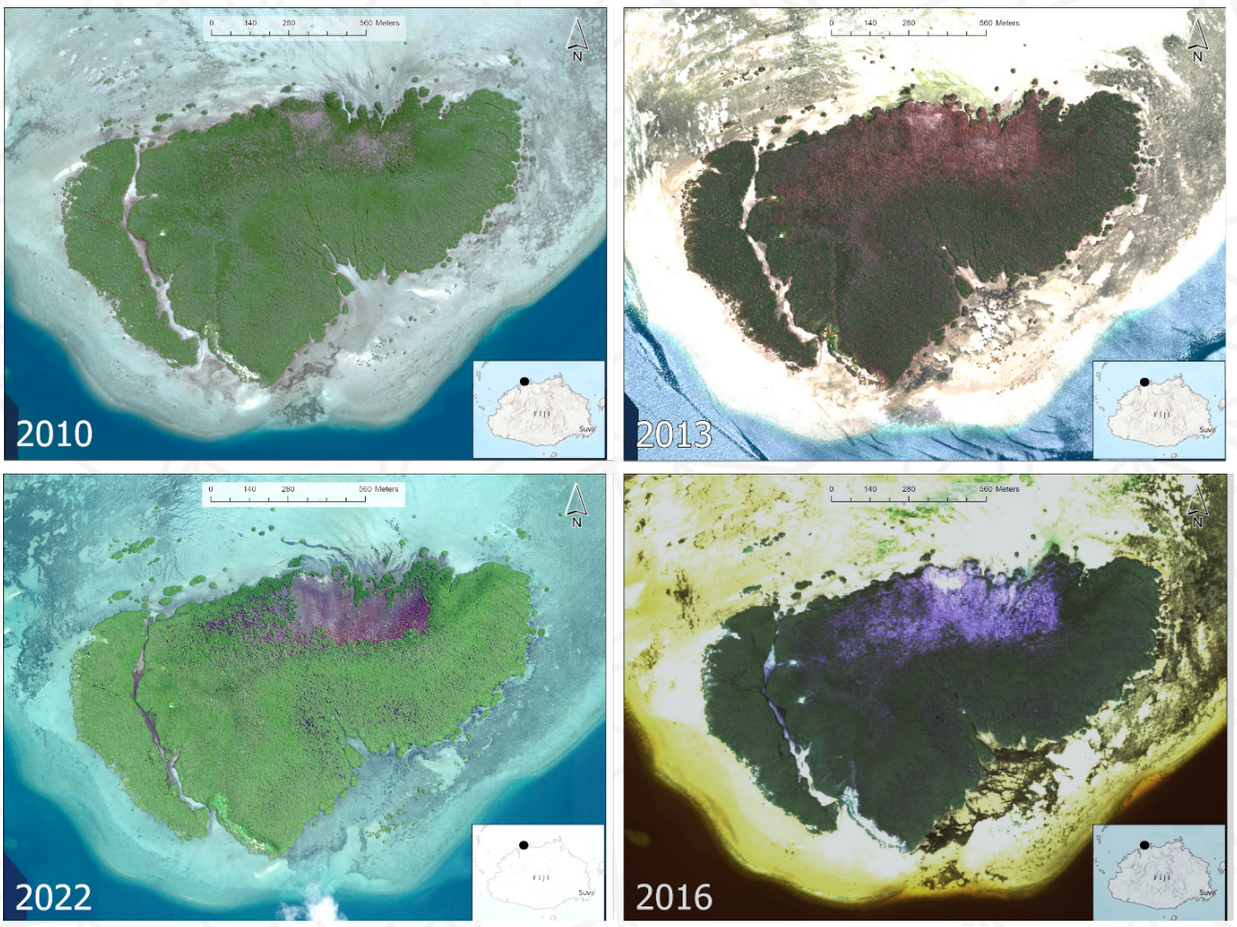


Figure 9. Satellite imagery of Yanuca Island showing partial damage inflicted by TC's Gene and Mick (top left) which was then exacerbated by TC Evan and TC Winston (top right and bottom right respectively). The most recent imagery from 2022 (bottom left) shows the lack of any subsequent recovery.

Drivers of Mangrove Deforestation and Degradation

A diversity of drivers of deforestation and degradation have been identified in the Ba Delta, and these drivers appear to have changed over time. A preliminary situation model mapping current drivers in the Ba Delta mangroves is presented in Figure 10. Situation model (draft) mapping causal connections between underlying causes, direct threats, and biophysical impacts resulting in mangrove loss, deforestation, and degradation in Ba Delta. Question marks and dashed lines represent uncertainties in factors and links, respectively..

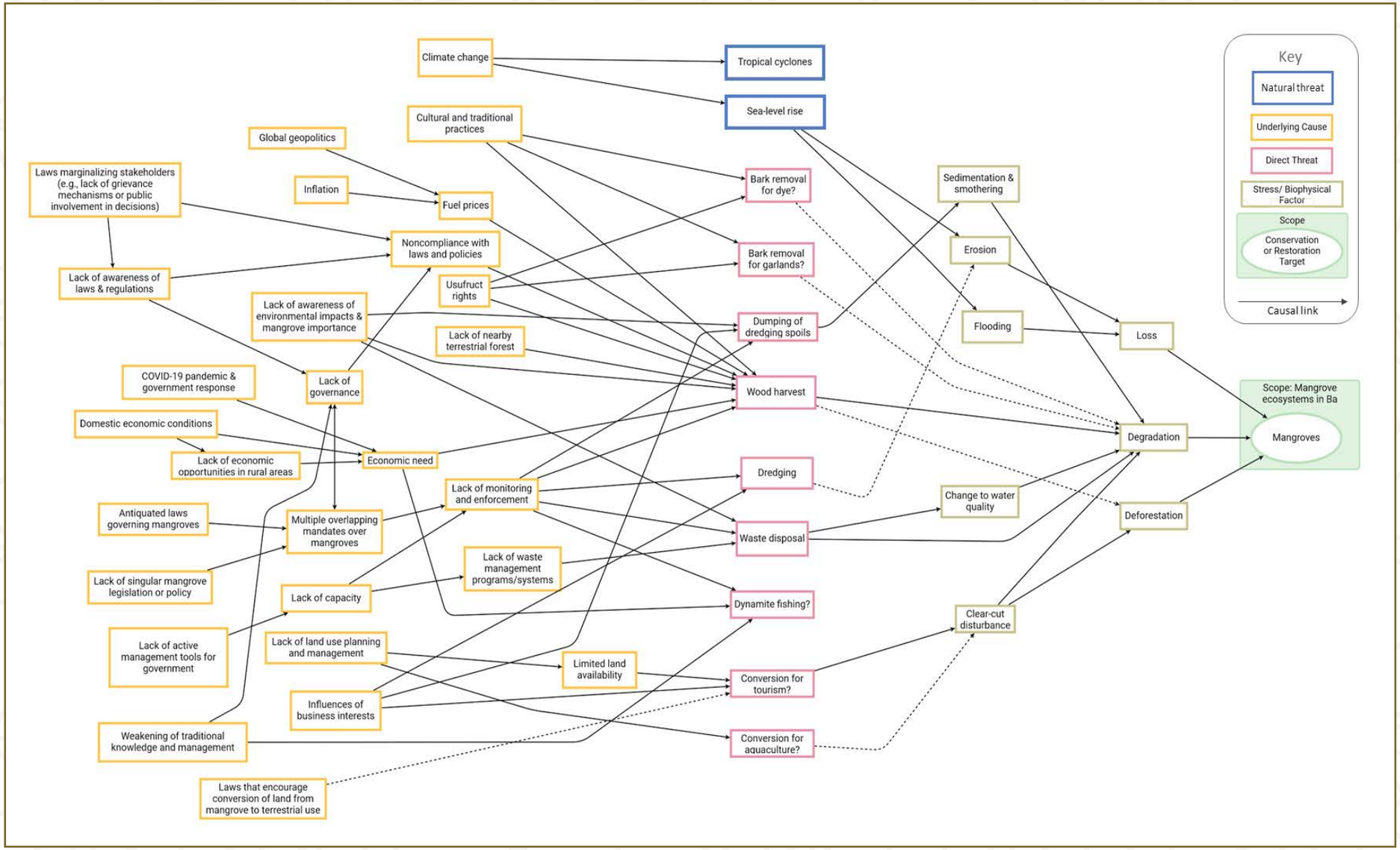


Figure 10. Situation model (draft) mapping causal connections between underlying causes, direct threats, and biophysical impacts resulting in mangrove loss, deforestation, and degradation in Ba Delta. Question marks and dashed lines represent uncertainties in factors and links, respectively.

Direct Threats

Wood Harvest

Wood harvest is a direct threat to mangroves in the Ba Delta. Based on the socio-economic survey, 95% of respondents to the socio-economic survey identified this as a mangrove practiced by themselves or other members of the community. Some 92% of respondents indicated that they use mangroves for collecting firewood, whereas 18% indicated logging use. When asked about community uses of wood and other products harvested from the mangroves, 96% indicated use for firewood, 42% indicated use for medicine, 38% indicated use for building materials, 17% indicated use for dye (bark, roots), and 9% reported sale of wood. Nearly all respondents (94%) reported harvest of "*dogo*" (*Bruguiera gymnorrhiza*), while about half (43%) reported harvest of *"tiri"* (*Rhizophora* spp.). About two-thirds (63%) of respondents suggest that less than 5 trees are harvested at a time, with the remaining third (37%) indicating that greater than 5 trees are harvested at once.

Estimates of the area of mangroves harvested varied widely. The survey used a rugby field, which vary in size from 0.72 to 1.01 ha, as a reference and asked each respondent to estimate the area of mangroves harvested per month in their area. Some 55% estimated one quarter rugby field, 27% estimated one half a rugby field, and 17% estimated one full rugby field worth of mangroves was harvested per month, for a weighted average of 0.32-0.45 ha/month. However, it is important to note that this question did not specify whether this area estimate represented clearing of mangroves in a single patch or distributed cutting over a large area, and the question did not ask respondents to specify which areas were being discussed.

Conversion for Tourism Development

Based on a mangrove cover change analysis for 2001-2018 (GIZ, SPC, SPREP, 2019), Cameron *et al.* (2021) reported an estimated loss of 120 ha of mangroves in Ba Delta due to tourism development, representing 35% of all mangrove loss occurring in Ba Delta during that period. In responding to the socio-economic survey, community members attributed mangrove loss to land reclamation for different purposes, including for settlement (10%), agriculture (6%), and wharfs/boat berthing (3%).

Disposal of Dredging Spoils

Disposal of dredging spoils in the mangroves has been identified as a cause of tree mortality in Ba Delta (Figure 11. Mangrove loss and conversion to terrestrial forest due to dredging spoil disposal in Ba Delta mangroves (2010-2022).). Beginning in 2005, at least three separate areas of mangroves within the delta totalling ~13.5 hectares were converted into terrestrial forest through smothering and raising of soil elevation above the level of tidal amplitude (Google Earth Pro timeseries analysis by Clint Cameron, 2019); this contributed to an estimated 4% of mangrove losses in Ba Delta between 2001 and 2018 (Cameron *et al.*, 2021). There is some potential that dredging may exacerbate erosion and lead to mangrove loss along coastal and river margins, however, this hypothesis requires additional scrutiny and collection of evidence. The degree to which disposal of dredging spoils continues to be a direct threat to mangroves depends on changes to legislation and policy, government responses, monitoring, and enforcement, as well as awareness of mangrove impacts by those performing and ordering such activities.

Figure 11. Mangrove loss and conversion to terrestrial forest due to dredging spoil disposal in Ba Delta mangroves (2010-2022).

Agriculture and Related Development

Historically, the sugarcane industry has been responsible for development in Ba Delta that led to loss of mangroves, though expansion of sugarcane agriculture is not considered to be a present direct threat to mangroves. In the past, there had been major developments in the Ba Delta, with mangrove areas converted to agricultural land for sugar cane and tram lines for sugar cane transport (Figure 12. Sugarcane tram line cutting across mangroves in Ba Delta (Source: Google Earth Pro).). This occurred in the 1970s and early 1997 due to a boom in the sugarcane industry. While sugarcane is still harvested as an economic and agricultural activity in Ba Delta, there is no major expansion of sugarcane agriculture into mangroves observed within the past 10 years at least. Furthermore, in the socio-economic survey, no community members attributed loss of mangrove area to land reclamation for agriculture. Therefore, this is not considered to be a present direct threat to mangroves.

Figure 12. Sugarcane tram line cutting across mangroves in Ba Delta (Source: Google Earth Pro).

Another potential threat related to agriculture is the dumping of wastewater from sugar factories into the river, negatively impacting water quality. Communities identified this issue, but the specific impact on

mangrove health has not been assessed with field data at this time.

Sand Mining, Dredging, and Erosion

Dredging projects in the Ba River have been carried out as part of efforts to safeguard the township of Ba and the neighbouring communities from flooding. During consultations, communities have suggested that sand mining and dredging lead to erosion and are primary drivers of mangrove loss, especially around the communities of Nawaqarua and Votua. Other communities within the lower Ba River, including Sorokoba, have also described being affected by the sand mining and dredging. In the socio-economic survey, 6% of community members attributed loss of mangrove area to sand and other mining activities. Comparison of the riverbank around these communities between satellite images from 2010 and 2022 show that, in some areas, 25-45 meters have been lost along the river margin, while, in other areas, mangroves have expanded by a similar amount (Figure 13. Erosion and accretion along the riverbank resulting in change in mangrove extent near the villages of Nawaqarua and Votua in Ba Delta. The satellite image shows the margin of the river in April 2022, and the white dotted line shows the margin of the river delineated based on satellite imagery from August 2010.). Further analysis is required to quantify the extent of change due erosion along the margins of rivers and streams and attribute the processes of erosion and accretion to particular cause and agent.

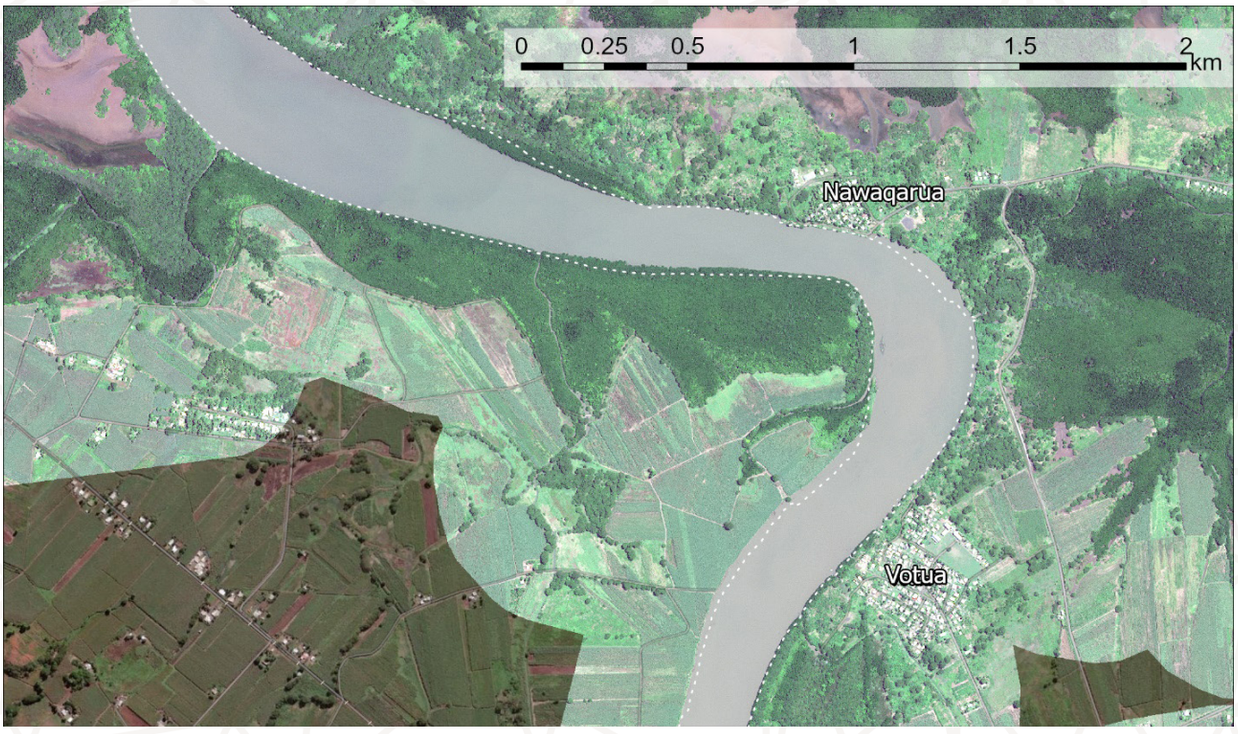


Figure 13. Erosion and accretion along the riverbank resulting in change in mangrove extent near the villages of Nawaqarua and Votua in Ba Delta. The satellite image shows the margin of the river in April 2022, and the white dotted line shows the margin of the river delineated based on satellite imagery from August 2010.

Waste Disposal

Waste dumping and disposal in mangroves has been identified as a potential DoDD, but additional analysis is required to determine the location and size of areas affected by such practices and the associated agents. In the village of Votua, the community identified community members and mining companies as being responsible for dumping rubbish along the river.

Dynamite fishing

Some communities in Ba Delta identified dynamite fishing as an issue affecting mangroves. The ease of catching fish using this practice as well as the lack of enforcement of regulations against this were both

cited as underlying causes of this practice continuing despite being prohibited by law. The degree to which this is being caused by sea-level rise due to climate change versus localized actions and the area of mangrove loss resulting from this process require additional data collection and analysis.

Sea-Level Rise and Coastal Erosion

Coastal erosion is evident along portions of the coastal and river margins of the Ba Delta. The degree to which this is being caused by sea-level rise due to climate change or by localized actions requires additional data collection and analysis.

Underlying Causes

Community consultations and household surveys indicate that the underlying causes for the direct threats identified are similar to those observed in other mangrove areas. These include lack of compliance with laws and regulations (dredging spoils, waste dumping, dynamite fishing, unsustainable wood harvest and sale), lack of monitoring and enforcement (for EIAs, regarding dumping of sugarcane wastewater and dredging spoils) lack of awareness of the importance of mangroves, and lack of awareness of management practices, use rights and ownership conflicts, and economic need (harvesting of mangrove wood for sale). Sea level rise due to climate change may be contributing to coastal erosion and loss of mangroves at the coastal margin. It is also important to note that traditional management was not present at sites visited during community consultations, with traditional taboos only put in place for three to six months after the death of a chief or when there is a decline in marine resources. Some community members expressed concern that there was a lack of effective management that could potentially be resolved by the government returning ownership to communities.

Navitilevu Bay (Ra Province)

Site Description

Mangroves in Navitilevu Bay show a pronounced zonation, with shorter *Rhizophora* spp. growing in higher salinity areas at the margins, closest to the sea, and taller *Bruguiera gymnorrhiza* as the dominant overstory tree in the mangrove interior and along the terrestrial margins.

Though intensive surveys have not yet been conducted at this site, it could be expected that biodiversity and ecological values at Navitilevu Bay would be similar to that of the Ba and even the Rewa Delta, though it is important to note that the extent of mangroves at this site is smaller than the others. Like the mangroves along the leeward side of the island, the general stature of mangroves is short and stunted in nature. It is possible that all eight mangrove obligatory plant species are to occur within the bay, as well as fauna including common species of geckoes, snakes, skinks, and amphibians. Along the foreshore area, it is also anticipated that a composition of land birds, shorebirds, seabirds, and bats are likely to be observed in their roosts as one of the many occupants of existing mangrove stand. Within the brackish water streams, crustaceans and fishes are expected to occur in abundance (Tuiwawa, S. pers. comm.). A full assessment of biodiversity is planned for future work.

Mangrove Loss Due to Tropical Cyclones

Significant, persistent cyclone damage is evident in Navitilevu Bay mangroves, as confirmed by satellite imagery analysis and fieldwork conducted for this site (Figure 14. Satellite imagery showing changes to mangroves in Navitilevu Bay from 2010 to 2022, including damage following TC Winston (2016).). Satellite imagery show healthy mangroves of Navitilevu Bay in 2010 and 2013, which were almost completely defoliated or downed following TC Winston in 2016 (post-TC image in 2017) except for coastal fringing *Rhizophora* trees. Imagery from 2022 shows limited recovery of mostly *Rhizophora* species, with large interior tracts of *Bruguiera gymnorrhiza* continuing to exhibit limited regrowth.

Figure 14. Satellite imagery showing changes to mangroves in Navitilevu Bay from 2010 to 2022, including damage following TC Winston (2016).

Visual assessment and remote sensing analysis of satellite and drone imagery provided a means to identify, map, and quantify the area damaged by TC Winston. Mangrove extent in Navitilevu Bay was mapped for 2010, 2013, 2017, and 2022 by applying remote sensing analysis to high-resolution (50-cm) satellite images. NDVI maps were generated for each year, and thresholds in NDVI values were identified by comparing these values to the extent of mangroves visible in the image, and a mangrove/non-mangrove map was produced for each. Change in NDVI values (dNDVI) were calculated for each pair of years to identify areas of mangrove cover change. The mangrove/non-mangrove maps and dNDVI change maps were overlain to delineate areas based on a set of mangrove cover change classes depending on the initial, intermediate, and final states of the mangroves and the time period over which change occurred. Manual corrections were performed to reclassify errors in the maps due to artifacts in the data (e.g., those caused by clouds or shadows in the imagery). Mangrove cover change classes were defined as follows:

- **Mangrove (Stable)** – Areas of continuous mangrove cover throughout the period 2010-2022. This included areas minimally affected by tropical cyclones, in which trees were not fully defoliated, snapped, or windthrown by the storm.
- **Expansion/Regeneration –** Areas of mangrove expansion or regeneration relative to 2010, the initial year of the analysis period. This included establishment of mangroves into areas of previously bare sediment, primarily along channels and coastal margins, and may include recovery from previous disturbances.
- **Cyclone Damage, Regrowth/Regeneration –** Areas damaged by TC Winston in 2016 where natural regrowth of leaves occurred on defoliated trees or natural regeneration had occurred (including new tree establishment) by 2022.
- **Cyclone Damage, No Recovery –** Areas damaged by TC Winston in 2016 where no recovery (regrowth of leaves, regeneration/recruitment) has occurred. Includes large dead patches with snapped and windthrown trees.
- **Other loss** – Loss attributed to factors other than TCs. Further analysis will ultimately assign these areas of loss to different drivers or causes.

To facilitate interpretation and restoration planning, the site was divided into zones using two different zonation schemes. Zonation scheme "A" divides mangroves in the bay into a "primary" zone, located in the south of the bay and containing the largest areas of mangroves, and a "secondary" zone, containing multiple, disconnected patches of mangroves located in the north of the bay.

Areas of mangrove cover change for each class are provided in Table 7. Areas of mangrove cover change by class for Navitilevu Bay.. Maps of mangrove cover change for 2010-2022 are provided for the primary and secondary zones in Figure 15 and Figure 16, respectively. The largest patches of cyclone-damaged mangroves that have not recovered in the six years since TC Winston are in the primary zone.

Table 7. Areas of mangrove cover change by class for Navitilevu Bay.

Mangrove Cover Change (2010-2022)			
Zone	**Change class**	**Area (ha)**	**% of Total**
Primary	Mangrove (Stable)	208.83	46.5%
	Expansion/Regen (2010-2022)	6.36	1.4%
	Cyclone Damage, Regrowth/Regen	168.68	37.6%
	Cyclone Damage, No Recovery	65.17	14.5%
	Total	**449.05**	**100.0%**
Secondary	Mangrove (Stable)	76.59	64.3%
	Expansion/Regen (2010-2022)	5.93	5.0%
	Cyclone Damage, Regrowth/Regen	28.71	24.1%
	Cyclone Damage, No Recovery	7.92	6.6%
	Total	**119.15**	**100.0%**
All	Mangrove (Stable)	285.42	50.2%
	Expansion/Regen (2010-2022)	12.30	2.2%
	Cyclone Damage, Regrowth/Regen	197.39	34.7%
	Cyclone Damage, No Recovery	73.09	12.9%
	Total	**568.20**	**100.0%**

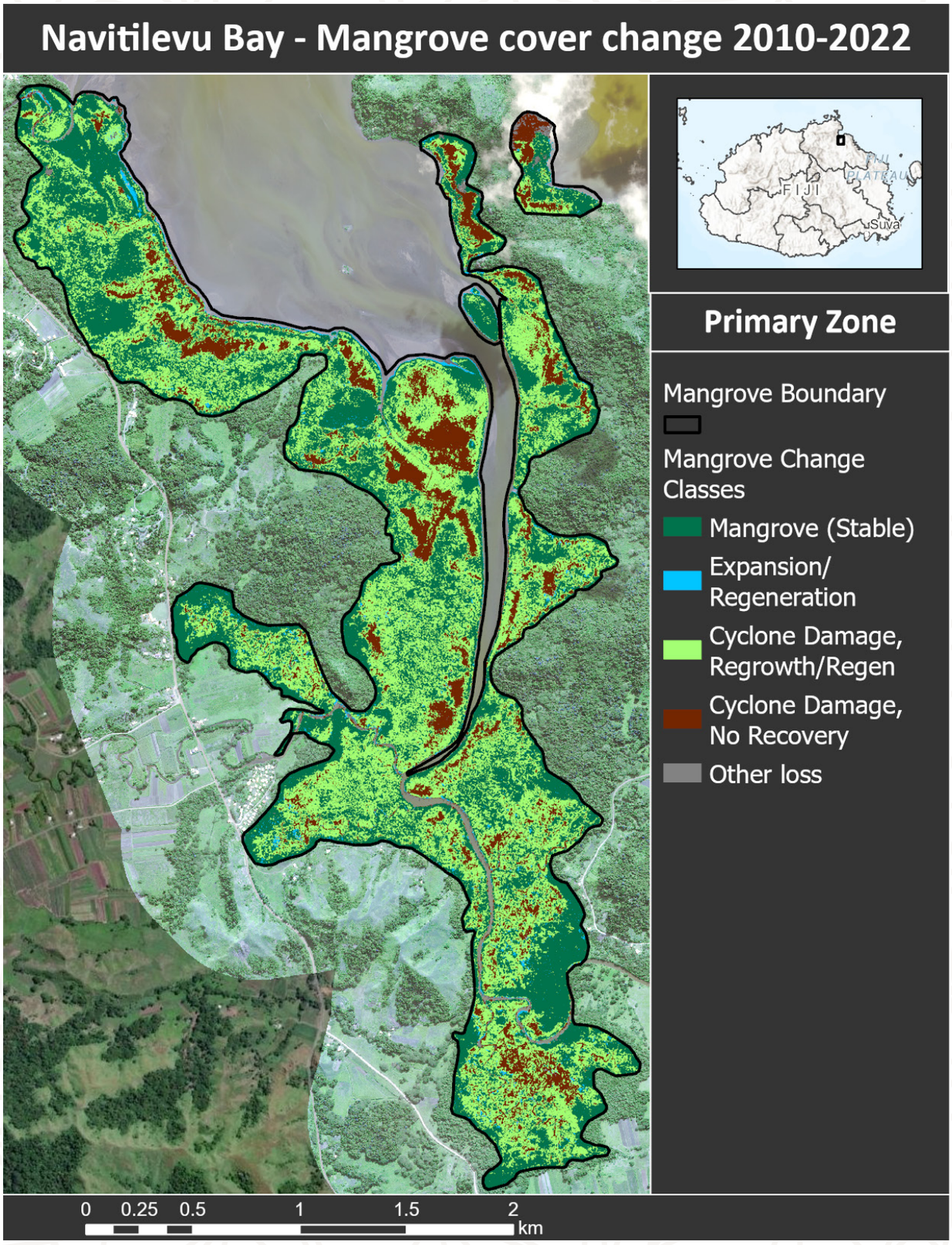


Figure 15. Map of mangrove cover change classes for the primary zone of Navitilevu Bay.

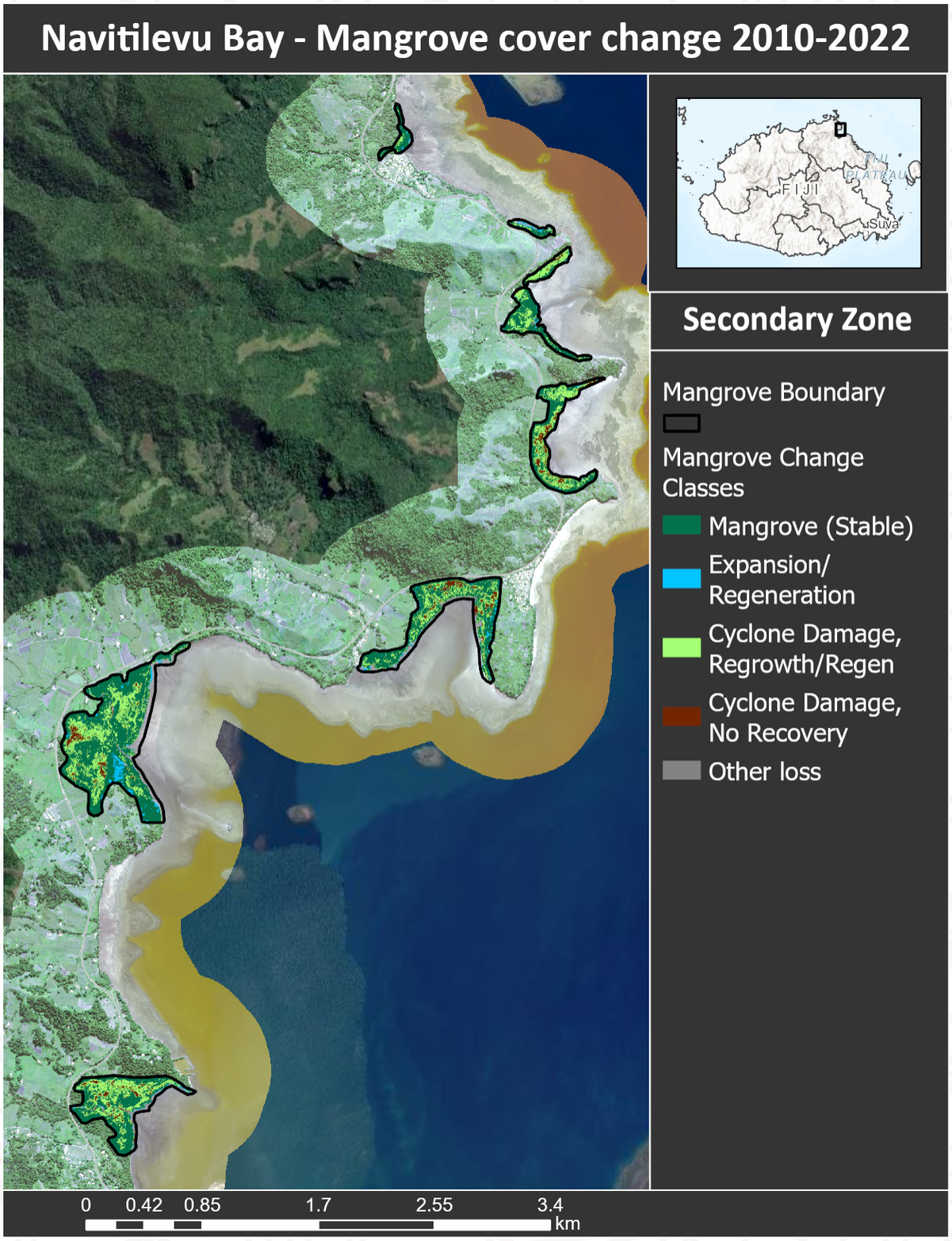


Figure 16. Map of mangrove cover change classes for the secondary zone of Navitilevu Bay.

Site reconnaissance surveys were conducted in Navitilevu Bay in March 2019 and November 2022. These surveys confirmed that significant areas of taller (>15 m) interior *Brugeria gymnorrhiza* mangrove forests were almost completely destroyed by TC Winston. While many of these trees were still standing, albeit with considerable structural damage (e.g., snapped limbs and trunks), there was little foliage cover or evidence of canopy regrowth, and many standing trees were dead. In contrast, a narrow band of coastal-fringing, shorter-stature (<8 m) *Rhizophora* spp. mangroves showed little structural damage and almost complete canopy coverage. Importantly, some landward patches of the *Brugueria gymnorrhiza* forest abutting the

terrestrial boundary showed abundant, dense clusters of seedlings – indicative of conditions suitable for recruitment and recovery – while extensive interior areas have not (Figure 17. Panoramic images from cyclone damaged areas Navitilevu Bay showing the team conducting biomass surveys in interior Bruguiera gymnorrhiza mangroves damaged extensively from TC Winston (top), as well as a cohort of ~2-3-year-old saplings which are growing on the periphery of the site nearest to water margins (bottom).). In the socio-economic survey, the majority of respondents (59%) perceived a net loss of mangroves in Navitilevu Bay, and nearly two-thirds of respondents (64%) identified tropical cyclones as the cause of this loss.

Figure 17. Panoramic images from cyclone damaged areas Navitilevu Bay showing the team conducting biomass surveys in interior Bruguiera gymnorrhiza mangroves damaged extensively from TC Winston (top), as well as a cohort of ~2-3-year-old saplings which are growing on the periphery of the site nearest to water margins (bottom).

Drivers of Mangrove Deforestation and Degradation

Satellite image analysis and fieldwork suggest that direct threats to mangroves from anthropogenic sources are not causing widespread deforestation or degradation in Navitilevu Bay. This evidence corroborates the findings of Cameron *et al*. (2021), which estimated that tropical cyclones were responsible for 98% of observed mangrove losses in Ra Province. Despite the lack of widespread anthropogenic deforestation, social and economic data collected with stakeholders suggested that harvest and use of trees and other non-timber forest products from mangroves was common in communities. This suggests that (a) degradation may be occurring at present, which is difficult to detect using remote sensing, and (b) there is a possibility that direct threats could increase over time as resource needs or other social or economic factors change over time. A preliminary situation model mapping current drivers in the Navitilevu Bay mangroves is presented in (Figure 18. Situation model (draft) mapping causal connections between underlying causes, direct threats, and biophysical impacts resulting in mangrove loss, deforestation, and degradation in Navitilevu Bay. Question marks and dashed lines represent uncertainties in factors and links, respectively.).

Direct Threats to Mangroves

Wood Harvest

Wood harvest is a direct threat to mangroves. Based on the socio-economic survey, 90% of respondents identified wood harvest as a mangrove use that they or other members of the community practice. Some 90% of respondents indicated that they use mangroves for collecting firewood, whereas 3% indicated logging use. When asked what people do with the wood and other products harvested from the mangroves, 97% said it was used for firewood, and 40% indicated use for medicine; building materials, dye, and sale of wood only accounted for 6%, 6%, and 1% of responses, respectively. Nearly all respondents (87%) reported harvesting "*dogo*" (*Bruguiera*), while about half (50%) reported harvesting *"tiri"* (*Rhizophora* spp.).

Estimates of the area of mangroves harvested varied widely. The survey used a rugby field, which vary in size from 0.72 to 1.01 ha, as a reference and asked about the size of the area of mangroves harvested per month. Some 39% of respondents estimated one quarter rugby field, 52% estimated one half a rugby field, and 9% estimated one full rugby field worth of mangroves was harvested per month, for a weighted average of 0.48-0.67 ha/month. However, it is important to note that this question did not specify whether this area estimate represented clearing of mangroves in a single patch or distributed cutting over a large area, and the question did specify geographically which areas were being discussed. Communities have stated that there has not been much change in areas targeted for logging over the past 10 years and that there has been noticeable decrease in mangroves in these areas, indicating potential that current degradation for wood harvest could ultimately lead to deforestation.

In the site visit conducted in November 2022, CI did not observe areas of live trees cut for wood harvest. In field surveys and discussions with community members, cutting and collection of wood from trees killed by tropical cyclones was recorded. Because the harvest of these dead trees causes minimal impact to healthy mangrove systems (minimal soil disturbance was observed), this activity is not considered to be a direct threat causing deforestation or degradation. Use of wood from cyclone-killed trees may be reducing the impact on healthy mangroves because dead trees are replacing live trees in meeting community demand for firewood.

Small-Scale Gravel Mining

Small-scale gravel mining has been identified as a potential DoDD, but additional analysis is required to determine the location and size of areas affected by such practices and the associated agents. Communities did not attribute any change in mangrove area to this cause in the socio-economic survey.

Waste Disposal

Waste dumping and disposal in mangroves has been identified as a potential DoDD through discussions with community members. However, this was not observed at a large scale in satellite imagery or field visits. Additional analysis is required to determine the location and size of areas affected by such practices and the associated agents.

Sea-Level Rise and Coastal Erosion

Coastal erosion is evident along portions of the coastal and river margins in Navitilevu Bay. The degree to which this is being caused by sea-level rise due to climate change versus localized actions and the area of mangrove loss resulting from this process require additional data collection and analysis.

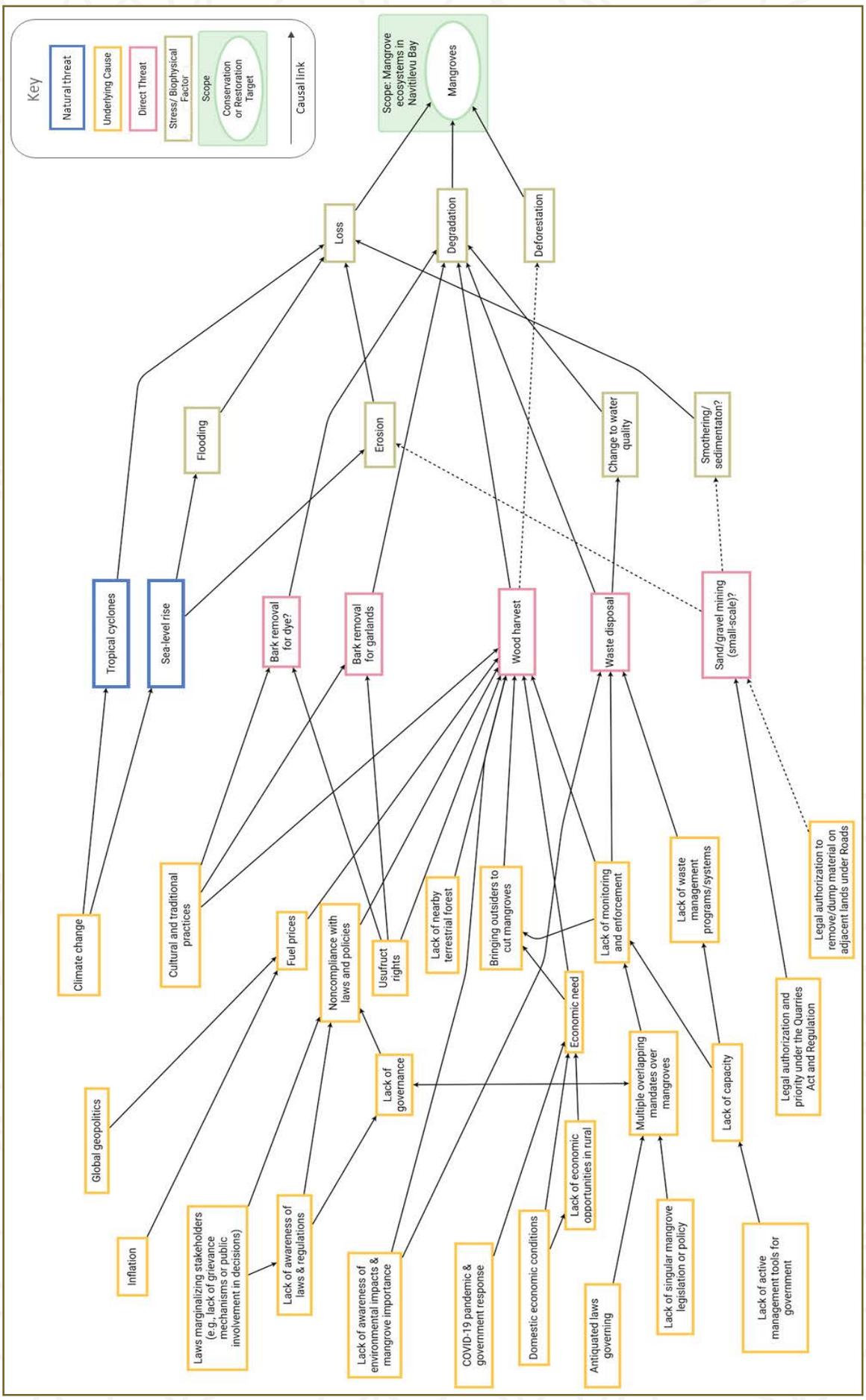


Figure 18. Situation model (draft) mapping causal connections between underlying causes, direct threats, and biophysical impacts resulting in mangrove loss, deforestation, and degradation in Navitilevu Bay. Question marks and dashed lines represent uncertainties in factors and links, respectively.

Traditional Uses of Mangroves

During the field visit, evidence of bark harvest from live *Brugueira* trees was observed at one site along the major river in Navitilevu Bay. This site had healthy mangroves and mature trees that had successfully recovered after being defoliated during TC Winston (Figure 19. Evidence of bark harvest from Bruguiera trees in healthy mangrove sites, likely for traditional use in garlands by local communities. Trees were girdled by removal of bark in a ring, causing these trees to die.). Discussions with CI-Fiji field staff and community members suggested that bark was likely collected for traditional use in garlands by local communities. Trees were girdled by removal of bark in a ring, causing some of these trees to die.

Figure 19. Evidence of bark harvest from Bruguiera trees in healthy mangrove sites, likely for traditional use in garlands by local communities. Trees were girdled by removal of bark in a ring, causing these trees to die.

Underlying Causes

Community consultations and household surveys indicate that the underlying causes for the direct threats identified are similar to those observed in other mangrove areas. These include lack of understanding of existing regulations and management rules (regarding traditional management practices and regulations), need for firewood (for fuel), lack of alternative subsistence and economic livelihood sources (wood harvest), and lack of building materials (wood harvest), and economic reliance on mangroves generally. Regarding wood harvest, household surveys indicated that harvest of wood for sale was limited. Survey responses indicate that wood use primarily serves subsistence needs (93%) rather than being sold commercially (7%). When sold, wood primarily went to family members or other members of the community.

Figure 20. Evidence of deadwood harvest in cyclone damaged mangroves, likely for direct use as firewood by local communities.

Underlying Causes

Community consultations and household surveys indicate that the underlying causes for the direct threats identified are similar to those observed in other mangrove areas. These include lack of understanding of existing regulations and management rules (regarding traditional management practices and regulations), need for firewood (for fuel), lack of alternative subsistence and economic livelihood sources (wood harvest), and lack of building materials (wood harvest), and economic reliance on mangroves generally. Regarding wood harvest, household surveys indicated that harvest of wood for sale was limited. Survey responses indicate that wood use primarily serves subsistence needs (93%) rather than being sold commercially (7%). When sold, wood primarily went to family members or other members of the community.

Rewa Delta (Rewa & Tailevu Provinces)

Site Description

The Rewa Delta comprises Fiji's largest mangrove ecosystem, encompassing an area of approximately 7,110 hectares, and is a recognized priority site for conservation by the Government of Fiji (MoE 2018). A number of communities continue to reside within the delta, with mangrove management and extractive use rights shared between villages. The delta is composed of two primary mangrove communities: a seaward fringing assemblage dominated by *Rhizophora* spp. and a landward or hinterland *Bruguiera gymnorrhiza* dominated forest. Findings from Phase 1 of the project and field research conducted in 2019 as well as follow up socio-economic surveys shows that, while there is some extractive harvesting pressure within the Rewa Delta, it is small scale and localized in extent. The management of mangroves within the Rewa Delta is regulated through a moratorium enacted in 2013 that prohibits commercial logging but allows for subsistence extraction by local communities, with predominately *Bruguiera gymnorrhiza* extracted for use as timber in community housing and squatter settlements (Conservation International 2018). While extraction is localized and small-scale, there are concerns that an increased influx of people migrating from inland rural areas to coastal communities will subsequently drive demand for construction materials needed to build new houses (Conservation International 2018). For instance, the Fiji Bureau of Statistics census (2017) reports an increase in the proportion of people residing in urban settlements from 37.2% in 1976 to 55.9% in 2017.

Mangrove Loss Due to Tropical Cyclones

In a review of DoDD and mangrove loss, Cameron *et al.* (2021) estimated that 58% of mangrove loss in Rewa and Tailevu provinces could be attributed to tropical cyclones. However, comparison of mangrove extent in satellite images from 2010-2022 suggests that the vast majority of mangroves have recovered from cyclone damage. Widespread, persistent cyclone damage of the like present in Navitilevu Bay is not seen in the Rewa Delta.

Drivers of Mangrove Deforestation and Degradation

Direct Threats

Overview

In one study conducted in the Rewa Delta, it appeared that mangrove degradation near to the villages was primarily due to human activities such as over-harvesting, bark removal, sapling damage, discarded domestic waste, and domestic animals grazing freely (Dayal, et al, 2022). Additionally, tree species such as lemons, guava, and papaya, proliferated in sites near human habitation, thus reducing mangrove floral integrity of these areas. Dayal *et al.* (2021) noted that villagers were generally aware of sustainable practices, but it was also evident that mangroves near the village were degraded. A preliminary map of drivers in the Rewa Delta (Figure 21. Map depicting key findings relating to mangrove loss and disturbance in the Rewa Delta.) and situation model (Figure 22. Situation model (draft) mapping causal connections between underlying causes, direct threats, and biophysical impacts resulting in mangrove loss, deforestation, and degradation in the Rewa Delta. Question marks and dashed lines represent uncertainties in factors and links, respectively.) were developed through discussions with CI-Fiji staff and consultants familiar with DoDD in Rewa and Tailevu and data collected with communities.

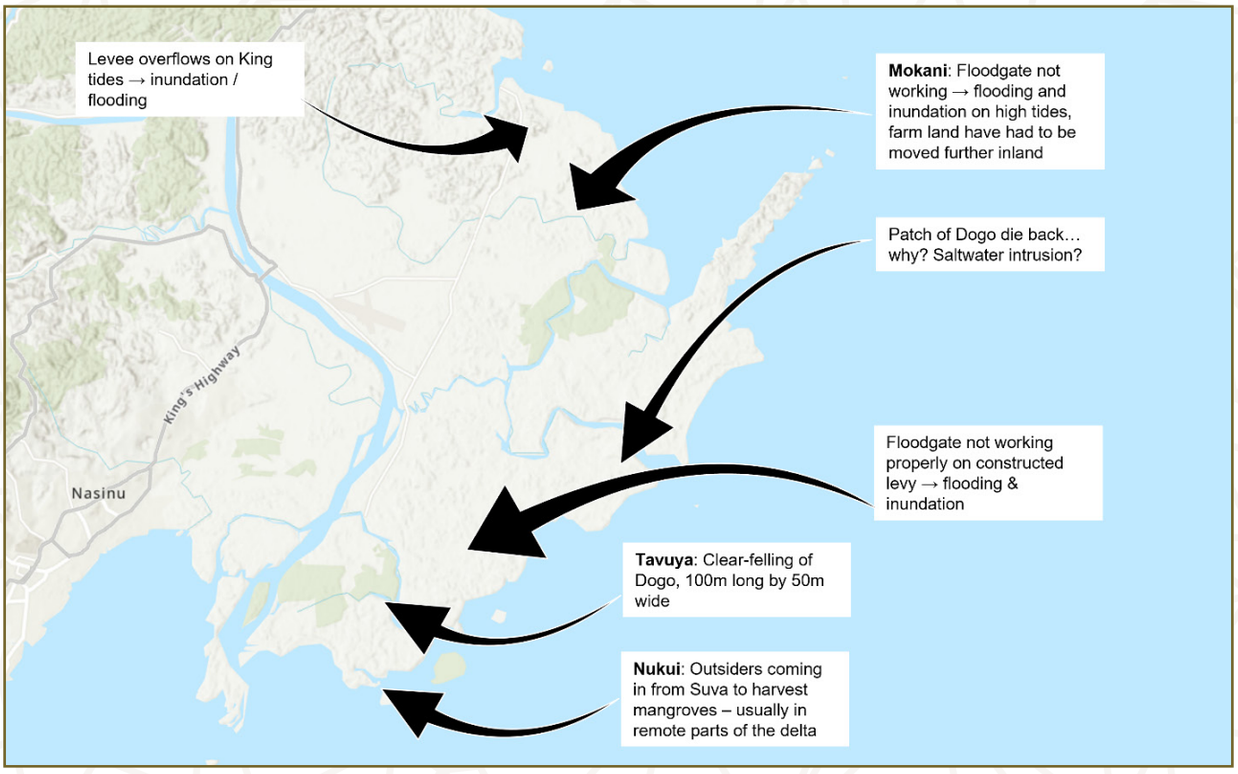


Figure 21. Map depicting key findings relating to mangrove loss and disturbance in the Rewa Delta.

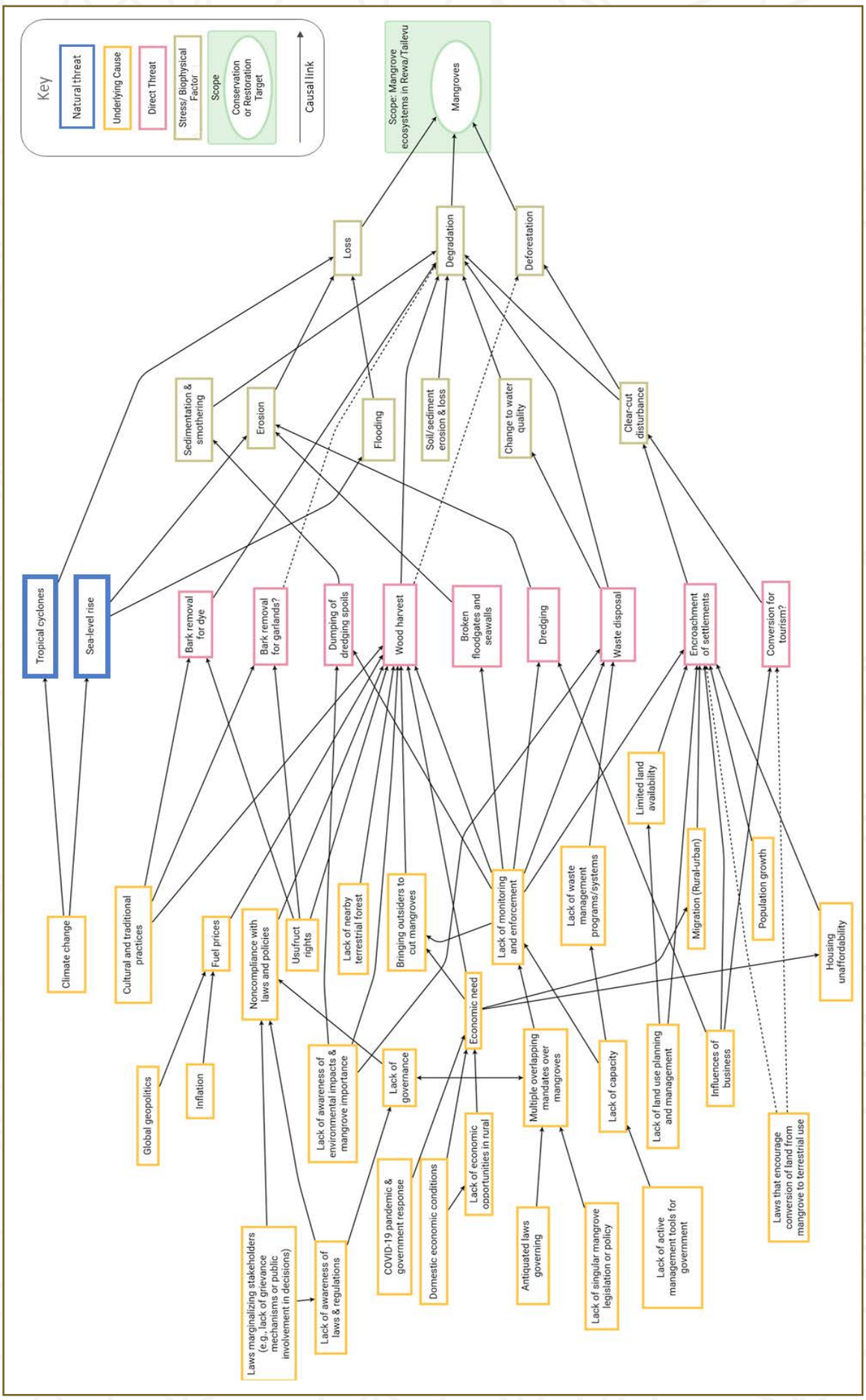


Figure 22. *Situation model (draft) mapping causal connections between underlying causes, direct threats, and biophysical impacts resulting in mangrove loss, deforestation, and degradation in the Rewa Delta. Question marks and dashed lines represent uncertainties in factors and links, respectively.*

Wood Harvest

The management of mangroves in the Rewa Delta is regulated through a moratorium enacted in 2013. It prohibits commercial logging but allows for subsistence extraction by local communities. Additionally, *Bruguiera gymnorrhiza* is extracted for use as timber in community housing and squatter settlements and is highly valued as a fuelwood for use in traditional Hindu crematorium ceremonies, given its high calorific content and density. Parts of the Rewa Delta remain subject to extraction for this use, particularly where mangroves are situated in close proximity to main roads that enable ease of transportation (Conservation International, 2018).

In 2022, household surveys and community consultations were used to collect additional data on wood harvest. Based on these results, harvest of wood from mangroves is a direct threat to mangroves. Some 94% of respondents in Rewa and 87% of those in Tailevu identified wood harvest as a mangrove use that they or other members of the community practice. A majority of the respondents indicated that they use mangroves for collecting firewood (Rewa: 93%, Tailevu: 87%), whereas a smaller percentage indicated logging use (Rewa: 10%, Tailevu: 6%). When asked what people do with the wood and other products harvested from the mangroves, the majority of respondents indicated they were used for firewood, followed by building materials, medicine, dye, and sale of wood (Table 8. Responses from communities surveyed near mangroves in Rewa and Tailevu Provinces to the question, "What do you or others do with the wood or other products you harvest from the mangroves?"). Survey responses indicate that wood use appears to primarily serve subsistence needs (Rewa: 96%, Tailevu: 92%) rather than being sold commercially (Rewa: 5%, Tailevu: 8%).

Estimates of the area of mangroves harvested varied widely. The survey used a rugby field, which vary in size from 0.72 to 1.01 ha, as a reference and asked about the size of the area of mangroves harvested per month. In Rewa, 78% estimated one quarter rugby field, 16% estimated one half a rugby field, and 6% estimated one full rugby field worth of mangroves was harvested per month, for a weighted average of 0.24-0.33 ha/month. In Tailevu, 76% estimated one quarter rugby field, 15% estimated one half a rugby field, and 9% estimated one full rugby field worth of mangroves was harvested per month, for a weighted average of 0.25-0.36 ha/month. However, it is important to note that this question did not specify whether this area estimate represented clearing of mangroves in a single patch or distributed cutting over a large area, and the question did specify geographically which areas were being discussed. Agents for these activities are members of the communities themselves, though some have reported community members bringing in people from outside to harvest from mangroves, possibly in exchange for money.

Table 8. Responses from communities surveyed near mangroves in Rewa and Tailevu Provinces to the question, "What do you or others do with the wood or other products you harvest from the mangroves?"

Province	Rewa		Tailevu	
Wood Use	**# Respondents**	**%**	**# Respondents**	**%**
Firewood	245	98%	91	92%
Building materials	85	34%	22	22%
Medicine	65	26%	20	20%
Dye	33	13%	13	13%
Sale	7	3%	5	5%
Total Respondents	**251**	**100%**	**99**	**100%**

These results agreed with surveys conducted in two villages in the Rewa Delta in 2021, which found that the main benefits the villagers received from the mangrove forests were collection of firewood for domestic use, materials for house building and fenceposts, and materials for traditional uses such as medicines and making dyes (Dayal et al., 2022).

Data from a study by Cameron *et al.* (2021) supported this assessment, noting that extractive harvesting pressure within the Rewa Delta is small in scale and localized in extent. In sites assessed in Rewa and Tailevu, impacts on mangrove forest structure were caused through human activities related to both selective harvesting and small-scale (<1 ha) clearance in small, dispersed patches, with mangroves extracted for use as fuelwood and timber.

Land Reclamation and Dredging

Pollution from dredging for flood mitigation has been identified as a major threat to mangroves (Watling, 2013, Cameron et al, 2021). In 2022, 18 major dredging activities were being undertaken in the Rewa River and these were to maintain the discharge capacity and avoid any major flooding (FBC News, 2022). A dredging project in the Ba River has increased efforts to safeguard the township of Ba and the neighbouring communities from flooding.

Dumping of dredging spoils in the Rewa Delta has been damaging to mangroves, resulting in mortality of mangrove trees. There appears to have been little or no attempt in either location to dispose of dredge spoil away from mangrove areas; or to contain and manage dredge spoil so as to stop it spreading through the mangroves (SPREP, 2014).

Encroachment of Settlements

Poorly conceived or implemented large-scale mangrove reclamation and piecemeal or unsound development in peri-urban areas have been identified as major threats to mangroves in Fiji, especially in Rewa Delta (Watling, 2013, Cameron et al, 2021). Encroachment of unregulated, informal residential settlements into mangrove areas within the Suva peri-urban areas has been increasing over the past 10 years. Mangrove extraction occurs in these areas, especially cutting for daily firewood use, house posts, and other building needs and dye for making "*masi,*" thus linking settlement expansion with other direct drivers of mangrove deforestation and degradation. Movement into informal settlements increased during the COVID-19 pandemic when people lost homes or could not afford rent because of loss of income. Associated increases in mangrove resource use for firewood and fisheries also occurred during this time. The rural-to-urban migration trend began before the pandemic and is expected to continue after the effects of the pandemic wane, resulting in an increase in informal settlements at the periphery of mangroves, as discussed in Section 4.2. In the socioeconomic survey, 6% of respondents in Rewa and Tailevu provinces identified land reclamation for settlements as a driver of mangrove cover change, while 31% identified building materials as the end use of wood harvested from mangroves; this suggests that degradation from wood harvest may be having a larger impact on mangroves than clearing for construction, though this hypothesis requires additional investigation and validation in the field.

Transport Channels

Construction of transport channels in mangroves has been identified as a potential DoDD through discussions with communities and experts familiar with the region, but additional analysis is required to determine the location and size of areas affected by such practices and the associated agents.

Waste Disposal

Waste dumping and disposal in mangroves has been identified as a potential DoDD (Dayal *et al.,* 2022), but additional analysis is required to determine the location and size of areas affected by such practices and the associated agents.

Sea-Level Rise and Coastal Erosion

Coastal erosion is evident along portions of the coastal and river margins of the Rewa Delta. The degree to which this is being caused by sea-level rise due to climate change or by localized actions requires additional data collection and analysis. Broken or damaged floodgates and seawalls were identified as the cause of recent increased erosion and loss of mangroves in several communities, and dredging may also be a factor

(Figure 21. Map depicting key findings relating to mangrove loss and disturbance in the Rewa Delta.).

Underlying Causes

Community consultations and household surveys indicate that the underlying causes for the direct threats identified are similar to those observed in other mangrove areas. These include lack of understanding or adherence to existing regulations and management rules (regarding traditional management practices and regulations), need for firewood (for fuel), lack of alternative subsistence and economic livelihood sources (wood harvest), lack of building materials (wood harvest), and economic reliance on mangroves generally. Regarding wood harvest, household surveys indicated that harvest of wood for sale was limited. Survey responses indicate that wood use primarily serves subsistence needs (93%) rather than being sold commercially (7%). When sold, wood primarily went to family members or other members of the community.

Synthesis of Drivers of Deforestation and Degradation Across Three Study Sites

By comparing these sites, we aim to understand the threats faced by mangroves in Fiji, including the similarities and differences in drivers throughout the country. These three sites represent some of the largest and most significant mangroves in the country from social, ecological, economic, and climate perspectives. They are located on Viti Levu, the largest island in Fiji both in terms of land mass and population. The sites are distributed in different political jurisdictions, socioeconomic contexts, and climates. They represent a range of social, economic, and ecological conditions, aiming to provide a holistic picture of mangrove DoDD at a national scale while at the same time identifying differences in the importance of each driver on mangroves at the local scale. However, it is important to recognize that Fiji is a diverse nation comprised of hundreds of islands spread over tens of thousands of square kilometres in the South Pacific. Therefore, while this study captures the most important drivers and patterns of mangrove use at the national scale, the study of these three sites may not encompass all anthropogenic factors influencing mangroves in Fiji. For this reason, the site-specific studies are supplemented by the national-scale expert consultations and literature reviews presented in Sections 4.1 and 4.2.

Based on literature reviews, socio-economic surveys, satellite imagery analysis, and field visits, there are commonalities between the three study sites that represent broader patterns in mangrove DoDD at the national scale. Across all three sites, the most reported mangrove use was wood harvest. Most people use mangrove wood as firewood (96 to 97% of respondents[1]), with low levels of variability in the frequency of this use between sites. Use of mangrove wood for firewood was far more common than use for building or construction materials (6-38%). The underlying causes of mangrove wood extraction for firewood likely depends on local context, since Indo-Fijian communities use firewood for funerary purposes whereas Indigenous Fijians do not (CI, 2020). Traditional uses of mangroves are also widespread, including for medicine (24 to 42%) and for dye (6 to 17%), highlighting the cultural importance of mangroves as has been identified at the national scale. Sale of mangrove wood does not appear to be a major driver of wood at any of these sites (3 to 9%) and may not be a significant motivation for mangrove harvest at a national scale. Use of both dominant mangrove tree species was common, but communities tend to favour *"dogo"* (*Bruguiera*) (60-94%) rather than *"tiri"* (*Rhizophora* spp.) (43-71%) across all sites despite the geographic variation in the relative dominance of these species. Regarding the size of mangrove area harvested, these estimates ranged from 0.24 to 0.67 ha per month across the three sites, indicating that small patch clearance is the most common practice across all three sites. The relatively small scale of patch clearance as reported by communities; selective logging practices observed at some sites (such as within Rewa Delta); and the lack of large-scale land clearing at any of these sites within the past 10 years, as observed through inspection of high-resolution satellite imagery, indicate that mangrove uses identified at this site may primarily be driving forest degradation rather than deforestation.

There are also key differences in patterns and drivers of mangrove deforestation, degradation, and loss between the three sites. When socio-economic surveys evaluated community perceptions on the change in mangrove area over time, most respondents perceived an increase in mangrove area in Rewa Delta and

[1] Numbers reported in this section represent the percent of socio-economic survey respondents, aggregated at the site level.

Ba Delta. In contrast, respondents in Navitilevu Bay perceived a decrease in mangrove area, likely because of the lack of recovery after successive major tropical cyclones. These differences – as well as satellite imagery analysis – show large differences in TC impacts on mangroves, which are reflected in public perceptions of mangrove change. Drivers also vary between sites depending on geographic and social contexts. For example, encroachment of settlements poses the biggest risk in Rewa Delta due to its proximity to Suva, the country's capital and largest city, population growth, and a tendency for rural-to-urban migration. This may drive both conversion of mangroves as well as increased resource use pressure (e.g., building materials). In contrast, Ba Delta and Navitilevu Bay have primarily rural and agricultural settlings with smaller cities and towns. Drivers like tourism development are also not distributed evenly throughout the country, with tourism centers like Nadi (not one of the three study cites) much more likely to lose mangroves to expansion of ports and resorts (SPREP, 2014; Cameron *et al.,* 2021).

5. THEORY OF CHANGE FOR ADDRESSING MANGROVE DEFORESTATION, DEGRADATION, AND LOSS

During this DoDD study and given the mandate to assess the feasibility of a Fiji Blue Carbon project, preliminary strategies were developed by identifying opportunities and designing activities that could achieve project objectives. Under the theory of change framework used for this study, a strategy is defined as, "a set of activities with a common focus that work together to achieve specific goals and objectives by targeting key intervention points, optimizing opportunities, and limiting constraints," (CMP, 2020). This work built on the situation models developed in the previous section to begin to identify specific interventions linked to DoDD (both direct threats and underlying causes) as well as restoration interventions to improve the health of mangrove ecosystems and the interdependent, ecological, human, and other-than-human communities.

5.1 Site-Specific Strategies and Opportunities for Addressing Mangrove Loss and DoDD

Pilot Site Selection for a Fiji Blue Carbon Project: Navitilevu Bay

As a result of the analyses performed for each of the three study sites, Navitilevu Bay in Ra Province shows the most potential as a pilot project for mangrove forest carbon offsets due to extensive cyclone damage and lack of recovery as well as strong community interest in restoration developed through stakeholder engagement. Project activities selected for this site include augmented or assisted recovery.

The restoration potential area at Navitilevu Bay was estimated based on a mangrove cover change mapping exercise conducted using remote sensing analysis of satellite imagery. Areas considered suitable for regeneration were those damaged by TC Winston (2016) that have not recovered or regenerated by 2022. These areas are primarily large patches of bare mud and woody debris with snapped and windthrown *Bruguiera* trees. They are also characterized by an absence of recruitment, as indicated by lack of seedlings and saplings, resulting in a low probability of short-term natural regeneration and recovery. For practical purposes related to the implementation of restoration activities, only areas with a minimum size of 0.01 ha (100 m^2) were included in the estimate of areas with restoration potential.

Table 9. Potential size of areas for restoration in Navitilevu Bay mangroves by zone and in total.

Potential Restoration Area (Cyclone Damage with No Recovery, Patches > 0.01 ha)							
Zone A	Patches	Area (ha)					
		Total	Mean size	Median size	Max size	Min size	Patch count
Primary	Largest 25 patches	37.45	1.63	0.74	6.38	0.41	23
	Largest 50 patches	43.19	1.00	0.41		0.19	43
	All patches	57.36	0.12	0.02		0.01	463
Secondary	Largest 25 patches	1.28	0.64	0.64	0.77	0.51	2
	Largest 50 patches	2.53	0.36	0.29		0.19	7
	All patches	6.25	0.06	0.03		0.01	105
Total	**Largest 25 patches**	**38.73**	**38.73**	**38.73**	**6.38**	**0.41**	**25**
	Largest 50 patches	**45.72**	**45.72**	**45.72**		**0.19**	**50**
	All patches	**63.61**	**63.61**	**63.61**		**0.01**	**568**

Limited recovery since TC Winston may be due to (a) a lack of suitable physical recruitment space due to high levels of downed wood; (b) downed wood altering soil chemistry; (c) reductions in seedlings and saplings post-TC Winston; and (d) limitations to seedling production and dispersal because of reduced hydrological connectivity. Further site-specific research could seek to investigate the biophysical conditions imposed by a legacy of past TC disturbances which may be hindering mangrove recruitment. For example, the physical removal of coarse woody debris may alleviate issues around space for seedlings as well as reducing localized impacts on soil chemistry caused from decomposition, provided this can be achieved without compacting soils. Moreover, the clearing of tidal creeks could improve hydrological connectivity which is necessary for the dispersal of propagules from healthy mangrove estate and could drain waterlogged soils. These hypotheses will be tested through implementation of diverse restoration activities and monitoring practices.

Significance of a Restoration Project in Navitilevu Bay

In addition to the climate benefits of a potential Fiji Blue Carbon project, mangrove restoration in Navitilevu Bay is likely to provide many co-benefits to biodiversity and communities. The social and economic data collected with stakeholders highlights the importance of fisheries – and the mangroves that support them – to the livelihoods of local communities. In addition, mangroves provide many climate change adaptation benefits, serving as a buffer to storm surges and reducing erosion.

Fishing is essential to the lives and livelihoods of these communities. Mangroves, as nurseries of the sea, are essential to fisheries. In socio-economic and livelihood surveys, 90% of those interviewed were fishers. Almost all fishers were both subsistence and commercial fishers. The numbers of fishers ranged between two to six per household, with men and women equally participating in fishing activities. Fishing activities for women mainly focused on mangrove areas and mudflats, while most men fished in and outside of reef areas. Target species in mangroves included crabs, shrimp, mud lobster, oysters, and fish. Typical fishing practices in mangroves include fishing lines, along the fringes of mangroves, and hand nets, which are used both for day and night fishing. When conducting site visits with local communities, one community leader estimated a 50% decrease in harvest of mud crab after TC Winston in 2016. This is potentially associated with the loss of habitat resulting from the cyclone damage, especially considering that ~15% of the mangroves have not recovered (Table 7. Areas of mangrove cover change by class for Navitilevu Bay.), highlighting the potential positive impact of a mangrove restoration project on fisheries.

Based on socio-economic data, primary sources of income in communities around the bay were from fishing activities, followed by the sale of agricultural products. A smaller number of respondents had some permanent jobs or received remittances. Secondary sources of income also included fishing, agriculture, and remittances, while some relied on casual work in dredging companies and road construction. The main sources of subsistence livelihoods were fishing and agriculture.

Fishing is important both for subsistence and personal use as well as for sale and income generation. Crabs, mud lobsters, prawns, and shrimps, *kuka*, *kanace*, *salala*, *damu*, *nuqa*, *saqa*, and *ika loa* are commercial species sold by community members, while *kurukoto*, *qitawa*, *ki*, *matu*, *damu*, *maleya*, *kaikai*, and crabs are caught for subsistence. Because selling activities are mostly semi-subsistence, most species caught for home consumption are sold when there is a surplus. There are, however, fishers whose livelihood is focused primarily on selling at municipal markets.

Management interventions in mangroves exist throughout Fiji, but community adoption, awareness, and enforcement are limited. Some 33% of respondents have seen some form of unsustainable fishing, with nearly all cases related to the use of *duva* (plant-based poison) and one relating to the use of dynamite. The use of *duva* is still widespread despite being banned. This unsustainable method of fishing is usually used by women in mangroves, reefs, mudflats, and sandflats. Most community members surveyed are aware of management interventions in mangroves (53%), however, there were few management initiatives in place in sites visited. Some respondents were unaware of management practices that may be in place, as most of these regulations are known only to those who actively fish. Improvement of sustainable fishing practices

and raising awareness are two potential project activities that could be incorporated into a project, with the potential of increasing the resilience of fisheries and supporting food and economic security for local communities.

Potential Strategies and Activities for Additional Sites

Despite the selection of Navitilevu Bay as the best site to pilot a blue carbon project, it may be possible to develop a "bundled" or "grouped" blue carbon project that includes additional sites and pursues both conservation (avoided deforestation, improved forest management) and restoration. In such a case, a portion of revenue from the sale of carbon credits generated via restoration activities at Navitilevu Bay could be used to support improved management practices at other sites. A forthcoming spatial analysis of mangrove change across additional geographies will help to quantify deforestation and degradation as well as carbon-crediting potential of additional sites.

Ba Delta & Yanuca Island

Section 4.3 highlights some of the main DoDD findings from field research and interviews with communities which reside in and around the Ba Delta and Yanuca Island. Results indicate that an assisted restoration project within the Ba Delta is unnecessary given that most areas damaged by the succession of tropical cyclones have largely recovered and display regrowth. On Yanuca Island, however, there remains a ~20 ha interior patch of bare mud and woody debris that shows limited recovery after more than six years. A site visit confirmed that seedlings and saplings are present in this patch as of 2022, with establishment concentrated on the periphery of tropical-cyclone damaged areas, demonstrating improved recovery as compared to the complete lack of mangrove establishment observed in a 2019 visit. An assisted restoration project is therefore potentially viable at this site, particularly given strong community support, the use of the island by local fishers, and the importance of the wider seascape as a Marine Protected Area. Yanuca Island has not been included as a project site in the current budget allocation given funding limitations but could be included in the future.

Due to its size and significance to local communities, ecosystems, and climate, the Ba Delta remains a high-priority site for forest management and conservation. Based on discussions within the CI-Fiji team and results of community consultations, potential activities for improving conservation outcomes include:

- working with communities to stop dynamite fishing;
- working with government to strengthen EIAs (Environmental Impact Assessments) and their enforcement (e.g., dumping of sugar factory wastewater);
- working to reduce impacts of dredging and sand mining activities, especially illegal waste disposal and actives causing the greatest impacts to mangroves;
- conducting monitoring patrols and enforcement of existing laws, policies, and regulations to ensure remote areas are not logged;
- conducting a study to evaluate the effectiveness, costs, and benefits of seawalls to reduce erosion;
- working with government, local partners, communities, and business to implement waste management programs;
- conducting skills training to create alternative livelihoods to reduce extraction from mangroves for subsistence and commercial purposes;
- strengthening traditional and community management; and
- raising awareness among stakeholders of the importance of mangroves and the impacts of human activities identified as DoDD.

Rewa Delta (Rewa & Tailevu Provinces)

Section 4.3 highlights some of the main DoDD findings from field research and interviews with communities residing in and around the Rewa Delta. Results indicate that a standalone avoided deforestation project would be unlikely for this area, given the small-scale, patchy deforestation and degradation, limiting the ability to generate substantial volumes of carbon offsets. The Rewa Delta, however, remains a high priority site and forest management and conservation. Based on discussions within the CI-Fiji team, Ministry of

Forestry, and results of community consultations, potential activities for improving conservation outcomes include:

- working with communities to shift from clear cutting to selective logging, including co-creation of sustainable harvest plans;
- conducting monitoring patrols and enforcement of existing laws, policies, and regulations to ensure remote areas are not logged;
- improving the condition of flood gates and carrying out levee remediation works;
- working with government, local partners, communities, and business to implement waste management programs;
- conducting skills training to create alternative livelihoods to reduce extraction from mangroves for subsistence and commercial purposes (e.g., boat repair training programs);
- strengthening traditional and community management; and
- raising awareness among stakeholders of the importance of mangroves and the impacts of human activities identified as DoDD.

5.2 Legal and Policy Strategies and Opportunities for Addressing DoDD

The legal and policy analysis conducted for the DoDD study provided the following recommendations for improving the legal and policy structures and instruments for mangroves management.

- Mangroves should be regarded as a matter of national importance, with regulations developed and amendments made to existing legislations to harmonize laws and assist in practical implementation.
- The absence of specific legislation and policy on mangrove may add to the lack of centralized responsibility. Current legislation, such as the Environment Management Act (2005), does not include provisions for the sustainable management of mangroves. Recommendations to improve legislation and policy include updating the (proposed) Management of Mangrove Regulation enabled under the Environment Management Act (2005) and the Forest Bill No 13(2016) to supersede the Forest Decree (Act) of 1992 to better reflect and formalize customary sustainable management. For example, include harvesting for fuelwood and the ability to establish "taboo" periods, and work with iTaukei to undertake monitoring to ensure extraction is sustainable.
- A clear definition of mangroves is needed to define which department or ministry is responsible for the resource. If it is, per se, a forest resource, then the Ministry of Forestry should be responsible for mangrove management. If it is a foreshore resources, then the Ministry of Lands and Mineral Resources should take lead.
- A fragmented and uncoordinated system is currently in place for obtaining approvals and decisions on mangroves from key government departments and ministries. Once an application for foreshore development is received by Ministry of Lands and Mineral Resources, an application is then submitted to Ministry of Fisheries, Department of Environment, Department of Town and Country Planning, Provincial Administration (Ministry of iTaukei Affairs), and other relevant ministries for comments within 30-days period. If no comment is received within the mandated period, then it shall be deemed there are no more comments. This system reinforces the multiple overlapping mandates for regulation of mangrove resources, causing confusions and potentially facilitating undesirable outcomes.
- Improved communication and clear reporting mechanisms amongst government agencies are required for work and decisions relating to mangroves. A guideline such as a Standard Operating Procedure should be developed and made available to other government agencies and private entities by a responsible authority to ensure that approvals processes are understood within clear timeframes.
- All existing land access and resource development legislation should be reviewed and harmonized for consistent application of mangrove protection. Any current application that may be inconsistent with mangrove ecosystem protection should be removed. General application of provisions should be carried out to enhance mangrove conservation and restoration.
- Current regulations do not cover the value appraisal of restoration and compensatory payments amongst its scope of fines and penalty provisions. Inventory valuation of mangrove ecosystem

should be ascertained to include the value of restoration and special indigenous rights owners of registered qoliqoli (traditional fishing rights).

- Periodic assessments and resource audits should be conducted to highlight the value of ecosystem services provided by mangrove ecosystems. This is a reference point for the consideration for the Minister responsible for Environment regarding to application for development proposals.
- There is presently a lack of public awareness about mangroves, their importance, and the rights, laws, policies, and regulations that apply to their protection and use. Mangroves are still treated as a common resource despite such provisions.
- Improved enforcement, monitoring, and evaluation is required, as applied through existing policies, legislation, and procedures. This is important if the intended outcomes are to be achieved.

In addition to the specific recommendations provided above, the legal and policy analysis was used to produce a preliminary framework for a theory of change (Table 10. Key law and policy elements for developing a theory of change to reduce mangrove deforestation and degradation in Fiji.) and identify potential opportunities for implementing such strategies. Natural resource policies, laws and regulations articulate clear intentions and substantial legal provisions rendering recognition of various sustainable environmental management and conservation approaches. This is evident from recent developments (post-2000) in policies, laws, and regulations in Fiji and in the international context. For example, there have been two iterations of Forest Laws since 1992, with the latest being Forest Bill No. 13 of 2016, currently going through the Parliamentary process of being made law. All resource laws are clear in their structure regarding administration powers and in terms of defining offences and penalties. The Climate Change Act (2021), for example, provides such definitions under Part 17 and other orders related to breaches of the Act. Under sections 107-108, the court may issue other orders requiring the restoration of the environment to as near to its original condition as possible, with costs to be borne by the person convicted of the offense. In addition, in Part 5 of the Climate Change Act requires that all State entities ensure that any decision or any policy program or process developed or implemented by the State entity adequately take climate change into account. Section 33(m)-mandates the development and maintenance of a publicly accessible information platform including amongst others, information regarding national climate, coastal zones, river deltas, agriculture and forestry, and biodiversity. The Act also recognizes the principles of inter-generational equity, which is supported and protected through an equitable, and environmentally sustainable where diversity and productivity of the environment are protected and enhanced for the benefit of future generations. However, strict enforcement and compliance is key to these provisions and their success.

Table 10. Key law and policy elements for developing a theory of change to reduce mangrove deforestation and degradation in Fiji.

Goal	Sustainable management, protection, and restoration of mangrove ecosystems under designated acts and regulations under one responsible ministry
Strategic Directions	• Shared vision and goals for deforestation reduction must be reached. • Rights and interests of stakeholders must be clarified and accepted. • Monitoring framework must be defined and agreed upon.
Outcomes	• Broader institutional context must be developed: National government must endorse new measures aimed at achieving the goals and remove conflicting policies. • A consistent Framework must be implemented: High-impact, locally devised interventions and policies should be designed and carried out.

Action Areas (Interventions)	• National-level policy direction and advocacy work • Resource mobilization • Promotion of changes to existing laws, policies, regulations, and frameworks • Fund raising for advocacy and implementation work • Capacity-building, raising awareness, and creation of opportunities for effective interactions • Spatial planning • Resource inventory surveys and data interpretation (e.g., drone mapping, inventories)

5.3 Social, Economic, Cultural, Traditional, and Governance Factors as Strategies and Opportunities for Addressing DoDD

Support for Traditional Ecological Knowledge

Although classified by some as "non-scientific," traditional knowledge has been accumulated through centuries of extensive trial-and-error experiences from which people have learned, and such knowledge can be applied to improve outcomes for mangroves (Veitayaki 2004). Because of their long association with mangroves, communities have a wealth of traditional empirical and scientific knowledge on the direct and indirect benefits of mangrove ecosystems. Awareness of community knowledge and utilization patterns of mangrove ecosystems and their services is integral to conservation and management (Thaman et al., 2013). Time-tested indigenous fishing knowledge (IFK) of Fiji and the Pacific Islands is seriously threatened due to the commercialization of fishing, breakdown of traditional communal leadership and oral knowledge transmission systems, modern education that does not value such knowledge, and migration of younger generations to urban areas for work and study (Veitayaki 2002, Kitoleilei et al., 2021). Traditionally, during fishing activities, older fishers, highly skilled and knowledgeable with strong leadership qualities, were responsible for designating roles to the young fishers, sharing their knowledge, advising, and demonstrating techniques, thus transmitting their knowledge through hands-on experiences "in the field." For example, in a study of ecosystem services in Kubulau Bua, cultural services benefits included services of spiritual and religious value (through the use of *yaqona*, *tabua*, mangrove dyes, and mats), knowledge gain, and the education.

In recent years, there has been an increase in socio-economic management of mangroves that incorporate both traditional and scientific knowledge. These efforts recognize the needs of local inhabitants while at the same time implementing a biodiversity conservation agenda (Vierros et al., 2010; Pollard et al., 2015). These initiatives also provide a medium for documenting traditional knowledge and conservation methods, and they promote local community, cultural, and spiritual benefits (Thaman, 2002). In Fiji, native communities possess in-depth knowledge of coastal fisheries that provide baseline data for monitoring the effects of environmental degradation and efficacy of conservation initiatives (Thaman et al., 2014). Greater appreciation for traditional knowledge will provide additional insight into how the people use and depend on their environment and its resources.

While the loss of traditional ecological knowledge may be an underlying cause of deforestation and degradation in mangroves, there is an opportunity for a blue carbon project to build upon these existing programs and create new programs. A blue carbon project can support communities by facilitating the sharing and propagation of such knowledge within and across communities and generations. Such knowledge can also be integrated into mangrove management and conservation, with communities leading, taking ownership, and providing key insights as to changes to mangrove ecosystems and potential interventions. Considering the long history of sustainable traditional use of mangroves, traditional use rights of communities, and the demonstrated value of both traditional and scientific ecological knowledge, a collaborative process and co-management arrangement to facilitate a bottom-up approach using traditional institutions, knowledge, and practices should be considered as a viable alternative to reduce

deforestation/degradation and improve conservation and sustainable livelihood outcomes (Veitayaki 2008).

6. CONCLUSIONS AND NEXT STEPS

6.1 Restoration Plan Development

Proposed Timeline for Development and Implementation

- Draft restoration plan (completed in July 2023), including restoration goals and objectives aligned to a workplan of activities.
- The implementation of restoration activities will use a staged approach, with small-scale trials to determine which techniques have the highest success rates (e.g., hand-planted propagules vs. out-planting of nursery-raised seedlings).
- Results of small-scale trials will inform following larger-scale restoration efforts.

Project Design Document development

Project Idea Note (PIN) Draft to be completed by July 2023. This will draw on information already available as well as results from field work conducted in November 2022. We will use Plan Vivo as the voluntary market standard, but use (as far as resources allow) a VCS (Verified Carbon Standard) methodology (VM0033) for assessing carbon benefits from the project as this is the most rigorous methodology available. A draft of the Project Design Document (PDD) is expected by April 2024.

Further biophysical research requirements

The following biophysical assessments are important to determine the viability of project success and accurately measure carbon and biodiversity benefits. However, their implementation is subject to budget constraints and the ability to source specialised equipment (e.g., from universities):

a. **Hydrological studies to determine impediments to tidal inundation (e.g., blockages created by dead and downed wood debris):** This requires the procurement and installation of water level loggers (~NZD 10,000) which will provide the data to assess whether the removal of blockages creates conditions favourable for mangrove re-establishment.

b. **Installation of equipment to assess sediment accretion and subsequent soil carbon burial resultant from project activities:** Simple evaluation could be conducted using sediment pins or feldspar marker horizons for cost-savings, but more accurate methods should also be considered [2]. Currently, the project site is expected to be losing soil (erosion) and slowly subsiding (compaction) due to a lack of fine root turnover from living mangrove trees; as fine roots decompose, they form a source of organic (autochthonous) soil carbon, but this process is currently absent from potential restoration sites due to a lack of living mangrove trees. Once replanting activities have been completed and trees in the restoration site mature, this autochthonous soil carbon burial process will be reinstated. Sediment pins will facilitate an estimation of sediment accretion (and soil carbon gain) over time.

c. **Greenhouse gas (GHG) analysis to assess baseline soil carbon dioxide (CO_2) and methane (CH_4) emissions:** Currently, the restoration site is likely acting as a net source of CO_2 to the atmosphere through the respiration of microbial communities as they decompose organic matter within soils. Restoration activities such as reinstating hydrological regimes through the removal of dead and downed wood are expected to mediate (lower) this flux, especially because CO_2 diffuses more easily into the air than it does when inundated by water. This is an important component in the scope of work, as it will maximise the amount of creditable emissions reductions and removals generated through project activities.

2 The most accurate means of measuring soil accretion in mangrove ecosystems is through the installation of Rod-Surface Elevation Tables (RSET). These act as the equivalent of benchmarks that surveyors use in terrestrial environments to measure topography. RSETs are composed of steel rods that are manually hammered down through softer soil layers until the tip reaches underlying bedrock. RSETs account for both subsidence (as mangrove forests accumulate soil, the weight at the top leads to compaction and subsidence) and accretion processes (mangrove forests accrete sediment by trapping riverine/oceanic sediment ["allochthonous" sources] as well as through fine root turnover and burial ["autochthonous" sources]), measure of net overall surface elevation change resulting from the difference between the two processes. However, RSETs are relatively costly to purchase and install (~AUD $1,500 per RSET, with the project requiring at least 5) and require specialist measuring equipment (the cost of a portable measuring arm is ~AUD $4,000) and training. However, we are not aware that such technology has ever been deployed in Fiji, providing an opportunity for new scientific research and technical training for project staff and community members.

d. **Baseline biodiversity surveys using a before-after/control-impact methodology:** A key goal of the project is to measure co-benefits (alongside carbon) such as improvements in biodiversity metrics. A baseline survey of keystone and/or indicator fauna species for mangrove ecosystems (e.g., worms, molluscs such as snails, and crabs) is planned for the July 2023.

6.2 Importance of the DoDD Study for the Fiji Blue Carbon Project

Project Design

Understanding the drivers of deforestation and degradation and the potential for addressing these as part of a blue carbon crediting project is a first step in project design. Projects can only generate and sell carbon credits if they are able produce real, durable, verifiable GHG emissions reductions or removals. To achieve this goal, project activities must be successful in addressing the direct drivers and underlying causes of deforestation and degradation (for emissions reductions projects, such as REDD+) and/or capturing more carbon than would occur in the baseline or "business-as-usual" scenario (for removals projects, such as afforestation, reforestation, and restoration). A valid theory of change provides the framework necessary for achieving these goals because, in order to solve a problem, the cause must be understood. The present study provides preliminary frameworks for each study site – and for mangroves across Fiji – that can be built upon in an iterative fashion throughout the process of project design, development, and implementation. Additional work to quantify mangrove loss, attribute these losses to different causes, and design site-specific strategies and interventions will be conducted to produce fully formed theories of change with the potential to generate carbon credits.

Additionality Argument

This study also forms the basis for an additionality argument for the Fiji Blue Carbon Project. Additionality is a key principle for carbon crediting, and a compelling argument for additionality is required for generating carbon credits from a project validated and verified under high-quality standards. A project is only considered to be "additional" to the degree that greenhouse-gas benefits produced would not have happened without the project (i.e., under the baseline or "business-as-usual" scenario). This study has established the groundwork for developing an additionality argument for a Fiji Blue Carbon project by identifying direct threats to mangroves and using spatial analysis to quantify mangrove cover change. An analysis of historical satellite imagery has also demonstrated the lack of natural regeneration from cyclone damage, indicating the additional benefits of restoration activities at Navitilevu Bay and Yanuca Island. This study has also described elements of common practice, including a lack of existing legislation that would require the activities considered for this project and a lack of enforcement of existing laws for mangrove protection. Further work is needed to strengthen these arguments and bolster them with empirical evidence, including ranking of the impact of each direct threat in terms of mangrove loss and GHG emissions to demonstrate additionality for an avoided deforestation and degradation project and demonstrating that such a project is not financially viable over the long term without some funding from the sale of carbon credits.

Critical Information Gaps

Critical information gaps identified by this study include the following:

- There is a need to perform additional evaluation of direct threats. This includes a threat assessment in order to evaluate and rank the importance of each direct threat in terms of its quantitative impact in causing mangrove deforestation and degradation. There is also a need to evaluate each driver in terms of its underlying causes at a greater level of detail through additional data collection and analysis and examine the likelihood that project activities can influence and reduce deforestation and degradation.
- There is a need for a comprehensive, historical assessment of mangrove extent, loss, and recovery (e.g., following tropical cyclones) at a national scale using remote sensing tools such as otical satellite imagery, spectral indices (e.g., NDVI), synthetic aperture radar (SAR), and classification

methods. The range in estimates of the spatial extent of mangroves in Fiji varies by as much as ~60%, the difference in reported mangrove extent between Giri (2011) and Cameron *et al.* (2021). This creates significant issues with regards to accurately monitoring changes over time or developing a robust baseline for the Fiji Blue Carbon Project. Such data are particularly important for gauging the degree of additionality. For restoration interventions, the GHG benefits of carbon sequestration from assisted regeneration efforts must be compared to those produced by natural recovery post-disturbance. For potential avoided deforestation or degradation activities, historic trends must be analysed across sites. CI is currently performing additional analyses to map mangrove change at the sites considered for this project to address this need, but a comprehensive, standardized, national effort is also required to facilitate future work.

- There is a need to develop a standardised classification system for land use and land cover change in mangroves and adjacent habitats. This should include delineation of mangroves into sub-categories, such as "healthy mangroves", "disturbed mangroves" (i.e., dead mangrove vegetation impacted by tropical cyclones or infrastructure), and "regenerating mangroves", as well as include additional non-mangrove land covers that co-occur with mangroves such as water bodies, unvegetated areas (e.g., tidal mud flats), grazing lands, anthropic development (e.g., human settlements), and terrestrial vegetation. A recent paper by Rodríguez-Zúñiga (2022) describes a national scale mangrove monitoring system in Mexico, which could be used to guide the development of LULC categorisation in Fiji.
- There is a need to build on the socioeconomic studies and methodologies performed by Pearson (2020) and Dayal *et al.* (2022). This is particularly important for the Rewa Delta, where community surveys in conjunction with drone mapping (to identify small-scale patch clearance) will be conducted to assess the viability of an avoided deforestation and/or improved forest management intervention for the Fiji Blue Carbon Project.

REFERENCES

REFERENCES

Agrawal S., Ota T., Hagenstad MSJ., van Aalst M., Koshy K., and Prasad B. (2003). Development and climate change in Fiji: Focus on coastal mangroves. Working Party on Global and Structural Policies, Organization for Economic Cooperation and Development. France: OECD (Organization for Economic Cooperation and Development).

Asian Development Bank (ADB). (2013). Country Partnership Strategy: Fiji, 2014–2018. Asia Development Bank, Manila.

Asian Development Bank (ADB), (2015). Fiji country gender assessment. Asian Development Bank, Manila, Philippines.

Asbridge E., Lucas E., Rogers, K., & Accard, A. (2018). The extent of mangrove change and potential for recovery following severe Tropical Cyclone Yasi, Hinchinbrook Island, Queensland, Australia. *Ecology and Evolution*, Volume 8, Issue 21, p. 10416-10434.

Avtar, R., Navia, M., Sassen, J., & Fuji, M. (2021). Impacts of climate change in mangrove ecosystems in Ba and Rewa deltas, Fiji using multi-temporal Landsat data and social survey. *Coastal Engineering Journal*, Vol 63, issue 3.

Becker, P. (2017). Dark side of development: modernity, disaster risk and sustainable livelihoods in two coastal communities in Fiji. *Sustainability*, 9, 2315

Cahoon, D. R., Hensel, P., Rybczyk, J., McKee, K. L., Proffitt, C. E. & Perez, B. C. (2003). Mass tree mortality leads to mangrove peat collapse at Bay Islands, Honduras after Hurricane Mitch. *Journal of Ecology*, 91: 1093–1105

Cameron, C., Kennedy, B., Tuiwawa, S., Goldwater, N., Soapi, K., & Lovelock, C. E. (2021). High variance in community structure and ecosystem carbon stocks of Fijian mangroves driven by differences in geomorphology and climate. *Environmental Research*, Volume 192.

Cameron, C., Maharaj, A., Kennedy, B., Tuiwawa, S., Goldwater, N., Soapi, K., & Lovelock, C. E. (2021). Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. *Environmental Challenges*, 2, 100018

Chattier, P. (2015) Women in the House (of Parliament) in Fiji: What's Gender Got to Do with It?, The Round Table, 104:2, 177-188, DOI: 10.1080/00358533.2015.1017253

Conservation International. (2018). Drivers of deforestation and forest degradation and identification of forest strategies.

Conservation International. (2020). Selecting Blue Carbon Sites in Fiji, Conservation International.

Conservation Measurements Partnership (CMP). (2020) Open Standards for the Practice of Conservation,

Version 4.0. *Conservation Measurements Partnership*.

Crooks, S., Herr, D., Tamelander, J., Laffoley, D., & Vandever, J. (2011). Mitigating climate change through restoration and management of coastal wetlands and near-shore marine ecosystems: challenges and opportunities. *Environment Department Paper* 121, World Bank, Washington, DC.

Dayal, S., Waqa-Sakiti, H., Tabe, T., & Hodge, S. (2022). An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. *Pacific Dynamics: Journal of Interdisciplinary Research*.

Diamond, H. J. (2017). South pacific enhanced archive of tropical cyclones (SPEArTC)
FBC News, 21 January 2022. Work to mitigate flooding continues.

Fiji Bureau of Statistics, (2017). Fiji 2017 population and housing census: administrative report and general tables.

Giri, C., Ochieng, E., Tieszen, L.L., Zhu, Z., Singh, A., Loveland, T., Masek, J. & Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. *Global Ecology & Biogeography*, 20, 154–159

GIZ (Gesellschaft für Internationale Zusammenarbeit), SPC, SPREP. (2019). Fiji Forest Change Detection 2006-2018. Data available on-line from: http://www.pacgeo.org/layers/geonode:fiji_fcd_2019_w84_1

Kitoleilei, S.,Thaman, R., Veitayaki, J., Breckwoldt, A., & Piavano, S. (2021). Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. *Frontiers in Marine Science*, 8. p. 684303.

Lal, P (ed). 1983. *Mangrove Resource Management*. Proceedings of an Interdepartmental Workshop Held on 24th February 1983, MAF HQ Conference Room, Suva. Technical Report No 5, Fisheries Division, MAF, Fiji

Lal, P. N. (1990a). Ecological economic analysis of mangrove conservation: a case study from Fiji. Mangrove Ecosystems Occasional Papers No. 6. UNDP/UNESCO Regional Project for Research and its Application to the Management of the Mangroves of Asia and the Pacific (RAS/86/120).

Lal, P.N. (1990b). Conservation of conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Center, Occasional Paper 11.

MESCAL, (2013). Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

Ministry for Economy, (2018). Fiji Low Emission Development Strategy 2018-2050. Government of Fiji

Murray, B. C., Pendleton, L., Jenkins, W. A., & Sifleet, S., (2011). Green Payments for Blue Carbon: Economic Incentives for Protecting Threatened Coastal Habitats. Report NI R 11-04. Nicholas Institute for Environmental Policy Solutions, Duke University, Durham.

Nellemann, C., & Corcoran, E. (2009). Blue carbon: the role of healthy oceans in binding carbon: a rapid

response assessment: UNEP/Earthprint

Nunn, P.D. (2013). "The end of the Pacific? Effects of sea level rise on Pacific Island livelihoods. *Singapore Journal of Tropical Geography*, 34: 143-171.

Pillai, G. (1985). Mangrove of Fiji their uses and management. In Field C. D., and Dartnall, A. J., eds., Mangrove Ecosystems of Asia and the Pacific, pp. 150-160. Australian Institute of Marine Science, Townsville.

Pollard, E. M., Thaman, R., Brodie, G., & Morrison, C. (2015). Threatened Biodiversity and Traditional Ecological Knowledge: Associated Beliefs, Customs and Uses of Herpetofauna among the `Are`Are on Malaita Island, Solomon Islands. *Ethnobiology Letter*s, 6(1), 99-110.

Rahman, M.H., & Singh, S. (2011). Towards Strong Local Governance: Current Reform Scenario in Fiji, *International Journal of Public Administration*, 34:10, 674-681.

Rodríguez-Zúñiga, M. T., Troche-Souza, C., Cruz-López, M. I., & Rivera-Monroy, V. H. (2022). Development and Structural Organization of Mexico's Mangrove Monitoring System (SMMM) as a Foundation for Conservation and Restoration Initiatives: A Hierarchical Approach. Forests, 13(4), 621.

Secretariat of the Regional Environment Program (SPREP), (2014). Fiji State of the Environment Report. SPREP, Apia, Samoa.

Schoene, D., Killmann, W., Lüpke, H. von., LoycheWilkie, M. (2007). Forests and Climate Change Working Paper 5: Definitional issues related to reducing emissions from deforestation in developing countries. Rome. Italy.

Thaman RR, Balawa A, and Fong T. (2014). Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. Johansson Fua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji

Thaman, R., Lyver, P., Mpande, R., Perez, E., Carino, J., and Takeuchi, K. (2013). The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies with Science. Paris: UNESCO/UNU

Thaman, R., Balawa, A., & Fong, S. (2008). I Lava ni Navakavu. Fin Fishes of the Vanua Navakavu, Viti Levu, Fiji Islands. Institute of Pacific Faculty of Islands and Oceans University of the South Pacific.

Thaman, B., Vunisea, A., Naikatini, A., & Guanavinaka, T. (2003). Fiji. In Proceedings of the Pacific Regional Workshop on Mangrove Wetlands, Protection and Sustainable Use. South Pacific Regional Environment Program, Apia, Western Samoa, pp 127-140.

Tuiwawa, M., Pene, S. and Tuiwawa, S. (eds.). (2013). A Rapid Biodiversity Assessment, Socio-Economic Study and Archaeological Survey of the Rewa River Mangroves, Viti Levu, Fiji. Suva, Fiji. IUCN Oceania.

Tuiwawa, S. H. (2022). A Mangrove Management Guideline: Community-based Management Guideline for

Mangrove Rehabilitation and Restoration in Fiji. Ministry of Forestry, Suva, Fiji.

UNCCD National Focal Point. (2007). *National Action Plan to Combat Desertification/Land Degradation and to Mitigate Against Drought*.

UNFCCC, (2001). *Decision 11/CP.7 Land use, land-use change and forestry*; Vol. 2.

Veitayaki, (2002). Taking advantage of indigenous knowledge, the case of Fiji. *International Social Science Journal*, 54, pages 395-402.

Veitayaki, J. (2004). Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies: linking local knowledge to science. University of the South Pacific. Conference Proceedings.

Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in Culture and Sustainable Development in the Pacific, ed A. Hooper (Canberra: ANU Press), 9. Veitayaki, J; Varea, R; Rollings, N; Waqalevu, V. 2017 Mangroves in Small Island Development States in the Pacific: An Overview of a Highly Important and Seriously Threatened Resource.

Vierros M., Tawake A., Hickey F., Tiraa A., & Noa, R. (2010). Traditional marine management areas of the pacific in the context of national and international law and policy. United Nations University—Traditional Knowledge Initiative, Darwin

Vunisea, A. (2016). The participation of women in fishing activities in Fiji. *Women in Fisheries Information Bulletin* No. 27, Page19-28

Watling, D. (2013). Mangrove Management Plan for Fiji - Prepared for the National Mangrove Committee. MESCAL

Watling, D. (2021). Best Practice Mangrove Planting for Fiji–A Discussion Document–August 2021. Environmental Consultants Fiji Pty Ltd, 259 Prince's Road, Suva. https://www.environmentfiji.com/best-practice-mangrove-planting-for-fiji-a-discussion-document-august-2021/

Worthington, T., and Spalding, M. (2019). Mangrove restoration potential: a global map highlighting a critical opportunity. The International Union for the Conservation of Nature and The Nature Conservancy.

APPENDICES

APPENDIX 1: FIJI BLUE CARBON PROJECT - ANALYSIS OF MANGROVE DEGRADATION & DEFORESTATION COMMUNITY SURVEY PLAN

1. BACKGROUND

Mangroves provide critical ecosystem services to Fijian communities by providing protection from storms, shoreline stability, and habitat and breeding grounds for important subsistence and small-scale commercial fisheries. To improve the management, restoration, and future financing options to preserve Fiji's mangroves, it is critical to understand what is driving their deforestation and degradation.

In alignment with the Fijian Government priorities and with support from the Australian Department of Foreign Affairs and Trade, Conservation International (CI) is partnering with colleagues from the Ministry of Forestry, the World Wildlife Fund (WWF), and other key Government Ministries in Fiji, to assess the state of deforestation and forest degradation with Fiji's blue carbon ecosystems, initially focusing on mangroves. This work is being delivered through three main integrated activities: 1) legal and policy review; 2) social survey of mangrove use and benefits; 3) geospatial assessment of mangrove cover and loss over time.

2. SOCIAL SURVEY

Since 2009, the Fijian Ministry of Forestry and partners have carried out extensive consultations under the REDD+ programme to identify and understand the drivers of deforestation and forest degradation, increase awareness and buy-in of relevant stakeholders, including resource users and resource owners, in the REDD+ programme, and develop appropriate and effective benefit-sharing recommendations. The following survey will extend these surveys and consultations to Fiji's blue carbon ecosystems, learning from the lessons learnt from previous consultations undertaken under REDD.

In partnership with WWF and the Ministry of Forestry, CI will undertake a series of community surveys to assess the drivers of mangrove loss and degradation within three key mangrove areas on Vitilevu: The Ba Delta, the Rewa Delta, and Navitilevu Bay in Ra Province. These surveys will be conducted in more than 30 communities across the three deltas, and include a mix of key informant interviews, household surveys and focused group discussions. Village and community sites have been selected based on the following criteria: extent of mangrove areas and the degree of perceived or potential threats to their health; sites with biodiversity hotspots; sites where communities depend on mangroves; and sites with planned restoration with current potential users. These sites will also include selected mangrove areas and concerned communities.

3. SURVEY OBJECTIVES

1. Gather detailed information and data regarding the social, culture and economic factors that influence people's relationship with mangroves and affect mangrove health, restoration, and conservation efforts.
2. Gather baseline information to inform design of a specific Consultation and Participation Plan (C&P) for communities located in the Rewa and Ra Delta, and Navitilevu Bay in Ra.

The community survey will aim to:

- Analyse the social and cultural needs that place pressure on mangrove including traditional structures, norms and laws and the needs of vulnerable and marginalised groups.
- Assess the dependency if local communities on mangroves and identifying their role as stewards for mangrove restoration and conservation
- Identify the community-level economic activities and associated incentives that are proven and/or have

potential to support mangrove conservation, sustainable management of mangroves and mangrove carbon stock enhancement.
- Analyse the influence of current land tenure structures and formal and informal land access arrangements in supporting mangrove conservation and sustainable management of mangroves
- Assess the effectiveness of current community management regimes in supporting mangrove conservation, and the sustainable management of mangroves
- Identify the main social and cultural issues that serve as either barriers or opportunities for mangrove restoration.

4. Survey Design & Methodology

The survey has been designed with a team of social and blue carbon scientists, to ensure that the survey methodology and delivery provide relevant information for the project, in alignment with the priorities outlined above. A total of 27 villages and settlements were identified as relevant to the survey in the Ba and Rewa Deltas, and within Navitilevu Bay in Ra Province. Lessons learnt from previous engagement and activities conducted in each site were incorporated into the survey design. The survey design and preparation process are outlined below:
- Identify and gather preliminary information about each mangrove site, including collating existing demographic data, and conducting a literature review to identify preliminary drivers prevalent in each site.
- Conduct consultations with government agencies, non-governmental organizations (NGOs) and other stakeholders to determine the survey approach and communicate the survey goals.
- Conduct stakeholder mapping and identification of communities within each site to participate in the survey, select appropriate dates for the surveys, and answer questions outlined above in Section 3.
- Design the survey methodology, methods of assessment and analysis in partnership with the Fijian Government and identify the survey team composition based on need (e.g gender breakdown required, language skills required, etc.).
- Inform all relevant authorities of the final survey dates, secure participation of partners and lead agencies, and secure necessary approvals.
- Provide training to all identified volunteers and participants on the survey questionnaire and use of AKVO, an app-based data-collection and analysis tool that will be used during the survey.

Stakeholder Mapping: A stakeholder mapping is critical to assess the different stakeholders that have access to, mandates over, and interest in mangrove areas in Fiji. Given increasing foreshore development and expansion of settlements into mangrove areas, it is important to review stakeholders in each site. CI conducted a mapping exercise to identify relevant settlements and communities to engage across each province.

Survey Methods: We will use a mixed methods approach combining data from both qualitative and quantitative approaches, collected through a series of 110 questions comprising of constrained choice structured questions and open-ended descriptive questions.

Data collection:
In total, 27 communities will be surveyed across the Rewa Delta, Ba Delta, and Navitilevu Bay in Ra Province. Data will be gathered using the following approaches:

a. Household Questionnaire: At least 10% of households in each community who are key mangrove users will be surveyed. Where possible, interviewers will aim to interview two individuals – a male and a female—from each household.

b. *Focused Group Discussion (FG):* Focused group discussion will be held with key stakeholder groups, specifically targeting responses from women and youth.

c. Key People Interviews (KPI): KPIs will target priority stakeholders, such as the village headman or Roko, as well as key individuals whose inputs are not captured through other methods. This will specifically target persons with disabilities or other vulnerable and marginalized stakeholder groups.

Data analysis:
The data collected from the survey will enable the determination of primary agents and drivers of deforestation and degradation at the three project sites, through qualitative and quantitative analysis. Causal models will be developed highlighting the causes of deforestation and degradation feeding into supply chains as well as sustainability of fishing practices. Descriptive analysis will evaluate management interventions, livelihood dependencies on mangroves and impacts of climate change down to family levels. Overall data analysis will be supported through comparative qualitative analysis of data collected from focused group discussions and key people interviews which will delve deeper into gender disaggregated use of mangroves with focus on youths and community members with disabilities.

5. SOCIAL SAFEGUARDS

The survey has been designed in alignment with the principles of the Rights-Based Approach to Conservation and Free Prior and Informed Consent. The following principles will guide implementation of the survey across each of the 27 communities:

- Ensure inclusivity – facilitate full and effective participation of relevant stakeholders' people with special needs, marginalized groups and people living in informal settlements in the survey. Multiple approaches have been selected to best capture responses from all stakeholder groups in an inclusive manner.
- Apply the Free Prior Informed and Consent (FPIC) principles – this supports informed decision making by all concerned stakeholders.
- Promote transparency – ensure information and processes are well understood, credible and open to scrutiny.
- Integrated approach – promote the participation and involvement of various sectors and agencies at all levels. This survey will be delivered in partnership and with the support of the Fiji Ministry of Forestry, the Ministry of iTaukei Affairs, and WWF Oceania.
- Promote ownership – ensure effective involvement of participating stakeholders and strengthen the feedback mechanism process.
- Respect for culture and tradition – recognize the importance of cultural and traditional values in REDD+ implementation.
- Gender Inclusivity – ensuring gender issues and concerns are addressed at all levels of the consultation and participation processes.

Adhering to Traditional Protocols: Fiji has 14 iTaukei provinces (Yasana) and Rotuma. Each of the 14 provinces are governed by a Provincial Council headed by a Roko Tui[1] A province is made up of a group of sub-units called Tikina (akin to district level). The Tikina comprises of several villages. The Tikina and Yasana boundaries were drawn up during the colonial era, largely for administrative purposes. However, most of these clusters are based on traditional socio-political ties. The iTaukei Affairs Board, constituted under the iTaukei Affairs Act (Cap. 120) governs all matters concerning the administration of iTaukei affairs, including iTaukei custom services. Each village has a headman called the Turaga ni Koro who is the link between Provincial Office and the villagers. However. Each village also has the Liuliu ni Yavusa who is of chiefly status, likewise for the Liuliu ni Tikina (Tikina chief) and Liuliu ni Yasana (Provincial chief).

During the survey design process, CI provided regular updates to the Ministry of Lands, Ministry of Forestry, Ministry of Economy's Climate Change, and International Cooperation Division (CCICD), and importantly, the Ministry of iTaukei Affairs. In alignment with traditional protocols, visits to iTaukei villages and communities under the survey were coordinated through the Provincial Offices of Rewa, Tailevu, Ba and Ra.

Traditional protocol must be adhered to when entering iTaukei village communities. Upon entry to each village, CI will perform a sevusevu and present kava (yaqona) to the Village Headman who will then discuss the intentions of the visit.

Inclusive Participation to ensure an all-inclusive and active participation of all iTaukei communities the following engagement tools are recommended:

[1] the title for the executive head of Fiji's individual 14 Provincial Councils

- Use existing vanua protocols and plan through the Provincial Office to ensure inclusive participation. In this case fishermen and women, those who use mangroves for other uses, businesses, should also be included.
- Support and utilize the Village Development Committee and the Yaubula Committee.
- Village chief and other leaders to be interviewed separately.

Gender Inclusion: The most disenfranchised community members are usually the most vulnerable ones (women, the elderly, persons with disabilities, members of informal settlers and the youth). They are sidelined from community-level and national decision-making on forest sector management, and as a result, are underutilized in implementation of forest sector activities.

iTaukei women have more status than non-iTaukei women because they are also customary owners of land alongside men, whereas non-iTaukei women cannot own customary land and are not included in leasing agreements. However, there are issues with iTaukei women being able to fully benefit from their status as customary landowners. While iTaukei women have considerable autonomy in their daily lives in the public arena they have extremely limited opportunities to actively participate. (SESA (Strategic Environmental and Social Assessment, 2018)

Considerations for survey delivery:

- Women and men do not have equal voice and decision-making power in rural institutions and organizations. There are exceptions where there are women chiefs or matrilineal land ownership.
- Women and men do not have equal rights, access to and control over natural and productive resources, to contribute to and benefit from sustainable rural development.
- Women and men do not have equal rights and access to services, markets and decent work and do not have equal control over the resulting income and benefits.
- Women are more regular fishers of mangrove resources than men in most cases and have a wealth of knowledge related to mangroves yet are often not included in decision making and management discussions.

General challenges and issues to consider in the delivery of the consultation and survey:

Issue/Challenge	How to address the issue
Expectations from the community for assistance, money, etc	Be transparent and well informed on mangroves issues. Deliver the message/ ask questions as it is and do not include any other assumed or incorrect information. Admit to knowledge gaps and revert with correct answers.
There are unwritten rules of engagement in a community, thus the hierarchical structure and different designations of the people should be respected.	Use Participatory tools and facilitators to be aware of the dynamics within a community setting. Community responses are taken and recorded as is and not corrected by the facilitator because it is their perspectives.
People in communities are well versed with mangroves resources and have knowledge accumulated over generations of use.	Getting knowledge and direction from the community. Listen to their stories and their concerns.
Be informed of the existing religious groups and the different religious beliefs that can raise different opinions on how they view REDD+	Get information about communities, tikinas from the provincial office before community consultations

Women cannot speak freely in certain groups.	Ensure group work separates men from women, and elders to enable women and youths to voice concerns and speak freely
Be mindful of the internal conflicts and disagreements that exist within iTaukei village communities	Consult with the respective Provincial office to identify the existing internal conflicts and disagreements prior to carrying out consultations
Be informed of traditional relationships that can be a barrier to open discussions	Consult with the respective Provincial office to be aware of traditional relationships prior to carrying out consultations
Not everyone will be interested in the consultations	Consultations should also be awareness sessions where the youth, women and other marginalized groups can be informed of regulations, etc.
Women are not always present at such consultations	Have the consultations at time convenient or women.
Other groups in the community to be part of the consultations	Peoples with disabilities, women and youth groups to be included
Other ethnic groups who may have access to mangroves	Identify other users and they can be included in KPIs and HH interviews

6. Lessons From Previous Consultations and Surveys

As noted above, Fiji has conducted extensive community consultations under the REDD+ programme, many of which CI was deeply engaged. These consultations have provided significant lessons learnt for the different stakeholder engagement approaches relevant to forest carbon initiatives. Some of these lessons learnt are outlined below, and will be integrated into the:

- **Awareness and capacity building approaches** – Consultation process should use approaches and tools that promote inclusivity to ensure full and active participation of all team members.
- **Use of existing communication structures** – to ensure effective participation of stakeholders in all consultation and participation processes.
- **Effective coordination** – Roles and responsibilities are clearly defined for better planning and monitoring of the consultation and participation processes
- **Clear documentation and dissemination of information** – to guide consultation and participation processes

7. Timeline & Survey Delivery Plan

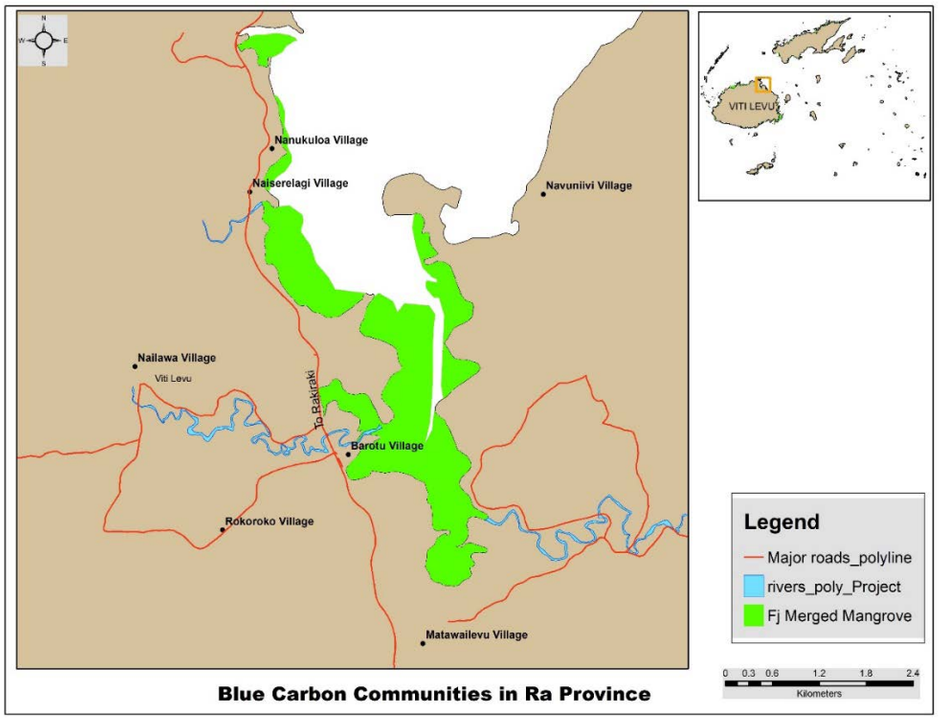
Tuesday, August 16th— Training of Survey volunteers and participants: On August 16th, CI will organize a one-day training of survey participants and volunteers. Trainees will include CI staff, WWF volunteers, divisional representatives from the Ministry of Forestry, and representatives from additional government agencies. The training will cover the following content:

- Overview of the survey design and methodology, including objectives and goals of the survey.
- Overview of AKVO and use of tablets for surveying participants.
- The Rights-Based Approach to Conservation and Free, Prior and Informed Consent in the context of social surveys and community consultation.
- Best practices for ensuring gender inclusion and participation of marginalized groups in the survey.
- Logistics and timeline for the survey delivery in the next month.

August 17th to 19th—Surveys in Navitilevu Bay, Ra Province: Surveys will be conducted within communities and informal settlements surrounding the Navitilevu mangrove area. In total, the following communities will be surveyed over the course of the three days. The survey team composition will include at least 50% men and 50% women, with both iTaukei and Hindi language skills. The surveys will take place

in the following communities and informal settlements:

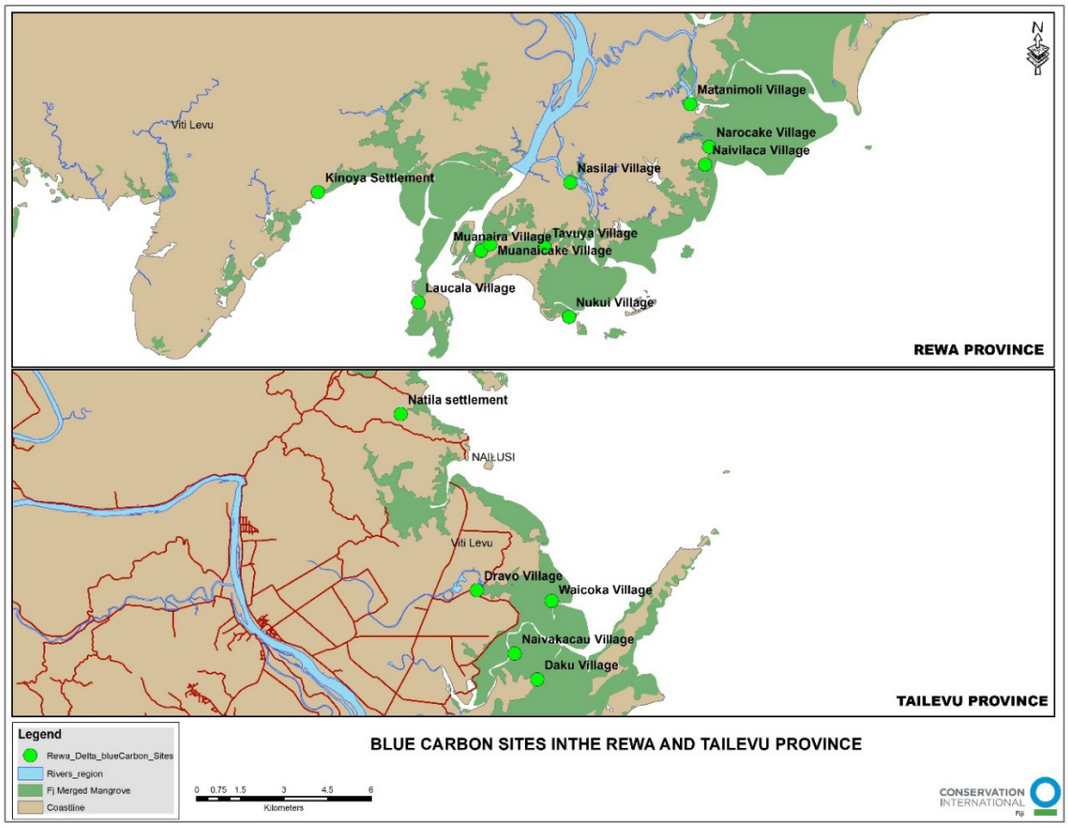
Community or Settlement	Women	Men	Total
Nanukuloa	125	126	251
Naiserelagi	82	90	172
Barotu	122	133	235
Matawailevu	63	67	130
Navuniivi	106	127	233



August 22nd to September 2nd —Surveys in Rewa Delta (Rewa and Tailevu Provinces): Surveys will be conducted within communities located within and surrounding the Rewa Delta mangrove area, including informal settlements and peri-urban areas. As Fiji's largest contiguous mangrove area, community surveys will be the most extensive in the Rewa Delta to capture a representative sampling of stakeholders from across the entire mangrove forest. Surveys are planned to take place over the course of two weeks. The survey team composition will include at least 50% men and 50% women, with both iTaukei and Hindi language skills. The surveys will take place in the following communities and informal settlements:

Community or Settlement	Women	Men	Total
Nukui	75	66	141
Tavuya	112	118	230
Muanaira	91	94	185
Kinoya Sett	298	299	597
Muanaicake	32	38	70
Naivilaca	91	81	172

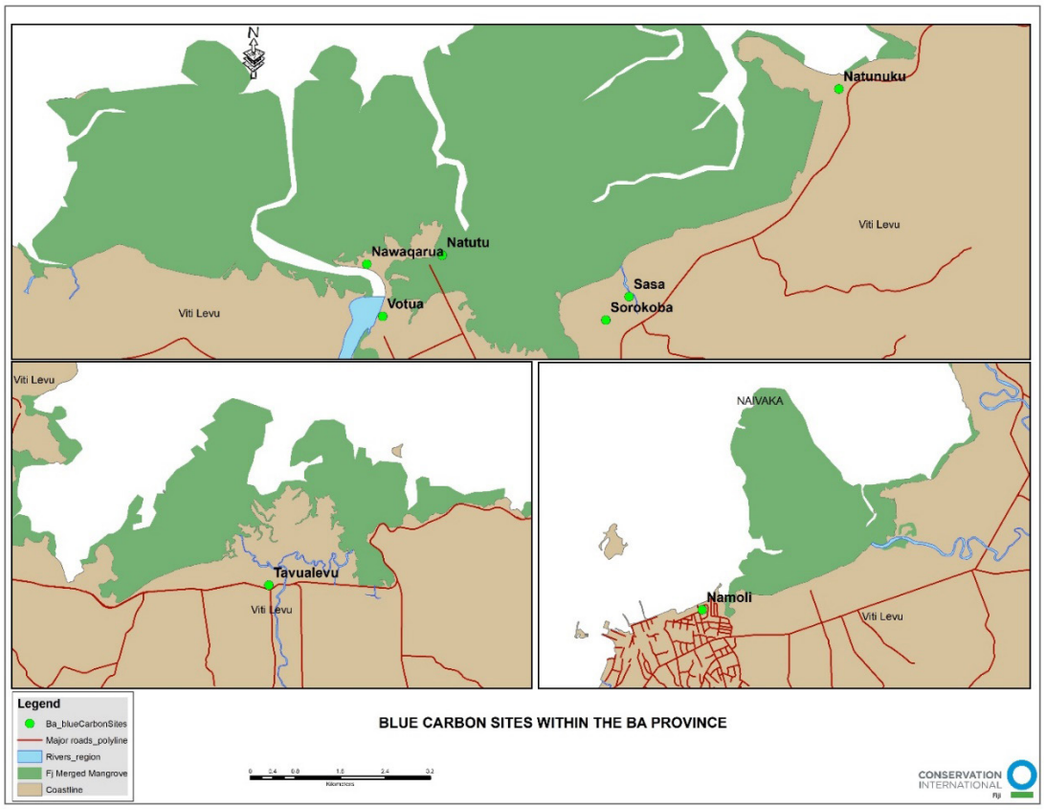
Naivakacau	106	124	230
Waicoka	94	90	184
Matanimoli	133	137	270
Dravo	182	154	336
Daku	94	97	191
Nasilai	62	61	123
Laucala	10	11	21
Natila	33	25	58



5th to 9th —Surveys in the Ba Delta: Surveys will be conducted within communities located within and surrounding the Ba Delta mangrove area, including informal settlements and peri-urban areas on the outskirts of the delta. In total, the following communities will be surveyed. The team composition for this survey will be formalized in the coming weeks together with the Ministry of Forestry and other key stakeholders, however, will include at least 50% men and 50% women, with both iTaukei and Hindi language skills. The surveys will take place in the following communities and informal settlements:

Community or Settlement	Women	Men	Total
Tavualevu	493	517	1010
Votua	356	362	718
Sorokoba	185	168	353
Natunuku	162	152	314
Natutu	111	132	243

Nawaqarua	139	122	261
Sasa	180	167	347
Namoli Settlement	474	439	913



8. Data Analysis and Report Back

Upon completion of surveys across all 27 communities and settlement, CI will upload all data to AKVO and begin review, coding and analysis. CI will use standard analytical software to determine survey results and findings. A summary of the report will be translated into iTaukei and Hindi and shared back to participating communities in coordination with each respective Provincial Administration and Provincial Office.

APPENDIX 2: SOCIO-ECONOMIC SURVEY QUESTIONNAIRE

SECTION A: SOCIO-ECONOMIC SURVEY

Please sign as the respondent if you agree to participate in this field survey:

Interview Location: _____ Date of the Interview:

Interviewer's Name: _____ Interviewer signature:

Respondent Name: _____ Do you wish to participate in the survey? Yes No

If yes please sign here: _____ Mobile Number: _____

Respondent Particulars	
Village: **Respondent No:**	**Response**
a. Age:	
b. Sex: (M/F)	
c. Gender: Male, Female	
d. How many individuals are present in the household?	

Education Particulars	
a. Education Level Attained:	
b. Ease of Access to Education (Easy/Hard):	
c. If Hard, can you share why:	

Vanua Particulars	
a. Mataqali:	
b. Traditional Role:	
c. Access to Land/Qoliqoli: (Yes/No)	
d. If no, can you share why:	
e. Do you share your qoliqoli with other villages?	
f. If yes, which villages?	

Economic Activity			
a. Main income earner(s) (husband, wife, children)			
b. Primary source of income (past 24 months)			
c. Secondary source of income			
d. Subsistence activities			

5. Financial Particulars			
a. Income range (weekly)			
b. Savings account (Yes/No)			
c. Percentage saved (income)			
d. Receive remittance (Yes/ No)			
e. If yes, where is it sent from			
f. How frequent is it sent	Weekly	Fortnightly	Monthly
g. Main expenditure(s) - list 3			

6. Impact of COVID-19	
a. Any impact of COVID-19 on economic activity/finance? (Yes/No)	
b. If yes has it improved, worsened, or remained the same?	

7. Farming Practice	
a. Land preparation/fallow period (machine, manual, shifting cultivation)	
b. Farm site/landscape (close to river, slope), Fish site (Mangrove, river, inshore)	
c. Use of chemicals/fertiliser	

8. Workshop/ Training	
a. Any training/workshop(s) attended (last 3 years) (Yes/ No)	
b. Organisations conducting training/workshop	
c. Type of skills, awareness, knowledge gained i. Environment/Climate Change ii. Financial Literacy iii. Leadership iv. Livelihoods v. Other	
d. Were the training workshops you attended were useful? (Yes/No)	
e. Which training workshop did you find useful and what were the topics covered?	

9. Use of Traditional Knowledge	
a. Understanding of traditional knowledge on sustainable farming/fishing, DRR (Yes/No)	
b. If yes, is it still being used, examples:	

10. Fishing Practice

	Fishing method used	Type of fish	Time of Fishing (Day/ Night)	Fish for Subsistence or for Sale	At what time do you go out fishing?	Place of fishing? (river)
Respondent	Net Fishing Line Spear gun Spear Hand net	Ika Ura Duna Kai Vivili	Day Night	Subsistence For Sale		Tobutobu Drodro Savu Tobu (Pond)

11. Unsustainable Fishing Practice			
Fishing Method	Type of Fish	Is it Used	Frequency of Use
Poison Duva (Tephrosia) Dynamite Small nets Other	Ika Ura Duna Kai Vivili	Yes No	A lot of times Sometimes Once in a while

12. Sustainable Fishing Practice	
	Yes/ No/ Not aware
Is there a management plan for the sustainable use of resources?	a. Yes b. No c. Not Aware
If there is one, do you know the resource management plan?	a. Yes b. No c. Not Aware
Is there a marine protected area?	a. Yes b. No c. Not Aware
Do you know the reason why a tabu is in place?	a. Yes b. No c. Not Aware
Is the marine resource management plan effective?	a. Yes b. No c. Not Aware

13. Impacts of Climate Change
Do you understand what climate change is and its impacts? Yes/No
If yes, what types of impacts have you experienced? a. Constant weather change on a daily basis b. Drought conditions c. More rain than usual d. Increase in communicable disease e. Decrease in marine and/or agricultural yield f. Saltwater intrusion g. Others

14. Impacts of Climate Change at Family Level
We would like to understand the change in farming over the last 5-10 years. In the last 5-10 years has crop yield reduce/increased/ remained the same?
Have you experienced any change in the planting season? shortened/ lengthened/stayed the same?
If you have been using the river as a source of livelihoods, over the last 5-10 years has resources yield reduced/increased/remained the same?
If you have been using the river as a source of water for household use, farming, or any other use, for the past 5-10 years has the source increased/decreased/remained the same
If you have been using marine resources as a source of livelihoods, over the last 5-10 years has resources yield reduced/increased/ remained the same?
Over the past 5-10 years have you witnessed any other unusual weather patterns/ (Yes/No)
If yes, what unusual weather pattern have you witnessed?

Community Emergency Guidelines			
Is there any Emergency Plan for the village?	a. Yes	b. No	c. Not Aware
Is there an Emergency Response Committee?	a. Yes	b. No	c. Not Aware
Is there an Evacuation Centre?	a. Yes	b. No	c. Not Aware
Is the Evacuation Centre disability friendly?	a. Yes	b. No	c. Not Aware
Is the Evacuation Centre Category 5 standard?	a. Yes	b. No	c. Not Aware
Has there been any training on emergency response of evacuation drill?	a. Yes	b. No	c. Not Aware

SECTION B: AGENTS, DRIVERS, AND UNDERLYING CAUSES OF MANGROVE DEFORESTATION AND DEGRADATION

This document restructures the questionnaire in terms of the different questions to answer regarding the agents and drivers of deforestation and degradation.

DIRECT THREATS RESULTING IN DEFORESTATION/DEGRADATION
B1. What are the different activities that you access the mangroves for? a. logging b. firewood c. food harvesting d. farming e. other
B1.1 What species you are most likely to harvest? Dogo (*Bruguiera gymnorrhiza*) Tiri (*Rhizophora* spp.) Others (*Please specify*)
B1.2 Which part of the mangrove tree you harvest the most? a. branches b. trunks c. roots d. entire tree e. other
B1.3 How much are you able to harvest at a time? a. >5 trees b. <5 trees c. cannot recall d. other
B1.4 How much wood do you extract? Provide estimated weight or volume (if available) a. >5 pieces of wood b. <5 pieces of wood c. an entire tree d. I don't know
B2.1. How often do you cut/harvest or log mangrove trees for individual use? a. everyday b. every week (if so, how many days in a week?) c. more
B2.2 How often do you harvest or log mangrove trees for household use? a. everyday b. every week (if so, how many days in a week?) c. more

B2.3 How often do you or members of your community harvest or log mangrove trees for community use?

a. everyday
b. every week (if so, how many days in a week?)
c. more

B2.4 Can you please provide an estimate of the area of mangroves harvested in your area?

one rugby field
half rugby field
quarter rugby field

DRIVERS/UNDERLYING CAUSES

B3. What do you or others do with the wood or other products you harvest from the mangroves?

Sale
Firewood
Building Materials
Medicine
Dye
Others

B4. Do you use mangrove products for commercial or for personal use only?

B5. If you are selling mangroves which mangrove parts, are you selling?

B6.1 Who is using or buying them?

Family member
□. Community member
□. Middleman
□. other

B6.2 Where are you selling these?

a. in the community
b. town market
c. middlemen
d. others

B6.3What areas do you or others target for wood supply?

a. mangrove swamp
b. intertidal areas
c. along the coast

B7 Has the area of mangroves increased/decreased or remained the same in the last 5-10 years

B7.1 If mangrove has increased or decreased what has caused this?

- □. Mangrove accretion
- □. Mangrove Replanting
- c. Mangrove reclamation for settlement
- d. Reclamation for agriculture
- e. Reclamation for wharf/boat berthing.
- f. Sand mining and other mining activities
- g. Recreational activities
- h. Tropical cyclone damage

BARRIERS/OPPORTUNITIES

B9. Are there any traditional mangrove management in place? (Yes/No)

B9.1 If yes, what is being done?

- Partial Ban
- Full Ban
- Ban on mangrove harvesting
- Ban on mangrove resource harvesting

B9.2 How long has this ban been in place?

- Less than one year
- More than a year
- More than 5 years

B9.3 Do you think that the ban is working/not working/no change?

B9.4 Why do you think the ban is working/not working?

- Poaching
- Lack of equipment for policing
- No warden
- Lack of traditional leadership
- Effective policing
- Strong leadership

B9.4 How often is the taboo opened?

B10. Are there any other management interventions in place?

B11. Has there been any awareness training on mangrove protection use done?

B12. Has there been any replanting of mangroves? (Yes/No)

B12.1 If yes by whom?

- Non-governmental organizations
- Private companies
- Government departments/ministries
- Schools
- Groups
- Others

B12.2 Has the mangrove replanting been successful/not successful/not changed?

B12.3 Why do you think the mangrove replanting has been successful or not successful?

SECTION C: LIVELIHOOD SURVEY

C1. Are you a fisherman/fisherwoman (Yes/No)?

C1.1If yes, do you fish/collect:

- for subsistence only
- for subsistence and commercial purposes
- only fish occasionally
- process and sell fish/other species

C2. How many fishers are in your household?

- How many men?
- How many women?

C3. Where do you fish?

- mangrove areas
- sand flats
- mudflats
- coral reefs
- outer reef areas

C4. i. If you fish in mangrove areas, what do you target?

- Crabs (all types)
- Oysters/shells
- Fish
- Shrimps
- All species

C4.ii. What fishing techniques/gear do you use?

- Fishing line
- Net
- Mask and snorkel
- Scuba
- Other

C4.iii. How many mud crabs / oysters / shells would you collect per month?
C4. iv What is the area of areas you harvest mud crabs/oysters/shells from?
C4.v. How much fish would you catch per month (kg)
C4.vi Which qoliqoli do you fish from?
C4 vii Which area do you usually catch fish from? Kg from mangrove areas and mudflats___ Kg from sand flats and mudflats___ Kg from coral reefs___ Kg from outer reef areas ___
C5. What percentage of your livelihood/income comes from mangrove products?
C6. Would you say that your community is a fishing-dependent community? (Yes/No)
C6. What are other sources of livelihood in your community? Sale of root crops Non-timber forest products Handicrafts Others

APPENDIX 3: SOCIO-ECONOMIC SURVEY RESULTS (SELECT RESULTS)

Table A2.1. Responses to the question, "What are the different activities that you or others access the mangroves for?"

Site	Province	Tikina	# Respondents						% of Respondents					
			TOTAL	Logging	Firewood	Food	Farming	Wood harvest	% Logging	% Firewood	% Food	% Farming	% Wood harvest
Ba Delta	Ba	All	265	48	243	154	13	252	18%	92%	58%	5%	95%
		Bulu	83	16	72	49	5	77	19%	87%	59%	6%	93%
		Nailaga	72	15	71	47	5	72	21%	99%	65%	7%	100%
		Tavua	64	10	60	33	3	61	16%	94%	52%	5%	95%
		Vitogo	46	7	40	25	0	42	15%	87%	54%	0%	91%
Navitilevu Bay	Ra	All	70	2	62	52	1	63	3%	89%	74%	1%	90%
		Nalawa	14	0	11	12	1	11	0%	79%	86%	7%	79%
		Navitilevu	16	0	14	11	0	14	0%	88%	69%	0%	88%
		Saivou	40	2	37	29	0	38	5%	93%	73%	0%	95%
Rewa Delta	Rewa & Tailevu	All	350	32	320	217	19	322	9%	91%	62%	5%	92%
	Rewa	All	251	26	234	151	15	236	10%	93%	60%	6%	94%
		Noco	86	7	79	53	4	80	8%	92%	62%	5%	93%
		Rewa	79	7	75	45	4	75	9%	95%	57%	5%	95%
		Settlement	30	8	28	16	2	29	27%	93%	53%	7%	97%
		Vutia	56	4	52	37	5	52	7%	93%	66%	9%	93%
	Tailevu	All	99	6	86	66	4	86	6%	87%	67%	4%	87%
		Bau	44	0	38	30	2	38	0%	86%	68%	5%	86%
		Buretu	40	4	35	26	2	35	10%	88%	65%	5%	88%
		Dravo	15	2	13	10	0	13	13%	87%	67%	0%	87%

Table A2.2. Responses to the question, "What do you or others do with the wood or other products you harvest from the mangroves?"

Site	Province	Tikina	# Respondents						% of Respondents				
			TOTAL	Sale	Firewood	Building Materials	Medicine	Dye	% Sale	% Firewood	% Building Materials	% Medicine	% Dye
Ba Delta	Ba	TOTAL	265	25	255	101	110	45	9%	96%	38%	42%	17%
	Ba	Bulu	83	9	80	34	38	18	11%	96%	41%	46%	22%
	Ba	Nailaga	72	9	71	35	34	9	13%	99%	49%	47%	13%
	Ba	Tavua	64	5	61	18	20	14	8%	95%	28%	31%	22%
	Ba	Vitogo	46	2	43	14	18	4	4%	93%	30%	39%	9%
Navitilevu Bay	Ra	ALL	70	1	68	4	28	4	1%	97%	6%	40%	6%
	Ra	Nalawa	14	0	13	0	5	0	0%	93%	0%	36%	0%
	Ra	Navitilevu	16	0	16	1	6	0	0%	100%	6%	38%	0%
	Ra	Saivou	40	1	39	3	17	4	3%	98%	8%	43%	10%
Rewa Delta	Rewa & Tailevu	ALL	350	12	336	107	85	46	3%	96%	31%	24%	13%
	Rewa	ALL	251	7	245	85	65	33	3%	98%	34%	26%	13%
		Noco	86	1	83	23	18	11	1%	97%	27%	21%	13%
		Rewa	79	4	77	32	21	13	5%	97%	41%	27%	16%
		Settlement	30	1	30	18	12	4	3%	100%	60%	40%	13%
		Vutia	56	1	55	12	14	5	2%	98%	21%	25%	9%
	Tailevu	ALL	99	5	91	22	20	13	5%	92%	22%	20%	13%
		Bau	44	1	39	5	7	4	2%	89%	11%	16%	9%
		Buretu	40	3	37	15	8	6	8%	93%	38%	20%	15%
		Dravo	15	1	15	2	5	3	7%	100%	13%	33%	20%

Table A2.3. Responses to the question, "What species do you or others harvest?"

Site	Province	# Respondents			% Respondents	
		Total	Dogo (*Brugueira gymnorrhiza*)	Tiri (*Rhizophora* spp.)	% Dogo	% Tiri
Ba Delta	Ba	265	250	114	94%	43%
Navitilevu Bay	Ra	70	61	35	87%	50%
Rewa Delta	Rewa	251	217	133	86%	53%
Rewa Delta	Tailevu	99	59	70	60%	71%

Table A2.4. Responses to the question, "How much are you or others able to harvest at a time?"

Site	Province	Tikina	# Respondents			% of Respondents	
			TOTAL	<5 trees	>5 trees	% <5 trees	% >5 trees
Ba Delta	Ba	All	251	159	92	63%	37%
		Bulu	78	47	31	60%	40%
		Nailaga	72	52	20	72%	28%
		Tavua	58	33	25	57%	43%
		Vitogo	43	27	16	63%	37%
Navitilevu Bay	Ra	All	64	35	29	55%	45%
		Nalawa	10	5	5	50%	50%
		Navitilevu	15	7	8	47%	53%
		Saivou	39	23	16	59%	41%
Rewa Delta	Rewa & Tailevu	All	296	177	119	60%	40%
	Rewa	All	220	132	88	60%	40%
		Noco	75	52	23	69%	31%
		Rewa	70	40	30	57%	43%
		Settlement	26	12	14	46%	54%
		Vutia	49	28	21	57%	43%
	Tailevu	All	76	45	31	59%	41%
		Bau	31	20	11	65%	35%
		Buretu	31	17	14	55%	45%
		Dravo	14	8	6	57%	43%

Table A2.5. Responses to the question, "How has the area of mangroves changed in the last 5-10 years?"

BA DELTA		
Change	**#**	**%**
Same	33	13%
Increased	162	63%
Decreased	63	24%
Total respondents	258	**100%**

NAVITILEVU BAY		
Change	**#**	**%**
Same	10	14%
Increased	19	27%
Decreased	41	59%
Total respondents	70	**100%**

REWA DELTA	Rewa		Tailevu		Both	
Change	**#**	**%**	**#**	**%**	**#**	**%**
Same	38	16%	17	18%	55	16%
Increased	158	66%	60	63%	218	65%
Decreased	43	18%	18	19%	61	18%
Total respondents	239	**100%**	95	**100%**	334	**100%**

Table A2.6. Responses to the question, "What has caused [the change to the area of mangroves in the last 5-10 years]?"

Cause	Direction of change (+/−)	BA DELTA		NAVITILEVU BAY		REWA DELTA					
		Ba Province		Ra Province		Rewa Province		Tailevu Province		Rewa + Tailevu	
		#	**%**	**#**	**%**	**#**	**%**	**#**	**%**	**#**	**%**
Mangrove accretion	+	166	63%	26	37%	191	76%	67	68%	258	74%
Mangrove replanting	+	106	40%	9	13%	49	20%	38	38%	87	25%
Tropical cyclone damage	−	79	30%	45	64%	65	26%	14	14%	79	23%
Mangrove reclamation for settlement	−	27	10%	0	0%	14	6%	6	6%	20	6%
Reclamation for agriculture	−	15	6%	0	0%	11	4%	3	3%	14	4%
Sand and other mining activities	−	17	6%	1	1%	6	2%	2	2%	8	2%
Reclamation for wharf/boat berthing	−	9	3%	0	0%	2	1%	6	6%	8	2%
Recreational activities	−	8	3%	0	0%	8	3%	0	0%	8	2%
Total respondents	−	265		70		251		99		350	

ANNEX

ANNEX I

LITERATURE REVIEW OF PUBLISHED STUDIES RELATING TO DRIVERS OF DEFORESTATION AND FOREST DEGRADATION IN FIJIAN MANGROVES

Dr Clint Cameron
Conservation International
2023

1. Introduction and scope

This report reviews and summaries published studies which have assessed the drivers of deforestation and forest degradation (DoDD) and / or reported mangrove extent and rates of loss in Fijian mangrove ecosystems. Understanding the DoDD of the country's mangroves is a critical component for developing the evidence base needed to support the Pacific Blue Carbon Fiji Project, with reforestation activities to be conducted in Ba and Ra Provinces and a (potential) avoided deforestation / improved forest management intervention in the Rewa Delta.

2. Methods and materials

A Google Scholar search was conducted using the Boolean operator 'OR' between similar terms and the Boolean operator 'AND' between each major heading. The resultant search string used was: 'Mangroves OR mangrove ecosystems OR coastal ecosystems AND Fiji OR Fijian AND forest degradation OR deforestation OR landuse change OR conversion OR impacts. Approximately the first hundred entries (assumed to be those studies of most relevance) in both databases were screened and assessed for relevance.

3. Results and Main findings

While the search string produced more than 4,00 0 results, only a handful of studies (~10) provided data relating to DoDD, rates of loss, or mangrove extent (i.e. few studies had conducted field assessments or GIS analysis with data explicit to either rate or drivers of mangrove loss). The main findings from a selection of the most relevant and recent studies are outlined below.

3.1 Cameron et al. (2021). Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific.

Cameron *et al*. (2021) provides the most comprehensive summation reported to date on the spatial extent of mangroves, changes in extent, and drivers of loss across the Fijian archipelago. The study used an on-line geographical information system (GIS) dataset from the Global Forest Change (GFC) 2000-2018 and Fiji Forest Change Detection 2006-2018 (GIZ, SPC, SPREP 2019) studies. Annual mangrove extent and change from 2000 through 2018 were assessed across all 14 Fijian provinces using a time-series analysis of Landsat composite images from the GFC 10-20° S, 170-180° E granule. Forest loss during this period was defined as a stand-replacement disturbance, or a change from a forest to non-forest state (Hansen *et al*. 2013). Specific drivers of annual mangrove loss for the selected provinces of Ba, Nadroga-Navosa, Rewa and Tailevu, and Ra were then identified through time series analysis of satellite imagery using platforms such as Google Earth Pro (2019) and Google Earth Engine (2019), with results verified through field surveys at selected sites in 2019.

Mangrove Extent
The areal extent of mangroves in the Fijian archipelago was reported as 65,243 ha, with the majority of coverage evenly distributed around the coastlines of the two largest islands of Viti Levu (31,509 ha) and Vanua Levu (29,938 ha). At the site level, the largest contiguous areas of mangroves are located in the Rewa (7,110 ha) and Ba Deltas (5,540 ha) of Viti Levu followed by the Labasa Delta (1,545 ha) on Vanua Levu. Some of the coral atoll islands directly offshore from Vanua Levu such as Talailau (690 ha) and Nadogo (1,210 ha) are also significant mangrove habitats and are almost exclusively covered in mangroves (Cameron *et al*. 2021).

Mangrove Loss
Mangrove loss over the period 2001-2018 across Fiji was estimated at 1,135 hectares, a decrease of 1.7% in cover since 2001 with an average annual rate of loss of 0.11% (Table 1). Provinces exhibiting the highest losses are Ra (315.3 ha, 12.2%), Ba (343.5 ha, 2.6%) and Bua (Vanua Levu, 223.7 ha, 2.3%). In contrast, regions with significant mangrove cover but minimal loss included Cakaudrove and Macuata on the south-east and north-east coasts of Vanua Levu (0.7% and 0.3% loss of cover between 2001-2018 respectively) and Rewa, Nadroga-Navosa and Serua on the south-east, western and southern coast of Viti Levu (0.8%, 0.6% and 0.3% coverage loss between 2001-2018 respectively).

DoDD in Fijian mangroves
Interpretation of annual mangrove cover loss with corresponding satellite imagery data reveals that approximately 77% of loss (~870 ha) can be directly attributed to the successive impacts of Tropical

Cyclones (TCs) Gene (Category 3, January 2008), Mick (Category 2, December 2009), Evan (Category 4, December 2012), and Winston (Category 5, February 2016), with mangrove loss largely concentrated in the Ra, Ba and Bua provinces.

After TCs, the next most significant drivers of coverage loss were the conversion of mangroves for tourism development and coastal reclamation (~120 ha) followed by the disposal of dredging spoil in the Ba and Rewa Deltas (~33 ha). The remaining 112 ha of loss was attributable to smaller scale conversion for industrial estates, squatter housing, agriculture and construction of sugarcane tram lines, as well as harvesting for both fuelwood and construction materials, all of which were previously recognised drivers of mangrove loss in Fiji (MoE 2018).

Table 1. Summary of mangrove extent, mangrove coverage loss and drivers of loss for selected provinces in Fiji 2001-2018. The unsurveyed Bua Province of Vanua Levu accounts for an additional ~223.7 ha of loss due to tropical cyclones. N/A = not applicable. Reproduced from Cameron *et al*. (2021).

Province	Mangrove extent 2018 (ha)	Mangrove loss 2001-2018 (ha)	% loss (per annum)	Drivers of mangrove loss and estimated extent (ha) and proportion (%)			
				TCs	Tourism development	Dredge disposal[1]	Other
Ba	13,066	343.5	2.6 (0.16)	~210 (61%)	~120 (35%)	~13.5 (4%)	N/A
Nadroga-Navosa	2,599	16.2	0.6 (0.04)	~16.2 (100%)	N/A	N/A	N/A
Rewa and Tailevu	11,005.6	105	0.9 (0.1)	~61.1 (58%)	N/A	~18.9 (18%)	~25.1 (24%)
Ra	2,271.8	315.2	12.2 (0.76)	~307.7 (98%)	N/A	N/A	~7.5 (2%)
Fiji total	**65,243**	**1,135**	**1.7 (0.11)**	**~870 (77%)**	**~150 (13%)**	**~32.4 (3%)**	**~82.6 (7%)**

The results reported in Cameron *et al*. (2021) revise the estimated extent of mangroves within the Fijian islands to 65,243 ha, an increase in spatial area of over 25, 000 ha from the MFW database[1]. It also revises estimates of mangrove loss between 2001-2018 to 1,135 ha, with the vast majority of loss (~870 ha) occurring post-2012 and coinciding with TCs Evan and Winston. Historical mangrove loss in Fiji was estimated at 4,313 ha between 1896-1986 (Lal 1990), representing a decrease in spatial extent of approximately 6% at an annual rate of loss of 0.06% (extrapolating data on estimated historical extent from the current study). Combining historical (Lal 1990) and contemporary (this study) datasets reveals that Fiji has lost an estimated 5, 447 ha of its mangrove ecosystems, or 7.7% of original extent since 1896. The historical loss of 4, 313 ha of mangroves between 1896-1986 was driven primarily through conversion to sugarcane plantations (Lal 1990)[2], and in contemporary times this has been exceeded by losses resulting from tropical cyclones. The results from Cameron *et al*. (2021) highlight changes in both the temporal drivers of mangrove loss and the geographical variability of where loss occurs within Fiji, with anthropogenic stressors (e.g. conversion to sugarcane plantations) now superseded by natural disturbances from tropical cyclones.

Limitations

However, while the study is the most comprehensive to date to report mangrove extent, rates of loss and DoDD across Fiji, it was also limited in a number of critical ways. Firstly, the dataset used to classify and delineate mangrove extent (GIZ, SPC, SPREP 2019) requires further screening to test and ensure accuracy (e.g. assess whether areas classified as mangroves actually represented mangroves in the field, as opposed to terrestrial systems or mudflats). This is a key criticism of Watling (2021), although it is unclear which technical aspects of the analysis were 'unfit for purpose'[3] and clarification of this statement should be pursued. The Ministry of Economy (2018) in the 'Fiji low emissions development strategy 2018-2015' also notes that the discrepancies between various estimates of mangrove extent as 'significant and will require considerable additional data collection and analysis to resolve'.

[1] The Mangrove Forests of the World (MFW) database (Giri *et al*. 2011) estimated mangrove spatial extant in Fiji at ~40, 000 ha, while Worthington and Spalding (2019) estimated mangrove coverage in Fiji at 50, 968 ha with an area of loss of 637 ha since 1996 (Cameron *et al*. 2021).

[2] Singh *et al*. (2021*a*) also note that infrastructure and tourism development was (and remains to some extent) another major DoDD of mangroves, citing the construction of the Denarau Island resort development which resulted in the clearance of 130 ha of mangrove forest to create a golf course and artificial marina in the 1990's.

[3] Watling makes the following observation of the GIS analysis reported in Cameron *et al*. (2021): 'It (Cameron *et al*. 2021) bases its assessments of mangrove area and loss on two sources – the Global Forest Watch (Hansen *et al*. 2013) and GIZ, SPC, SPREP PacGeo9, both of which are viewed with considerable scepticism by observers in Fiji, both by those with an understanding of what is happening on the ground, and those with a good understanding of satellite imagery - as such it is 'not fit-for-purpose'.

Secondly, the dataset assessed changes in mangrove extent between 2000-2018 as a whole, which made it difficult to attribute mangrove loss to a particular year or cause. Google Earth historical imagery (where available) was used instead to correlate cause (e.g. tropical cyclone damage) to effect (mangrove loss). Results, however, could be substantially improved through the use of remote sensing techniques like Normalized Difference Vegetation Index (NDVI) using Landsat (or similar) timeseries imagery for each year imagery is available. This will enable a much more accurate analysis of the extent of loss from cyclone damage over time, as well as identify patterns of regrowth (see Pokorn [2018] below).

Finally, in the Rewa Delta, while field surveys revealed evidence of selective harvesting and small patches of clear felling, these were not detected through the GIS analysis of mangrove cover loss. Small-scale harvesting is recognized as one of the most widespread forms of resource use in mangrove forests worldwide (Scales and Friess 2019) and, unlike larger-scale forest clearance (e.g. clearing for agriculture, or the impacts of dredge spoil disposal observed in other parts of the Rewa and Ba Delta's), it is not often detectable through remote sensing analysis (Dahdouh-Guebas *et al*. 2005; Scales and Friess 2019). This signals a clear research prerogative in the need for further investigation of the prevalence, distribution, rate (i.e. number of trees extracted per year) and impacts from extraction – whether small scale selective harvesting or clear felling – within other areas of the Rewa Delta. This can be achieved through the use of drones, field surveys and the conduction of semi-structured interviews with communities that reside within and around Rewa to complement existing data (Cameron *et al*. 2021).

3.2 Avtar et al. (2021). Impacts of changes in mangrove ecosystems in the Ba and Rewa deltas, Fiji using multi-temporal Landsat data and social survey.

More recently, Avtar *et al*. (2021) assessed changes in mangrove extent in the Ba and Rewa deltas using multi-spectral Landsat data and community surveys between 2000- 2020. Reported results showed that mangroves *increased* by +572 ha (12%) in the Ba Delta and *decreased* by -697 ha (9%) in the Rewa Delta.

The reported increase in mangrove extent within the Ba Delta can be attributed to the successful regrowth of mangroves in abandoned grassland areas (an increase in mangrove extent of 128.9 ha) that were not utilized by communities, as well as an increase in sediment deposition around riparian areas (conversion of water bodies to mangroves, 193.1 ha) which enables mangrove recruitment and growth (Avtar *et al*. 2021). These findings are in direct contrast to the findings of Cameron *et al*. (2021), with the discrepancy likely due to differences in the classification of land use and land cover (LULC). Avtar *et al*. (2021) did not classify tropical cyclone damage as a change in 'land cover' (mangroves lost or destroyed through tropical cyclones are still classified as mangroves). In the Rewa Delta, the majority of loss was attributed to conversion or changes from mangroves to 'forest/vegetative area[4]', most likely due to the dumping of dredge spoil which resulted in a change in land elevation above mean high water springs. The authors also note that road construction and housing development are additional drivers of mangrove loss in the Rewa Delta (Avtar *et al*. 2021).

3.3 Singh et al. (2021b). Change detection of a coastal woodland mangrove forest in Fiji by integration of remote sensing with spatial mapping.

Singh *et al*. (2021b) also undertook a GIS and remote sensing analysis of land cover change between 1999-2018 focussing on the Ba Delta. This analysis showed an overall trend of mangroves expanding into what were mudflats (Mudflats to Mangrove, Figure 1), the landward expansion of mangroves to terrestrial vegetation (UpLandVeg to Mangrove, Figure 1), as well as the conversion (or loss) of mangroves to terrestrial vegetation (Mangrove to UpLandVeg, Figure 1) which correlates to the deposition of dredge spoil. Overall, mangroves increased in extent by +28.62 ha in the Ba Delta between 1999 and 2018, which is an order of magnitude lower than the change in overall extent of 572 ha observed by Avtar *et al*. (2021). Similar to Avtar *et al*. (2021), the study by Singh *et al*. (2021b) also did not delineate tropical cyclone damage and/or recovery of mangroves despite base satellite imagery clearly showing such impacts (Figure 1).

[4] This LULC classification is defined as '*natural forest and vegetation that are non-mangroves. These include evergreen forest, deciduous forest and costal vegetation*'.

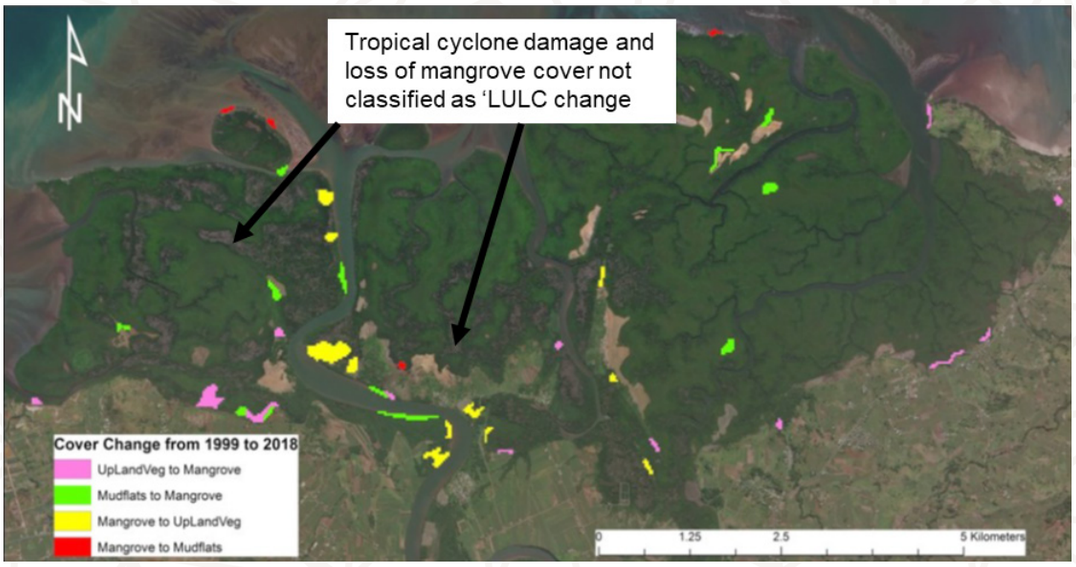


Figure 1. Extract from Singh (2021*b*) which illustrates land cover change in the Ba Delta but does not delineate tropical cyclone damage (dead and / or recovering mangroves), despite the base satellite imagery clearly showing tropical cyclone impacts (see inset text box).

3.4 Pokorn (2018). Combing Sentinel-1, SAR, and Landsat NDVI time series for abrupt disturbance detection of Fiji's mangrove forests.

Pokorn (2018) combined multi-temporal Sentinel-1 C-band synthetic aperture radar (SAR) with Landsat NDVI to assess the damage to mangrove ecosystems along the eastern coastline of Viti Levu caused by Tropical Cyclone Winston (2016) as part of a MSc dissertation. Results showed that 37% of mangrove ecosystems assessed experienced damage (Figure 2). While the spatial extent of loss was not provided, the study nonetheless provides an example of a methodological approach which could be adapted and applied Fiji-wide to assess loss (and recovery) of mangroves from large scale damage caused by impacts such as tropical cyclones (noting limitations in the ability of satellite based remote sensing to assess small scale patch clearance).

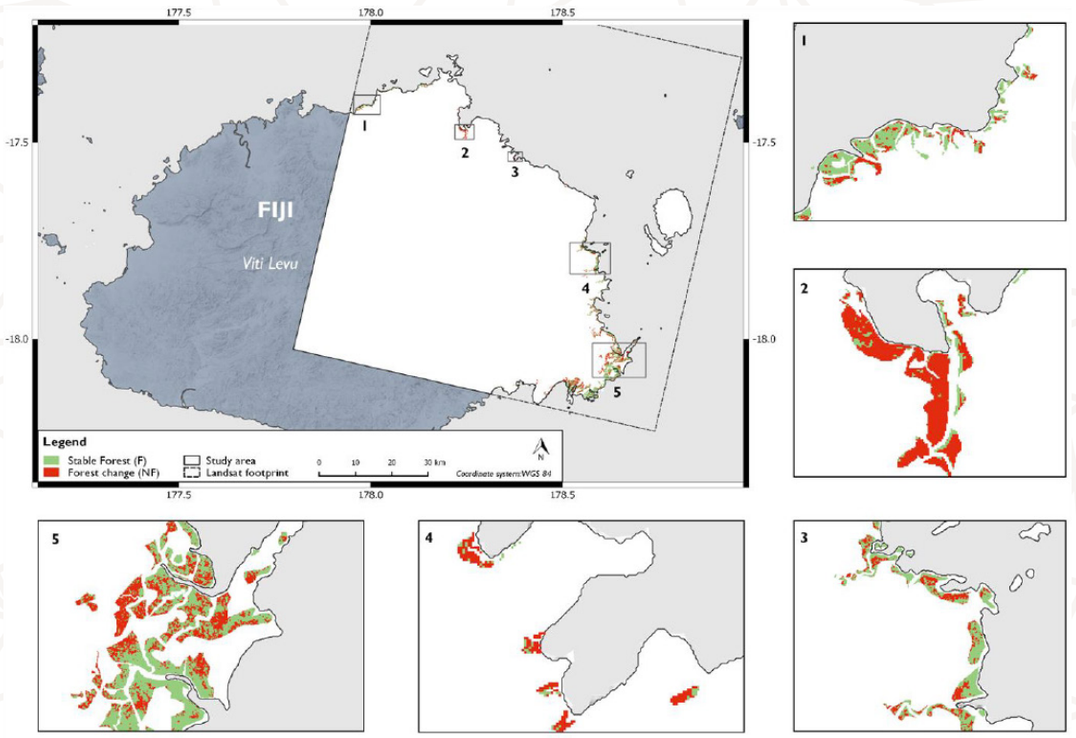


Figure 2. Extract from Pokorn (2021) showing the impacts from Tropical Cyclone Winston on mangrove ecosystems along the eastern coastline of Viti Levu.

3.5 Dayal et al. (2022). An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach.

This study assessed biophysical properties (e.g., salinity, pH, nitrogen and phosphorus) and human use of and perceptions about mangrove ecosystems around the Nasilai River in the Rewa Delta. Local communities from two villages, Nasilai and Vadrai, were interviewed about (*inter alia*) their use of mangroves, with results indicating mangroves provided multiple resources such as timber for house building and fenceposts, firewood for domestic use, traditional medicines, while bark was used for making dyes. Aside from harvesting the mangrove trees themselves, villagers also pick or collect non-timber forest products from the mixed mangrove-associated vegetation, such as *Inocarpus fagifer* ('ivi'), coconuts, *Barringtonia edulis* ('vutu') and *Pometia pinnata* ('dawa'), during their respective fruiting seasons. These products can be sold in markets for additional income. Pandanus leaves are also processed and woven into mats and fans for cultural purposes (such as weddings and funerals) and also generate additional income. Fish and crabs were also harvested from mangrove forests, with the portion not directly consumed sold at local markets to supplement income (Dayal *et al*. 2022). Of importance, the use of mangrove resources correlates strongly to proximity to mangrove forests. Nasilai is located within the mangrove zone, while Vadrai is about 200m from the edge of the mangrove forests. 93% of respondents from Nasilai indicated they harvested mangrove products weekly vs. 12.5% from Vadrai. Additionally, the Nasilai village leaders are 'owners' of the mangrove forests and villagers from Vadrai require permission to extract mangroves for timber or firewood (Dayal *et al*. 2022).

In terms of changes in mangrove forests, degradation evident near to villages was primarily due to human activities such as over-harvesting, bark removal, and dumping of domestic waste, rather than from climate change effects (Dayal *et al*. 2022). However, respondents from Nasilai (the village closest to the coast) also reported impacts from sea-level rise in that the village boundary was often flooded to ankle hight during King tides while elderly respondents reported that this did not occur 30 to 40 years ago (Dayal *et al*. 2022). Similar to results reported in Cameron *et al*. (2021), the intensity of selective mangrove harvesting for timber and firewood was low with negligible observed impacts on overall forest structure and health.

While limited in the spatial scope of application (two villages), the framework, methods, and questionnaire used in Dayal *et al*. (2022) to conduct socioeconomic surveys of mangrove resource use and perceptions of change over time provide a robust platform to build on for the conduction of further, wider ranging studies of other communities within the Rewa Delta. As the authors note, long-term monitoring requires the adoption of standardized procedures that can provide meaningful quantitative data for comparisons with established reference baselines (Dayal *et al*. 2022), and adopting the methods used in this study can help build a better understanding of whether an avoided deforestation and/or improved forest management intervention is warranted for the Rewa Delta.

3.6 Lawson et al. 2021: Historical Maps provide insight into a century and a half of habitat change in Fijian coasts

Lawson *et al*. (2021) used historical maps and aerial photography to compare and contrast coastal development around the Fijian coastal cities of Suva and Savusavu. Results show that mangrove coastal extent around Suva had declined by 44% between 1898 and 2019, with loss attributed to the construction of seawalls in and around the city centre. In contrast, mangrove coastal extent around Savusavu did not change extensively between 1880 and 2018, reflective of lower rates of population growth (Lawson *et al*. 2021). This study adds empirical weight to the fact that urban development around growing city centres like Suva has been an important DoDD of mangroves in the past.

3.7 Pearson (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.

Pearson's PhD thesis focussed on iTaukei (Indigenous Fijian) knowledge systems with regards to human-mangrove relationships in coastal and rural Fijian villages of Vanua Levu. Objective 2 investigated key changes in mangrove socio-ecological systems, the drivers behind changes, and resulting impacts on iTaukei livelihoods. The main biophysical changes identified were mangrove loss and damage, while mud crabs, fish and other marine species were observed to be in decline. The key factors driving these changes are mostly attributed to local clearing, tropical cyclones and chemical run-off from sawmill companies. The main socioeconomic changes were increasing costs of mudcrabs, unsustainable fishing practices, and a transition from collecting mudcrabs primarily for consumption to primarily for income. The key factors driving these changes were the commercialisation of the fisheries industry and a growing market-based

economy which add pressure on local communities to prioritise income over other livelihood factors. As a result, the evolving social and economic realities of iTaukei communities are also contributing to the biophysical changes in mangrove ecosystems, and vice versa. Moreover, it was found that this changing mangrove socio-ecological system was compromising the livelihoods of iTaukei communities, especially in coastal villages that are more exposed to impacts of sea-level rise and cyclones (Pearson 2020).

Objective 3 examined the traditional management techniques used by iTaukei communities to protect, conserve and restore mangrove ecosystems, and used semi-structured interviews to illicit feedback. The results showed that iTaukei communities have been utilising traditional strategies to sustainably manage mangroves and associated coastal resources throughout history. The main management techniques used were the implementation of tabu areas, community replantation, and knowledge sharing through oral transmission. Tabu areas are essentially protected areas put in place for a certain period of time to allow resources to replenish. This usually covers marine areas such as coral reefs and mangrove ecosystems, in which local people are prohibited from taking any resources from until the tabu is over. Tabu areas are usually designed by local people at village community meetings with permission from the Chief. Reasons for implementing tabu areas varied between villages. In Koroinasolo and Denimanu villages, tabu for mangrove areas were applied in response to declining resources. In Bua village, tabu areas for mangroves were put in place for 100 days whenever there is a death within the village (Pearson 2020).

While focussed on Bua Province in Vanua Levu (rather than Viti Levu where the Pacific Blue Carbon Fiji Project will be located), the study provides an important contribution to the literature and confirms the impact of tropical cyclones and local clearance as a key DoDD in mangrove ecosystems in accordance with other studies (e.g., Cameron *et al*. 2021, Dayal *et al*. 2022). It also identifies a new threat in the form of chemical run-off from a sawmill. Additionally, and in the same vein as Dayal *et al*. (2022), the semi-structured interviews used to assess traditional management techniques under research Objective 3 provide a robust basis to adapt and apply for the conduction of community surveys planned for the Pacific Blue Carbon Fiji Project.

4. Key findings and recommendations

There are several key findings and recommendations arising from this literature review, as summarised below.

- The need for a comprehensive, historical assessment of mangrove extent, loss and recovery (particularly following tropical cyclones) at a national scale using remote sensing tools such as NDVI and SAR. As noted, the range in estimates of the spatial extent of mangroves varies by as much as ~60% (difference in reported extent between Giri [2011] and Cameron *et al*. [2021]). This creates significant issues with regards to accurately monitoring changes over time or developing a robust baseline for the Pacific Blue Carbon Fiji Project. It is particularly important for gauging the degree of 'additionality' derived from restoration project interventions planned in Ra and Ba, as opposed to natural recovery.
- Development of a standardised classification system for categorising LULC in mangroves and adjacent habitats. This should include delineation of 'mangroves' into sub-categories of 'healthy mangroves', 'disturbed mangroves' (i.e., dead mangrove vegetation impacted by tropical cyclones or infrastructure), and 'regenerating mangroves', as well as include the other categories used in Singh *et al*. (2021*b*) and Avtar *et al*. (2021) e.g., water bodies, unvegetated (e.g. tidal mud flats), grazing lands, anthropic development (human settlements etc.), and terrestrial vegetation. A recent paper by Rodríguez-Zúñiga (2022) describes a national scale mangrove monitoring system in Mexico, and this could be used to guide the development of LULC categorisation in Fiji.
- Build on the socioeconomic studies and methodology used by Dayal *et al*. (2022) and Pearson (2020). This is particularly important for the Rewa Delta, where community surveys (in conjunction with drone mapping to identify small-scale patch clearance) will be conducted to assess the viability of an avoided deforestation and/or improved forest management intervention for the Pacific Blue Carbon Fiji Project.

5. Literature reviewed

Avtar, R., Navia, M., Sassen, J., & Fujii, M. (2021). Impacts of changes in mangrove ecosystems in the Ba and Rewa deltas, Fiji using multi-temporal Landsat data and social survey. *Coastal Engineering Journal*, *63*(3), 386-407.

Cameron, C., Maharaj, A., Kennedy, B., Tuiwawa, S., Goldwater, N., Soapi, K., & Lovelock, C. E. (2021). Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. *Environmental Challenges*, *2*, 100018.

Dahdouh-Guebas, F., Hettiarachchi, S., Seen, D. L., Batelaan, O., Sooriyarachchi, S., Jayatissa, L. P., and Koedam, N. (2005). Transitions in ancient inland freshwater resource management in Sri Lanka affect biota and human populations in and around coastal lagoons. Curren. Bio. 15(6), 579-586.

Dayal, S., Waqa-Sakiti, H., Tabe, T., & Hodge, S. (2022). An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. Pacific Dynamics: *Journal of Interdisciplinary Research*. DOI : http://dx.doi.org/10.26021/12508

Giri, C., Ochieng, E., Tieszen, L.L., Zhu, Z., Singh, A., Loveland, T., Masek, J. and Duke, N. (2011). Status and distribution of mangrove forests of the world using earth observation satellite data. Glob. Ecol. Biogeo. 20, 154–159

GIZ, SPC, SPREP. (2019). Fiji Forest Change Detection 2006-2018. Data available on-line from: http://www.pacgeo.org/layers/geonode:fiji_fcd_2019_w84_1

Lal, P. N. (1990). Conservation or conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Centre. Occasional Paper No. 11. Honolulu, Hawaii.

Lawson, K. N., Letendre, H., & Drew, J. A. (2021). Historical Maps provide insight into a century and a half of habitat change in Fijian coasts. Ecology and evolution, 11(22), 15573-15584.

Ministry of Economy. (2018). Fiji low emission development strategy 2018-2050. Government of Fiji. https://unfccc.int/sites/default/files/resource/Fiji_Low%20Emission%20Development%20%20Strategy%202018%20-%202050.pdf

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. PhD thesis, School of Earth and Environmental Sciences, University of Queensland.

Pokorn, J. (2018). Combing Sentinel-1, SAR, and Landsat NDVI time series for abrupt disturbance detection of Fiji's mangrove forests. Thesis Report GIRS-2018-05. Centre for Geo-Information, Wageningen University.

Rodríguez-Zúñiga, M. T., Troche-Souza, C., Cruz-López, M. I., & Rivera-Monroy, V. H. (2022). Development and Structural Organization of Mexico's Mangrove Monitoring System (SMMM) as a Foundation for Conservation and Restoration Initiatives: A Hierarchical Approach. *Forests*, *13*(4), 621.

Scales, I. R., and Friess, D. A. (2019). Patterns of mangrove forest disturbance and biomass removal due to small-scale harvesting in southwestern Madagascar. Wet. Ecol. Manage. 1-17.

Singh, S., Bhat, J. A., Shah, S., & Pala, N. A. (2021*a*). Coastal resource management and tourism development in Fiji Islands: a conservation challenge. Environment, Development and Sustainability, 23(3), 3009-3027.

Singh, A.A., Maharaj, A.A., Naidu, H., Raj, K., Charan, D., Chand, R., Singh, S., Joseph, L., Singh, P. and Prasad, R. (2021*b*). Change detection of a coastal woodland mangrove forest in Fiji by integration of remote sensing with spatial mapping. *Asian Journal of Conservation Biology*, *10*(2), pp.222-233.

Watling, D. (2021). Best Practice Mangrove Planting For Fiji–A Discussion Document–August 2021. Environmental Consultants Fiji Pty Ltd, 259 Prince's Road, Suva. https://www.environmentfiji.com/best-practice-mangrove-planting-for-fiji-a-discussion-document-august-2021/

Worthington, T., and Spalding, M. (2019). Mangrove restoration potential: A global map highlighting a critical opportunity. The International Union for the Conservation of Nature and the Nature Conservancy.

ANNEX: II

LEGAL AND POLICY ANALYSIS FOR BLUE CARBON ECOSYSTEMS IN FIJI

Ulaiasi Baya and Nikheel Sharma
Conservation International
2023

Table of Contents

Page No

EXECUTIVE SUMMARY

The blue carbon legal and policy assessment report provides an analysis of policies, laws, and regulations related to the protection and sustainable management of mangrove forest ecosystems in Fiji. The assessment reveals a complex situation characterized by a lack of custodianship under a single legislation and overlapping responsibilities due to multiple legal coverages. As a result, mangrove protection remains limited to the scope defined by specific laws, many of which are outdated and fail to address the modern emphasis on environmental sustainability.

One concerning trend highlighted in the report is the lack of active management tools and instruments for resource and environmental management. Most statutes allow permissible actions without clearly identifying correspondent or complementary requirements for resource management. Additionally, the lack of public involvement in decision-making and grievance redress mechanisms marginalizes stakeholders and the wider public interest in the environment.

The report identifies some legislation, such as the Land Conservation and Improvement Act and the Drainage Act, which demonstrate a more enlightened and inclusive approach to protecting natural resources. However, significant improvements are required to update natural resources policy and enhance environmental protection in Fiji. The proposed Management of Mangrove Regulation enabled under the Environment Management Act (2005) and the Forest Bill No 13(2016) are cited as important pieces of legislation that reflect fidelity to international treaties and conventions.

The report recommends several key actions to improve legal instruments for mangrove management. These recommendations include updating the proposed Management of Mangrove Regulation and the Forest Bill to better reflect and formalize customary sustainable management practices, reviewing and harmonizing existing land access and resource development legislations, and including value appraisal of restoration and compensatory payments in regulations. Periodic assessments and resource audits are also advised to determine the value of ecosystem services provided by mangroves and inform development proposals.

Finally, the report notes the importance of Fiji signing and ratifying the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) to ensure the protection of existing indigenous rights and institutions related to mangrove ecosystems. Proper valuation of indigenous values, customary user rights, and land tenure must be considered in managing mangroves sustainably.

In conclusion, the blue carbon legal and policy assessment report highlights the complexity and shortcomings in the current legal framework governing mangrove forest protection and management in Fiji. Addressing these issues and implementing the recommended improvements will be essential to safeguarding the valuable blue carbon ecosystems and promoting environmental sustainability in the region.

INTRODUCTION

Mangrove forest is crucial to Fiji's blue carbon capture projects through the large contiguous coastal ecosystem and the high carbon storage potential it provides. Central to the feasibility of such projects pertains to coastal habitat conservation and sustainable management to protect healthy coastal mangrove environments. This, in turn, provides benefits to people such as recreational activities, storm and flood protection, and a nursery for fisheries, amongst others. Yet, despite its clear importance, mangroves are vulnerable to both natural and human-induced impacts such as urbanization, squatters, unplanned development, solid and liquid waste pollution runoff, and invasive species. (SPREP, Regional Wetlands Action Plan, 2011-2014).

A possible option for sustainable management, protection, and slowing down the deleterious impacts of climate change on coastal ecosystems is to incorporate mangroves as blue carbon projects under a market platform for trading carbon offsets. In so doing, an inventory of mangroves must be assessed, considering the cause and effect of deforestation and the degradation of its ecosystem.

Fiji does not have legislation specifically for mangroves nor does it have a specific wetlands policy. As such, there is no single government body or institution that is dedicated to governing mangroves. Therefore, the legal framework for mangrove ecosystem uses and management is provided through the intersecting coverage of laws, sectorial policies, and regulations of activities. It is the result of the converging interplay of the major legislation(s) such as the Fisheries Act 1942 (Cap 158), Environment Management Act (2005), Forest Bill (2016), iTaukei Land Act (Cap 133), and State Lands Act (Cap 132) that impacts mangrove regarding ownership, governance, customary use rights, and sustainable management. There are other national laws and regulations relating to resource use that also affect mangroves indirectly that are discussed below. Overall, Fiji's legislative framework is aided by its international obligations owed under various international instruments, which it is a signatory of.

This report evaluates Fiji's existing legal framework in the context of mangroves through detailed consideration of national policies, laws, and regulations with the overlay of Fiji's obligations under international instruments.

BACKGROUND

As a former colony, Fiji's current legal system is sourced from the laws of England. Laws relating to property ownership and dealings became formal laws of the land through the doctrines of adoption and reception, translated into local context after the Cession of 1874. Fiji being a common-law country, it is generally accepted through the inference arising from the application of common law principles that ownership of forest carbon rights lies with the owners of the land through the nexus of landowners, forest trees (mangroves), and sequestered forest carbon. A forest plantation owner, under this interpretation, does not own forest sequestered carbon from the plantation forest, unless there is a prior existing agreement of consent from the landowner to this effect. Despite the absence of specific legislation, Fiji does have relevant legislation that will assist with the implementation of blue carbon, such as those addressing sustainable forest management, biodiversity, and special land use conditions affecting mangroves and mangrove ecosystems. These are briefly discussed, firstly according to Fiji's international and regional obligations, and second in the local context.

INTERNATIONAL CONTEXT

Fiji is a signatory to several international instruments that binds its future actions concerning forest, wetlands, and plant protection. Biodiversity, and conservation. It is noted that there has been impressive growth in the number and coverage of treaties and other instruments governing environmental issues. This proliferation of treaty-making has arisen from a global recognition that many environmental problems are transboundary in nature and are beyond the capability of countries to address by acting alone. Nations have successfully negotiated treaties to address species loss and climate change, for example, wherein global standards and measures are agreed which parties then adopt and apply domestically.

Typically, domestic adoption involves action by governments to emplace controls in respect of national behaviour, very often through the enactment of legislation expressed in the terms of the particular international instrument. Such domestic controls might involve prohibitions or creating a permissions system. It is through the collective action of countries within their jurisdiction that the goals and standards enunciated in an international instrument will be attained. Importantly, the relevant treaty or convention enables the government to undertake actions that it would otherwise not possibly be able to do. As mentioned, in the case of the environment it has been recognized that many issues require international cooperation if these problems are to be solved.

Fiji embraced the global commitment to shift toward sustainable development at the UN Conference on Environment and Development (UNCED) in Rio (1992). Concerning forests, the key outcomes of the UNCED were the Rio "Forest Principles. Fiji ratified two key multilateral environmental agreements that promote the conservation of forests and their ecosystems and influence national policies on forests [See; Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests at 32]. These are:

- The UN Convention on Biological Diversity (CBD), and its two subsequent protocols: The Cartagena Protocol on Biosafety in [2010] and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in [2010]; and

- The UN Framework Convention on Climate Change (UNFCCC), which was followed by the Kyoto Protocol in 1997 and the Paris Agreement in 2015.

The most recent international policy instrument that addresses key drivers of overall deforestation and degradation is the Agenda for Sustainable Development (2030) and the Sustainable Development Goals (SDGs). Most certainly, the 17 SDGs have some relevance in addressing matters pertinent to drivers of deforestation and degradation. SDG-15 specifically addresses forests, aiming to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss".

Another crucial development in Fiji's international obligation to forests is its acceding to the UN Convention to Combat Desertification (1994). The UNCCD aims to guarantee a long-term commitment to the parties concerned through a legally binding document. As a signatory, Fiji is obligated to report to the Convention Secretariat on the progress of implementing the Convention. If implemented effectively, the Convention would contribute significantly to achieving the goals of sustainable land management and preventing land degradation. This is not always possible given the limited systemic, institutional, and individual capacity to fully implement the obligations and requirements of the Convention and to benefit fully from involvement in it. A list of International Instruments with real and perceived implications for mangroves is summarized below as Multi Environment Agreements (MEAs)

INTERNATIONAL INSTRUMENT	DATE	SUMMARY
The International Timber Agreement	1940	Provide an effective agreement for consultation and international cooperation and policy development amongst all members of the world timber economy, to provide for a non-discriminatory timber practice and to contribute to the process of sustainable development.
International Convention for the Prevention of Pollution from Ships (MARPOL)	1973	The main international Convention covers the prevention of the marine environment by ships from operational and accidental causes. This intent has logical application for small island States like Fiji, given it has potential ramifications, and the susceptibility of its mangrove ecosystems.
The Convention on International Trade on Endangered Species CITES	1975	Largest and oldest Convention on conservation and sustainable use agreements. Aims to ensure international trade in specimens of wild animals and plants does not threaten the survival of the species in the wild, and it accords varying degrees of protection to species of animals and plants.
The Convention on Wetlands of International Importance - Especially as water flow Habitat	1975	An international treaty for the conservation and sustainable use of wetlands, named after RAMSAR, in Iran where the Treaty was signed.
International Plant Protection Convention	1979	The International plant health convention aims to protect cultivated and wild plants by preventing the introduction and spread of pests.
Convention on Biodiversity	1992	A multilateral treaty with three main goals: 1. Conservation of biological diversity 2. Sustainable use of its components, 3. Fair and equitable sharing of benefits arising from the use of genetic resources.
UN Framework Convention on Climate Change	1992	International treaty addressing climate change with the aim to prevent dangerous human interference with the climate system by seeking to stabilize GHG concentrations in the atmosphere at a level that would prevent anthropogenic, human-induced interference with the earth's climate system.
UN Convention to Combat Desertification	1994	Sole and legally binding international agreement linking environment and development to sustainable land management
Kyoto Protocol	1998	Operationalizes the UNFCCC by committing industrialized countries and economies in transition to limit and reduce GHG emissions under agreed individual targets.
Cartagena Protocol on Biodiversity	2000	An international agreement that aims to ensure the safe handling, transport, and use of living-modified organisms resulting from modern biotechnology that may have adverse effects on biological diversity
International Treaty on Plant Genetics Resources for Food and Agriculture (Seed Treaty)	2001	A comprehensive international agreement in harmony with the International Agreement Convention of Biological Diversity, through the conservation, and exchange of sustainable use of the world's plant genetic resources for food and agriculture, fair equitable benefit sharing from its use, and the recognition of farmer's rights.
Statute of International Renewable Energy Agency	2009	Desired to promote the widespread and increased adoption and use of renewable energy with a view to sustainable development. Parties are also convinced that renewable energy could play a major role in reducing greenhouse gas concentrations in the atmosphere, therefore contributing to the stabilization of the climate system, and allowing for a sustainable, secure, and gentle transition of the economy.
Cancun Agreement	2010	Set of significant decisions by the international community to address the long-term challenge of climate change collectively and comprehensively over time and to act immediately to attract a global response. It includes the safeguards now referred to as the Cancun Safeguards.

Nagoya Protocol to Genetic Resource and Fair and Equitable Benefit Sharing	**2011**	Nagoya is a supplementary Agreement to the Convention on Biodiversity aimed at the implementation of one of the three objectives of the CBD, the fair and equitable sharing of benefits arising out of genetic resources, thereby contributing to the conservation and sustainable use of biodiversity.
International Convention for the Prevention of Pollution from Ships (MARPOL)	**1973**	The main international convention covers the prevention of harm to the marine environment by ships from operational and accidental causes. This intent has logical application for small island States like Fiji, with potential ramifications given the susceptibility of its mangrove ecosystems.
Paris Agreement under UNFCCC	**2015**	A legally binding international agreement on climate change. Its goal is to limit global warming to well below 2 degrees but preferably below 1.5 degrees Celsius as compared to pre-industrial levels. Sets Fiji's commitment to National Determined Contributions (NDC).
Multilateral Environment Agreements (MEAs)	Summary	Committing the government to develop national policies and legislations to give effect to the UN Convention on Biological Diversity (UNCBD), UN Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, UN Framework to Combat Desertification (UNFCD), Convention on International Trade of Endangered Species (CITES), the RAMSAR Convention on Wetlands of International Importance, World Heritage Convention (WHC), UN Convention on the Law of the Sea (UNCLOS), and the International Convention for the Prevention of Pollution from Ships (MARPOL), which entail obligations of relevance to mangroves.

Property in the forest and interests are protected under ***Fiji Constitution (2013)***. Under Section 27, every person has the right not to be deprived of property by the State, other than in accordance with a written law limited mainly regarding land for public purposes. The Section further adds that no such law may permit arbitrary acquisition or expropriation of any interest in a property. Under Section 28, rights of ownership are affirmed and protected with regards to iTaukei, Banaban, and Rotuman lands, which shall not be permanently alienated, whether by sale and grant, transfer, or exchange except under a written law for the facilitation of lands for the public purpose for just compensation. Section 28 also guarantees the reversion of public-purpose land to original owners once the requirement 'for a public purpose' ceases under Sections 28 (2), 28 (4), and 28(6) respectively. Section 29 affords protection of ownership and interest in land. This is particularly important in the consideration of the elements of customary fishing rights of iTaukei owners in contiguous mangrove areas.

Sections 27-29 provide a contextual reference to the unique tenure system in Fiji, where ninety percent of all lands are customarily owned by registered landowning units, six percent freehold, and the remaining four percent under the classification of state lands. All development land needs have been the result of the effective leasing regimes of State lands under the Ministry of Lands and customarily owned iTaukei lands under statutory trust in the iTaukei Land Trust Board (TLTB) and Land Use Unit (LUU) of the State administering designated land leases of iTaukei lands, [*see Land Use Decree (2010)*]

Under the Constitutional Bill of Rights chapter, environmental rights are guaranteed under Section 40, stating that every person has the right to a clean and healthy environment which includes the right to have the natural world protected for the benefit of present and future generations through legislative and other measures. The inviolability of this Section, however, can be limited, where it is deemed necessary to authorize such limitations at law in the matter of public interest.

The context of laws relating to any development needs relating to mangroves can be summarized as follows.

- Under the *State Lands Act* [Cap 132], ownership of all mangroves forest as 'foreshore" is reserved for State ownership and administered under the Department of Lands which regulates the use of all State lands. All applications for use, conversion, and/or development are decided by the Department of Lands (DoL).
- Under the *Environment Management Act EMA* (2005), any developmental proposal likely to impact mangroves requires an environmental impact assessment (EIA) under *Environment Management Regulation (2007)*. The Department of Environment (DoE) manages the EIA process and delivers the

decision, with or without conditions, to the Department of Land. The DoL is not bound to act on the advice of the DoE except if the EIA is rejected. It is noted that EMA is binding on all government departments.

- Under EMA, the DoE is also charged with monitoring the conditions of approval of EIAs, preventing dumping and pollution, and monitoring the status of mangroves as a natural resource.
- Saved under the *Forest Bill (2016), which is ["*an Act to provide for the management of Fiji's forest and other related matters", and the Bill's precursor in the *Forest Decree (1992),* a Decree relating to forest and forest products, mangroves are classified inclusively within as 'forest' and the Forest Department regulates the utilization and management of all forest resources. This is only after the Department of Lands has approved an application for mangrove harvesting. This involvement is limited to regulating harvesting. There is no monitoring role or presence. *Forest Bill (2016)* defines the protection of forests as a special dedication to the protection and maintenance of biological diversity and ecological integrity with values such as soil conservation and cultural heritage. This predominantly would apply to mangroves given linkages to customary use, biodiversity, and conservation.
- The *Fisheries Act (Cap 158)* regulates a wide range of activities about fishing and marine life, including the regulation of locally managed fishing conservation areas within the Fiji waters and as such is relevant to mangroves.

With the prevalence of foreshore development and its impact on customary fishing grounds, the government's response by way of Cabinet Paper CP74(204) of 197, recognized and instituted traditional fishing rights owners, recorded, and surveyed since 1940, to receive recompense for the loss of fishing rights which remain the sole basis for fishing rights compensation today. A discussion of policies, laws, and regulations including plans related to the use and management of mangroves and mangroves ecosystems is presented in the next section.

POLICIES

There is no specific mangrove policy in Fiji, but there is a mangrove management plan from 1985/86 that was reviewed in 2013. However, Fiji has several policies, laws, and regulations from other sectors, including agriculture, the energy sector, national adaptation plans, and the Green Growth Fund, that provide for transparent and effective national forest governance structures. These have varying degrees of impact on mangroves given their sectorial intent, but their collective application and parallel consideration provide tangible outcomes for mangrove protection, sustainable use, and management.

Fiji's policies have shown marked evolution in recent years, supporting a shift towards sustainable development, the conservation of biodiversity, sustainable management, and the use of forests and other natural resources, aligned with the articulation of a sustainable development framework for Fiji. This materialized in the Green Growth Framework (2014), and under the impetus of Fiji's 33 international environmental commitments. However, the legal reform process has not kept pace and has yet to provide the required enabling tools and processes to practically implement these policies. These are listed in the table below.

National Policy/ Plan	Summary
Agriculture Sector Policy Agenda (2020)	The Policy complements the National Green Growth Framework recently launched and provides new dimensions by opening to global innovation for climate-smart agriculture that generates both adaptation and mitigation benefits. The policy also addresses sustainable diversification that will increase production with a holistic and focused vision pursuing sustainable development. It also creates the right atmosphere and incentives for stakeholders
Fiji Forest Policy Statement (2007)	Mangroves are well covered within the plan and are identified as one of the four categories of protected forest, where forest and biological diversity, together with values such as water supply soil conservation, and ecological integrity or scenic appeal, will be protected. The policy sees the protection of mangrove ecosystems to maintain their ecological values as a priority.

Fiji Liquid Waste Management Strategy and Action Plan (2006)	Covers all forms of liquid waste that in one way or another affects mangroves and the mangrove ecosystem. Whilst not specifically mentioned about mangroves, their impacts on coastal waters and the coastal environment have been highlighted. This strategy plan impacts mangroves by the proximity of its coverage of coastal waters contiguous to mangroves and the mangrove ecosystem
Fiji Low Emission Development Strategy 2018-2050 (2017)	Implementation of existing and official policies, targets, and technologies that are unconditional in the sense that Fiji would implement and finance them without reliance on external or international financing. Implementation of existing and official policies, targets, and technologies that are conditional in the sense that Fiji would rely on external or international financing to implement mitigation actions, thus this scenario would have a higher ambition than "BAU" unconditional. Relies on the adoption of new, more ambitious policies and technologies and the availability of additional financing to implement mitigation actions and achieve significant emission reductions by 2050 compared with the business-as-usual scenarios. A "Very High Ambition scenario" project ambitions well beyond those already specified in policies, thus relying on the adoption of new, significantly more ambitious policies and availability of new technologies and additional financing to implement mitigation actions in which most sectors achieve net zero or negative emissions, by 2050.
Fiji National Adaptation Plan (2018)	To spearhead efforts to comprehensively address climate change, in response to Fiji's international commitments and national needs; To bring adaptation efforts across multiple government sectors under one document; To influence and accelerates the national development pathway towards climate resilient development; It seeks to improve resilience against climate change but also climate variability which will also increase under future scenarios; Created as a continuous, progressive, and iterative process to support a systematic and strategic approach to adaptation by all government decision making, which will facilitate institutional coordination, resource mobilization and ultimately effective adaptation actions. To increase the efficient use of energy and the use of indigenous energy resources to reduce the financial burden of energy imports on Fiji.
Fiji National Energy Policy (2013)	To establish environmentally sound and sustainable systems for energy production, procurement, transportation, distribution, and end-use.
Fiji REDD+ Policy (2011)	Mangroves are classified under protected forest and are also considered a nature reserve and national heritage site. Given its classification, mangroves are covered under Fiji REDD+ policy and thus its management Policy has the overall intention of enhancing the national forest-based carbon balance by supporting and strengthening initiatives that address the drivers of forest-based carbon emissions and encouraging the drivers of forest-based carbon sinks; It will regularly review policy and technical issues to maintain alignment with ongoing international policy and technical developments. Furthermore, the implementation policy will ensure REDD+ plus program will involve the participation of all relevant stakeholders coming from the various sectors and agencies.
Fiji State of Environment Report (1992)	To document key drivers and pressure in Fiji that are behind changing environment. To provide a full assessment of Fiji's environment using the best available information on the state of Fiji's environment for 7 key themes; Atmosphere and Climate, Inland Waters, Land, Marine, Biodiversity, Culture and Heritage, and Built Environment. To document the impacts on Fiji's society, economy, and environment from changes in the State of the Environment. To document current responses by Fiji to address the environmental changes, to protect and better manage Fiji's resources
Fiji Tourism Development Plan (2016)	The Plan provides a framework for the sustainable growth of tourism in Fiji. It recognizes the link between tourism development and the environment. The protection of mangroves has been acknowledged and recognized in the Plan. Initiatives through the plan have seen mangrove planting in some regional areas with the regional strategy (Yasawas) to encourage the development of marine protected areas and discourage overfishing and programs to implement sewage treatment and the provision of ecologically sustainable wastewater and solid waste solutions.

Green Growth Framework for Fiji (2014)	A tool to accelerate integrated and inclusive sustainable development; Inspires action at all levels, to strengthen environmental resilience, build social improvement and reduce poverty; Supports economic growth and strengthens capacity to withstand and manage adverse effects of climate change; To be innovative in finding new transformative solutions to long-standing problems through bold and adaptive leadership and fair and transparent consultative processes, in advancing the transition to a people-centred green economy; Integrated through a holistic approach to support development that is sustainable and climate change resilient; Inclusive of all sectors and cultures from the village to corporate boardrooms to seek to address root causes of poverty and promote sustainable, social, economic, and environmental development. To inspire through the creation of empowerment of all members of the community to make decisions and take actions to build a green economy; To invest in transformative change to better align the economy and society with the environment to sustain livelihoods now and future generation
Integrated Coastal Management (ICM) Framework (2011)	Administered through the Department of Environment and reviews current coastal conditions in the context of tourism development, coral reef degradation, siltation and erosion, waste management, coastal reclamation and construction, and natural disasters. It assesses the current legal and institutional governing framework to recommend a proposal for actions and policy toward sustainable coastal resources management. Provides direct coverage to mangroves in Section 4.6 and indirectly through coastal environment discussions. The development of the ICM plan should directly impact mangrove management. The importance of the plan to cover ridge to reef areas ensures the effective protection and sustainable management of Fiji's coastal environments.
Mangrove Management Plan [Phase I and 2] (1985)	Extensively covered management and protection of mangroves. Review of the Plans to revisit some of its earlier recommendations. A national policy on mangroves was highlighted in the plans looking specifically at zonation through mangrove reserves (resource and national reserves), managed resource areas for traditional use, wood, and shoreline protection zones) and development zones for sewage processing, urban expansion, tourism, and agriculture.
Ministry of Forestry Strategic Plan (2013)	To formulate and implement Forest Strategies and Policies. Provide and administer the regulatory function under the Ministry's respective legislation and regulations. Monitor, and evaluate current strategies, policies, and deliverables. Develop and promote effective training, communication and awareness, and extension advisory services. Strengthen community and industry networks and support infrastructure. Maintain international bilateral and multilateral commitment. Undertake applied research for sustainable forest resource management practices and product development.
National Biodiversity Strategy and Action Plan 2020-2025 (2020)	The goal is to conserve and sustainably use Fiji's terrestrial, freshwater, and marine biodiversity and to maintain the ecological process and systems which are foundations of national and local development. Mangrove and mangrove ecosystems are covered in detail. Committed to developing and implementing national strategies to conserve and use components of biological diversity sustainability. Integrating biodiversity policy into relevant sectoral or cross-sectoral plans, programs, and plans. Monitoring and periodically reporting on the status of biodiversity in the environment. NBSAP underpins the protection of Fiji's unique biodiversity and essential ecosystem goods and services, which support the national economy. Aligns the Fiji NBSAP with the global CBD strategic plan and Aichi targets. The Department of Environment to evaluate and assess how much is achieved in the Plan as part of the review process.
National Climate Change Policy (2012)	Mangrove is indirectly covered in the Policy through the adaptation and mitigation objectives and strategies of the NCCP calling for resource management planning such as integrated coastal watershed management plans, ecosystem-based approach, vulnerability assessments, best practice adaptation measures, and implementation of key policies such as Fiji REDD+ Policy and Fiji Biodiversity Strategy Action Plan. To integrate climate change issues in all national and sector policy and planning processes by incorporating climate change into national plans and budgets with Climate Change Policy framework and to ensure all national and sectorial policies align with NCCP; To collect manage and use accurate and scientifically sound climate change related data and information through a clearing house mechanism for climate change. To increase awareness and understanding of climate change-related issues across all sectors and at all levels in Fiji; Integrate climate change in school curricula, tertiary courses, vocational, non-formal education, and training programs through the development of appropriate materials and learning tools; Reduce the vulnerability and enhance the resilience of Fiji's communities to the impacts of climate change and disasters; Reduce Fiji GHG emission and implement initiatives to increase the sequestration and storage of greenhouse gases; To ensure sustainable financing for climate change efforts; To effectively participate in and contribute to international and Pacific region climate change negotiations, discussions, and outcomes

National Development Plan (2017) 5-YEAR and 20-YEAR Development Plan (2017)	Ensures inclusive socio-economic development through consideration of scenarios to consider all socio-economic rights in the Constitution are acknowledged. It emphasizes a policy of no one left behind an approach to gender and ethnicity, and geographical location; Furthermore, it seeks a formulation of a national land use plan; To develop a plantation policy on forest conservation to ensure better sustainable forest management; To formulate a Fire management strategic plan and to provides for training and development and will provide a new regulatory framework for native and pine forests.
National Forest Policy (2007)	Ensures ecosystem stability through conservation of forest biodiversity, water catchments, and soil fertility. Ensures sustainable supply of forest products and services by maintaining a sufficiently large permanent forest area under efficient and effective management. Increased engagement by landowners and communities in sustainable forest management and ensure an equitable distribution of benefits from forest products and processes including ensured protection of intellectual properties. Increased employment in the forestry sector, sufficient supply of domestic markets, and increased foreign exchange earnings through sustainable forest-based industry development. Enhanced national capacity to manage and develop the forest sector in collaboration with the involvement of all stakeholders
National Housing Policy (2011)	Key areas of the policy that are related to mangrove ecosystem, their use, and conservation are highlighted in the policy measures, calling for the provision of tenure to squatters and informal settlements on State lands and Freehold lands, improving land supply for urban development, urban land use planning, to better reflect housing needs, future expansion of cities, changing weather patterns and the periodic updating of Master Plans and Zoning Plans by local governments and development authorities.
National Solid Waste Management Strategy and Action Plan. (2011-2014)	Administered through the Department of Environment. It sets a direction for sustainable solid waste management through informed and responsible communities. The proposed goal is to increase the proportion of solid waste that is managed in a cost-effective, financially sustainable, legally compliant, and in environmentally sound manner. This goal will be accomplished through an integrated approach in eight thematic areas of sustainable financing, legislation, awareness and education, capacity building, environmental monitoring, policy and planning, solid waste industry, and integrated solid waste management.
Road Map for Democracy and Sustainable Development (2009-2014)	This is an overarching policy that sets the framework to achieve sustainable democracy, good and just governance, socio-economic development, and national unity. Mangrove, mangrove management, and mangrove use, and protection have been indirectly addressed in the key sectors of development addressed in the roadmap. The road map embraces sustainable development and management. The benefits of these sectors would indirectly impact the mangrove ecosystems and mangroves. Calls for a detailed EIA to be submitted to the relevant authorities and government approval agencies on the port, jetty, and any related marine transport development. This directly impacts mangroves and the mangrove ecosystem.
Rural Land Use Policy (2006)	Strengthening the foundation of sustainable development through establishing a policy framework, having a system of law and regulations promoting sustainable development in place. To outline strategic objectives for sustainable development. Establishing natural resources and environment monitoring systems, natural resources statistics, planning, and information support systems for social economic rural development. Developing education, raising awareness of the sustainable development issues, and building capacities for implementing sustainable practices. The strategies contained in the policy concern management measures on land, which would indirectly provide positive impacts on the management of mangroves and the protection of mangroves.
Sustainable Economic and Empowerment Strategy (SEEDS) 2008-2009 (2007)	The document provides coverage of mangroves, their use, management, and ecosystem. This includes water and sewerage (5.8) land resource and management (8.1), forestry (8.4), marine resources (8.5), and urban development (9.6) Sustainable development, sustainable management of resources, sustainable land use and practices and environment protection forms key objective of the strategies. Environmental sustainability is discussed in Section 22.5 to see the sustainable use and management of Fiji's natural resources, highlighting the policy objective at (9.4) that Fiji's environment is protected from degradation and provides people with a healthy clean environment. It promotes awareness of environment management at all levels, to mobilize communities to manage their environment as a priority. Also call to strengthen legislations which include environment management provisions e.g. (*Forest Act, Public Health Act, and Litter Decree*) and coordinate implementation in the framework of the EMA. Also, to enforce EMA giving priority to early enforcement of provisions of EIA, Waste Management, and Pollution Control. Finally, it calls for the continuous implementation of the Biodiversity Strategy Action Plan and Endangered and Protected Species Act, and *Ozone Depleting Substance (ODS) Act*

NATIONAL LAWS

National laws on access development, impacts on sustainable development, and management of mangrove ecosystems have direct and consequential impacts. These are discussed in this section relating to tenure, planning, conservation, and the environment.

LAND TENURE

State Lands Act 1946 (Cap 132)

Section 2 of the *State Lands Act (Cap 132)* defines State lands as all public lands in Fiji including 'foreshore and soil under the waters of Fiji…and all lands which have been or may be hereafter acquired by or on behalf of the State for any public purpose. A wider interpretation of the term "public purpose" can import environmental conservation purposes and use for the acquisition of land adjacent to environmentally significant mangrove areas in the context of the implementation of a national mangrove management plan. There is no express definition for the term "foreshore", but it is understood to mean the intervening area between the high-water mark and average low-water mark. Ownership of lands connotes ownership of natural resources on the land, including natural forest trees in mangroves. Therefore, ownership of mangroves within the contiguous coastal areas belongs to the State. Administration of State Lands is under the auspices of the Ministry of Lands and Mineral Resources, in particular through the Department of Lands and Survey. The foreshore is regulated under (part V) of the Act and managed by the special foreshores Unit, where the Minister's approval is required when approving leases in the public interest, per Section 2 (1) of Cap 132. The Act does not expressly refer to mangroves, but the quoted provisions effectively provide the mandate to the Ministry of Land for the stewardship of mangroves and the responsibility to manage mangroves in the public interest.

State Acquisition of Lands Act 1940 (Cap 135)

Land may be acquired by the State for public purposes under this Act. Public Purpose is broadly defined as the utilization of land necessary for the expedient to the interest of defence, public safety, public order, public morality, public health, town and country planning or the utilization of any property in such a manner to promote public benefit per Section 2 of Cap 135(1940). The power to acquire may vest in an "acquiring authority" that may see changes in land tenure to freehold in fee-simple or a term lease in consideration for a compensation payment under Section 3. Whilst the term "public purpose" is not expressly synonymous with environmental conservation, it is logical to infer environmental conservation within the foregoing definition, especially where there is an acquisition of land adjacent to environmentally significant mangrove areas. This can be appropriately applied in the context of the implementation of a mangrove management plan. There is a paucity of evidence on whether State land in the past has been acquired for such a purpose albeit via a legal machinery. An amendment to the Act to be expressly clear for such acquisitions purpose.

State Lands Cap 132 and State Lands Leases and Licenses Regulations

Regulations on the sale, leasing, and licensing of State lands are under-expressed under this regulation, where the power to deal in land is vested in the Director of Lands under Section 10 of Cap 132. The exercise of this power is, however, subject to Sections 21, 22, 25, and 26 of the Act and the general or special directions of the Minister of Lands. The leasing of foreshore lands or soil under the waters of Fiji by the Director of Lands is subject to special provisions. These include the approval of the Minister Section 21(1), under public notice following consideration by the Minister of raised objections under State Lands Act (Cap 132) Section 21(2) and (3). This is subject to the Minister having considered and declaring that the lease does not create substantial infringement to public rights per Section 21(1) of (Cap 132). Further, the Minister must disclose the purposes for which such foreshore soil is required under Section 21(1) followed by the payment of compensation for any rights that may be infringed by the lessee to the owner of any alienated iTaukei Land that adjoins the leased foreshore as mandated under Section 22(3) of State Lands Act (Cap 132). The application of this Act to mangrove forests may be deduced from prohibited activities such that the lessee cannot dispose of or sell any forest produce growing on the land without the prior consent of the lessor (State) or the obtainment of special conditions under the Forest Regulation. Section 3 State Lands subject the approval of the sale, leasing, and licensing arrangements on State Land to the requirement of any other legislation in force.

iTaukei Lands Act (Cap 133)

The iTaukei Lands Act is one of the statutes governing land in the interests of customary owners or iTaukei through their landowning units. The Act is to identify and connect iTaukei lands to rightful landowning units after which these are administered under the leases and licenses regulations of the *iTaukei Trust Act (Cap 134)*. Customary owners are the Mataqali (ownership proprietary unit) or other division of iTaukei(s) having the customary right to occupy and use any native lands, under Section 2. Fundamental to this definition is that the landowning unit, not an individual, owns iTaukei land. In addition, the nature of the ownership is circumscribed to occupation and use; selling the land or charging for its use is legally prohibited within the scope of ownership contemplated under the *iTaukei Lands Act*. A Native Land Commission appointed by the Minister is charged with ascertaining which land is the property of native owners under Section 4. State lands and those the subject of a state grant cannot be iTaukei lands under Section 2. The Commission inquiries into the status of all lands claimed by mataqali and is empowered to summon witnesses to give evidence in this regard, under Section 6. Following the commission of any proceedings, the decision as to native ownership is announced by the Commission, per Section. 7. The Act contains appeal and dispute mechanisms. Vacant lands are also anticipated and shall be treated as State land following declaration by the Minister, the purview of Section 19. The definition of native lands does create some uncertainty, in the wording that iTaukei lands as: "lands which are neither state lands nor the subject of a State grant". The meaning of the second limb in this instance is unclear as the creation of a fee simple tenure — where a unit of land is sold or disposed of by the State — is a grant. Under the definition of native land, even such a parcel held under freehold would become available as native land.

iTaukei Lands Trust Act, 1940 (Cap 134)

iTaukei Lands Trust Act (otherwise known as the Native Land Trust Act 1940 (Chapter 134)) Section 4 of this Act establishes a Native Land Trust Board and vests it with the control of customary land "for the benefit of the iTaukei owners". This legislation is to be read in conjunction with the *iTaukei Lands Act (Cap 133)*. This Act administers and controls all iTaukei land use. Section 7 stipulates that native land may only be alienated under the Act and subject to the provisions of the Crown Acquisition of Lands Act, the Forest Act, the Petroleum (Exploration and Exploitation) Act, and the Mining Act. Regulations under this Act include the following: *Native Land (Forest) Regulations; and Native Land Trust (Leases and Licences) Regulations.*

The Board is authorized to grant leases or licenses for accessing native land, facilitated under Section 8. The test to be applied is that of beneficial use, whereby "the Board must be satisfied that the land under question is not beneficially occupied, nor likely to be occupied throughout the duration of the lease Sections 8 & 9). Most of the regulatory detail relates to processes for leasing iTaukei land and the disbursement of rent from its use relating to equal benefit sharing through landowning unit private trusts. The main uses anticipated under this Act and Regulations are forestry, agriculture, grazing, dairying, and residential and commercial activities. Reservations about forest trees on iTaukei leases remain under the ownership of the lessor. A new classification of REDD+ leases was recently added to recognize the new property in sequestered forest carbon trading. Also, the leasing requirements are oriented toward the productive use of the land; minimal attention is given to soil and water conservation e.g., see Section 25 and Sections 28–30. Cap 134 also recognizes that native land can be further classified as a native reserve, under Section 15, for future maintenance and support of landowning units.

Marine Spaces (Cap 158A)

The Marine Spaces Act establishes the nature and extent of Fiji's offshore jurisdiction but is also an instrument for regulating fishing. The latter aspect will be dealt with later under the discussion of resource development legislation. Under the former, the Marine Spaces Act is cast in terms very consistent with the *United Nations Convention on the Law of the Sea* (UNCLOS) 1982. In particular, the establishment of Fiji's offshore zones, regarding internal and archipelagic waters, territorial sea, and exclusive economic zone (EEZ), relies very faithfully on the enabling provisions of the UNCLOS (see Sections 3–6, and s.8). The legal character of these marine areas derives directly from the UNCLOS, both in terms of Fiji's jurisdiction and that of other States in Fiji's waters per Sections 9–11

Importantly, the Minister is the responsible decision-maker for many of the roles under the legislation.

The Marine Spaces Act does contemplate a range of ocean uses, consistent with UNCLOS, which can be regulated, including marine scientific research, and protecting and preserving the marine environment, as an example. No such regulations have been made, however, leaving the government without legislation to address such uses. In addition, UNCLOS provides the considerable capacity to elaborate a statutory regime to address the entire range of issues associated with these maritime activities. Enacting legislation cast in these terms is preferable to the promulgation of regulations. That is because UNCLOS provides a complete regime for governing various uses, any domestic adoption of these provisions should be achieved through implementing legislation, rather than left to regulation. The *Marine Spaces Act* deems that the seabed and subsoil of Fiji's EEZ under UNCLOS form part of the continental shelf, negating the need to separately designate these areas as such under the *Continental Shelf Act*.

Continental Shelf Act (Cap 149)

The purpose of the *Continental Shelf Act* is to extend the application of other legislation offshore. Such an approach is necessary to ensure that the development of the continental shelf does not occur in a legal vacuum. Rights over the continental shelf flow from international Conventions (*Convention on the Continental Shelf [CCS] and UNCLOS {1982)*. The Continental Shelf Act enables all other laws to apply to the superjacent waters as if these were part of Fiji in connection with exploring and exploiting the continental shelf per Section 4. The Minister may also exercise control over vessels in terms of interfering with continental shelf activities and assuring the safety of navigation (Sections 6- 7). These provisions are adopted very directly from the CCS.

The *Continental Shelf Act* departs from the parent Convention in one main respect: by applying only to designated areas rather than to the continental shelf in its entirety. The Convention on the Continental Shelf has an unqualified application, so the approach of the Fiji legislation is unnecessary. Moreover, UNCLOS enables the Continental Shelf Act to be updated, for example by redefining the continental shelf consistent with its more contemporary formulation. The *Marine Spaces Act* deems that the seabed and subsoil of Fiji's EEZ under UNCLOS form part of the continental shelf, negating the need to separately designate these areas as such under the *Continental Shelf Act*. The reasons for extending Fiji's jurisdiction offshore using this method are not apparent.

Customary Fishing Ground- iQoliqoli Rights (Cabinet PAPER CP74/204) 1974.

This was in response to the concerns by the Government on the growing development proposals about the reclamation of foreshores and their effect on customary fishing grounds. With ownership laws recognized and observed under customs, these areas were surveyed and mapped by the government in 1940. There is a total of 411 registered iqoliqoli areas in Fiji and are now registered with the *iTaukei Lands and Fisheries Commission* (ITLFC), sanctioned under Cap 133 mentioned above. Rights to iqoliqoli areas are inherent to any discussion regarding mangroves, sustainable management, and conservation given its multiple constituents within the customary property register. These are, however, dealt with in the context of development under the lens of the western property development paradigm. Proper value considerations to accommodate special indigenous values to mangrove ecosystems and surrounding areas have never been established in terms of procedures and practice and is a highly controversial topic. Conservation and mitigation measures for the protection of the mangrove ecosystem may be possible using the customary connections to customary fishing grounds and special indigenous values. This requires the support of the Ministry of Fisheries, Department of Environment, and Ministry of Lands.

PLANNING

Town Planning Act (Cap 139)

Section 3 of the Act creates the Office of the Director of Town and Country Planning (Office). Part I vests in the Office the power to order areas to be town planning areas, which are then subject to restrictions on development. Parts II-V provide for the creation of town planning schemes that extensively regulate how land is developed and used. The Act empowers local councils to implement planning schemes and therefore interacts with the Local Government Act. This Act was amended in 1995 and 1997 in minor ways. During the period before a town planning scheme has been approved, the Minister can compulsorily acquire land under the *State Acquisition of Lands Act*. The test to be applied is "where a town council is

satisfied that the acquisition of any land under this Section is expedient for my purpose which appears to it to be necessary for the interests of the proper planning of that area" per Section 12. Town planning schemes are the preferred instruments for controlling land use within town planning areas (rather than development permissions). A construction discrepancy of this Act relates to the compulsory acquisition of land before a scheme is finalized. The applicable legislation — the *State Acquisition of Lands Act* — enables the compulsory acquisition of land for purposes relating to the public good. The provision within the *Town Planning Act* makes no such qualification in referring to using the *State Acquisition of Lands Act* to compel acquisition.

The relevant Section purports to apply that other Act on the basis that the acquisition of any land thereunder is expedient for any purpose which appears to it to be necessary for the interest of the proper planning of that area under Section 12 [1]. The scope of the *State Acquisition of Lands Act* would seem not to support the acquisition of land as purported by the Town Planning Act. Section 17 (4) proffers questionable validity. This provision of the Act attempts to elevate a town planning scheme above the operation of any inconsistent Act, (regulation or by-law). That an instrument prepared by a public official can prevail over a superior legislative tool is confounding. Finally, several drafting errors also occur. For example, Section 9(1) refers to permissions issued under Section 6 of the Act. A cursory review of that Section shows that it is in fact not at all concerned about the issuing of permissions.

Environment Management Act (2005)

The Environment Management Act is an Act "[f]or the protection of the natural resources and for the control and management of developments, waste management, and pollution control and the establishment of a national environment council and related matters." The purposes of the Act are provided in Section 3(2), which include the following:

- to apply the principles of sustainable use and development of natural resources; and
- to identify matters of national importance for the Fiji Islands as set out in sub-Section (3).

Key provisions of the Act include Section 3 stating the Act "extends to the exclusive economic zone within the meaning of the Marine Spaces Act" per Section 3(1). Further, Part 4 deals with *Environmental Impact Assessment (EIA*). Part 5 provides for waste management and pollution control where under Section 2. If an inspector believes that a government body or facility is contravening or has contravened the *Environment Management Act* or a scheduled Act, they have the power to issue an improvement notice over Section 44. There are offenses for interfering with or failing to assist persons exercising powers and duties under the Environment Management Act or a prescribed Act. Section 54 Contains a wider provision as "[a]ny person may institute an action in a court to compel any Ministry, department, or statutory authority to perform any duty imposed on it by this Act or a Scheduled Act. Section 55 Establishes an Environmental Trust Fund. Section 56 of the Act establishes an Environmental Tribunal.

In addition to legislation, Fiji also has several strategies and policies for protecting the environment, including the *National Environment Strategy (1992),* the *National Biodiversity Strategic Action Plan (NBSAP) (2007)*, and the *National Climate Change Policy (2012).*

Subdivision of Land Act (Cap 140)

Controls over planning and development outside of towns are found in the *Subdivision of Land Act*. The Act applies to areas as gazette by the Minister but excludes unleased State land, urban areas under the Local Government Act, and native reserves under the Native Trust Land Act under Section 2. Under Ministerial order, the *Subdivision of Land Act* applies to all lands within three miles of any public road on the islands of Viti Levu, Vanua Levu, Taveuni, and Ovalau. Land located more than three miles from a town may be subdivided without approval if the lots are at least five acres in size clarified under Section 4. For subdivisions that require approval, an application is made to the Director of Town and Country Planning, providing basic descriptive details of the land that is the subject of the application per Sections 5-6. Regulations promulgated under Section 19 list additional descriptive information required in the application such as watercourses, important natural or historical features, land availability, and drainage features. The relevant local authority, under Section 7, also has a month to comment on a proposed subdivision. The Director has wide power to approve applications subject to conditions or in part or to reject these per Section 8.

The Subdivision of Land Act establishes a basic process for subdividing non-urban land. The exceptions from the application of the Act are expressed ambiguously, though; townships are excepted, as is land within three miles. In practice, this uneven approach may not present difficulty, but the drafting may require greater clarity. A more pressing criticism relates to the absence of details for processing applications. The Act does not stipulate timeframes for either applying for approval to subdivide or for the treatment of such applications. Similarly, no detail is given in terms of the considerations for approving or refusing an application. The only guidance is the Director's opinion that development is "undesirable" or "unsuitable". Minimally, considerable elaboration of these provisions is needed. A much more profound rethinking of how land lease and development relate to environmental assessment would be a more satisfying way forward.

Local Government Act (Cap 125)

Very little capacity to plan for and manage the environment is found in the Local Government Act. Essentially, the purpose of the Act is to create spatial units around which communities can be organized, which are then given limited powers relating generally to maintaining order in terms of traffic, buildings, and other local facilities. Included within the local council remit are powers to ensure that the area remains clean and inhabitable, which are exercised as by-laws that cover issues such as the frequency of garbage collection, for example.

The Local Government Act is an administrative tool, not one for actively planning the use of an area (this is the purpose of the Town and Country Planning Act). Additionally, the Act is not at all engaged with environmental issues. By-laws are intended to facilitate the peace, good order, and governance of local areas.

Roads Act (Cap 175)

The Roads Act enables the construction of public roads and provides the government with fairly broad powers to achieve its objectives. The rights of adjoining land users yield to the State, as a few examples illustrate. For example, the permanent secretary may possess the land for both opening and widening roads, on a compensable basis per Section 4. Similarly, material may be forcibly extracted from any land proximate to public road roadworks under Sections 7 and 8. Excavated material and roadwork debris may be dumped on lands adjacent to roadworks under Section 10. In terms of both governance and environmental issues, the *Roads Act* is outdated and should be replaced. This is of concern, especially regarding road construction along the coasts on major islands for mangrove ecosystem management and conservation.

Water Supply Act (Cap 144)

The legislation governing the supply of water in Fiji is similar to the Drainage Act (discussed later). Much of the *Water Supply Act* relates to the infrastructure for delivering water to consumers, and the powers to intervene associated therewith. The Commissioner of Water Supply is widely empowered to lay, repair, and alter main pipelines to ensure continuity of supply (Sections 5 and 9). By-laws specify the details relating to technical specifications of pipes, meters, cisterns, valves, and the like (Subsidiary Legislation, Section 1 & Section 11). Charges for supplying water occupy a considerable part of the Water Supply Act. Very little content is concerned with the environmental aspects of water supply. Catchment areas can be declared by the Minister following a two-month notice period. An owner, lessee, or licensee concerning such an area may object to a proposed declaration. Following consideration of such an objection, the Minister may declare the catchment area in whole or in part. It then becomes prohibited to pollute the water contained therein under Section 4. It is also an offense to pollute water in the waterworks (i.e., the water supply system) (Section 24). Catchment areas are therefore intended to protect water quality from pollution.

Catchment areas are a basic concept in the supply of water. As it occurs with the *Drainage Act*, however, no elaboration of the concept is provided relating to the definition that "catchment area means any area of land or water declared by the Minister to be a catchment area under the provisions of this Act" under Section 2. Other problems exist with the legislation. Again, no detail is contained for objecting to the declaration of a catchment area, and the presumption is that such objections will be dismissed. There is minimal transparency concerning the process. The definition of pollution — which only becomes relevant

for catchment areas — is deficient and cumbersome: Pollution under the *Water Supply Act,* therefore, does not recognize environmental degradation of water. In addition to their function as water supply reservoirs, catchment areas are widely recognized as fulfilling broad environmental services and indeed are the basis of contemporary management approaches. Finally, there does not seem an obvious connection between catchment areas and dams. Reservoirs, drains, and weirs are included under the definition of waterworks, but no powers to construct or maintain them are apparent. Moreover, there is no elaboration of catchment areas in terms of their purpose and relationship to the water supply system.

Sewerage Act (Cap 128)

For most coastal towns and cities, this Act has high impact implications on the mangrove ecosystems. The *Sewerage Act* provides for the construction and maintenance of infrastructure for the treatment of sewage. Powers to this end are shared between local councils and the Government. The *Sewerage Act* expects that councils are responsible for sewerage, with the government, under Section 16, able to intervene in situations where the former is remiss in its responsibilities. The construction of the legislation is somewhat imperfect, but any government involvement in sewerage is intended not to be derogatory to council powers per see Section 3. The *Sewerage Act* applies to all towns, and other sewerage works or systems as specified (Section 2). Several plants have been brought within the scope of the Act through this mechanism. All proposed new works or alterations to existing sewerage systems by a council need ministerial approval, except Suva (and other specified towns under Section 4.

Councils are empowered to enter "any lands whatsoever" and undertake work necessary to service sewerage infrastructure e.g., cutting, drilling, digging, and removing earth (the removal of material from private properties is not allowed). The only constraint is that "the council shall do as little damage as may be necessary" in undertaking such construction and maintenance work. Damage caused by sewerage system work is compensable by the Council under Section 7. The *Sewerage Act* enables areas within a town to be declared as sewerage areas per Section 3. Once declared, the council formulates and implements a scheme for disposing of "sewerage" (sic, i.e., of sewage) within that area. Several towns have made by-laws specifying the technical requirements of sewerage systems. Such details are the size of pipes, thickness or weight of materials, and general design of system elements.

Property owners can be compelled to connect septic works or private drains to sewerage systems.

The *Sewerage Act* does not evidence an awareness of environmental considerations. Neither the construction nor operation of sewerage facilities is subjected to any constraints or controls to protect the environment or to attain an environmental goal. The Act is a product of its time. Even the advent of a new environmental protection regime would likely do little to this end, except if a license to pollute was introduced and this coerced an improvement in effluent discharge in terms of volume or quality parameters, or both. The power to declare sewerage areas is a curious one. On the one hand, this would seem to allow for undesirable land use to be planned for and consolidated into a suitable area. However, there is no linkage between this provision and those provisions exerting regulatory control over actual sewerage works. It would seem sensible to link the two provisions whereby the construction of new (or alterations to existing) sewerage systems occur according to a strategic planning approach as provided for through the sewerage area mechanism. Any work of this type should require an assessment of its environmental impacts or another planning approval, with the expectation of agency concurrence and public comment.

ENVIRONMENTAL PROTECTION

Traffic Regulations Act (1974)

Air pollution is not considered by law except for a regulation outlawing the use of a motor vehicle that emits visibly polluting exhaust causing a nuisance or property damage. The application of the regulation is non-existent, as evidenced by current practice. Moreover, this approach lacks any meaningful basis such as identifying emissions and attempting to meet environmental goals.

Public Health Act (Cap 111)

The Public Health Act is of slight relevance to environmental protection through the concept of a nuisance.

A common law principle, nuisance has been codified and given a statutory basis to protect public health. Polluted waterbodies (harbors, ponds, rivers, and foreshores) are deemed to be a public nuisance (ss57-59). The local authority has powers to compel an owner or occupier to abate the nuisance and to seek a court order in the event of non-compliance. The Public Health Act has very limited utility in terms of environmental protection. The Act provides a few remedies for compelling the abatement of nuisance events that may impinge on human health (pollution of internal waterways, and smoke emissions). The Act is not an instrument for regulating and controlling pollution or waste, although it may provide a means for intervening in limited situations, in the absence of other means.

Ports Authority of Fiji Act (Cap 181)

This Act, through proximity, has correlative effects on mangrove ecosystems. Port services are maintained by a statutory authority on behalf of the government under this legislation. Regulations thereunder establish some controls over pollution (under Section 63). The discharge of oil, waste, sewage, and contaminated ballast into the waters of a port is prohibited unless authorized by the Authority. To assist in implementing these regulations, the Authority 1988 produced 'Standards for Effluent Discharge to Ports' wherein allowable concentrations of heavy metals, organic chemicals, and other pollution parameters are specified. To obtain a discharge permit, the effluent must conform to these standards. As well, the disposal of solid matter is regulated, although primarily from the perspective of shipping obstructions. The 1990 Regulations, possibly aided by the operations of particular provisions and penalties of the *Environment Management Act (2005)* provide some framework for marine pollution control within the limits of ports and in terms of effluent and direct discharge. The Standards are a practical means of giving effect to these Regulations. However, permission to discharge would need to reflect these standards, perhaps incorporated as a permit condition to ensure enforceability.

Environment Management Act (2005)

The *Environment Management Act* is an Act "[f]or the protection of the natural resources and for the control and management of developments, waste management, and pollution control and the establishment of a national environment council and related matters." The purposes of the Act are provided in Section 3(2), which include the following:

- to apply the principles of sustainable use and development of natural resources; and
- to identify matters of national importance for the Fiji Islands as set out in sub-Section (3). Key provisions of the Act include:

Section 3 The Act "extends to the exclusive economic zone within the meaning of the Marine Spaces Act" (s 3(1)). Schedule 1 of the Act prescribes the following Environment and Resource Management Acts: · Factories Act (Chapter 99) · Fisheries Act (Chapter 158) · Forest Decree 1992 · Ionizing Radiations Act (Chapter 102) · Litter Decree · Marine Spaces Act (Chapter 158A) · Mining Act (Chapter 18) · Ozone Depleting Substances Act 1998 · Petroleum Act (Chapter 190) · Public Health Act (Chapter 111) · Rivers and Streams Act (Chapter 136) · Quarries Act (Chapter 147 · Sewerage Act (Chapter 128) · Town Planning Act (Chapter 139) · Water Supply Act (Chapter 144)

Sections 7-8 establish a National Environment Council with various functions such as approving, monitoring, and overseeing the implementation of the National Environment Strategy, ensuring regional and international environment and development commitments are implemented, and advising the government on international and regional treaties, conventions, and agreements about the environment. Part 4 Deals with Environmental Impact Assessment (EIA). Fiji: Review of Environmental Legislation 10 Part 5 Provides for waste management and pollution control. Section 21 If an inspector believes that a government body or facility is contravening or has contravened the Environment Management Act or a scheduled Act, they have the power to issue an improvement notice.

Schedule 2 Sets out the types of proposals that require EIA, including, but not limited to: · a mining proposal, reclaiming of minerals, or reprocessing of tailings; · a proposal for commercial logging or a sawmilling operation; · a proposal that could jeopardize the continued existence of any protected, rare, threatened or endangered species or its critical habitat or nesting grounds; · a proposal that could harm or destroy designated or proposed protected areas; and · a proposal that could destroy or damage an ecosystem of

national importance. The Environment Management (EIA Process) Regulations 2007 have been enacted concerning EIA and contain provisions for EIA procedures.

Environmental Impact Assessment (EIA) (2007 Regulations)

Is governed by Part 4 of the Environmental Management Act. The substantive provisions include the following: Section 27(1) An approving authority must examine every development proposal it receives and "determine whether the activity or undertaking in the development proposal is likely to cause significant environmental or resource management impact". Section 27(4) Any activity or undertaking that the approving authority determines will cause a significant environmental or resource management impact must be subject to the EIA process. Under Section 28, EIA is comprised of screening, scoping, preparation of an assessment report, reviewing the report, and a decision on the report. Schedule 2 Sets out the types of proposals that require EIA, including, but not limited to:

- a proposal for mining, reclaiming of minerals or reprocessing of tailings;
- a proposal for commercial logging or a sawmilling operation;
- a proposal that could jeopardize the continued existence of any protected, rare, threatened, or endangered species or its critical habitat or nesting grounds;
- a proposal that could harm or destroy designated or proposed protected areas; and
- a proposal that could destroy or damage an ecosystem of national importance. The *Environment Management (EIA Process) Regulations 2007* have been enacted about EIA and contain provisions concerning EIA procedures.

RESOURCES CONSERVATION & DEVELOPMENT

The overwhelming bulk of existing legislative capacity to govern the environment and natural resources relates to development. Broadly, this law covers access to and the allocation of resources, and their utilization by developers. Most of Fiji's natural resources are subject to 13 some legislative coverage. Generally, however, the provisions are heavily predisposed towards the interests of the government rather than the greater public good or private investors.

Agricultural Land and Tenant (Cap 270)

The relationship between the tenant farmer and the owner of the holding is governed under the *Agricultural Land and Tenant Act*. Very little other than the roles of the two parties (lessor and lessee), and how they relate is covered. In this context, the only reference as to how the land is to be used is found in provisions relating to extensions of tenant contracts. Under Section 13, the notion of good husbandry is defined in terms of traditional farming practices; for example, constructing terraces, hedges, and drains, maintaining soil fertility, and controlling pests. The legislation conspicuously does not address limits to the use of farmland. Issues such as retaining remnant vegetation, preserving groundwater quality, soil compaction, and enrichment of surface water are all neglected in the Act. While the purpose of making land available for farming is fundamental to any leasing system, this must be promoted based on an appreciation of environmental sustainability. This Act is primarily geared towards production and not conservation, except for good farming practices and the reservation of ownership of trees and any related commercial dealings rights with the lessor.

Irrigation Act (Cap 144A)

The *Irrigation Act* is "[a]n Act to make provision for land irrigation". Sections 3-4 established the Office of Commissioner of Irrigation which shall be responsible for the construction, improvement, and maintenance of irrigation works and establishing and administering irrigated agriculture. The Act contains offenses including an offense of wilfully wasting irrigation water or taking water that the person is not authorized to take under Section 20. This Act operates alongside the Drainage Act.

The *Irrigation Act* is an instrument designed to optimize agricultural production; environmental conservation and its needs are non-existent. Indeed, under the legislation, farmers can be compelled to remove vegetation from their land, a policy that has contributed to comparative, massive environmental degradation in many countries. Little support for protecting the environment is found in the legislation. Even the single provision to protect against pollution is miscast it is an offense to pollute irrigation works

rather than the water. In terms of governance, the *Irrigation Act* is coercive and clumsily drafted in parts. Commissioners' power to adjust agricultural holdings, and with owner or occupier approval, creates uncertainty. Combining the assumptive power of the Commissioner with the need for the approval of the landholder is awkward and ambiguous per Section 8. The policy intention is unambiguous, however, with the Commissioner having almost invasive powers to direct landholders in the use of those farms included in an irrigation area. In this regard, the capacity of the Commissioner to exercise powers and then retrospectively seek approval is an illogical statutory provision. From both environmental and public policy perspectives, the *Irrigation Act* needs rigorous review for want of more contemporary legislation.

Drainage Act (Cap 143)

The *Drainage Act* operates by first establishing drainage areas under the jurisdiction of a local Drainage Board, which in turn is enabled to carry out works for that drainage area. Drainage works are designed to prevent or mitigate flooding or erosion by physically altering watercourses, installing pumps and associated machinery, and constructing or reinforcing defensive barriers. Watercourses include most natural and artificial bodies of water. The Controlling Authority (CA) is a peak body under *the Drainage Act* (The Land Conservation Board under the *Land Conservation and Improvement Act*, which is discussed below). If the CA considers that a parcel of land should become a drainage area, with Ministerial consent, it must publicize its intention to declare a drainage area and receive objections for at least two months. During this period, any disaffected landowner may object to the proposed declaration and request consideration and a decision from the CA; objectors dissatisfied with the CA's decision may appeal to the Minister within 30 days, whose decision is final. The boundaries and status of a drainage area may be varied by the CA (with the approval of the Minister) provided that new areas are not included given the stipulation of Section 3. The CA has wide powers to enter onto and assess the status of land for declaring drainage areas. Drainage Boards are appointed by the minister for each area, comprising at least seven members, two of whom are landowners, under Section 4. The Board is responsible for draining land within the drainage area, being broadly empowered to undertake works to this end. Much of the *Drainage Act* is devoted to levying rates for drainage. In extreme situations, the Board may sue for the sale of land to recover defaulted payment of drainage rates. Boards may also compulsorily acquire land within their drainage area pursuant to the State Acquisition of Lands Act (Section 18). Several areas have been declared under the Drainage Act.

Considerable capacity for the government to intervene in the use of private land exists under the Drainage Act. The provisions relating to the process attempt to put in place a transparent regime but are very understated for issues such as the appointment of the CA, the role of the Minister, and appeal provisions. A major problem is that only landowners within a proposed drainage area may object to the area's designation. Other agencies or interested parties do not have any basis to express views or offer comments on proposals. The hydrological cycle is vital to the functioning of ecosystems. Historical practices such as drainage are being revisited in many places in favour of land use more sensitive to environmental needs. In this context, it is necessary to introduce an environmental basis to drainage; this could be achieved by updating the *Drainage Act* or by making decisions taken under the Act subject to environmental approval of some type. The Act is silent regarding the grounds on which an objection can be made and decided upon. Nor is there any requirement for the objector to be informed by the controlling Authority or Minister regarding the response to their objection. The lack of an implementable FGRM is therefore stark.

A major deficiency with the *Drainage Act* is the lack of attention applied to defining a drainage area: "means any portion of land declared a drainage area under the provisions of this Act". No other guidance is given and there is vast potential for application or even abuse of this tool. Given the centrality of drainage areas to the operation of the Act, the concept needs to be defined by reference to environmental and geographical factors, thereby injecting some discipline into the scheme.

Land Conservation and Improvement (Cap 141)

This is an Act to make provision for the conservation and improvement of the land and water resources of Fiji". Sections 4-5 establish a Land Conservation Board to supervise land and water resources and to promote public interest in conserving and improving land and water resources. Environmental problems such as erosion, eutrophication, soil compaction, and localized pollution are caused by livestock husbandry and the cultivation of crops. The *Land Conservation and Improvement Act* provides the statutory basis for

the government to act in anticipation of these types of farming-related impacts.

Plant Quarantine Act (Cap 156)

The Plant Quarantine Act is designed to anticipate and enable action in response to plant pests, or injurious species. These actions may be exercised both at the border and for plants already in Fiji. A regime restricting the importation of plants subject to ministerial permission is established with commensurate inspection and related powers covered by Sections 5–28. Under the Plant Quarantine Act, inspectors have a very crude power to instruct the owner or possessor of infected or infested plants to eradicate or control the pests and destroy or treat the plant per Section 29. Subsidiary legislation exists elaborates on the Plant Quarantine Act. This detail relates to the inspection and movement of vessels, eradication of noxious weeds, quarantine areas, and prohibited weeds. The Plant Quarantine Act is very much oriented toward protecting primary industries from infestation by noxious plants. In this regard, it does offer a basic set of provisions so far as border control is concerned. Domestic control is elaborated under regulations, but more could be done to clarify such issues as control measures, landowner and occupier duties, and inspectorial powers to determine infections or infestations. *The Act has no relevance as a tool to assist in biodiversity conservation.* Non-native plants that are pests to either the environment or agriculture are not controlled under the *Plant Quarantine Act* unless these are noxious or infected with a pest.

Pesticides Act (Cap 157)

Control over pesticides is achieved through a registration scheme under the Pesticides Act, which requires pesticides to be registered before being made available for sale. Regulations specify the type of information needed for registration and labelling under Sections 3, 4, 5, and 10. Registration is a common method for controlling pesticides and other hazardous chemicals. In Fiji, this control relates only to the availability of pesticides but not to their use, although regulations may be made under the *Pesticides Act* for the latter. Whether government should become involved in controlling actual use or this should remain the prerogative of the farmer is an interesting consideration. The current approach is premised on the user being responsible; that is, once the government has approved a pesticide for sale and without other controls existing, the pesticide is safe to use under normal applications.

Forest Bill No 13. (2016)

This Bill is for an Act to provide for the management of Fiji's forest and other related matters. Provisions to forge links between the objectives of the Act to international instruments are catered under Section 5(b) with an obligation on the Department of Forest to promote international cooperation and develop the capacity to strengthen, protect and develop forest resources. Its objectives are to ensure the protection sustainable management and use of Fiji's forest to provide social, economic, and environmental benefits to Fijians and future generations. Mangroves are indirectly subjected to this Act under the various general definitions of a forest. For example, deforestation activity is stated to mean direct human-induced conversions of forested land to non-forested land. Development activity likewise is defined under Section 2 as one that is likely to alter the physical nature of the land, also including under 2(d) removal of sand, coral, shell, natural vegetation, sea grass, or other substances. These are pertinent constituents of a mangrove ecosystem. The Minister under Section 14 can declare land as a nature reserve or forest reserve, and forest protection is specifically dedicated to the protection and maintenance of biological diversity and ecological integrity with values such as soil conservation and cultural heritage. Mangroves may be considered under the ambit of Section 5(13) whereby the Department of Forests must classify forests based on function in the category of protection forest which may include mangrove forests.

Forest Decree (1992)

The general scheme remains similar to that of its precursor in the *Forests Act* but some attempts to clarify and broaden the forestry agenda have been added. A Forestry Board is constituted to advise the Minister concerning forestry policy. Membership of the Forestry Board reflects key stakeholders' interests in forestry, including government officials, forest owners, industry, and the public under Section 4. Forests and nature reserves are maintained under the new law but with some substantial changes. Unalienated State land, unalienated native land already reserved for a public purpose, and land leased to the State may be declared by the Minister as a forest or a nature reserve.

Forestry can only occur within a forest or nature reserve, so the reservation of land is a precursor to any activity under Section 28. Once established, forest reserves are managed to permanently provide "the optimum combination of benefits of protection and production of which they are capable". On the other hand, the management of nature reserves is for the "permanent preservation of their environment, including flora, fauna, soil and water" per Section 7. A hierarchy of uses is then described whereby extractive activities — such as felling timber, removing earthen materials, fishing, and trapping — are allowed only under license, dependent upon the tenure of the land unit. Most such uses within forest and nature reserves require licensing; on State or native land "not being alienated" the felling of timber, extraction of forest products, and clearing of land need to be licensed; on alienated land only felling or extracting timber requires a license under Section 8. Licenses are issued by a licensing officer subject to the conditions. The prior consent of various statutory and other bodies is required, depending upon the tenure of the land; these consenting parties include the iTaukei Land Trust Board, Director of Lands, lessees, and owners (Section 10). An important addition to the forestry system is the development of logging plans. The issuance of a license is now contingent upon a logging plan being prepared, which specifies the annual harvest quota, minimum tree size and retention rates, and any reforestation requirements.

The Forest Decree still does not demand any active management of nature reserves, however, nor are tools for management available. So, while the clear conservation mandate concerning nature reserves is welcomed, the legislation does not assist in terms of preserving biodiversity. Forestry and other extractive activities are allowable uses of nature reserves.

Mining Act (Cap 146)

All land in Fiji is essentially open for mining under the Mining Act, with some qualifications. Minerals are the property of the State regardless of the status of the land on which they are located, according to Section 3. The government may also declare any parcel of land up to 250 hectares to be a government protected area, allowing the Director of Mines to exercise tighter control over the minerals found therein by tendering for access under Section 7. The Minister may variously prohibit or restrict access to minerals by order, or otherwise grant these rights exclusively to a preferred developer under Section 4. Some types of land are closed to mining. For instance, farmland and residential properties can only be accessed consensually by the owner or occupier. Reserved forests and water supply areas require the consent of the responsible public executive official. With ministerial approval, however, the Director may issue tenements for closed lands as stipulated under Section 11).

Rights granted under mining tenements are expensive; landowners or occupiers merely need to be informed of intended mining activities. The Mining Act does contain provisions relating to damages and compensation. Tenement holders are required to compensate for surficial damage as a result of prospecting or mining. If the parties cannot agree as to the level of compensation the Director determines the amount under Section 40. There is a requirement to restore the land by filling extraction damage and removing marking posts under Section 43. Lengthy regulations specify the technical and administrative details of mining operations.

- The Mining Act is fairly typical of legislation in other Commonwealth jurisdictions. The regimes established by and under the Mining Act are purposed to expedite the prospecting of minerals. The clear legislative intent is to ensure that land is available for mining, with the rights of the landowner tending to yield to those of the miner.
- Some uncertainty exists in terms of the timing for compensation payments; in particular, whether compensable damage is payable before or following operations.
- The principal decision maker under the legislation is the Director rather than the Minister. This approach is unusual insofar as decisions about accessing minerals would tend to repose with elected ministers rather than officials. In practice, these powers may often be delegated to agency heads, but the Mining Act doesn't give the Minister this option, as the Director is the responsible person.
- The Minister does possess some quite extraordinary powers, however. One of these relates to the definition of minerals, which is expressed in detail in the statute.
- Notwithstanding this definitional detail, the Minister can include or exclude substances by gazettal. The rationale for this approach — in which the legislature carefully elaborated the definition of minerals but then allows the Minister to alter that definition —is not obvious.

- More worrying is the convention that gives the Minister discretion to set aside the enacted provisions of the legislation. For example, "the Director may, subject to the approval of the Minister, grant a mining tenement to any person on such terms and conditions … whether under the provisions of this Act or not, as the Minister may think fit…" (Section 11(3)). The effect of this provision is to allow the statute to be set aside to set conditions at the whim of the Minister (in this example). The existence of such provisions is reckless and in need of reform.

Quarries Act (Cap 147)

The *Quarries Act* complements the *Mining Act* and applies to the extraction of minerals not covered by the latter statute. The orientation of the Quarries Act is very much towards safety in the quarry workplace. It is an extremely brief statute, comprising only four Sections. The *Quarries Act* simply enables the making of regulations, and this is where the substance of the legislation is found. The regulations under the Quarries Act are considerable, being concerned with maintaining a safe working quarry site. Some specifications address health and sanitation but the environmental impacts of quarrying are not anticipated at all.

Petroleum (Exploration and Exploitation) Act (Cap 148)

The *Petroleum (Exploration and Exploitation) Act* is "[a]n Act to make provision relating to the exploration for and exploitation of petroleum resources". Key provisions include Section 3 which deems all petroleum in or under lands within a designated area to be the property of the Crown. Part II-III Provisions relate the exploration and extraction of petroleum by requiring various licenses. Under Section 10, To be a holder of a petroleum license, a company must comply with the provisions of the Companies Act. Part V Sets out when compensation is payable. There are a few provisions in the Act aimed at protecting the environment which by extension may extend to cover the mangrove ecosystem. For example, under Section 8, inspectors have the power to suspend petroleum operations to prevent pollution. Section 62 License holders have an obligation, when carrying out petroleum operations, to take all reasonable steps to prevent pollution of water.

Petroleum Act 1939 (Chapter 190)

The Petroleum Act is "[a]n Act relating to the carriage and storage of petroleum". The Act governs the import and export of petroleum. Several regulations have been created under the Act. This was amended in 1997. Under the Petroleum Act, the Minister has largely unfettered power to permit the construction of pipelines for conveying petroleum in, on, or under any public or private land, and imposing conditions thereupon (see Section 9). Under regulations, the release of oil from vessels and associated infrastructure into the sea is prohibited (R6). In terms of onshore oil pollution, a $100 fine applies concerning the escape of petroleum that may percolate into the sea, stream, or river (Regulation 50).

The ministerial power to lay pipelines is worrying, as the statute provides no framework for decision-making, especially in terms of avenues for redress or other recourse by landowners or occupiers. A logical approach would be to specify the expectations of pipeline laying in an MOU with the Department of Environment. On the other hand, the impact of pipelines is localized and there is no potential for further expansion of this infrastructure in Fiji, so the matter is not pressing. The prohibition on the release of oil from vessels also lacks any considered detail. For example, the regulation doesn't distinguish between accidental or deliberate discharges, nor anticipates the emergency release of oil. Polluting non-tidal waters through the release of oil is not prohibited; indeed, tidal waters are not even defined. Similarly, in terms of onshore storage, no offense exists for polluting the terrestrial environment through oil pollution.

Fisheries Act (Cap 158)

Fisheries Act 1941 (Chapter 158) The *Fisheries Act* is an Act to regulate fishing within "all waters appertaining to Fiji and includes all internal waters, archipelagic waters, territorial seas and all waters within the exclusive economic zone as these terms are defined in the Marine Spaces Act". Key provisions include:

- Section 5, Requires a person to obtain a license to take fish for commercial purposes.
- Section 10, It is an offense to take fish for commercial purposes without a license or to not comply with the terms of a license.
- Sections 13-14, Provisions for the protection of native customary rights.

Subsidiary legislation made under the Act includes:

- *The Fisheries Act – Fisheries (Protection of Turtles) Regulations*,
- *The Fisheries Act – Fisheries (Shark Reef Marine Reserve) (Serua) Regulations 2014*, and
- *The Fisheries Act – Fisheries (Wakaya Marine Reserve) Regulations (LN 40) 2015*.

Offshore Fisheries Management Act (2012)

The objective of this Decree is "to conserve, manage and develop Fiji fisheries to ensure long-term sustainable use for the benefit of the people of Fiji". The Act contains some mechanisms for the conservation, management, and development of fisheries including the concept of designated fisheries, fisheries management plans, and fisheries treaties as well as regulation by licenses. Minor amendments were made in 2014. The Decree is supported by the *Offshore Fisheries Management Regulations 2014*.

Rivers and Streams (Cap 136)

The Rivers and Streams Act is a brief statute enshrining the rights of the public to have access to riparian waterbodies. An easement exists along all riverbanks for public access, except where controls under the Town Planning Act have altered the status to another use under Section 3. Residents living adjacent to rivers and streams may apply for additional rights to extract water for consumptive purposes per Section 7. Similarly, these classes of people may seek to build on riverbanks and encroach upon or impede public access thereto (Section 10).

The Director of Lands is the responsible decision-maker for these matters. Under the Act, any person opposing an application may object within 30 days of the application and objectors may appeal to the Minister under Section 11 if dissatisfied with the Director's decision The *Rivers and Streams Act* is noteworthy for advocating public interest and the standing it gives to the community. Comparable provisions are uncommon in other legislation in Fiji. The Act could be broadened to capture other aspects of riverine management, such as preserving water quality and better-controlled extraction by adjacent land users. Additions of this nature would shape the Act as much more of a management tool than it currently is.

Birds and Game Protection Act (Cap 170)

Birds and Game Protection Act 1923 (Chapter 170) This is "[a]n Act to make provision for the protection of birds and game". The Act creates several offences. For example, it is an offense to take, harm or kill protected birds under Section 3, and to kill a game without a license under Section 6. Birds are protected from injury or being taken by the *Birds and Game Protection Act*, except for those species specified under schedules as not protected or treated as a game (Sections 2–3). The former category includes non-native species such as the Malay turtle dove and Mynahs. The Fijian wood and fruit pigeons are defined as a game under the 2nd Schedule. The two species are the only defined game in Fiji. To take any game listed in the second schedule requires a license issued under the Act (see Section 7.4). Closed seasons can be declared in the third schedule; the open season for the two-game species is one month, beginning on 15 May. The Minister may alter schedules without constraint.

Wildlife is virtually unprotected in Fiji. The *Birds and Game Protection Act* is designed to facilitate hunting rather than to protect wildlife from intentional or accidental harm. Because of Fiji's very poor complement of wildlife, the Act may be adequate in this regard. However, the marine situation is rather different, as Fiji's nearshore and offshore waters sustain an abundance of marine species. The legislation should be repealed and replaced with a statute that includes tools based on a contemporary understanding of wildlife needs and that contains an unambiguous statement of government policy.

As suggested by experts in the available literature, two alternative approaches can be used: all wildlife can be protected and then levels of protection reduced through various statutory tools; alternatively, individual species can be identified as needing protection and addressed under the law. Conservation tools and issues such as management planning, critical habitat, and access to biological resources must be contemplated in new legislation. As discussed in Part Three, threatened species are now the subject of very recently enacted laws, and this is to be commended. However, that new regime only applies to species under threat from international trade and thus has no relevance to the conservation of species in a purely domestic context.

Mangrove Conservation and Management Regulations for Fiji (Proposed-June 2022)

The proposed shall provide under the *Environment Management Act (2005)*, a regulatory framework that administers the management and protection of Fiji's mangrove ecosystem. This is an initiative under the partnership of the Ministry of Environment and WWF Pacific. The proposed Regulation TOR states that it must regulate the users and development prospects for mangroves and demarcate the boundary of protection. When passed the regulation does not derogate from any other written law that protects that regulates the protection of mangroves and will be binding on regulatory authorities, developers, non-government agencies, mangrove management committees, and users of the mangrove ecosystem. It seeks multi-stakeholder consultation through its processes that engage relevant government sectors and key stakeholders.

OTHERS

Ozone Depleting Substances Act (No. 26 of 1998)

The Ozone Depleting Substances Act 1998 is "[a]n Act to regulate the importation, exportation, sale, storage and use of ozone-depleting substances and to give effect to Fiji's obligations under the Vienna Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer, and for related matters". The Act provides for the phasing out and management of controlled substances that are ozone-depleting substances. In addition to these laws, Fiji has several strategies and policies aimed at dealing with waste and pollution. These include:

- National Air Pollution Control Strategy 2007.
- National Liquid Waste Management Strategy and Action Plan 2007.
- National Solid Waste Management Strategy 2011-2014.
- Fiji also has a National Marine Spill Contingency Plan.

Endangered and Protected Species Act (No. 29 of 2002)

As outlined earlier, wildlife is not afforded any general legal protected status; indeed, the extent to which legislation did exist was to treat wildlife as an exploitable resource. With the passage of the *Endangered and Protected Species Act (EPSA),* the government's ability to conserve threatened species was materially enhanced. The EPSA operates primarily to adopt Fiji's international controls under the Convention on International Trade in Endangered Species (CITES), an international treaty that works to protect wildlife at risk of extinction from the demand stimulated by international trade. In addition, the legislation also controls the trade of some indigenous wildlife as a matter of national policy outside of CITES controls. In both cases, the protection of wildlife exists only in a trade context, and the EPSA lacks relevance to species protection (whether endangered or otherwise) in a purely domestic setting, where the wildlife is threatened not by trade but by some other activities, such as habitat loss or bycatch. The regimes under the EPSA work by requiring permission to import or export any listed species (or specimen therefrom), see Sections 9–10. Broadly, the five lists established by EPSA correspond to the three appendices maintained under CITES and two relating to Fijian wildlife not listed by CITES under Section 3.

Climate Change Act (2011)

The Act is in recognition of a new property in sequestered forest carbon and enables its framework for international market trade. It creates a legal basis to support sustainable development objectives, long-term climate ambition, net-zero carbon emissions targets, and commitment to protecting Fiji's environment. It addresses carbon budgets, the framework of establishing a carbon market, climate-induced mobility(resettlement) nature-based solutions, the recognition of maritime boundaries relative to sea level rise, and climate finance and intergovernmental resilience. It also provides a platform for Fiji to meet its obligations under the Paris Agreement. The CCA recognizes the critical importance of the ocean to the identity and livelihoods of the people of Fiji and the Pacific Islands (see Section 79a), as it sets long-term sustainability targets for Fiji's internal water, archipelagic waters, territorial seas, contiguous zone, and EEZ to be 100 percent sustainably effectively managed and a marine protected area target at 30 percent under Section 81. The Act extends the duty of care under it to corporate directors under Section 94 and seeks financial risk reporting upon Directors such as those required under the *Companies Act (2015),* and licensed financial institutions.

ANALYSIS

Query	Laws/ Policies	Comments	Contribution to Deforestation and Forest Degradation
Existing laws and policies that create conditions or incentives that allow, legally or illegally, deforestation or degradation	*Policies*	*Policies in general, are by nature collective statements of policy considerations to inform the drafting of legislation and regulations. Of the 21 policies observed, all except one, are in post- year-2000 development, and all recognize sustainable environment management, conservation, and the importance of its application to good governance to sustain the future. The single exception is in the pre- 2000 development of the Mangrove Management Plan (1985), revised in 2013. Mangrove protection is recognized under Fiji Forest Policy (2007), Fiji Liquid Waste Management Strategy and Action Plan (2006), Fiji Tourist Development Plan (2016), Mangrove Management Plan (1985 &2013), NBSAP (2020), National Housing Policy (2011), and the Sustainable Economic Empowerment Strategy (2007)*	*Policies observed are sectorial in approach and therefore are not harmonized with regards to environment protection and sustainable development.* *Delay in substantial progress of the Mangrove Policy may point to the lack of awareness of its importance and political will.* *No clear lead agency with responsibility can be singled out, given the sectorial approach.* *Adequate resourcing issues and capacity* *Housing Policy highlights as a policy measure the provision of tenure and the formalization of informal settlements on State lands thus linking to a probable increase in mangrove use on coastal settlements near major cities.*
	Drainage Act (Chap143) 1961	*The Drainage Act operates by first establishing drainage areas under the jurisdiction of a local Drainage Board, which in turn is enabled to carry out particular works within that drainage area. Drainage works are designed to prevent or mitigate flooding or erosion by physically altering watercourses; installing pumps and associated machinery; and constructing or reinforcing defensive barriers. Watercourses include most natural and artificial bodies of water. The Controlling Authority (CA) is the peak body under the Drainage Act (being the Land Conservation Board under the Land Conservation and Improvement Act, which is discussed below).*	*Considerable capacity for the government to intervene in the use of private land exists under the Drainage Act. The provisions relating to the process attempt to put in place a transparent regime but are very understated concerning issues such as the appointment of the CA, the role of the Minister, and appeal provisions. A major problem is that only landowners within a proposed drainage area may object to the area's designation. That said, the Act, depending on the approve aspect of its program has the potential to affect hydrology flow with deleterious impact on mangroves or through enhance engineering designs can help restore and maintain mangrove forests.*
	Sewerage Act (Cap 128) 1965	*Relates to the operation, maintenance, and controlling of sewerage systems and other matter*	*Section 5-Council may enter and survey lands, bore, dig, and cut, get, or remove materials for sewerage works, as long as it is done with minimal damage. This can allow for undesirable land use to be planned and consolidated into sewerage area.* *No link between provision to declare an area and provisions exerting regulatory control.*

Fiji Roads Act (1914)	*The Roads Act enables the construction of public roads and provides the government with fairly broad powers to achieve its objectives. The rights of adjoining land users yield to the State, as a few examples illustrate. For example, the permanent secretary may possess the land for both opening and widening roads, on a compensable basis per Section 4. Similarly, material may be forcibly extracted from any land proximate to a public road for roadworks under Sections 7 and 8. Excavated material and roadwork debris may be dumped on lands adjacent to roadworks under Section 10. In terms of both governance and environmental issues, the Roads Act is outdated and should be replaced. This is of concern, especially regarding road construction along the coasts of major islands to mangrove ecosystem management and conservation.*	*Section 7: Power to Permanent Secretary or any officers to enter any land.* *Section 10: Power to throw rubbish upon adjacent lands of such earth, rubbish, or materials it shall or may be necessary to remove from the place of works.* *Section 8: Power to take materials as required on or near such public roads for the use of officers, workmen, This, inversely, could also allow for extraction of material from mangrove area for road use.*
Irrigation Act (Cap 144A) 1974	*The Irrigation Act is an instrument designed to optimize agricultural production; environmental conservation and its needs are not mentioned Indeed, under the legislation farmers can be compelled to remove vegetation from their land, a policy that has contributed to comparative, massive environmental degradation in many countries. Little support for protecting the environment is found in the legislation*	*The policy's intention is unambiguous, however, with the Commissioner having almost invasive powers to direct landholders in the use of those farms included in an irrigation area. In this regard, the capacity of the Commissioner to exercise powers and then retrospectively seek approval is an illogical statutory provision. From both environmental and public policy perspectives, the Irrigation Act needs rigorous review for want of more contemporary legislation. Perhaps this review could include measures relating to control of direct discharge that impacts mangroves.*
Forest Decree (1992)	*Under Section 6, Minister may declare forest reserve or nature reserve on un-alienated State lands, land leased to the State, or un-alienated iTaukei lands. Case of un-alienated iTaukei land requires the consent of the Trustee in TLTB.* *Forest reserves per Section 7(1) shall be managed as permanent forests, and under Section 7(2) nature reserves to be managed for the exclusive purpose of permanent preservation of their environment, including flora and fauna, soil, and water*	*Despite the text, the protection provided under the Forest Decree is not permanent protection. The Minister may, upon advisement of Forestry Board, rescind by declaration any forest reserve or nature reserve to whole or part of an area and it shall cease to be a forest or nature reserve respectively.*
Environment Management Act (2005)	*Section 3(2)(a) application and purpose of this Act are to apply principles of sustainable use and development. Section 3(a) alludes to the preservation of the coastal environment, margins of wetlands, lakes, and rivers*	*Absence of comprehensive regional and national land use plans.* *Limited protection and enforcement for conservation, especially in native forest areas. EIA process is not mandatory for every development. Monitoring of EIA conditions on leases often requires extensive land-owning unit (LoU) input*
Fiji Forest Policy [2007]	*In the 21st Century, the forest policy environment continues to change with increased emphasis on sustainable forest management, climate change, and globalization.* *Promotes policies that encourage sustainable forest management and support government strategic planning for sustainable development of Fiji.* *Ensured ecosystem stability through conservation of forest biodiversity, water catchment, and fertility.*	*Contingent upon [Forest Bill 2016] still in its Parliamentary passage. Protracted progression can lead to institutional weaknesses and entrenched bureaucratic processes given extended transitory expectations.* *Absence of detailed forest management and harvesting plans.*

	Fiji REDD+ Policy [2011]	*Offers an additional excellent opportunity for Fiji to conserve its forest and at the same time benefit from the continued environmental services of standing forests including benefits through the conservation of its forest biodiversity.*	*Recognizes that a significant proportion of Fiji's greenhouse emission is likely to arise from forest sector emissions.*
	Fiji's Constitution [2013]	*Section 40(1) -Every person has the right to a clean and healthy environment, which includes the right to have the natural world protected for the benefit of the present and future generations through legislative and other measures*	*Possible reversal- Section 40(2) a law or an administrative action taken under a law may limit or may authorize the limitation of the rights set out in this Section.*
Existing laws and policies that create conditions or incentives that encourage deforestation or degradation?	*Laws and Policies In general*	*Existing laws and policies are by design sectorial. In attempting to cover the field of its purposive intent, direct and indirect dis-harmonization may occur in terms of laws and regulation core intentions about the minimization of deforestation and forest degradation. These negative conditions are by no means intended but a by-product of the practical interplay of the various regulations and policies in the daily application as allowable by law*	*Inconsistencies that subsist may arise from the inherent sectorial intents of regulations and laws when applied*
Law and policy that allow for the coral sand mining in mangroves? Under what circumstances?	*Mining Act Chap 146)1966*	*The Ministry of Lands and Mineral Resources and Environment (MLMRE) is Fiji's main government agency that implements the country's mineral development policies under the Mining Act. Exploration licenses are granted for gold, base materials, bauxite, limestone/ marble, aggregate, and petroleum resources in the country. The Minister may declare ANY area, not exceeding 250ha government protection areas for mining and then grant mining tenements there over –Section 5(1). To mine means to disturb, remove, cart, carry or wash, sift, or otherwise deal with any rocks or earth by any mode or method to obtain any mineral. Mining for another mineral yes, but no, gravel, sand, or stone-see Section 2 definition of minerals and exceptions.*	*The Minister may by order prohibit or restrict prospecting for any specified mineral throughout Fiji and by the same or by a subsequent order grant the exclusive right to prospect for any mineral so specified to such a person as may be named in the order and the provision for this Section –Section 4. Any reserved forest is closed to mining except with the consent of the Conservator of Forest under Section 5(h)*
	Quarries Act and Quarries Regulation [Chap 147]	*Act applies to the excavation of minerals (not covered by the Mining Act such as rock, earth, clay, sand, or other common mineral substances as declared by the Minister under Section 2 (f) of the Mining Act. Such quarrying is worrying and could be a major cause of mangrove ecosystem degradation. This is authorized by the Minister of Lands and Mineral Resources or when extraction occurs on iTaukei Lands by a license issued by TLTB by agreement with Min of Lands and Mineral Resources*	*Land under Section 2, as defined by the act includes water and land covered by water. This definition may have implied application on mangroves given the possibility of quarrying in areas close to mangroves.*

Do law and policy allow for land reclamation in mangroves? Under what circumstances?	*Reclamation of Mangroves*	*The Lands Department is responsible for issuing a development lease for any activity relating to mangroves foreshore reclamation in general. Historically, much of the reclamation has recently been initiated through government agencies, primarily for agriculture and infrastructure development. The process does so only after mandatory institutional consultations have taken place between the various government departments represented on the Mangrove Management Committee. The Lands Department receives the development proposal, obtains relevant information about the customary fishing rights owners from iTaukei Fisheries Commission and forwards it to an independent arbitrator who then determines the value of potential loss of fishing rights because of reclamation. The recompense amount (which is a one-off payment) is then determined by customary right holders and developers and on information about productivity in the area on information provided by a government agency such as Fisheries Department.*	*The basis of valuation methodology for recompense amount is questionable given it does not consider special indigenous values and connection to fishing grounds.* *The process of final payment is preceded by a waiver of fishing rights form signed off by the registered owners of the fishing rights despite having no assessment of what is been waived nor the elements of the proposed taking being valued.*
Do law and policy allow for waste disposal (mining or otherwise) in mangroves? Under what circumstances?	*Waste Disposal under Roads Act (Chap 175)*	*Chap 175 provides wide powers to the Government. The rights of adjoining land users yield to the State*	*Workers may forcibly extract materials from any proximate land to a public road for roadworks. (Sections 7 and 8). Excavated material and roadwork debris may be dumped on lands adjacent to roadworks-Section 10.*
Do law and policy allow for the conversion of mangroves? For what purposes or under what circumstances?	*Conversion of mangroves*	*Forest Decree (1992)- Section 7-Minister, may upon advisement from Forestry Board rescind by declaration any forest reserve or nature reserve to whole or part of an area and it shall cease to be a forest or nature reserve respectively. This may include, for example, the prioritization of commercial interest, e.g., tourism development.*	
Do law and policy allow for harvest of flora and fauna from mangroves? For what purposes or under what circumstances?	*Fiji Constitution (2013)*	*Recognizes the traditional right of access to marine resources, but only guarantees the right of compensation or payment of royalties for infringement of these rights for mining operations.*	
	Forest Decree (1992)	*Part V- Saving of Customary Rights-Section 21(1)(a)(i) the exercise of any native rights established by custom to hunt, fish, or collect fruits and vegetables growing wild is allowed.*	*Section 21(1)(a) (ii) Cutting or removal by any iTaukei in accordance with iTaukei custom of forest produce which may be necessary for the permanent abode for himself or for his family but harvest for commercial use is not permitted.*
	Fisheries Act (1942)	*Regulates near-shore fisheries and recognizes the rights of indigenous users to fish.* *in traditional fishing grounds for subsistence purposes but does not prescribe the payment of any compensation to traditional owners for approving of rights to fish of an entity outside the community, or as compensation for waiver of fishing rights.*	
Do law and policy allow for harvest of wood from mangroves? For what purposes or under what circumstances?	*Forest Decree (1992)*	*Part V- Saving of Customary Rights-Section 21(1)(a) (i) the exercise of any native rights on iTaukei reserve, established by custom to hunt, fish, or collect fruits and vegetables growing wild. This application provides a broader interpretation beyond mangroves per se to cover wild fruits and vegetables.*	*Section 21(1)(a) (ii) Cutting or removal by any iTaukei in accordance with iTaukei custom of forest produce which may be necessary for the permanent abode for himself or for his family but harvest for commercial use is not permitted*
	Forest Bill No 13 (2016)	*Section 30 saved provisions and legal force of Section 21 of Forest Decree (1992) re: usufruct rights to hunt and collect flora and fauna*	*Question of monitoring re: volume and limiting harvest and frequency of harvest to a particular place is an issue.*

Do law and policy allow for possible land uses contributable drivers of Deforestation and degradation? For what purposes or under what circumstances?	*State Lands Act (Chap 132)*	*Leases for state lands ae generally unexceptional. Special conditions apply to the leasing of foreshore land or soil 'under waters of Fiji' to protect public access to the coast. Before awarding a lease over coastal areas, the application must be advertised, and any objections considered by the Minister. see Section 21. Regulations (R) under Section 41, of State Lands Act created 9 categories of leases; Agricultural, residential, dairying, tramway, quarry, and special purposes (R7)*	*Leases for farming and quarrying may run for 30 periods, while other categories can extend for 99 years.* *Farming leases impose minimum conditions to conserve soil and vegetation (R7 and 14)* *Annual leases can be issued to graze livestock, extract building material, cultivate crops and reside with attached conditions to recognize soil erosion and vegetation but this is not reflected in other types of licenses (see Regulations 35-39)*
People and/ or entities, if any, have the legal rights to convert or extract wood from mangroves?	*Forest Decree (1992)*	*Part V- Saving of Customary Rights-Section 21(1)(a) (i) the exercise of any native rights on iTaukei reserve, established by custom to hunt, fish, or collect fruits and vegetables growing wild. The application of this provision is broad and beyond but including mangroves, to cover, collection of fruits and wild fruits and vegetables.*	*Section 21(1)(a) (ii) Cutting or removal by any iTaukei in accordance with iTaukei custom of a forest produce which may be necessary for the permanent abode for himself or for his family.*
	Forest Bill No 13(2016)	*Section 30 saved provisions and legal force of Section 21 of Forest Decree (1992) re; usufruct rights of any iTaukei to hunt and collect flora and fauna. There may be an internal application of these to iTaukei communities who are not registered fishing rights owners to the coastal areas and may enter some form of traditional arrangement with registered fishing rights owners*	
	State Lands Act (Chap132)	*Individuals or private entities can apply for a foreshore and coastal leases. Special conditions will apply to leasing of the foreshore land or soil 'under waters of Fiji'. to protect public access to the coast. Before awarding a lease over coastal areas, the application must be advertised, and any objections must be considered by the Minister. see Section 21. Regulations, under Section 41, of State Lands Act created 9 categories of leases: Agricultural, residential, dairying, tramway, quarry, and special purposes (R7)*	
		Barriers and comments	***Comments.***
How do existing laws and policies create conditions that dis-incentivize deforestation or degradation?	*General*	*Resource Policies, Laws and Regulations articulates clear intention and substantial law provisions rendering various recognition of sustainable environmental management, and conservation approach. This is evident from recent developments, [post-2000] in Policies, Laws, and Regulations. In particular, there have been two iterations of Forest Laws since 1992, with the latest being Forest Bill 13 of 2016 currently through the Parliamentary process of being considered law. All resource laws observed are clear in their structure regarding administration powers. and in the Offences and Penalties Section.*	*The Climate Change Act, (2021) for example under Part 17 and other orders for breaches under the Act. While the general penalty of $ 750 000 and/or a 10year imprisonment is a deterrent enough, under Sections 107-108, Court may issue other orders requiring restoration and restoration, to restore the environment to as near to its original condition, with costs to be borne by the person convicted of the offense. Strict enforcement and compliance are however key to these provisions.*
	Climate Change Act (2021)	*Part 5-All State entities must ensure that any decision made, and any policy program or process developed or implemented by the State entity [from the commencement of this Act] adequately takes climate change into account.* *Section 33(m)-mandates the development and maintenance of a public accessible Information platform including amongst others, information regarding national climate, coastal zones, river deltas, agriculture and forestry, and biodiversity.*	*Recognizes under s 2(b)the principles of inter-generational equity, which is supported and protected through an equitable, and environmentally sustainable where diversity and productivity of the environment are protected and enhanced for the benefit of future generations.*

Are laws and policies designed with the intention of conserving/ protecting mangroves? If they are, are they effective? Are they enforced?	*General Response*	*There is currently no formalized national policy and/ or specific legal framework for mangrove use and updated mangrove resource management in place for Fiji. Mangroves as a forest resource are directly and indirectly covered in the existing policies. Few provide good coverage of mangroves as in the forest policy, mangrove management plans and National Biodiversity Strategic Action Plan (NBSAP).* *The subsisting deficiency in enforcement and monitoring of the existing policies, laws and regulations is of relevance and is an ongoing concern for mangrove use and management contributing to the continuing destruction of mangrove resources. This, in particular in peri-urban and urban areas at the cost of development. The fragmentation of current policies and implementation procedures will require a synoptic review and a possible harmonization, consolidation, or a separate stand-alone mangrove policy framework to be explored that is specific to the ecosystem it serves.*	

How could laws and policies be improved to promote conservation/ restoration and reduce deforestation/ degradation?	*General response*	*Mangroves should be regarded as a matter of national importance with regulations developed and amendments made to existing legislations to harmonize laws and assist in practical implementation.* *The absence of specific legislation and policy on mangrove may add to the lack of centralized responsibility. It is highlighted that current legislation like the Environment Management Act (2005) does not have provisions for the sustainable management of mangroves.* *Need a clear definition of mangroves to nominate which department or ministry is responsible for the resource. If it is per se, a forest resource then the Ministry of Forest be responsible. If it is a foreshore resource(s) then the Ministry of Lands and Minerals should take lead.* *Fragmented and uncoordinated system in place for approvals and decisions on mangroves with key government departments and ministries. Once an application for foreshore development is received by Min of Lands and Mineral Resources, an application is then sent to Min of Fisheries, Dept. of Environment, Dept. of Town and Country Planning, Provincial Administration (iTaukei Affairs), and other relevant ministries for comments within 30-days period. If no comment is received within the mandated period, then it shall be deemed there are no more comments.* *Lack of communication and clear reporting mechanism on work and decisions relating to mangrove amongst government agencies. A guideline such as a Standard Operating Procedure should be developed and made available by responsible authority to other government agencies and private entities to ensure approvals process are understood within clear timeframes.* *Lack of awareness by the public. Mangrove is still treated as a common resource.* *Lack of enforcement and monitoring and evaluation in existing policies, legislation, and procedures in place. This is important if the intended outcomes are to be achieved.*

SUMMARY

It can be deduced from the analysis of policies, laws, and regulations, that mangrove forest ecosystem protection, and their sustainable management is a complex project. This complexity is, in part, the result of a lack of custodianship under a single legislation. Similarly, the current sharing of its legal coverage under six pieces of legislation may mean overlapping responsibilities. How these responsibilities are shared among government agencies and their determined accompanied weighting, therefore, remains unclear. Mangrove protection is then limited to the levels of subject coverage intended under the specific laws. Most of the laws and regulations of Fiji governing the environment and natural resources reflect the paradigm thinking of the time related to its origin. Therefore, it is not logical to premise the protection of resources such as mangrove forests under the intersection of old pieces of law that have seen little change to adapt to the aspirations and value emphasis of modern times. An example is the preponderance of global warming with laws embracing the protection and management of new property such as carbon rights and climate change.

Overall, ancillary terrestrial laws and regulations highlight a worrying trend where little thought is given to environmental sustainability. Support in terms of instruments and general capacity to manage resources is therefore negligible. Limitations relate to the absence of resource and/or environmental management capacity, poor governance provisions, and to an extent questionable policy concerns within the statutes. The Roads Act illustrates that sourcing and dumping of source materials in the building of roads is allowed from adjacent property, meaning mangrove forest on coastal roads construction is legally convenient.

To manage resources and the environment, a common deficiency is the lack of any active management tools. Overall, none of the statutes discussed manifest an awareness of the necessity of managing resources or protecting environmental values from degradation. Where objectives of laws are not itemized and management tools or instruments are not available, almost all the statutes highlight actions that are permissible on one hand, and those that are not permissible, are categorized as constituting an offense. In this context, the correspondent or complementary requirements to manage resources are not readily identified.

In terms of wider issues relating to governance, most statutes worryingly marginalize stakeholders and the wider public interest in the environment. These legislations generally lack avenues for public involvement in decision-making; even those directly affected by decisions have no formal grievance redress mechanisms thus having few rights of redress. It is noteworthy that provisions exist in statutes purporting to empower the Minister to compulsorily acquire land for a range of uses that appear to be ultra vires to (transcend existing authority under the legislation) under the *State Acquisition of Lands Act*.

Another striking feature of some of the natural resources' legislation discussed is the ability of the Minister to set aside the relevant Act at his or her discretion. Procedurally, laws enacted by Parliament empower a Minister to rule, yet laws that may be under the discretion of the Minister, that can be considered not to apply is quite perplexing. Another similar example is the power of the Minister to redefine enacted terminology by changing the statutory definitions in some laws. Some statutes also contain clauses stating the laws do not apply to the State. Provisions of this type are inherent in several of Fiji's natural resources laws and need to be reviewed.

Two Acts do present a more enlightened and inclusive process for protecting both public and private interests regarding natural resources. The *Land Conservation and Improvement Act* and the *Drainage Act* emerge as better conceived and constructed, notwithstanding other limitations within the legislation per se. It is submitted that important and new legislation to update natural resources policy and improve environmental protection in Fiji exists, both in enacted and draft form such as the (proposed) *Management of Mangrove Regulation* enabled under the *Environment Management Act (2005)* and the *Forest Bill No 13(2016)* to supersede the *Forest Decree (Act) of 1992*. Much of this law is premised on the intents of international Treaties, and generally reflects a high degree of fidelity to those Conventions.

Ozone depletion, endangered and protected species, and climate change are the subjects of recent

local laws directly implementing international laws. Also, laws such as maritime pollution and fisheries management, and sustainable development contain an international dimension, although with marine pollution, the nexus is much less direct than is the case for the enacted ozone and endangered species laws. As well, the fisheries and sustainable development legislation addresses a wide range of issues of a domestic character and perhaps signifies the shifting of government policy toward the environment and natural resources in Fiji.

There is hope that Fiji will soon sign and ratify the *UN Declaration on the Rights of Indigenous People* (UNDRIP), so it is bound by it and transmute the application of its provisions into local laws. While the argument that Fiji is already an indigenous nation is respected, Fiji's current legal position will not obligate it to observe Article 45 of UNDRIP, regarding diminishing and extinguishing existing indigenous rights. Under this Article, a signatory party State is precluded to water down existing institutions concerning Indigenous People. In the context of mangroves and mangrove ecosystem protection, this may apply to existing institutions and governance relating to customary user rights, rights to customary fishing grounds, proper valuation of indigenous values to property rights to compensate takings, and land tenure, its control, and management.

Key recommendations to improve legal instruments for the management of mangroves:

- Update the (proposed) *Management of Mangrove Regulation* enabled under the *Environment Management Act (2005)* and the *Forest Bill No 13(2016*) to supersede the *Forest Decree (Act) of 1992* to better reflect and formalize customary sustainable management e.g., include harvesting for fuelwood, ability to establish Tabu periods, and work with iTaukei to undertake monitoring to ensure extraction is sustainable.
- Review and harmonize all existing land access and resource development legislations for consistent application regarding mangrove protection, and the removal of any current application that may be inconsistent with mangrove ecosystem protection. The general application of provisions must enhance mangrove restoration.
- Current regulations do not cover value appraisal of restoration and compensatory payments amongst its scope of fines and penalty provisions. Perhaps the inventory valuation of the mangrove ecosystem must be ascertained to include restoration value and special indigenous value of rights of registered qoliqoli owners.
- Periodic assessment and resource audits to highlight the value of ecosystem services provided by the mangrove ecosystem as a reference consideration point for the Minister of Environment regarding application for development proposals.

THEORY OF CHANGE

Goal	• Sustainable management and protection of mangroves and mangroves ecosystem under designated Act and Regulations under one responsible Ministry
Outcomes	• Broader Institutional Context-National government endorses new measures and removes conflicting policies. • Consistent Framework Implementation-High Impact locally devised intervention and policies.
Action Area (Interventions)	• National Level policy direction and advocacy • Resource Mobilization • Promotion of changes • Fund raising • Capacity awareness and creation of opportunities for effective interactions • Spatial planning • Resource Inventory survey and data interpretation.
Strategic Directions	• Shared vision and goals for deforestation reduction must be reached. • Rights and interests of stakeholders are clarified and accepted. • Monitoring framework is defined and agreed.
Challenges	• Initial funding • Initial social capital/trust • External regimes. • Resources • Multiple sources of knowledge • Facilitation

REFERENCES

Agrawala, S., Ota, T., Risbey, J., Hagenstad, M., Smith, J., Van Aalst, M., Koshy, K., Prasad, B. (2003), Environment Directorate Development Co-operation Directorate, Working Party on Global and Structural Policies Working Party on Development Co-operation and Environment, *Development and Climate Change in Fiji; Focus on Coastal Mangroves,* OECD, 2 Rue Pascal, 75775 Paris, Cedex 16, France.

Baines, G.K.B, (1984) *Mangrove Resource Management in a Pacific Island Nation, Fiji,* Australian National Parks and Wild Canberra ACT 2901, Australia**.**

Freund, J. (not-dated) *Review of Policy and Legislations relating to the Use and Management of Mangroves in Fiji*, Mangrove Ecosystem for Climate Change Adaptation and Livelihood

Ellison, J.C., & Fiu, M. (2010) *Vulnerability of Fiji's Mangroves and associated coral reefs to Climate Change*-A Review, WWF South Pacific Programme. Suva, Fiji

Evans, N. (2014) *Natural Resources and the Environment in Fiji- A review of existing s and proposed legislations*, A Report for Fiji's Department of Environment and IWP SPREP, Institute of Applied Science, University of the South Pacific, Suva, Fiji

Fiji Government (2002) 20 YR Development Plan (2001-2020) for the enhancement of participation of indigenous Fijians and Rotumans in the socio –economic development of Fiji. Parliamentary Paper No.73 of 2002.

Lal, P. N. (1990) *Conservation or Conversion of Mangroves in Fiji, An Ecological Economic Analysis*. Occasional Paper 11, Environmental and Policy Institute, East West Centre, Honolulu, Hawaii

Lal, P.N. (2002) Integrated and Adaptive Mangrove Management Framework-An action-oriented approach for the next millennium, in Lacerda, L.D., *Mangrove Ecosystems; Functions and Management*, Springer-Verlag Berlin Heidelberg, pp 235-256

Mshale, B., Senga, M., & Mwangi, E. (2017) *Governing Mangroves; Unique Challenges for managing Tanzania's Coastal Forest*, Gogor, Indonesia; CIFOR Washington, DC USAID TGCCP**.**

SPREP, (2018) *Review of natural resource and environment related legislation*, SPREP, Apia, Samoa

Techera, E. (2020) *Mangrove **E**cosystems and Services, Legal Recognition of protection in Indo-Pacific***,** University of Queensland Law Journal, Queensland, Australia. Vol 39(3), pp 475-501, Queensland, Australia.

Watling, R.(1986a) *A Mangrove Management Plan of Fiji*, Phase 1, Zonation Requirements, and a plan for the Mangrove of the Ba, Labasa and Rewa Deltas. Technical Report, The Mangrove Management Committee, Fiji-A joint project of the Fiji Government and the South Pacific Commission. Funded by MESCAL Fiji Project

Watling, R.(1986b) *A Mangrove Management Plan of Fiji*, Phase 2, A plan for the Mangroves of Nadi Bay and Suva-Navua locales, Technical Report, The Mangrove Management Committee, Fiji-A joint project of the Fiji Government and the South Pacific Commission, Suva, Fiji.

Laws of Fiji

- Agricultural Landlord and Tenant Act (1967)-CAP 270
- Constitution of the Republic of Fiji (2013)
- Climate Change Act (2021)
- Endangered and Protected Species Act (2002)
- Environment Management Act (2005)
- Fair Share of Minerals Royalties Act (2018)
- Fisheries Act 1942 (Cap 158)
- Forest Act (992 (CAP 150)
- Forest Act 1992 (CAP 150)
- iTaukei Lands Act 1905 (CAP 133)
- iTaukei Land (Amendment) Act (2002)
- iTaukei Lands Trust Act 1940-(CAP 134)
- Land Conservation and Improvement Act 1953 (Cap 141)
- Land Transfer Act 1971-(CAP 131)
- Land Use Decree (2010)
- Litter Promulgation (2008)
- Litter (Amendment) Decree (2010)
- Marine Act 1986 (Cap 158B)
- Mining Act 1966-(CAP 146)
- National Trust of Fiji Act 1970-(CAP 265)
- Public Health Act 1936 (Cap 111)
- Quarries Act (Cap 147)
- Petroleum (Exploration and Exploitation Act 1978-(CAP 148)
- Rivers and Streams Act 1882 (Cap136]
- Sea Ports Management Act (2005)
- State Acquisition of Lands Act 1940-(CAP 135)
- State Lands Act 1945-(CAP 132)
- Subdivision of Land Act 1937 (Cap 140)
- Town Planning Act 1946-(CAP 139)
- Water Authority of Fiji Promulgation (2007)

Regulations

- Endangered and Protected Species Regulations (2003)
- Environment Management (EIA Process) Regulations (2007)
- Environment Management (Waste Disposal and Recycling) Regulations (2007)
- Fisheries Regulations (Cap 158)
- Forest Harvesting Code of Practice (2013)
- iTaukei Land (Forest Regulations Act) (1940)
- iTaukei (Leases and Licenses) Regulations (1984), Regulation 23, Section 33
- Land Use Regulations (2011)
- Quarries Regulations [Cap 147]
- State Lands (Leases and Licenses) Regulations (2007)

ANNEX III

CULTURE, GENDER, AND TRADITIONAL INFLUENCES ON MANGROVE USE, DEFORESTATION, AND DEGRADATION INTERNATIONAL

Aliti Vunisea and Nikheel Sharma
Conservation International
2023

Detailed below are the main socio-economic influences on mangrove use, deforestation and degradation.

Mangroves are a valuable source of firewood, construction materials, tools, medicines, and dyes, in addition to supporting shoreline protection, sewage processing, and general aesthetics (MESCAL, 2013). One of the key challenges include the absence of a clear definition of mangroves and the lack of consistent, complementary legislation for the sustainable management of mangroves (MESCAL, 2013).

Non-human causes of deforestation

For an assessment of the impact of social and economic influences on mangrove deforestation and mangrove degradation, it is important to note that total non-human contribution to mangrove loss has been recorded at 77% loss of mangrove cover (-870 ha). Thus, in the discussion on socio-economic influences, all discussed drivers contribute around 23% to total degradation and deforestation[1] Tropical cyclones destroy mangroves, destroy related habitats and impact negatively on coastal people's livelihoods (ibid, 2020).

In a study by IUCN under the MESCAL project in the Rewa Delta, overall dieback resulting in mangrove loss were identified in 6% of fringing mangroves. Anthropogenic disturbances in the form of cutting and clearing of mangroves was only evident in 2% of fringing mangroves. This was a relatively low figure given the high population density and the many villages within the Rewa Delta [2]. Mangrove loss over the period 2001-2018 across Fiji was estimated at 1135 hectares, a decrease of 1.7%in cover since 2001, with an average annual rate of loss of 0.11%. Provinces that exhibited the highest losses were Ra(315.4ha, 12.2%), Ba (343.5 ha, 2.6%), and Bua (223.7 ha 2.3%).

After loss caused by tropical cyclone, the most significant drivers of coverage loss were the conversion for tourism development and coastal reclamation (-120 ha) followed by the disposal of dredging spoil in the Ba an Rewa Delta (-33 ha). The remaining 112 ha of loss was attributed to smaller scale conversion for industrial estates, squatter housing, agriculture and construction for agriculture tram lines In addition there was also harvesting for fuelwood and construction materials, all of which were previously stated drivers of mangrove loss in Fiji[3].

Socio-economic influences on deforestation and degradation

Fiji has the third largest mangrove area (38,000 hectares) in the Pacific but the coastal area and wetland reclamation have caused significant loss of mangrove areas and littoral forest, especially around heavily industrialized areas, towns, and cities[4] Where human habitation is close to, or within, the forests, over exploitation of mangrove resources can be evident on a local scale, with degradation occurring due to over harvesting of timber, the presence of non-native or non-mangrove plant species, dumping of domestic waste, and large amounts of plastic waste deposited along river channels and by tides[5]

Tourism Development

Large scale mangrove conversion for tourism were in Denarau,Vulani* (Sabeto River), Saweni* (Nadi Bay) –GoF, 2013. The continuation of large-scale tourism development, as in Denarau, Nadi changes a landscape relatively quickly over a short period, especially when mangroves are cleared for reclamation. Development of port facilities on delicate coastal ecosystems in Fiji is also increasing, with large areas of mangrove swamps being filled in for this purpose (UNCCD National Focal Point, 2007).

Unsustainable development has also been found to impact the environment and increase flood risk in and around some of the luxury tourist resorts[6]. One of these is the island of Denarau, where five-star establishments have mushroomed during the last decades. Natural mangrove forests acting as buffer zones were removed during the construction phases, which also affected livelihoods of locals as fish disappeared from the area[7]. The loss of buffer zones has permanently damaged the local communities and is now

[1] Cameron et al, 2020.
[2] (IUCN, 2013. Mangrove Watch assessment of shoreline mangroves in Fiji. A Report for the MESCAL project)
[3] Ministry for Economy, 2018.Fiji Low Emission Development Strategy 2018-2050. Government of Fiji.
[4] (Country Partnership Strategy: Fiji, 2014–2018).
[5] Cameron, C; Maharaj,A; Kennedy, B;Tuiwawa,S;Goldwater,N'Soapi,K; Lovelock, c. 2021.Landcover Change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. In Environmental Challenges, Volume 2.
[6] GoF. 2019. Disaster Risk Reduction in the Republic of Fiji, Status Report 2019
[7] Bernard, K. & Cook, S., 2015. Luxury tourism investment and flood risk: Case study on unsustainable development in Denarau island resort in Fiji.

repelling tourism due to the frequent flooding in the area, with an estimated loss reported in millions[8].

Disposal of dredging spoil

Major threats to mangroves were recorded as poorly conceived or implemented large scale mangrove reclamation, piecemeal or unsound development in peri-urban areas and pollution from dredging for flood mitigation (Watling, 2013, Cameron et al, 2020). In 2022, 18 major dredging activities were happening in the Rewa River and these were to maintain the discharge capacity and avoid any major flooding[9]. A *dredging* project in the Ba *River* has increased efforts to safeguard the township of Ba and the neighbouring communities from flooding[10].

There had been substantial but undocumented losses to dredging[11] and estuarine dredging and the disposal of spoil in mangrove areas. Despite introduction of Environmental Management Act (2015), EIAs and detailed Environmental Guidelines for dredging, there has still been problems with disposal of dredging spoils. The EIA for the development is deeply flawed but has been approved[12]

Recent dredging in the Labasa and Rewa deltas have been highly damaging to mangroves. In Labasa, 15-20 ha of highly productive mangrove appear to have been killed by uncontained spoil disposal direct into the mangroves. Similar extensive mangrove fatality has occurred in the Rewa delta as a result of dredge spoil disposal. There appears to have been little or no attempt in either location to Dispose of dredge spoil away from mangrove areas; or To contain and manage dredge spoil to stop it spreading through the mangroves (GoF, 2013)

Wherever dredge spoil is placed in mangroves, it alters the hydrodynamic regime and can affect mangroves in a variety of ways. More often than not, it kills all the mangroves, transforming the area to a terrestrial habitat unsuitable for mangrove restoration (Watling, 2021). For example, mangrove cover loss for the Ba Delta over the period 2002 to 2018 is estimated at 343.5 ha, or 2.6% of original extent (Maharaj, 2019). Some of this loss was caused by localized impacts, including the discharge of dredge spoil.

In certain circumstances where the hydrology is only slightly altered, small areas of the disposal do become colonized by mangrove regeneration, but this substitute is never a replacement of the original [13]. Dredge spoil placement in the mangrove causes a significant loss of mangroves that is avoidable and incompatible with Fiji's Low Emission Development Strategy (LEDS) and competent administration of the Environmental Management Act[14]

In the Mangrove Management Plan 2013, it was recommended that an enquiry be undertaken to report to the National Environment Council (NEC) whether the management failure with respect of the Rewa and Labasa dredge disposal is a result of deficiencies in the EIA, deficiencies in the dredging design, deficiencies in the dredging contract, contractor mismanagement or a lack of regulatory supervision (Watling, 2013). Thus, indirect causes of disposal of dredging spoil could be attributed to the processes and mechanisms involved in dredging operations. There are no specific references to any follow up to this recommendation.

Conversion for industrial purposes and residential use/ squatter housing.

In the 2013 Mangrove Management Plan, the loss of urban and peri-urban mangroves remained the single

International Journal of Disaster Risk Reduction, Volume 14, pp. 302-3011.

[8] Bernard,K &Cook,S.2015 Ibid.

[9] FBC News, 21 January, 2022. Work to mitigate flooding continues.

[10] Fiji Village.2022. Ba River Dredging Commenced. @7 January, 2022

[11] GoF.2013. National Mangrove Management Plan.

[12] GoF, 2013. National Mangrove Management Plan. Government of Fiji

[13] GoF, 2013, ibid.

[14] GoF. 2018. Fijis Low Emission Development Strategy, 2018-2050. Government of Fiji.

most conspicuous and contentious mangrove issue to the public (Watling, 2013).

112 ha loss of mangroves had been attributed to small scale conversion for industrial estates, squatter housing[15] (Cameron, 2021). Examples were the major mangrove conversions for industrial purposes in Rokobili (Suva Harbour), Saru & Namoli (Lautoka), Vakamasuasua (Labasa) (GoF, 2013).

Small-scale conversion for industrial activities, small scale development which include extraction activities, logging and unregulated residential settlements or squatter housing are all included in this section. Small-scale developments have continued to result in the loss of mangroves (Lal, 1983; Thaman et al., 2003). While extraction is localised and small-scale, there are concerns that an influx of people, mostly young families, migrating from inland rural areas to coastal or urban will drive demand for construction materials to build new houses (Conservation International, 2018)

Additionally, mangrove forests face threats of direct clearance to create land for domestic dwellings, tourism amenities, and for large-scale infrastructure such as roads and bridges.[16] [17] [18]

Agriculture, aquaculture

In the early 1970s and early 2000 3km2 of mangroves were converted to large scale agriculture schemes in Raviravi (Ba) for sugar cane, Dreketi (Macuata) for rice, Waidamu (Rewa) for agriculture (GoF, 2013). Before that the Colonial Sugar Refining Company (CSR), converted about 23 km2 in the Labasa delta for agriculture use[19], [20]Watling 2021, Cameron, 2020). Other factors like aquaculture ponds, sewerage, pesticide runoff, animal waste, introduced species, logging, and bioprospecting for natural products affect mangroves directly. 3km2 of *mangroves were used for aquaculture* (Ellison, J 2010).

Firewood, wood for cremation

Mangroves were heavily exploited as a major source of fuelwood in the past and during the period 2008-2012, a total of 16 licensees produced between 256-956 m3/year (Watling, 2013), while in 2013 harvesting of mangroves for fuel accounted for only 39 m3 (DoF, 2015). A few mangrove wood concessions are currently licensed, and all are in the southern division, though illegal harvesting has been estimated to be around 50% of recorded production (Watling, 2013). Ellison (2010) classified collection of firewood as one of the high threats to mangrove areas. Harvesting for both firewood and construction materials, are recognized drivers of mangrove loss in Fiji[21]).

Wood from mangrove is also used for cremation, as it takes longer to burn and provides a good source of heat due to its density. However, the impact in terms of CO2 emissions is negligible compared with conventional logging. For example, during a consultation process (fill in), in an interview with local stakeholders it was observed that a cremation facility nearby Vatuwaqa cemetery uses 60 to 84 tons of firewood per year, representing less than 100 tCO2/y.[22]

Data from a study by Cameron et all (2021) shows that while there is some extractive harvesting pressure within the Rewa Delta it is small scale and localized in extent[23]. The management of mangroves within the Rewa Delta is regulated through a moratorium enacted in 2013 which prohibits commercial logging but allows for subsistence extraction by local communities, with predominately Bruguiera gymnorrhiza

[15] Cameron C, Maharaj A, Kennedy B, Tuiwawa S, Goldwater N, Soapi K, and Lovelock CE. 2021b."Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific." Environmental Challenges 2: 1-11.
[16] Agrawal S, Ota T, Hagenstad MSJ, van Aalst M, Koshy K, and Prasad B. 2003. Development and climate change in Fiji: Focus on coastal mangroves. Working Party on Global and Structural Policies, Organization for Economic Cooperation and Development. France: OECD.
[17] Nunn PD. 2013. "The end of the Pacific? Effects of sea level rise on Pacific Island livelihoods. Singapore." Journal of Tropical Geography, 34 (2): 143-171.
[18] Cameron C, Maharaj A, Kennedy B, Tuiwawa S, Goldwater N, Soapi K, and Lovelock CE. 2021b."Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific." Environmental Challenges 2: 1-11.
[19] Lal, P (ed) 1983. *Mangrove Resource Management.* Proceedings of an Interdepartmental Workshop Held on 24th February, 1983, MAF HQ Conference Room, Suva. Technical Report No 5, Fisheries Division, MAF, Fiji
[20] Watling, D.2021.Best Practice Mangrove Planting for Fiji. A discussion document. Environment Consultants, Fiji.
[21] Ministry of Economy, 2018. Fiji Low Emission Development Strategy 2018–2050 Government of Fiji (2018)
[22] Considering a wood density of 0.703 grams per cm3 (Zanne, et al., 2009; Kauffman & Donato, 2012; Bosire, Bandeira, & Rafael, 2012), and a carbon fraction of biomass of 45%, that would represent 97 tCO2/y.
[23] Cameron et al, 2021.ibid.

extracted for use as timber in community housing and squatter settlements [24].

In a study that was conducted in Nasilai in the Rewa Delta, it appeared that mangrove degradation near to the villages was primarily due to human activities such as over-harvesting, bark removal, and dumping of domestic waste. Additionally, tree species such as lemons, guava, and papaya, proliferated in sites near human habitation, thus reducing mangrove floral integrity of these areas (Dayal, et al, 2022)

Study in 7 villages in Kubulau in Bua- respondents stated that majority of the timber used for construction for these wooden homes was sourced from nearby forests and mangrove trees. These cut trees were used for beams, poles, flooring, and panels. However, some areas show a reduction in mangrove cover, and these coincide with areas which are not close to large natural forests. Navatu, for example, does not have direct access to Kubulau's forested land and therefore depends heavily on mangrove forests to provide timber. Hence, there is a notable decline in certain mangrove areas on the island[25] In Fiji, in the 1980s mangroves were used mainly by rural dwellers on a sustainable basis for firewood, charcoal production, construction purposes, tannin, medicinal purposes, and the collection of fish, shellfish and other animals. (Lal 1984) Small-scale commercial and subsistence mangrove harvesting has long been known and continues to be an issue of local but not national concern (CI, 2020).

Mangroves were heavily exploited as a major source of fuelwood in the past, though are now more threatened by urban development than by collection for firewood. During the period 2008-2012, a total of 16 licensees produced between 256-956 m3/year[26], while in 2013 harvesting of mangroves for fuel accounted for only 39 m3 (DoF, 2015). A few mangrove wood concessions are currently licensed, and all are in the southern division, though illegal harvesting has been estimated to be around 50% of recorded production (Watling, 2013).

The management of mangroves in the Rewa Delta is regulated through a moratorium enacted in 2013. It prohibits commercial logging but allows for subsistence extraction by local communities. Additionally, *Bruguiera gymnorrhiza* is highly valued as a fuelwood for use in traditional Hindu crematorium ceremonies, given its high calorific content and density. Parts of the Rewa Delta remain subject to extraction for this end use, particularly where mangroves are situated in close proximity to main roads to enable ease of transportation (Conservation International 2018)

Table 1: Drivers of deforestation and degradation of Mangroves

[24] Conservation International, 2018. D rivers of deforestation and forest degradation and identification of forest strategies.
[25] Singh, S.A. 2011. A study of the relationship between ecosystem services and human well- being in the coastal villages of the Kubulau District in Vanua Levu, Fiji. A thesis submitted in fulfilment of the requirements for the Degree in School of Marine Studies Faculty of Science, Technology and Environment
[26] Watling, 2013. National Mangrove Management Plan. GoF

Socioeconomic driver of mangrove loss	Threat ranking	What actions have been undertaken to address drivers to date?	What further actions are needed?
Conversion for tourism……	High at the national level	Mangrove protection plans	Mangroves are now included within the Environmental Management Plan (2005) and Protected Species Act (2002) and have recently been included as priority habitats for conservation and restoration under Fiji's Low Emission Development Strategy 2018–2050 (MoE, 2018)
Sugar cane farms conversion	Not as high now	No longer used for sugarcane farming now.	
Firewood, charcoal and tradtional Hindu crematoriums	High at the community/ district/ provincial level	Community-based management	

DUMPING AND IMPROPER WASTE DISPOSAL

Ellison (2010)[27] classified high threats to mangroves in Fiji as coastal development, dumping and improper waste disposal, reclamation, and collection of firewood. Dumping and improper waste disposal was a further threat identified in the SPREP workshop as placing high threat on Fijis mangrove ecosystems. Litter and trash were observed at locations close to human settlements.[28].

Note that coastal development in this case has been discussed together with dumping and improper waste disposal, highlighting that fact that drivers of deforestation and degradation can overlap. In this case. Seawall construction in the Navua-Toquru area and Rewa Delta and the sewage treatment oxidation ponds in Lautoka, Labasa, Ba and Sigatoka[29] (GoF, 2013), have also been included. (GoF, 2013).

Infrastructure development and coastal reclamation

Coastal area development and wetland reclamation have caused significant loss of mangrove areas and littoral forest, especially around heavily industrialized areas, towns, and cities (ADB, 2013; Country Partnership Strategy: Fiji, 2014-2018).

Major threats identified for Fiji's coastal resources are the increasing rates of coastal activities such as land reclamation, coral, and extraction, compounded by unregulated residential and tourism development. Beginning in 2005, three separate areas of mangroves totalling ~13.7 ha were converted into terrestrial forest through smothering and raising soil elevation above the level of tidal amplitude (Google Earth Pro time series analysis, 2019).

Overharvesting and collection of fish, shellfish and other mangrove species

Overfishing, watershed alteration and coastal sedimentation, and industrial and hazardous waste spills contribute to mangrove degradation or mangrove loss (Ellison, J 2010; IUCN, 2013). A social survey of the Ba and Rewa delta in 2020 revealed that 45% of respondents in the Ba delta and 20% in the Rewa delta visited the mangrove area daily in search of food sources (Avtar, et al. 2021). While commercial harvesting activities conducted by communities require a license, small-scale subsistence harvesting is not generally monitored by the state. Extraction in addition, other activities conducted by communities and adjacent settlements include gathering of mangrove wood for funerals (as fuel during cremations), and collection

[27] Ellison J and Fiu M. 2010. Vulnerability of Fiji's mangroves and associated coral reefs to climate change. A Review. WWF South Pacific Office, Suva, Fiji.
[28] Aalbersberg,W; Thaman,B; Saulni,L and Power, M. 2003 Proceedings of the Pacific Islands Workshop on Mangrove Wetlands Protection and Sustainable Use. SPREP. Apia
[29] GoF, 2013. National Mangrove Management Plan. Government of Fiji

of mangrove bark to produce a red dye used for handicrafts from the coloured mangrove sap (CI, 2020). With increase in demand for tapa, collection of the mangrove red dye for tapa making also increases (Add a reference).

Over 60% of Fiji's commercially important fish and 83% of subsistence fish species depend on mangrove areas for some phase of their life cycle (Lal, 1983). Several species of mangrove crustaceans are vital to the subsistence industry. Threats to mangroves identified in Fiji were classed as high, medium, or low. Medium threats included: Overfishing, watershed alteration and coastal sedimentation, and industrial and hazardous waste spills. Low threats included: Global warming and sea-level rise, aquaculture ponds, sewerage, pesticide runoff, animal waste, introduced species, logging, and bioprospecting for natural products. (WWF, 2010).

Apart from harvesting the mangrove trees themselves, villagers also pick or collect non-timber forest products from the mixed mangrove-associated vegetation, such as Inocarpus fagifer ("ivi"), coconuts, Barringtonia edulis ("vutu") and Pometia pinnata ("dawa"), during their respective fruiting seasons. These products can be sold in markets for additional income. Pandanus leaves are processed and woven into mats and fans for cultural purposes (such as weddings and funerals) and also generate additional income[30] In addition, all households in Nasilai but one in Vadrai, indicated that they collected marine species such as fish and crabs and harvesting was mainly performed on a weekly basis. The Vadrai households and around half of the Nasilai households stated that they sell these marine products to supplement their income.[31].

UNDERLYING SOCIAL AND ECONOMIC INFLUENCES ON DEFORESTATION AND FOREST DEGRADATION.

Lack of policy/defined policy

Fiji currently has no national policy, plan for official guidelines for mangrove planting. A Mangrove Management Plan (2013) has not been endorsed. The LEDS has become the guiding document" Fijis Low Emission Development Strategy, 2018-2050.

The lack of a national policy could continue to result in drivers of deforestation and degradation not addressed. The lack of defined policy in urban and peri-urban reclamations, result in unplanned, piece-meal development and incremental loss of urban mangroves (Watling 2013) and related increased squatting in mangrove areas (ibid, 2013).

Complexities of a dual governance system

The complex governance structure due to the dual systems of traditional tenure and westernized state ownership means that while the state technically owns foreshore lands – where most mangroves grow – iTaukei coastal communities retain unalienable customary rights to the use of living resources in these areas[32] (MESCAL, 2013). This has historically been a beneficial arrangement for both parties, with the state's unofficial reliance on traditional communities as unpaid stewards resulting in their largely sustainable use for thousands of years[33]. However, given the changing socio-economic system for and increasing pressure on many rural communities, new initiatives will need to recognize and reward communities as major stewards of mangroves, as opposed to depending upon communities to protect mangroves out of tradition and self-interest alone (Watling, 2013).

There is a lack of enforcement of regulations for mangrove felling for commercial purposes (Watling, 2013) and the absence of an effective implementing agency for mangrove management and the MMP is a fundamental constraint to sustainable management of Fiji's mangroves (Watling, 2013).

[30] Dayal,S; Waqa-Sakiti, H; Tabe, T; Hodge,S.2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. In Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research
[31] Dayal,S; Waqa-Sakiti, H; Tabe, T; Hodge,S.2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. In Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research
[32] Watling, 2013. National Mangrove Management Plan. GoF
[33] Watling,D.2013. National Mangrove Management Plan for Fiji. GoF.

Marine reserves have been established with environmental management plans, but enforcement is clearly lacking because of lack of resources, lack of skilled labor, and unclear institutional arrangements (Country Partnership Strategy: Fiji, 2014–2018-Environment Assessment)

Overlapping mandates

Multiple mandates of Government Ministries over mangrove areas in Fiji, could be an underlying cause because with so many different agencies responsible, there is confusion and gaps that end up leading to deforestation and degradation. Legal enforcement mechanisms have also not changed attitude to mangrove use. Watling (2013) made reference to the fact that the Environmental Management Act (2005) and its EIA Regulations (2007) appear to have had no positive impact at all on sustainable management of the mangrove resource, rather poor EIA preparation and review has enabled unsustainable mangrove management. Loss of small areas of highly conspicuous mangrove in urban and peri-urban areas to squatting and ill-conceived reclamations continues and galvanizes public concern (Watling, 2013).

Socio-cultural norms:

Cultural values and norms support the diverse and varied use of natural resources. Communities pass traditional knowledge from generation to generation. With increasing population, pressure on the use of natural resources calls for planning and resource allocation- economic opportunities/markets

High dependence for social livelihoods and income/lack of alternatives

Mangroves, lagoons and coral reefs are important sources of fish for subsistence and sale in Fiji (Zann and Vuki, 2000). In addition, most of the urban centres and a vast majority of villages are located on the shore, along with much of the population, agriculture, industry, and commerce. Income from tourism and fisheries is directly tied to the condition and productivity of critical ecosystems and shoreline features such as coral reefs, beaches, seagrass beds and mangroves. ('Sustainable Coastal Resources Management for Fiji' 2002).

Thus, the dependence on food security and livelihoods will continue to accelerate given rapidly rising populations and expanding settlement and urban areas. Make the connection to mangroves: This fact will likely have implications for mangroves due to the products and foods extracted from them.

Mangroves, lagoons and coral reefs are important sources of fish for subsistence and sale in Fiji (Zann and Vuki, 2000).

Expanding settlement/informal housing in urban/peri-urban areas

In addition, most of the urban centres and a vast majority of villages are located on the shore, along with much of the population, agriculture, industry, and commerce. Income from tourism and fisheries is directly tied to the condition and productivity of critical ecosystems and shoreline features such as coral reefs, beaches, seagrass beds and mangroves. ('Sustainable Coastal Resources Management for Fiji' 2002). Thus, the dependence on food security and livelihoods will continue to accelerate given rapidly rising populations and expanding settlement and urban areas. Make the connection to mangroves: This fact will likely have implications for mangroves due to the products and foods extracted from them.

Lack of awareness of the critical role of providing ecosystem services

Mangroves provide a vast range of critically important ecosystem services which support the livelihoods and wellbeing of hundreds of millions of coastal people across the tropics. Of these ecosystem services, perhaps the most discussed in international discourse over the last decade has been the significant role mangroves can play in climate change mitigation and adaptation. (Cameron et al, 2021).

Proximity of villages to mangrove areas

Where human habitation is close to, or within, the forests, over exploitation of mangrove resources can be evident on a local scale, with degradation occurring due to over harvesting of timber, the presence of non-native or non-mangrove plant species, dumping of domestic waste, and large amounts of plastic

waste deposited along river channels and by tides[34] [35] This underlying cause is linked to urban expansion of informal settlements into mangrove areas.

High Rate of unemployment

In a study on drivers of deforestation and degradation in 2020, one of the main factors revealed in the Ba and Rewa delta was that the rate of unemployment was relatively high in both deltas, 71% in the Ba delta and 67% in the Rewa delta. Fishing, crab catching, and firewood collection were the main sources of income, with some secondary activities, including livestock rearing and the collection of medicine (Avtar et al, 2021). Although the dependency on mangrove resources differed in Ba and Rewa, the sale of goods was still an essential activity for the communities in both areas.

In most cases, the drive for economic opportunities far outweighs and can undermine the ecological and environmental benefits due to the lack of information that are readily available on the ecosystem service values and importance. The demand for proper ecosystem valuation is critically important to be able to make a well-informed decision on the most appropriate option to take.

Shift from subsistence to commercial

Mangroves around urban areas are particularly at risk from unsustainable harvesting, overexploitation, pollution, waste disposal, dredging, and development such as housing and industry, infrastructure for tourism (MESCAL, 2013). Urban development and increasing informal settlements are underlying factors that can lead to unsustainable harvests, waste disposal and other associated threats to mangroves.

Another underlying cause of deforestation is predominantly the shift from a subsistence-based economy to a commercial (market-driven)/industrial-based economy. Population growth and social change (rural-urban drift, accelerating the removal of mangrove areas for settlement/development), increased demand for livelihood sources, economic growth and development, poverty, and unequal access to land (Naiko, A.1999).

New needs, aspirations and wants are also being created. Consequently, Pacific Island countries are facing new challenges of balancing their economic development goals with those of conservation of their natural resources. Attaining this balance is essential given the limited natural resource endowments and economic opportunities in the islands, high population growth rates generally, and their vulnerability to natural disasters such as hurricanes and cyclones (USP, 2001).

ACTORS AND AGENTS

Local Population/Indigenous Communities

ITaukei communities, who have inherent communal rights to use mangrove forest resources in traditional activities, such as the harvesting of firewood, collection of produce, and medicinal purposes.

People who reside in villages on the fringes of mangroves are the everyday users of mangrove forests

Landowners

Fiji recognizes customary land ownership as enshrined in the Constitution. The rights flowing from customary land ownership, including traditional forest use, are regulated in the legislation. Traditional forest use rights for subsistence and customary purposes include harvesting of wood for firewood and other traditional uses, the collection of forest produce for food and medicinal purpose

Ministry of Forestry, whose role is to regulate, develop, and enforce restrictions within mangroves.

The Department of Environment, who is required to conduct an EIA for any commercial development in or

[34] Fiji Government. Ministry of Economy. 2018. Fiji Low Emission Development Strategy 2018–2050. Government of Fij

[35] Cameron et al, 2021. ibid

within mangrove areas.

The Department of Lands and Department of Fisheries, who together – along with the MoF and Department of Environment – manage Fiji's mangrove resources.

Department of Land for native logging in State Land as well as the establishment of Protected Areas in foreshore areas.

Landowners, who either fell trees themselves or consent to activity on their property by commercial logging operations.

Local population, whose growth requires building materials and cleared land for expansion.

TLTB, whose consent is required for licenses to harvest timber on iTaukei land.

Buyers of wood and timber, who place increased demand on timber production for international markets

The Ministry of Tourism, along with hotels and tourism agencies, whose growth has placed increased demand on Fiji's energy production and transportation infrastructure.

The Department of Environment, who is required to conduct an EIA for any development proposals, and also to enforce environmental codes and standards

Landowners, who either fell trees themselves or consent to activity on their property by commercial logging operations.

MoF- There is also the Reforestation of Degraded Forest Project under the 30 million trees in 15 years initiative which also focuses on mangrove restoration

Communities, Women and Men Fishers, Firewood Collectors

With increasing population, there is increased demand and pressure on resources as people rely on mangrove resources for both subsistence and economic needs. Thus, any management intervention must consider the high reliance of coastal populations on mangrove resources and the implications of mangrove use for their conservation and restoration.

BIBLIOGRAPHY

ADB, 2013.Country Partnership Strategy: Fiji, 2014–2018. Asia Development Bank, Manilla.

Avtar,R; Navia,M; Sassen,J.2021. Impacts of changes in mangrove ecosystems in the Ba and Rewa deltas, Fiji using multi-temporal Landsat data and social survey. In Coastal Engineering Journal, Volume 63

Cameron, C, Maharaj, A, Kennedy, B, Tuiwawa, S, Goldwater, N, Soapi, K and Lovelock, CE 2021, 'Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific', *Environmental Challenges*, vol. 2, p. 100018.

Conservation International, 2020.Selecting Blue Carbon Sites in Fiji, Conservation International.
Department of Environment, 2010. Fiji Fourth National Report to the United Nations Convention on Biological Diversity. Fiji Government.

Ellison, J. C., (1999a). Present status of Pacific Island mangroves. In Marine/ Coastal Biodiversity in the Tropical Island Pacific Region: Volume II. Population, Development and Conservation Priorities, Eds L. G. Eldredge, J. E. Maragos and P. L. Holthus, Pacific Science Association/ East West Center, Honolulu. P. 3-19.

Ellison, J.C. (2003b). Mangrove assessment and monitoring methodologies. In Proceedings of the Pacific Regional Workshop on Mangrove Wetlands, Protection and Sustainable Use. South Pacific Regional Environment Program, Apia, Western Samoa, pp 105-118.

Ellison, J. (2010). Vulnerability of Fiji's mangroves and associated coral reefs to climate change. A Review. Suva, Fiji, WWF South Pacific Office.

IUCN, 2013. MangroveWatch Assessment of Shoreline Mangroves in Fiji. A report for MESCAL Project, IUCN, Oceania.

Lal, PN 1984, *Coastal Fisheries and the Management of Mangrove Resources in Fiji*, Hawaii.

Lal, P. N. (1990a). Ecological economic analysis of mangrove conservation: a case study from Fiji. Mangrove Ecosystems Occasional Papers No. 6. UNDP/UNESCO Regional Project for Research and its Application to the Management of the Mangroves of Asia and the Pacific (RAS/86/120). Lal, P.N. (1990b). Conservation of conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Center, Occasional Paper 11.

Naioko,A. (1999). FOREST LIVELIHOOD A social and economic analysis of the causes and impact of deforestation in FIJI. Masters Thesis, University of the South Pacific, Suva)

Pillai, G. (1985). Mangrove of Fiji their uses and management. In Field C. D., and Dartnall, A. J., eds., Mangrove Ecosystems of Asia and the Pacific, pp. 150-160. Australian Institute of Marine Science, Townsville.

'Sustainable Coastal Resources Management for Fiji' 2002, in Suva, Fiji.

UNEP, (2006). Pacific Island Mangroves in a Changing Climate and Rising Sea. UNEP Regional Seas Reports and Studies No.

USP (2001) PROCEEDINGS OF THE PACIFIC REGIONAL WORKSHOP ON MANGROVE WETLANDS PROTECTION AND SUSTAINABLE USE THE UNIVERSITY OF THE SOUTH PACIFIC MARINE STUDIES FACILITY, SUVA, FIJI JUNE 12 – 16, 2001.

Watling, D, 2021. Best Practice Mangrove Planting for Fiji – A Discussion Document – August 2021. WWF, (2010) A Review. Vulnerability of Fiji's mangroves and associated coral reefs to climate change Review by WWF South Pacific Programme).

Watling, (2013) The Mangrove Management Plan for Fiji.

Zan L P and Vuki V (2000). The South Western Pacific Region

ANNEX IV :

LITERATURE REVIEW OF CULTURE, GENDER, AND TRADITIONAL INFLUENCES ON MANGROVE USE, DEFORESTATION, AND DEGRADATION

Aliti Vunisea and Nikheel Sharma
Conservation International
2023

Drivers Threats to Deforestation and Degradation

The following are some of the key direct cultural and gender related threats to mangroves.

Complex Governance structure

Weak governance, disconnect between formal and traditional management systems, limited baseline information, weakening traditional management, lack of awareness and limited capacity are some of the key challenges of mangrove management faced in the Pacific[1]. In addition, coordination and participation across sectors are complicated by the complexity of traditional social structures and unwritten norms that limit coordination between agriculture, forest, environment and fisheries sectors[2]. It should also be noted that the diminishing of traditional rights is important in the face of development because, although communities may have fishing rights in mangrove areas, mangroves are classified as "state land", which overrides usage rights[3]. In a study done in mangroves in 5 communities in Ra by the Pacific Community, following Tropical Cyclone Winston, one of the identified threats to management of fisherie and marine resources was the weak *vanua* governance[4], which means that there may be tradional institutions and governance mechanisms, but a lot depends on the continuing existence of good governance.

Custodianship over mangrove resources

Fijians, have customary or traditional unalienable rights of use to the living resources in intertidal areas, such as traditional fishing rights in their customary fishing grounds (Fiji. *qoliqoli*) under the Native Lands Act (Cap 33). Therefore, while customary use rights are recognized, there is no ownership over the resource. This arrangement contributes to the complexity of effective mangrove management in Fiji[5]. Despite having no ownership rights to mangrove or its resources, coastal village communities have considerable independence over the manner in which they use them, and as a generalisation they have been relied upon to be the unpaid custodians of the nation's mangrove resource [6].

Overlapping jurisdictions between traditional and state laws where mangroves are technically owned by the state with indigenous iTaukei communities holding rights to fish within mangrove systems and small-scale resource harvesting[7] could be cause of confusion where indigenous communities fishing rights is seen by traditional rights holders as synonymous with ownership[8]. On many occasions the owners of customary fishing areas have confronted fishers and tourist operators they believed were abusing their coastal resources. Although this situation is not conducive to the economic reputation of the country, it shows that the owners of customary fishing areas are serious about the proper use of their coastal resources. In some instances, fishing gear has been destroyed and lives threatened as customary owners exert control within their areas[9]. Limited understanding of potential tradeoffs between sustainable management and full extraction contributes to conflicting interests on the same land and resources.[10]

Continuing Traditional Uses of Mangroves

Coastal communities in Fiji have used mangrove resources for generations and as in other Pacific island countries, mangroves are recognised as significant resources with respect to the traditional lifestyles of indigenous peoples, providing resources such as fuelwood, construction materials, food, medicines, natural dyes, and ceremonial commodities such as flowers for garlands[11]. Mangrove resources have been traditionally exploited in Fiji for generations, for construction wood, fuel wood, herbal medicines, and

[1] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.
[2] Veitayaki, 2017. Veitayaki,J;Varea,R; Rollings, N; Waqalevu, V. 2017 Mangroves in Small Island Development States in the Pacific: An Overview of a Highly Important and Seriously Threatened Resource
[3] Ibid, 2013.
[4] Pacific Community, 2016. Coastal Community-Based Protected Areas, mangroves protection and fisheries management in Ra Province- Diagnosis and Action Plan.RESCUE, SPC, Noumea.
[5] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.
[6] Watling, 2013.Mangrove Management Plan for Fiji- Prepared for the National Mangrve Committee. MESCAL
[7] Ibid, 2013.
[8] Veitayki, 2004. Veitayaki,J. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies:linking local knowledge to science.
[9] Veitayaki,J 2008. "Fisheries resource-use culture in Fiji and its implications," in Culture and Sustainable Development in the Pacific, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09
[10] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN
[11] Veitayaki,J;Varea,R; Rollings, N; Waqalevu, V. 2017 Mangroves in Small Island Development States in the Pacific: An Overview of a Highly Important and Seriously Threatened Resource

the gathering of crabs and fish[12]. These traditional uses of mangroves are described in detail by P and Lal (1990a; 1990b)[13].

In a survey conducted in two villages in the Rewa Delta in 2021, it was found that the main benefits the villagers received from the mangrove forests were collection of firewood for domestic use, materials for house building and fenceposts, and collecting materials for uses such as in traditional medicines and making dyes[14]. Apart from harvesting the mangrove trees themselves, villagers also pick or collect non-timber forest products from the mixed mangrove-associated vegetation, such as *Inocarpus fagifer* ("ivi"), coconuts, *Barringtonia edulis* ("vutu") and *Pometia pinnata* ("dawa"), during their respective fruiting seasons. These products can be sold in markets for additional income. Pandanus leaves are processed and woven into mats and fans for cultural purposes (such as weddings and funerals) and also generate additional income[15].

Thus traditional uses of mangroves continue in coastal communities and will be a direct threat to mangroves given rising costs of living and lack of livelihood alternatuves in the delta areas of the main islands.

Small-scale subsistence fisheries not moniotored by State

In addition, while commercial harvesting activities conducted by communities require a license, small scale subsistence harvesting is not generally monitored by the state[16]. This results in poorly managed extraction activities conducted by communities and adjacent settlements to gather mangrove wood for funerals (as fuel during cremations), and to produce a red dye used for handicrafts from the colored mangrove sap[17].

Indigenous fishing practices

Indigenous Pacific island fishing practices and technologies reflect an intimate understanding of the aquatic food resources and their environments[18]. This is evident from the various ingenious traditional fishing methods like hand collection or reef gleaning, net fishing, spear fishing, hook and line, group fishing, fish poisoning, trap fishing, specialized targeted-species fishing, and other fishing methods and techniques reported throughout the Pacific, which testifies to the people's in-depth understanding of their natural world and how it works[19]. Living on islands, Pacific peoples not only adapted to their isolated environments but also developed knowledge system of fishing, based on their interaction with the marine and freshwater environments, knowledge which has been continuously refined over the generations and blended with the ancestral fishing knowledge and passed to the next generation[20]. This knowledge allowed the people to efficiently manipulate the environment and the species they have[21].

Wealth of traditional knowledge and skills

Although classified as non-scientific, traditional knowledge have been accumulated after centuries of extensive trial and error experiences from which people have learned[22]. Because of their long association with mangroves, communities have a wealth of traditional empirical and scientific knowledge on the direct and indirect benefits of the mangrove ecosystem. Awareness of community knowledge and utilization

[12] Ellison, J.C. 2003 Mangrove assessment and monitoring methodologies. In Proceedings of the Pacific Regional Workshop on Mangrove Wetlands, Protection and Sustainable Use. South Pacific Regional Environment Program, Apia, Western Samoa, pp 105-118

[13] . Lal, P. N. (1990a). Ecological economic analysis of mangrove conservation: a case study from Fiji. Mangrove Ecosystems Occasional Papers No. 6. UNDP/UNESCO Regional Project for Research and its Application to the Management of the Mangroves of Asia and the Pacific (RAS/86/120). Lal, P.N.

[14] Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research

[15] Ibid, 2022.

[16] Veitayaki,J;Varea,R; Rollings, N; Waqalevu, V. 2017 Mangroves in Small Island Development States in the Pacific: An Overview of a Highly Important and Seriously Threatened Resource

[17] CI, 2020.

[18] Veitayaki, 2008. Veitayaki, J. 2008.. "Fisheries resource-use culture in Fiji and its implications," in *Culture and Sustainable Development in the Pacific*, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

[19] Foale,S 2006. The Intersection of scientific and indigenous ecological knowledge in coastal Melanesia.implications for comtemporary marine resources management. In Int. Soc. Sci.J 129-137.
Thaman, B; Thaman,R; Balawa,A and Veitayaki, J.2017. The recovery of a tropical marine mollusk fishery. A transdisciplinary ommunity-based approachIn Navakavu, Fiji.J.Ethnobiol. 37:494.

[20] Veitayaki, 2002.Taking advantage of indigenious knowlwdge, the case of Fiji. Int.Soc. Sci. JJ54, 395-402.

[21] Basily,N.M and Vuki, V. 2014. Traditional fishing methods and traditional fisheries management in Gao District, Santa Isabel Island, Solomon Islands. In SPC, Women in Fisheries Bulletin. Vol 24.

[22] Veitayaki,J. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies:linking local knowledge to science.

patterns of mangrove ecosystems and their services is integral to conservation and management[23]. The time-tested indigenous fishing knowledge (IFK) of Fiji and the Pacific Islands is seriously threatened due to the commercialization of fishing, breakdown of traditional communal leadership and oral knowledge transmission systems, modern education, and the movement of the younger generations to urban areas for work and/or study [24] [25]. Because of their long association with mangroves, communities have a wealth of traditional empirical and scientific knowledge on the direct and indirect benefits of the mangrove ecosystem. Awareness of community knowledge and utilization patterns of mangrove ecosystems and their services is integral to conservation and management[26]. During fishing activities, older fishers, who are highly skilled and knowledgeable with strong leadership qualities, were in charge and responsible for designating roles to the young fishers also shared knowledge, advised or demonstrated techniques with the younger fishers while fishing, thus transmitting their knowledge through hands-on, in-the-field experiences.

In a study of ecosystem services in Kubulau Bua, cultural services benefit included services of spiritual and religious value (through the use of yaqona, tabua, mangrove dyes, and mats), benefits of knowledge gained, and the educational importance Thaman stated that where traditional ethnobiological knowledge exists, in-depth systematic traditional knowledge is usually held by a small number of men and women in the community[27]. This knowledge is being lost rapidly and is seriously lacking in the younger generation, urban populations, and among urban-based leaders and policy makers[28]. These wealth of knowledge and skills is slowly lost resulting in degradation of mangrove areas.

Lack of passing on of traditional knowledge

Fewer older people holding traditional knowledgeIndigenous fishing knowledge (IFK) has been fundamental to environmental, cultural and livelihood sustainability of Pacific peoples for millennia. This time-depth inter-generationally transmitted oral knowledge is, however, seriously threatened, its loss being seen as a major threat to the sustainable management of marine and freshwater fisheries resources [29] [30].

Loss of traditional knowledge and skills

The time tested indigenous fishing knowledge of Fiji and the Pacific is seriously threatened due to the commercialization of fishing, breakdown of traditional communal leadership and oral traditional transmission systems, modern education and the movement of younger generation to urban areas. [31].The loss of certain trees means the loss of the cultural heritage of tribes and clans (/ Cavuti) and their identity. Trees have religious and spiritual significance; they are often associated with the curing of sickness, the exorcism of evil spirits and good yields. For instance, the Ti plant is planted around gardens to chase away evil spirits and for good yields[32] . These trees also hold great ceremonial importance to the people of Fiji,[33] [34] e.g.; the pandanus that is used for trade, in ceremonies woven as mats. The loss of this traditional, spiritual connection that results from conflicts between state and traditional rights and a decrease in traditional

[23] Thaman, R., Lyver, P., Mpande, R., Perez, E., Carino, J., and Takeuchi, K. (2013). The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies With Science. Paris: UNESCO/UNU.

[24] Veitayaki, J. (2002). Taking advantage of indigenous knowledge: the Fiji case. Int. Soc. Sci. J. 54, 395–402. doi: 10.1111/1468-2451.00391.

[25] Kitoleilei, S; Thaman, R:Veitayaki, J; Breckwoldt, A;Piavano, S. 2021. Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. For Marine Consrvtuon and Sustainability.

[26] Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in Culture and Sustainable Development in the Pacific, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

[27] Thaman, B., Thaman, R., Balawa, A., and Veitayaki, J. (2017). The recovery of a tropical marine mollusk fishery: a transdisciplinary community-based approach in Navakavu, Fiji. J. Ethnobiol. 37:494. doi: 10.2993/0278-0771-37.3.494

[28] Thaman, B., Thaman, R., Balawa, A., and Veitayaki, J. (2017). ibid.

[29] Foale, S. 2006. The intersection of scientific and indigenous ecological knowledge in coastal Melanesia: implications for contemporary marine resource management. Int. Soc. Sci. J. 58, 129–137. doi: 10.1111/j.1468-2451.2006.00607.x (accessed February 2, 2020).

[30] Veitayaki, J. 2008.. "Fisheries resource-use culture in Fiji and its implications," in Culture and Sustainable Development in the Pacific, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

[31]

[32] Thaman KH. 2002. "Shifting sights: the cultural challenge of sustainability." Higher Education Policy, 15(2): 133-142.

[33] Thaman, R., Lyver, P., Mpande, R., Perez, E., Carino, J., and Takeuchi, K. (2013). The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies With Science. Paris: UNESCO/UNU.

[34] Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails:indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M. 'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji.

mangrove uses could have implications for mangroves. Loss of knowledge and skills can mean loss of appreciation of associated traditional conservation traditions.

Thus, preserving and recording this traditional knowledge associated with mangroves shoud be targeted to improve conservation and management outcomes[35].

OVERUTILISATION OF MANGROVES NEAR TO VILLAGES

While commercial harvesting activities conducted by communities require a license, small scale subsistence harvesting is not generally monitored. This results in poorly managed extraction activities conducted by communities and adjacent settlements to gather mangrove wood for funerals (as fuel during cremations), and to produce a red dye used for handicrafts from the colored mangrove sap (CI, 2020). In a survey on mangrove use in the Rewa Delta, it was obvious that villagers were generally aware of sustainable practices, but it was also evident that mangroves near the village were degraded, with visible signs of logging, bark removal, sapling damage, discarded domestic waste, and domestic animals grazing freely[36].

In the same study, regarding sustainable management and exploitation of the mangroves, all respondents from both villages said they considered sustainable approaches when cutting down trees, despite no formal management plans being implemented. This was because all respondents were aware of the benefits they derived from the mangroves, and the importance of maintaining mangrove health. However, 100% of respondents from Nasilai indicated they use the mangrove for dumping domestic waste[37]. Overall, in a study done in the Rewa Delta recently found that deterioration of the mangrove forests caused by human activities was more obvious than the damage caused by the impacts of climate change[38].

GENDER ROLES

Traditional decision making processes

Decision making in most areas, however, is still dominated by men, especially when setting up taboo areas, fishing restrictions, and protected areas, where fishing is banned or managed in areas where most subsistence resources are caught, commonly by women.[39] The fundamental dependence of community-based management work on traditional systems, institutions and customary practices and norms mean that the institutional barriers that women face in decision making and other areas of public life in communities will continue to exist into the future unless steps are taken to identify entry points for women participation in decision making[40]

As a result of this style of decision making and the "culture of silence" in the Pacific, where women and children are excluded from decision making, fishing activities of women, children, and the elderly, who usually have access to the nearby shallow fishing areas and are at risk of losing their fishing location[41].

> Women play key role in the harvest and use of mangroves. As a result of the mostly patriarch decision making in the Pacific and in Fiji, women are usually not included in decision making that relate to their fishing activities. In traditional Fijian practices, men were experts in gathering fish from the sea while women's specialization was in gleaning food from the reef, mudflats including mangrove swamps and freshwater streams. In modern Fiji some traditional fishing rites performed by women are still known . This is especially relating to fishing activities where women, or men only can participate[42]

[35] Veitayaki,J. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies:linking local knowledge to science
[36] Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach
[37] Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach
[38] Dayal, et al.2022 ibid
[39] Vunisea, A. (2016). "The participation of women in fishing activities in Fiji," in SPC Women in Fisheries Information Bulletin #27 - December 2016 (Noumea: SPC), 19–28.
[40] Vunisea,A.2014. Engagement of Women in the Fiswheries Sector in Fiji. WIFN/SPC, Noumea,
[41] Vunisea, 2016. Women Participation in the Fisheries Sector in Fiji. In WIF Bulletin, SPC, Noumea
[42] The Fiji times, 2021. Nakawakawa women' stange fishing tradition.

In different parts Fiji, women are the largest contrbuters to subsistence catches, and this is often smaller fish and shellfish[43]

Within the devolution of tenure rights in mangrove work to local communities, gender equity remains a missing element in mangrove conservation and management. The few available studies have shown that there is gender differentiation in the type of products harvested, for example women harvest in the inshore areas collecting mulluscs and crustaceans while men dominantly fished in outer reef areas. There is differences in the economic value of products harvested with women's catches mostly used for home consumption while men scatch are sold [44] [45]. In addition to gleaning invertebrates nd seaweed, women also caught over 100 species of fish[46]. The role of women in mangrove utilization and management is seldom recognized, and their representation in decision-making bodies is minimal. However, community-based rehabilitation or income generation programs are increasingly integrating gender-based considerations and some are even focused solely on empowering women[47].

Thus, gender should be considered and incorporated into ecosystem-service valuation and management interventions so that they can produce sustainable and equitable livelihood outcomes[48]

Traditional Management

In recent years, there has been an increase in socio-economic management of mangroves that incorporate both traditional and scientific knowledge, and recognizing the needs of local inhabitants in addition to implementing a biodiversity conservation agenda[49] [50]. These initiatives also provide a medium for documenting traditional knowledge and conservation methods, and promote local community, cultural and spiritual benefits[51]. In Fiji, native communities possess in-depth knowledge of coastal fisheries that provide baseline data for monitoring the effects of environmental degradation and efficacy of conservation initiatives[52]. Any management work on mangroves should therefore include scientific and local knowledge. An appreciation of some of the traditional knowledge will provide an insight into how the people use and depend on their environment and its resources.

Considering the long history of sustainable traditional use of mangroves, traditional use rights of communities, and the demonstrated value of traditional and scientific ecological knowledge, a collaborative process and co-management arrangement to facilitate a bottom-up approach using traditional institutions, knowledge and practice should be considered as a viable alternative to reduce deforestation/degradation and improve conservation and sustainable livelihood outcomes[53].

Tabu areas are essentially protected areas put in place for a certain period of time to allow resources to replenish. This is crucial, if we implement an 'improved forest management' type of scenario in Rewa then we will have to work within the systems for management already in place, so need to understand how these are declared and what criteria / threshold's of deforestation need to occur before this is enacted[54].

[43] Kronen,M and Vunisea,A.2007. Women never hunt but fish. Highlighting equlity for Women in Policy Formulation and strategic planning in the coastal fisheries sector in Pacific island countries. Women in Fishries Bulletin, 17. SPC, Noumea.
[44] Vunisea, 2014, Engagement of Women in the Fisheries Sector in Fiji.WIFN/SPC.
[45] WCS, 2020. The Critical Contribution of Women Fishers to Food Security, WCS..
[46] Thomas, A.and Waqairatu, S. 2021. Why they must be counted. Signifucant contribution of Fijian Women Fishers to Food securityand livelihoods. Ocean and Coastal Management. Volume 265
[47] WCS, 2020. Ibid.
[48] Pearson,J;McNamara,K;Nunn,P. 2019. Gender-specific perspectives of mangrove ecosystem services: Case study from Bua Province, Fiji Islands.
[49] Vierros M, Tawake A, Hickey F, Tiraa A, and Noa R. 2010.Traditional marine management areas of the Pacific in the context of national and international law and policy. UNU-IAS
[50] Pollard EM,Thaman R, Brodie G, and Morrison C. 2015. "Threatened Biodiversity and Traditional Ecological Knowledge: Associated Beliefs, Customs and Uses of Herpetofauna among the AreAre on Malaita Island, Solomon Islands." Ethnobiology Letters, 6(1): 99-110
[51] Thaman, 2000. Traditional Environmental Knowledge and community-based Conservation in Fiji. Current Status and priorities for its protection and utilization. USP Geography Working Papers. USP, Suva
[52] Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji
[53] Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in Culture and Sustainable Development in the Pacific, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09
[54] Pearson, J. (2020). The role of local and Indigenous knowledge in ecosystem-based management and adaptation: a case study of iTaukei

Nainoca argued that the combination of bula vakavanua, social capital, traditional ecological knowledge (TEK) and co-management is relevant. to the need for rigorous community engagement in management of resources[55]. Veitayaki highlighted that the contribution of traduional knowledge to ecosystem mnagement and practices in Fiji is important in ensuring sustainable management strategies[56] [57].

Locally Managed Marine Areas (LMMAs) in Fiji are set up using the traditional knowledge of fishers merged with modern science to better manage the fisheries resources at the grassroots level. A portion of the fishing grounds is usually set aside as a no-fishing zone to safeguard the future sustainability of fisheries resources[58].

Today, the Fijian network is made up of over 400 LMMAs, which not only focus on management but also on raising awareness, informing policies, and sharing information at the national and international levels[59]. In recent years, there has been an increase in socio-economic management of mangroves that incorporate both traditional and scientific knowledge, and recognizing the needs of local inhabitants in addition to implementing a biodiversity conservation agenda[60] [61]. In Fiji, native communities possess in-depth knowledge of coastal fisheries that provide baseline data for monitoring the effects of environmental degradation and efficacy of conservation initiatives[62].

By understanding the inter-reatedness of local expertise, customary marine management, traditional knowledge and practice as well as the roles of leaders and institutions, local knowledge practice belief systems can be used to inform adaptation to disasters[63].

Underlying Causes of Deforestation and Degradation

Traditional Fishing Access and Fishing Rights

Coastal communities have fishing access rights to coastal habitats, known as qoliqoli, and serve as custodians for the conservation and management of these areas. Any development activity occurring in a qoliqoli area (e.g. tourism development, infrastructure, etc.) can only advance with formal approval from the indigenous iTaukei clans, or mataqali, that hold traditional rights to these areas. If a clan approves industrial or other activities in their qoliqoli area, they also formally and irreparably waive their traditional access rights. The Ministry of Forestry is tasked with advising communities on the process for waiving their traditional rights to an area, including the potential ecosystem services and food security repercussions. These access means that use of mangroves will continue in all coastal communities throughout the country and ways to protect and manage mangroves into the future will need to be done with traditional users of mangroves .

Loss of Traditional Knowledge in Urban Youths and Urban Based Leaders

Centralised management initiatives have not prevented degradation and failed to improve lives[64]. Where traditional ethnobiological knowledge exists, in-depth systematic traditional knowledge is usually held by a small number of men and women in the community. This knowledge is being lost rapidly and is seriously

communities in Bua Province, Vanua Levu Island, Fiji. PhD thesis, School of Earth and Environmental Sciences, University of Queensland.

[55] Nainoca, W. 2011. The influence of the Fijian Way of Life. A thesis Presented in requirements for the Degree of Philosophy. Massey University.

[56] Veitayaki, 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies:linking local knowledge to science.

[57] Veitayaki, 2004. ibid.

[58] Tawake, A; Jupiter,S; Waqairagata, F; Clements,C; Vave, R. Rhe Effectiveess of Locally Managed Maine areas in Fiji. University of the South Pacific.

[59] Kitoleilei, S; Thaman, R:Veitayaki, J; Breckwoldt, A;Piavano, S. 2021. Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. For Marine Consrvtuon and Sustainability.

[60] Vierros M, Tawake A, Hickey F, Tiraa A, and Noa R. 2010.Traditional marine management areas of the Pacific in the context of national and international law and policy. UNU-IAS
Traditional Knowledge Initiative, Darwin, Australia

[61] Pollard EM,Thaman R, Brodie G, and Morrison C. 2015. "Threatened Biodiversity and Traditional Ecological Knowledge: Associated Beliefs, Customs and Uses of Herpetofauna among the AreAre on Malaita Island, Solomon Islands." Ethnobiology Letters, 6(1): 99-110

[62] Bryant-Tokalau, J. 2018. Indigenous Pacific approaches to Climate Change, University of Otago

[63] Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji

[64] Veitayaki, 2008. Fisheries Resource Use culture in Fiji and its implications. In Culture and Sustainable Development in the Pacificeds. Hooper(Canberra, ANU Press)

lacking in the younger generation, urban populations, and among urban-based leaders and policy makers[65].

Conservatuion Versus Development

In a study conducted in two villages in the Rewa Delta, villagers were generally aware of sustainable practices, but it was evident that mangroves near the village were degraded with visible signs of logging, bark removal, sapling damage, discarded domestic waste and domestic animals graze freely. Overall, it appeared that deterioration of the mangrove forests caused by human activities was more obvious than damage caused by the impacts of climate change[66].

Legal Ownership of Carbon

The legal ownership of carbon in mangrove and seagrass habitats has not been formally assessed. It is unclear whether the carbon stored and sequestered in mangroves and seagrasses is owned by the state or by the indigenous communities that serve as stewards to these critical ecosystems[67]. Ownership and benefit sharing from blue carbon will not be easy to determine given the complex nature of ownership and user rights of mangrove areas.

Traditional Activities in Urban Mangrove Areas

People from coastal rural areas move into urban areas and build homes in informal settlements straight into mangrove forests. Thus there is continuation of traditional reliance on mangroves and there will be higher use due to demands of living in urban areas. Health implications are severe, but settlements in mangrove forests provide protection against eviction. For example, the case study from Suva urban squatter areas, provides insight into people's lives, perception and actions in a degraded mangrove forest in the eastern part of Suva, the capital of Fiji[68].

Overlapping Juisdiction

Available data indicate that more than two thirds of reef fishes and invertebrates are taken for subsistence. The primary driver for decline in reef fishes and invertebrates are small scale local fishing for food, with the demand rising as population increases[69].

[65] Thaman, R; Balawa,A and Fong,S. 2008. I Lava ni Navakavu. Fin Fishes of the Vanua Navakavu, Viti Levu, Fiji Islands. Institute of Pacific Faculty of Islands and Oceans University of the South Pacific.

[66] Dayal,et al.2022

[67] Weber, E.2020. Socio-economic aspects of mangive degradation in an urban setting: A Case study of Environmental challenges and health in Suva squatter settlements. University of the Souh Pacific.

[68] Weber, E.2020. ibid.

[69] Veitayaki, 2017.Ibid.

BIBLIOGRAPHY

Arpina, S (2011). A study of the relationship between ecosystem services and human well-being in the coastal villages of the Kubulau District in Vanua Levu, FIJI. Masters Thesis, Marine Studies, University of the South Pacific, Suva.

Avtar,R;Navia,Miliana; Sassen,J; Fuji,M. 2021. Impacts of climate change in mangrove ecosysems in Ba and Rewa deltas, Fiji using multi-temporal Landstat data and social survey. Coastal Engineering Journal, Vol 63, issue 3.

Basily,N.M and Vuki, V. 2014. Traditional fishing methods and traditional fisheries management in Gao District, Santa Isabel Island, Solomon Islands. In SPC, Women in Fisheries Bulletin. Vol 24.

Boyle, M. (2017, September 2). Sustainable development needed in Mahogany Industry: Prime Minister. Retrieved from http://www.fbc.com.fj/fiji/54075/sustainable-developmentneeded-in-mahogany-industry-pm

Bryant-Tokalau, J. 2018. Indigenous Pacific approaches to Climate Change, University of Otago
Aalbersberg, W., Thaman, B., Sauni, L., and Power, M. (2003). Proceedings of the Pacific Regional Workshop on Mangrove Wetlands, Protection and Sustainable Use. South Pacific Regional Environment Program, Apia, Western Samoa.

Conservation International, 2020.Selecting Blue Carbon Sites in Fiji, Conservation International.

Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research.

DoF. (2015). Annual Report, Parliamentary Paper #19. Suva, Fiji: Government of Fiji / Department of Forestry. Ellison, J. C., (1999a). Present status of Pacific Island mangroves. In Marine/ Coastal Biodiversity in the Tropical Island Pacific Region: Volume II. Population, Development and Conservation Priorities, Eds L. G. Eldredge, J. E. Maragos and P. L. Holthus, Pacific Science Association/ East West Center, Honolulu. P. 3-19.

Ellison, J.C. (2003b). Mangrove assessment and monitoring methodologies. In Proceedings of the Pacific Regional Workshop on Mangrove Wetlands, Protection and Sustainable Use. South Pacific Regional Environment Program, Apia, Western Samoa, pp 105-118.

Foale,S 2006. The Intersection of scientific and indigenous ecological knowledge in coastal Melanesia. implications for comtemporary marine resources management. In Int. Soc. Sci.J 129-137.

GoF. (2017b). The Fiji National REDD+ Programme. Suva, Fiji: Government of Fiji / Ministry of Fisheries and Forests. Retrieved from http://fiji-reddplus.org/fiji-national-reddprogramme.

IUCN, 2013. MangroveWatch Assessment of Shoreline Mangroves in Fiji. A report for MESCAL Project, IUCN, Oceania.

Jaffar, M. 1992. Country Report on Mangrove ecosystem in the republic of Fiji. Proceedings Seminar and Workshop on integrated research on man- grove ecosytems in Pacific islands region II. ed. In T. Nakamura. Tokyo: Japan International Association for Mangroves.

Kitolelei,S;Thaman,R; Veitayaki,J; Breckwoldt,A; Piavano,S. 2021. Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. Frontiers in Marine Science.

Lal, P. N. (1990a). Ecological economic analysis of mangrove conservation: a case study from Fiji. Mangrove Ecosystems Occasional Papers No. 6. UNDP/UNESCO Regional Project for Research and its Application to

the Management of the Mangroves of Asia and the Pacific (RAS/86/120). Lal, P.N. (1990b). Conservation of conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Center, Occasional Paper 11.

MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

Nainoca, W. 2011. The influence of the Fijian Way of Life. A thesis Presented in requirements for the Degree of Philosophy. Massey University.

Pearson,J;McNamara,K;Nunn,P. 2019. Gender-specific perspectives of mangrove ecosystem services: Case study from Bua Province, Fiji Islands.

Pillai, G. (1985). Mangrove of Fiji their uses and management. In Field C. D., and Dartnall, A. J., eds., Mangrove Ecosystems of Asia and the Pacific, pp. 150-160. Australian Institute of Marine Science, Townsville.

Pollard EM,Thaman R, Brodie G, and Morrison C. 2015. "Threatened Biodiversity and Traditional Ecological Knowledge: Associated Beliefs, Customs and Uses of Herpetofauna among the AreAre on Malaita Island, Solomon Islands." Ethnobiology Letters, 6(1): 99-110

Rosazlin Abdullah and others "Community Knowledge, Attitude, and Practice towards Importance and Sustainability of Mangrove Forests: A Case Study of Kuala Langat, Malaysia" (2021) 05 International Journal of Research and Innovation in Social Science 222.

Rotich, B; Mwangi, E; Larry, S, 2016 WHERE LAND MEETS THE SEA A GLOBAL REVIEW OF THE GOVERNANCE AND TENURE DIMENSIONS OF COASTAL MANGROVE FORESTS.
State Land Act 1949 (Cap 132).

Tawake, A; Jupiter,S; Waqairagata, F; Clements,C; Vave, R. Rhe Effectiveess of Locally Managed Maine areas in Fiji. University of the South Pacific.

Thaman, B. and Naikatini, A. (2003). Report on the mangrove flora and fauna surveys conducted within Lomaiwai Reserve, Bole Reserve, Tikina Wai, Nadroga. Report produced by the IAS, USP for WWF?

Thaman, B, (1998). The importance of mangrove resources to rural and urban Fijian Villages: Cases studies of Daku, Nadoria, and Sawa Villages and Kinoya and Tamavua-I-Wai peri-urban settlements, Fiji Islands. Unpublished M.Sc. thesis. James Cook University, Townsville.

Thaman, 2000. Traditional Environmental Knowledge and community-based Conservation in Fiji. Current Status and priorities for its protection and utilization. USP Geography Working Papers. USP, Suva.

Thaman, R; Balawa,A and Fong,S. 2008. I Lava ni Navakavu. Fin Fishes of the Vanua Navakavu, Viti Levu, Fiji Islands. Institute of Pacific Faculty of Islands and Oceans University of the South Pacific.

Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails:indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M. 'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji.

Thaman, R., Lyver, P., Mpande, R., Perez, E., Carino, J., and Takeuchi, K. (2013). *The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies With Science*. Paris: UNESCO/UNU.

Thaman, B; Thaman,R; Balawa,A and Veitayaki, J.2017. The recovery of a tropical marine mollusk fishery. A transdisciplinary ommunity-based approachIn Navakavu, Fiji.J.Ethnobiol. 37:494.

Thomas, A.and Waqairatu, S. 2021. Why they must be counted. Signifucant contribution of Fijian Women Fishers to Food securityand livelihoods. Ocean and Coastal Management. Volume 265
USP, (2021). Proceedings of the Pacific Regional Workshop on mangrove wetlands protection and sustainable use. The University of the South Pacific, Marine Studies. Suva. June 12-16, 2001.

Vierros M, Tawake A, Hickey F, Tiraa A, and Noa R. 2010. Traditional marine management areas of the Pacific in the context of national and international law and policy. UNU-IAS

Veitayaki, 2002.Taking advantage of indigenious knowlwdge, the case of Fiji. Int.Soc. Sci. JJ54, 395-402.

Veitayaki, 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies:linking local knowledge to science.University of the South Pacific.

Veitayaki, 2008. Fisheries Resource Use culture in Fiji and its implications. In Culture and Sustainable Development in the Pacificeds. Hooper(Canberra, ANU Press)

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. Participatory Mangrove Management in a Changing Climate: Perspectives from the Asia-Pacific, 303-327.

Watling, 2013.Mangrove Management Plan for Fiji- Prepared for the National Mangrve Committee. MESCAL
WWF, (2020). How four communities value and protect their mangroves.

WCS, 2020. The Critical Contribution of Women Fishers to Food Security, WCS..

ANNEX V:

CULTURE, GENDER, AND TRADITIONAL INFLUENCES ON MANGROVE USE, DEFORESTATION, AND DEGRADATION

Aliti Vunisea
Conservation International
2023

Table of Contents

Page No

ACRONYMS

CBD	National Convention on Biodiversity
DFAT	Australian Government, Department of Foreign Affairs and Trade
DoDD	Drivers of deforestation and degradation
EIA	Environment Impact Assessment
FLMMA	Fiji Locally Managed Marine Area Network
FPIC	Free Prior and Informed Consent
GHG	Greenhouse gas
MoWE	Ministry of Waterways and Environment
MoF	Ministry of Forestry
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
PLA	Participatory Learning Activities
PRA	Participatory Rural Appraisals
REDD	Reducing emissions from deforestation and forest degradation
REDD+	REDD "plus" forest conservation, sustainable management of forests, and the enhancement of forest carbon stocks
TC	Tropical Cyclone
ToC	Theory of Change
UN	United Nations
UNDRIP	United Nations Declaration on the Rights of Indigenous People
UNFCCC	United Nations Framework Convention on Climate Change
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

This report is the result of the cultural, gender consideration included in the socio-economic work conducted in the mangrove areas of Ba, Rewa, Tailevu, and Ra. The fieldwork included visits to selected sites from different districts in the Rewa/Tailevu mangrove areas, Ba Delta, and Ra. A team comprising Department of Forestry representatives, the Provincial office, volunteers from WWF who acted as field enumerators and Conservation International staff conducted the work over a period of 6-8 weeks in communities.

Dependence on mangrove by coastal communities in Fiji for traditional sources of livelihoods is still very high. This is because communities in delta areas where most of these mangroves are found are mostly inaccessible and far from urban centres, thus communities have few alternatives for timber, firewood, and sources of cultural, social, and economic livelihoods. From discussions with communities, it was evident that there has not been much development in the Rewa/Taileu mangrove areas and the Ra mangrove areas. However, in the Ba District, dredging and sand mining in the Votua district were identified by communities as having significant impacts on mangrove areas and fisheries resources.

There is high dependence on mangrove areas for subsistence and economic livelihoods across all study areas, with all households identifying continued traditional uses of mangroves for fishing, firewood, and house building. Other uses, like the making of garlands, the use of mangrove bark for dye making, and use of mangroves for fishing activities, are still being practised.

Dual governance over foreshore areas, between traditional community rights and formal legal rights of the state, complicates the rights to fishing and resource uses, with the rights of the state to all areas up to the high-water mark. People only hold use rights, thus clear strategies on protecting and sustaining mangroves areas while also protecting user rights is important. Because of the broad rights to marine resources, *iqoliqoli* rights, users that have rights are widespread; this can be an underlying cause of the main drivers of mangrove deforestation, including illegal logging, illegal fishing, and use of unsustainable fishing methods.

Men and women have different uses of mangroves and cultural practices. Beliefs define gender roles and determine women and men's practical engagement in fishing, firewood collection, and other mangrove activities. Women remain the dominant fishers within and around mangrove areas, using traditional fishing methods of gleaning and using of small nets and fishing lines to catch shrimps and fish within mangrove estuarine locations and around mangrove areas. Men are dominantly engaged in mangrove cutting for building houses and cutting of mangroves for firewood.

There are a few direct mangrove management interventions in place. Traditional management practices, such as taboos, are usually temporary, put in place after the death of a chief or when there is evidence of overfishing.

After the COVID-19 pandemic, there had been increased reliance on mangrove resources for settlement (people moving into informal settlements) around urban and peri-urban areas and for subsistence and economic livelihoods.

Deforestation and degradation of mangrove systems are underpinned by unsustainable use, climate change, and lack of a dedicated policy framework and mangroves around urban areas are particularly at risk from unsustainable harvesting, overexploitation, pollution, waste disposal, dredging, and development such as housing, industry, and infrastructure for tourism. When mangroves are converted to other uses, traditional fishing rights owners receive compensation for loss of fishing access and rights; however, this is generally a perverse incentive, as communities receive massive one-time payments when mangroves are destroyed, leading some to destroy mangroves themselves or allow others to do so[1].

Drivers to deforestation and degradation are also highly influenced by traditional ways of harvesting, traditional practices and reliance on mangroves for primary livelihoods sources.

Traditional and cultural norms and nuances impact on women's roles in mangrove use and management. Although they are everyday users of mangrove resources, they are not usually opart of decision making processes in communities. Gendere roles in mangrove use and protection need to be included in mangrove interventions on development nd management.

1 MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

Women as daily foragers and fishers within mangrove areas have a wealth of kn owlwdge and skills that could be capitaluized on when introducing interventions to protect and manage mangroves.
Underlying causes of deforestation is influenced by traditional user rights, the communal qolioli system and traditional ways of management of resources. Multiple government agencies working within mangrove areas with different mandates, also complicate existing understanding of user rights and mandates and responsibilities over resources.

With the increasing loss of traditional knowledge and skills and the new emerging challenges like shifting of settlements into mangrove areas within urban areas, the loss of traditional sites and practices, existing traditional knowledge needs to be documented and used with scientific and more morden ways of management and mangrove protection.

Sustainable and planned extension of settlements in mangrove areas, moving away from the use of mangroves as waste disposal areas should be addressed in any management intervention and awareness work introduced to mangroves communities.

Traditional institutions and structures and existing community groups are important pathways for ensuring awareness, protection and sustainable use of respources and these need to be capitalised on when working on management interventions.

Signifinatly impacting on mangrove degradation and deforestation is the high reliance of coastal communities on mangroves for subsistence and income generating needs. With limited alternatives available at the community level, there is need to look outside of the existing community resources for alternatives that could provide for subsistence and economic needs.

1. INTRODUCTION

This socio-cultural and gender report is based on findings from the socio-economic consultations carried out in the Mangrove areas of Ba, Rewa, Tailevu, and Ra. The fieldwork included visits to selected sites from different districts in the Rewa/Tailevu mangrove areas, Ba Delta and Ra Provinces. A team comprising Conservation International Staff, Ministry of Forestry Representatives, the Provincial office representatives, volunteers from WWF who were field enumerators and conducted the work over a period of 6-8 weeks in selected communities.

This report include the result of participatory discussions from the PLA/PRA exercises that were carried out, key-people interviews, and some household interviews conducted in the communities in the Ra Province. Tools used key people interviews, participatory tools used in focus group discussions, and household questionnaires. A one-day district consultation was conducted in Suva to triangulate information collected from the fieldwork.

Tools used included household questions conducted at random in Ra, key people interviews and Participatory tools used in focus group discussions. A one- day district consultation was conducted in Suva, and this was mostly to triangulate information collected from the fieldwork.

Gender Consideration
Women and men in coastal communities are often closely connected to their coastal ecosystems and gender roles are often traditionally identified and clearly divided. Women and men differ in how they interact and depend upon mangroves – how they use the ecosystem, which mangrove products they choose, and the benefits they receive. For coastal and rural communities throughout Fiji, it is therefore common for women to be the main caretakers of mangroves, as they access and utilise mangrove resources on a regular basis.

A study conducted in six rural villages within the Bua Province, Fiji highlighted how gender roles influenced the ways people value and interact with local ecosystems. This paper concluded with a call to incorporate gender into ecosystem-service valuation and management interventions so that they can produce sustainable and equitable livelihood outcomes[2].

1.1 Purpose of the Consultations

- To collect information on Mangrove deforestation and degradation.
- Collection of sex disaggregated data on resource use, livelihood sources dependent on mangroves.
- Identify the different uses and users of mangroves in the 3 target sites- Ba Delta, Rewa Delta and Ra.
- Establish socio economic factors affecting mangroves in the three sites.

1.2 Target Sites

Fieldwork Target Areas

Province	Communities
Rewa	Naivilaca, Narocake, Matanimoli, Nasilai, Muanaicake, Muanaira, Laucala,Kinoya Koro
Tailevu	Dravo, Daku, Naivakacau, Natila, Waicoka
Ba	Namoli, Sasa, Sorokoba,Votua, Natutu, Tavualevu, Natanuku
Ra	Nanukuloa,Nareseilagi, Barotu, Matawailevu, Navuniivi

1.3 Approach and Study Methodology

Literature review
A literature review of reports on mangrove use in Fiji was conducted. The desk review looked at reports on mangroves in Fiji and in the three target areas, work that has been done in mangrove areas and historical changes to mangroves in the three target provinces.

[2] Pearson,J; MacNamara,K.E; Nunn,P. 2019. Gender-specific perspectives of mangrove ecosystem services: Case study from Bua Province, Fiji Islands. Ecosystem Services, Vol.38.

Stakeholder Engagement

For all work at the community level, Conservation International went through the Provincial Offices following the required protocol in working with communities. The Provincial offices in Ba, Ra, Tailevu, and Rewa, then contacted the targeted villages to prepare the communities for the consultations. Representatives from the Provincial Offices also accompanied the team on fieldwork in the three target sites. The one-day workshop held at the end of the fieldwork also included representatives of the Provincial offices, and district representatives. Community Engagement at all levels, which included household level, Participatory discussions with different groups in communities and engagement of the Provincial Council office and provincial and Tikina representatives, also ensured that the Free, prior and informed consent (FPIC) of people living or those who accessed mangrove areas for their livelihoods were also ensured through these different approaches used. The use of PRA, key people interviews, group discussions were to ensure that communities demonstrated free and informed consent in a decision-making process, particularly when addressing mangrove e deforestation, degradation and management interventions.

Gender Inclusive Approaches

The community consultations used different tools to enable the meaningful participation of men, women, youth, and other vulnerable members of the communities. In traditional settings, culture dictated the participation of women in larger community forums, and women could not just speak if they were in the presence of chiefs, elders. Thus, participatory tools were used to enable the full participation of women and other members of the community. Care was also taken that consultations were held when women could attend focus group discussions and other group meetings.

In the communities where the study was carried out there were also the designation or traditional roles of the different clans in the mataqali. These included the chiefly clan, the traditional speakers, the traditional carpenters, fishers, and warriors. Understanding these different roles also helped in understanding how people used resources and accessed resources.

Key People Interviews

Key people interviews were held with men, women, youth leaders at the community level. This included the Turaga ni Koro, Mataqali leaders, chiefs or elders, leaders of Women and youth groups and fishers or those that use mangrove resources.

Household Questionnaires

Household interviews were held randomly in communities. A group of the WWF volunteers assisted in carrying out Household surveys. Households were randomly chosen, and interviews conducted to one of the household members in their homes.

Stakeholder Mapping

A stakeholder mapping exercise was carried out to identify Government agencies, NGOs, FBOs, CSOs, the Private Sector and community groups that used or relied on mangrove for the livelihoods, partners that work on development or management in mangrove areas and Government Agencies that work in mangrove and coastal areas. The Stakeholder mapping was also important in identifying any development work that had taken place in the different communities, as they were asked on what development or management work on mangroves had taken place in the last 10 years, and who had supported or funded the work. This was to help in identifying what types of development had taken place, who had funded developments or management and what the impacts of these work had been.

Figure 1: Stakeholder mapping

Resource Mapping
To identify what resources/mangrove resources are present in the tikina and identify changes over the last 10 years. There are many variations of this activity. Maps that can show what the area was like 10 years before and what changes can be seen today- in terms of mangrove areas.
Discussions on resource mapping included:

- Identifying main subsistence and commercial resources-which of these are related to mangroves
- Selling outlets, markets
- Main mangroves areas (areas remaining) and changes to mangroves
- Causes of loss of mangroves
- Species ranking- for both subsistence and commercial

Problem identification:

- After groups had presented their social maps, a discussion on the drivers of mangrove removal, degradation was conducted.

Problem-Solution Tree- identification of root causes/underlying causes
In this activity, people identify the main causes of mangrove removal; through discussions, causes of the main causes are discussed and root causes are isolated. The impacts and multiplier effects of problems are then also identified, by tracing what happens after various activities. This helps people see problems constructively, and by tracing causes and impacts they can put other community problems into perspective.

- Finding the Root cause of problems

Problems	Root Causes	Solutions
Mangrove logging	House construction-lack of income	Awareness work and capacity building on villages and at tikina level
Removing bark for dye	Income needs	Leadership training to be done

In this exercise the problem-solution tree is used to identify indirect causes of mangrove loss and mangrove degradation Because it is in the shape of the tree, it is explained that for everything that happens at the trunk there is a root cause and every cause is rooted in some other factors. This session further analysed information from the problem analysis exercise.

2. LITERATURE REVIEW

Fiji is home to the third most abundant stands of mangroves in the Pacific Island region; however, while estimated at nearly 38,000 ha in 2010, this extent is decreasing[13]

. The coastal area and wetland reclamation have caused significant loss of mangrove areas and littoral forest, especially around heavily industrialized areas, towns, and cities[4]. Where human habitation is close to, or within, the forests, over exploitation of mangrove resources can be evident on a local scale, with degradation occurring due to over harvesting of timber, the presence of non-native or non-mangrove plant species, dumping of domestic waste, and large amounts of plastic waste deposited along river channels and by tides[5]

Fiji is also a signatory of many multilateral environmental agreements, for which mangroves play a key role, including the CBD, UNFCCC and the Kyoto Protocol, United Nations (UN) Convention to Combat Desertification, Convention on International Trade in Endangered Species, the Ramsar Convention on Wetlands, the World Heritage Convention, UN Convention on the Law of the Sea, and International Convention for the Prevention of Pollution from Ships[6]. Mangroves are also included in Fiji's REDD+ policy

[3] MESCAL, 2013.
[4] Country Partnership Strategy: Fiji, 2014–2018).
[5] Cameron, C; Maharaj,A; Kennedy, B;Tuiwawa,S; Goldwater,N' Soapi,K; Lovelock, c. 2021.Landcover Change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. In Environmental Challenges, Volume 2.
[6] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

as well as in the adaptation portion of Fiji's Intended Nationally Determined Contribution[7,8]

Locally Managed Marine Areas (LMMAs) in Fiji are set up using the traditional knowledge of fishers merged with modern science to better manage the fisheries resources at the grassroots level. Under LMMA program, a portion of the fishing grounds is usually set aside as a no-fishing zone to safeguard the future sustainability of fisheries resources[9].

Today, the Fijian network is made up of over 400 LMMAs, which not only focus on management but also on raising awareness, informing policies, and sharing information at the national and international levels [10] . In recent years, there has been an increase in socio-economic management of mangroves that incorporate both traditional and scientific knowledge and recognizing the needs of local inhabitants in addition to implementing a biodiversity conservation agenda[11,12]. In Fiji, native communities possess in-depth knowledge of coastal fisheries that provide baseline data for monitoring the effects of environmental degradation and efficacy of conservation initiatives.[13]

By understanding the inter-relatedness of local expertise, customary marine management, traditional knowledge, and practice as well as the roles of leaders and institutions, local knowledge practice belief systems can be used to inform adaptation to disasters. [14]. Veitayaki[15] highlighted that the contribution of traditional knowledge to ecosystem management and practices in Fiji is important in ensuring sustainable management strategies.

A social survey of the Ba and Rewa delta in 2020 revealed that 45% of respondents in the Ba delta and 20% in the Rewa delta visited the mangrove area daily in search of food sources[16] While commercial harvesting activities conducted by communities require a license, small-scale subsistence harvesting is not generally monitored by the state. In addition, other activities conducted by communities and adjacent settlements include gathering of mangrove wood for funerals (as fuel during cremations), and collection of mangrove bark to produce a red dye used for handicrafts from the coloured mangrove sap[17]

Over 60% of Fiji's commercially important fish and 83% of subsistence fish species depend on mangrove areas for some phase of their life cycle[18].

Apart from harvesting the mangrove trees themselves, villagers also pick or collect non-timber forest products from the mixed mangrove-associated vegetation, such as *Inocarpus fagifer* ("ivi"), coconuts, *Barringtonia edulis* ("vutu") and *Pometia pinnata* ("dawa"), during their respective fruiting seasons. These products can be sold in markets for additional income. Pandanus leaves are processed and woven into mats and fans for cultural purposes (such as weddings and funerals) and generate additional income[19]. In addition, all households in Nasilai but one in Vadrai, Rewa indicated that they collected marine species such as fish and crabs and harvesting was mainly performed on a weekly basis. The Vadrai households and around half of the Nasilai households stated that they sell these marine products to supplement their

[7] GoF. (2017b). The Fiji National REDD+ Programme. Suva, Fiji: Government of Fiji / Ministry of Fisheries and Forests. Retrieved from http://fiji-reddplus.org/fiji-national-reddprogramme

[8] Watling, 2013.Mangrove Management Plan for Fiji- Prepared for the National Mangrve Committee. MESCAL
WWF, (2020). How four communities value and protect their mangroves.

[9] Tawake, A; Jupiter,S; Waqairagata, F; Clements,C; Vave, R. Rhe Effectiveess of Locally Managed Maine areas in Fiji. University of the South Pacific.

[10] Kitoleilei, S; Thaman, R; Veitayaki, J; Breckwoldt, A;Piavano, S. 2021. Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. For Marine Consrvtuon and Sustainability.

[11] Vierros M, Tawake A, Hickey F, Tiraa A, and Noa R. 2010.Traditional marine management areas of the Pacific in the context of national and international law and policy. UNU-IAS
Traditional Knowledge Initiative, Darwin, Australia

[12] Pollard EM,Thaman R, Brodie G, and Morrison C. 2015. "Threatened Biodiversity and Traditional Ecological Knowledge: Associated Beliefs, Customs and Uses of Herpetofauna among the AreAre on Malaita Island, Solomon Islands." Ethnobiology Letters, 6(1): 99-110

[13] Bryant-Tokalau, J. 2018. Indigenous Pacific approaches to Climate Change, University of Otago

[14] Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves,

[15] Veitayaki, 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies: linking local knowledge to science.

[16] Avtar,R;Navia,Miliana; Sassen,J; Fuji,M. 2021. Impacts of climate change in mangrove ecosystems in Ba and Rewa deltas, Fiji using multi-temporal Landstat data and social survey. Coastal Engineering Journal, Vol 63, issue 3.

[17] Conservation International, 2020.Selecting Blue Carbon Sites in Fiji, Conservation International

[18] Lal, P. N. (1990a). Ecological economic analysis of mangrove conservation: a case study from Fiji. Mangrove Ecosystems Occasional Papers No. 6. UNDP/UNESCO Regional Project for Research and its Application to the Management of the Mangroves of Asia and the Pacific (RAS/86/120). Lal, P.N. (1990b). Conservation of conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Center, Occasional Paper 11.

[19] Dayal,S; Waqa-Sakiti, H; Tabe, T; Hodge,S.2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. In Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research

income.[20] Thus from literature reviewed, there is high dependence on mangroves for social and economic livelihoods.

3. THE CONTEXT

Culture & Governance

The Fiji Islands is divided into 14 provinces, comprised of 189 districts (*tikina*), comprised of 1169 villages. Approximately 88% of land in Fiji is communally owned by indigenous people under customary ownership through the iTaukei Land Trust Board (TLTB), 8% is private freehold land, and 4% is state land. The land that is communally owned by indigenous Fijians is administered by the TLTB in a statutory trust. At least 60% of registered living members of the clan (*mataqali*) under the official register of native landowners (*Vola ni Kawa Bula*) must come to consensus to approve any commercial development on their land; however, they have privilege of access and use for subsistence purposes. Under these mataqali ownership, women and men have equal control and access to land, however, decision making on the use of men, almost always rests with men.

Decision making mechanism at the community level

Understanding the traditional administrative system of decision-making at the village and district level and how this links to government administrative structure is important when trying to identify and address traditional uses of mangrove and causes of deforestation and degradation.

The traditional structure is based on understandings of and relationships within the "*vanua*", which may also be understood as structures which serve to maintain the integrity and harmony of the community. The authority of chiefs remains relatively intact in contemporary Fiji, with governance rooted in a deep historical and empirical knowledge of the use of mangrove forests; however, in some cases, chiefs have assumed a more advisory or ritualistic role.[21], Decision making at the community level, both at the vanua level, where mataqali heads make decisions and general community decision making, men are usually part of the decision making processes. In some communities, women also are part of decision making.

Control and Access to Land

Within the indigenous communities, ownership, and access to land among other resources are determined by an individual's relation to a mataqali, or a clan. There are different clan designations, there are the chiefly tribes (Turaga), the traditionally priestly class (Bete), warriors (Bati), the fisher's tribe (gonedau) and the carpenter tribe (mataisau). Each village also have the Liuliu ni Yavusa who is of chiefly status and the chief (Turaga) who with the clan leaders (Liuliu ni mataqali) form the bose vanua the traditional decision-making body for each village. Understanding the ethnical composure and hierarchies among them is important, especially in the context of resource use and management as they will invariably have an effect on the social cohesion and community response. All mataqali members including women have equal access to land.

Despite the still predominant influence of traditional institutions at community level, underlying causes of mangrove degradation has been largely influenced by the shift from a subsistence-based economy to a commercial-based (market-driven) economy. With this shift comes population growth, social changes, and the exploitation of natural resources for commercial purposes. In addition, new needs, aspirations and wants are also being created[22,23].

[20] Dayal,S; Waqa-Sakiti, H; Tabe, T; Hodge,S.2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. In Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research

[21] Cooke, A, and Kolinio M. "Current Trends in the Management of Qoliqoli in Fiji." Traditional Marine Resource Management and Knowledge

[22] USP, 2001. Proceedings of the Pacific Regional Workshop on Mangrove Wetlands Protection and Sustainable Use. The University of the South Pacific, Maine Studies Facility.Suva.

[23] Ruddle, Kenneth. "A Guide to the Literature on Traditional Community based Fishery Management in Fiji." Traditional Marine Resource Management and Knowledge Information Bulletin 5 (1995): 7-15. Print

4. THE STUDY SITES

Mangrove sites targeted under this study are the Rewa, Tailevu, Ba and Ra mangrove areas.

Table 1: Study sites

Project Sites	Province	Communities
Ba Delta	Ba	Namoli, Sasa, Sorokoba, Votua, Natutu, Tavualevu, Natanuku
Rewa Delta	Rewa	Naivilaca, Narocake, Matanimoli, Nasilai, Muanaicake, Muanaira Laucala, Kinoya
	Tailevu	Dravo, Daku, Naivakacau, Natila, Waicoka
Navitilevu Bay	Ra	Nanukuloa, Nareseilagi, Barotu Matawailevu, Navuniivi

In the Rewa Delta and as is the case in the Ba Delta, communities have easy access to schools and medical facilities. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centres and community dispensaries are accessible to all communities. Except for Kinoya, which is an urban settlement located in the Suva peri-urban area, the rest of the communities are primarily under traditional governance with traditional or customary laws influencing use of resources and gender differences in decision making, and roles defining fishing activities and gendered mangrove use.

Ra communities have easy access to schools and medical facilities. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centres and community dispensaries are accessible to all communities.

In the Ba communities, they have easy access to schools but there is need for Health dispensaries to be set up for those far from hospitals. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centres and community dispensaries are accessible to all communities.

4.1 Complex Governance Structure

Dual ownership/user rights

The complex governance structure due to the dual systems of traditional tenure and westernized state ownership means that while the state legally owns foreshore lands – where most mangroves grow – iTaukei coastal communities retain unalienable customary rights to the use of living resources in these areas[24] This has historically been a beneficial arrangement for both parties, with the state's unofficial reliance on traditional communities as unpaid stewards resulting in their largely sustainable use for thousands of years[25] However, given the changing socio-economic system for and increasing pressure on many rural communities, new initiatives will need to recognize and reward communities as major stewards of mangroves, as opposed to depending upon communities to protect mangroves out of tradition and self-interest alone[26]

Multiple Government Department Mandates

Multiple agencies deal with mangroves, including: the Department of Lands, which is responsible for foreshore land and reclamation, however inadequately equipped to facilitate on the ground management activities; the Ministry of Forest (MoF), which is responsible for issuing and regulating commercial harvesting licenses for the use of mangrove but with reduced capacity to monitor activities; the Ministry of Fisheries, which is responsible for issuing and regulating licenses to fish; and the Department of Environment, which is responsible for protecting mangroves and associated biodiversity, providing considerable management responsibility but limited capacity for enforcement or implementation.

[24] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.
[25] Watling, 2013.Mangrove Management Plan for Fiji- Prepared for the National Mangrve Committee. MESCAL
WWF, (2020). How four communities value and protect their mangroves.
[26] Ibid, Watling, 2013.

Communal Ownership and Rights to Compensation

Traditional clans, or mataqalis, in Fiji communally 'own' a vanua, which includes the physical resources and the environment, and the boundaries of the qoliqolis or fishing right areas does not distinguish between the terrestrial and aquatic components. During a brief period in the early 1980s, the rate of reclamation was reduced considerably once the government partially accepted traditional claims over the coastal (area between spring high water mark and the seaward limits of fringing reefs) resources, just as the nature of the indigenous ownership of the land was undisputed. While the state still declared itself as the rightful owners, mataqali members were seen as custodians. With this recognition came large claims from mataqali members about the value of the expected loss of fisheries resources and their source of livelihood as a result of the proposed mangrove reclamation by the government.

However, this recognition of indigenous rights did not last very long, and the government changed its position and the exact nature of the mataqali rights remains confused. Traditional clans are recognized communal owners of the coastal areas, but the government also declared that these rights were *usus fructus* only and were not recompensable. Such an ambiguity affected the entitlements the mataqalis could claim. The traditional owners could not adequately exercise their 'ownership' rights and demand adequate compensation for the loss of mangroves due to reclamation or waste disposal, with mataqali's receiving compensations in orders of magnitude lower than what could be legitimately claimed for at least direct goods lost through reclamation. This would have encouraged owners of the mangroves to demand compensation for the value of the opportunity cost of development. On the other hand, the users of mangroves would be made to fully consider the true costs of resource use, giving then incentives to use the resources efficiently[27].

In addition, within mangrove areas, there are existing cultural and traditional sites that lie buried within the forests and swamps of surveyed deltas. These can be centuries-old sites with histories often documented and stored in the Fiji Museum or in the oracles of tradition spoken amongst villagers and community members. Sites can be identified as old house mounds, ancestral burial grounds, or old village sites, including taboo sites that often are left alone out of reverence and enforced with traditional management structures as by-laws within community settings

There has however, been many changes to traditional and cultural sites and uses and this had been attributed to changing dynamics at community level, people migrating, extension of village boundaries and continuing use of mangroves for firewood and other uses. Building of roads, irrigation systems and other infrastructure has changed cultural sites and also uses.

4.2 Land And Marine Ownership and Access

Within the indigenous communities, ownership and access to land among other resources are determined by an individual's relation to a mataqali, or a clan, and households are usually able to request an access from the clan[28]. There are differences between men and women control and access to land, and this is based on the patriarchal nature of land inheritance. However, there are regional differences in the mechanism by which the clan hierarchies operate. For example, the access to fishing rights in Solevu is determined by a membership to yavusa (tribes) a larger social unit consisting of number of mataqalis - rather than an individual relation to a Mataqali group[29]. Vanua (land) has an important communal importance which is attached to the hierarchies of yavusa, and further to the branches of mataqali below these tribal groups. Mataqalis have various social ranks, such as chief of villages (Turaga), the traditionally priestly class (Bete) and warriors (Bati).

Understanding the ethnical composure and hierarchies among the different clans is important, especially in the context of disasters and climate, as they will invariably influence the social cohesion and community response and shape the efforts to enhance community resilience terms of gender equality, there are differences within the i-Taukei and Indo-Fijian groups of women, but male-dominated hierarchies are common and prevalent in the society regardless of ethnicity[30]. Commitments for gender equality are not well mainstreamed into institutional structures, planning and budgeting, and despite the fact that the constitution guarantees equality, cultural norms, social environment and the lack of capacity to enforce

[27] Lal, P.2003. Economic valuation of mangroves and decision-making in the Pacific Graduate Studies in Environmental Management and Development, National Centre for Development Studies, Australian National University, Canberra ACT 0200, Australia

[28] Becker, P., 2017. Dark Side of Development: Modernity, Disaster Risk and Sustainable Livelihoods in Two Coastal Communities in Fiji. Sustainability, 9(12)

[29] Ibid, Becker, 2017.

[30] Chattier, P., 2015. Women in the House (of Parliament) in Fiji: What's Gender Got to Do with It?. The Commonwealth Journal of International Affairs, 104(2), pp. 177-188.

legislature obstructs the achievement of gender-equality at the grass-root levels[31]

4.3 iTaukei Village Communities

Fiji has 14 iTaukei provinces (Yasana) and Rotuma. Each of the 14 provinces are governed by a Provincial Council headed by a Roko Tui[32] A province is made up of a group of sub-units called Tikina (akin to district level). The Tikina comprises of several villages. The Tikina and Yasana boundaries were drawn up during the colonial era, largely for administrative purposes. However, most of these clusters are based on traditional socio-political ties. The iTaukei Affairs Board, constituted under the iTaukei Affairs Act (Cap. 120) governs all matters concerning the administration of iTaukei affairs, including iTaukei custom services.

Each village has a headman called the Turaga ni Koro who is the link between Provincial Office and the villagers. However, each village also have the Liuliu ni Yavusa who is of chiefly status, likewise for the Liuliu ni Tikina (Tikina chief) and Liuliu ni Yasana (Provincial chief). Provincial Council meetings are held twice a year. There are also District (Tikina) meetings held within the year. REDD+ consultation and awareness can be part of the agenda for these meetings. In these meetings, men usually represent communities and districts, however, there are differences in some parts of Fiji where there are women village heads and women representatives at district and provincial level meetings.

4.4 Outreach Process

Reaching out to iTaukei villages, the Provincial Council Office headed by the Roko is the one to approach to consult with the purpose, date and time of intended visit. Tikina level meetings are to be arranged through the Roko. The Roko will be responsible for contacting the Tikina representatives who will then contact the village headman (Turaga ni Koro) to set a date and time for consultation with the Tikina and Household questionnaires with villagers.

4.5 Gender Inclusion

Gender defined fishing activities

Women are the dominant fishers of mangroves as they catch crabs, mud lobsters, shrimps, fish and bivalves within the mangrove areas. Women dominantly fish along the inter-tidal zones, mangroves, mud flats and sand flats and hunt for and collect fish, shellfish, crabs, octopus and a wide range of other marine products. Women still use traditional knowledge and skills in most of these fishing activities. Some of these activities are seasonal in nature, while other marine products are collected or fished all year round. Women's catches are basically for home consumption, however there is increased selling of catches to local municipal markets. Men on the other hand concentrate fishing activities in the deeper reef areas and in the open sea. Some help their wives in fishing activities in mangrove areas closer to villages.

In traditional Fijian practices, men were experts in gathering fish from the deeper sea areas while women's specialization was in gleaning from the reefs, mudflats and mangrove areas. In modern Fiji some traditional fishing rites performed by women are still known. This is especially relating to fishing activities where women, or men only can participate. Men's use of mangrove areas on the other hand include mangrove cutting for house posts and firewood, and these harvesting practices of men (less frequent, small scale, selective harvesting of larger trees).

Women non-inclusion in decision-making

As a result of the mostly patriarch decision making in Fiji, women are usually not included in decision making that relate to their fishing activities. In different parts Fiji, women are the largest contributors to subsistence catches, and this is often smaller fish and shellfish.[33] Decision making in most areas, is still dominated by men, especially when setting up taboo areas, fishing restrictions, and protected areas, where fishing is banned or managed in areas where most subsistence resources are caught, commonly by women.[34] The fundamental dependence of community-based management work on traditional systems, institutions and customary practices and norms mean that the institutional barriers that women face in decision making and other areas of public life in communities will continue to exist into the future unless

[31] Vunisea, A., 2016. Entry Points for Gender Participation of women in the fisheries sector of Fiji throws up several challenges, especially in the search for potential entry points for gender integration and positive discrimination, Suva: Women in Fisheries Network

[32] A Roko Tui is the executive officer who looks after the administration and welfare of iTaukei villages and provinces. For example, Roko Tui Cakaudrove means he/she presides over the iTaukei administrative affairs of the Province of Cakaudrove. In the absence of the Roko Tui there is the Senior Assistant Roko Tui (SART) and Assistant Roko Tui (ART). 4 Readiness Preparation Proposal (R-PP) for Fiji, Forest Carbon Partnership Facility, 2009 Pg. 22

[33] Kronen,M and Vunisea,A.2007. Women never hunt but fish. Highlighting equlity for Women in Policy Formulation and strategic planning in the coastal fisheries sector in Pacific island countries. Women in Fishries Bulletin, 17. SPC, Noumea.

[34] Vunisea, A. (2016). "The participation of women in fishing activities in Fiji," in *SPC Women in Fisheries Information Bulletin #27 - December 2016* (Noumea: SPC), 19–28.

steps are taken to identify entry points for women participation in decision making[35].

Culture of Silence

While iTaukei women have considerable autonomy in their daily lives generally in the public arena, there are limitations to these opportunities to actively participate. As a result of this style of decision making and the "culture of silence", where women and children are excluded from decision making, fishing activities of women, children, and the elderly, who usually have access to the nearby shallow fishing areas, are at risk of losing their fishing knowledge and location[36].

Gender issues considered while undertaking consultations:

- Women and men do not have equal voice and decision-making powers in rural institutions and organizations, however, there are exceptions where there are women chiefs or matrilineal land ownership.
- Women and men do not have equal rights, access to and control over natural and productive resources, to contribute to and benefit from sustainable rural development. Women have equal access to land and qoliqoli areas, however, the decision making processes are effectively dominated by men.
- Women and men do not have equal rights and access to services, markets and decent work and do not have equal control over the resulting income and benefits. Women are largely disadvantaged through access to credit, control of transportation, their large participation in the informal sector, thus lesser engagement in formal decent work.
- Women are more regular fishers of mangrove resources than men in most cases and have a wealth of knowledge and skills related to mangroves- yet not included in decision making and management discussions.

Gender - a missing element in mangrove management

Within the devolution of tenure rights in mangrove work to local communities, gender equity remains a missing element in mangrove conservation and management. The few available studies have shown that there is gender differentiation in the type of products harvested, there is differences in the economic value of products harvested with women's catches mostly used for home consumption while men's catch is sold.[37,.38.] From fieldwork undertaken, there is increased sales of women catches, and this does not include selling of the surplus only, as species like crabs are targeted solely for selling. In addition to gleaning invertebrates and seaweed, women also catch over 100 species of fish[39]. The role of women in mangrove utilization and management is seldom recognized, and their representation in decision-making bodies is minimal. However, community-based rehabilitation or income generation programs are increasingly integrating gender-based considerations and some are focused solely on empowering women[40]. Thus, gender should be considered and incorporated into ecosystem-service valuation and management interventions so that they can produce sustainable and equitable livelihood outcomes[41].

4.6 Wealth of Traditional Knowledge and Skills

Although classified as non-scientific, traditional knowledge have been accumulated after centuries of extensive trial and error experiences from which people have learned[42].Because of their long association with mangroves, communities have a wealth of traditional empirical and scientific knowledge on the direct and indirect benefits of the mangrove ecosystem. Awareness of community knowledge and utilization patterns of mangrove ecosystems and their services is integral to conservation and management[43]. The time-tested indigenous fishing knowledge (IFK) of Fiji and the Pacific Islands is seriously threatened due to the commercialization of fishing, breakdown of traditional communal leadership and oral knowledge transmission systems, modern education, and the movement of the younger generations to urban areas for work and/or study [44] [45]. Because of their long association with mangroves, communities have a wealth

[35] Vunisea, A.2014. Engagement of Women in the Fisheries Sector in Fiji. WIFN/SPC, Noumea,
[36] Vunisea, 2016. Women Participation in the Fisheries Sector in Fiji. In WIF Bulletin, SPC, Noumea
[37] Vunisea, 2014, Engagement of Women in the Fisheries Sector in Fiji.WIFN/SPC.
[38] WCS, 2020. The Critical Contribution of Women Fishers to Food Security, WCS..
[39] Thomas, A.and Waqairatu, S. 2021. Why they must be counted. Significant contribution of Fijian Women Fishers to Food security and livelihoods. Ocean and Coastal Management. Volume 265
[40] WCS, 2020. Ibid.
[41] Pearson,J;McNamara,K;Nunn,P. 2019. Gender-specific perspectives of mangrove ecosystem services: Case study from Bua Province, Fiji Islands.
[42] Veitayaki,J. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies:linking local knowledge to science.
[43] Thaman, R., Lyver, P., Mpande, R., Perez, E., Carino, J., and Takeuchi, K. (2013). *The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies With Science*. Paris: UNESCO/UNU.
[44] Veitayaki, J. (2002). Taking advantage of indigenous knowledge: the Fiji case. *Int. Soc. Sci. J.* 54, 395–402. doi: 10.1111/1468-2451.00391.
[45] Kitoleilei, S; Thaman, R:Veitayaki, J; Breckwoldt, A;Piavano, S. 2021. Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the

of traditional empirical and scientific knowledge on the direct and indirect benefits of the mangrove ecosystem. Awareness of community knowledge and utilization patterns of mangrove ecosystems and their services is integral to conservation and management[46].

In a study of ecosystem services in Kubulau Bua, cultural services benefit included services of spiritual and religious value (through the use of yaqona, tabua, mangrove dyes, and mats), benefits of knowledge gained, and the educational importance. Thaman[47] stated that where traditional ethno-biological knowledge exists, in-depth systematic traditional knowledge is usually held by a small number of men and women in the community. This knowledge is being lost rapidly, especially with the loss of mangroves and its functions, and is seriously lacking in the younger generation, urban populations, and among urban-based leaders and policy makers[48].

5. FINDINGS: USES OF MANGROVES

5.1 Land and Marine access

In all Provinces, qoliqolis or marine areas adjacent to communities and land they own, are communally or yavusa owned. All share the i qoliqoli and people do not have to seek permission to fish in the "qoliqoli cokovata" (communal fishing grounds). All the communities interviewed have access to land and qoliqoli. 2 households were leasing or lived on land through a goodwill arrangement with the landowners.

Figure 2: Fishing Ground Access

In the Ra, Rewa Provinces for example, villages along Navitilevu Bay (Toki, Roborobo, Navunibitu, Nasereilagi, Tokio, Rokonoko, Nukuloa, Matawailevu, Navuniivi, Nailawa, Mataveikai - have access to land for farming and have shared access (qoliqoli cokovata) to the qoliqoli or traditional fishing grounds.. Some households in Naunukuloa, Nasereilagi, Rokorojo, Nalawa stated they had no land, and accessed land leased for subsistence use. Those without land maybe those who are not originally from the communities. This is the same for Rewa and Ba where almost all coastal communities share fishing grounds or qoliqoli areas.
Communities in targeted sites have easy access to schools and medical facilities. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centres and community dispensaries are accessible to all communities. Except for Kinoya, Rewa, which is located in the Suva peri-urban area, the rest of the communities are primarily under traditional governance with traditional or customary laws influencing use of resources and gender differences in decision making, and roles defining fishing activities and gendered mangrove use.

Dependence on mangrove by coastal communities for traditional livelihoods, is still very high, and the geographical nature of delta areas where most of these mangroves are found, result in communities having

Pacific. For Marine Consrvtuon and Sustainability.

[46] Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in *Culture and Sustainable Development in the Pacific*, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

[47] Thaman, B., Thaman, R., Balawa, A., and Veitayaki, J. (2017). The recovery of a tropical marine mollusk fishery: a transdisciplinary community-based approach in Navakavu, Fiji. *J. Ethnobiol.* 37:494. doi: 10.2993/0278-0771-37.3.494

[48] Thaman, B., Thaman, R., Balawa, A., and Veitayaki, J. (2017). ibid.

minimal alternatives for timber for firewood and marine resources for food and income source. Traditional uses of mangroves include mangroves for firewood, funerals, weddings, dye for masi, garlands and for traditional medicine. In some areas there are specific uses of mangroves like the use of mangroves to cook food for the paramount traditional chief in Naivilaca in Rewa, the use of mangroves bark for dye to be used by the masi makers of Vatulele, and children's medicine.

In the Ra area, other cultural uses of mangroves include, charcoal made from mangrove species, timber from mangrove, smoked fish using mangroves leaves and stalk, bait fish caught in mangroves area, medicines made from mangrove leaves and bark, masi cloth made using mangrove bark. Many artefacts are made with products from mangroves, e.g. woven baskets, garlands made from bark. Most of these are for household use. In the Ra Province, a traditional cloth made from mangroves is used for weddings and other ceremonies. This is a highly valued cloth and is made to order by village women. The cloth dye (masi) is from mangrove bark and carbon from burnt charcoal[49]

All respondents questioned were familiar with or knew traditional knowledge of marine and land resources and knew their traditional roles, tasks in their communities. Tradition plays a big part in people's lives and customary practices and norms influence how people use or protect resources.

Main users of the mangroves for 100% of target communities was for collection of firewood for domestic use, materials for house building, especially kitchen construction and fence posts, traditional medicine and fisheries resources. Other uses like collection of dye for masi making, making of garlands cutting of mangrove for fishing activities depended on demand. Traditional uses include use of firewood for firewood, for traditional functions like funerals or weddings, dye for masi, garlands and for traditional medicine. Cooking of food by the people of Naivilaca, for traditional chief of Rewa and dye making for the masi makers of Vatulele, and children's medicine are some specific traditional uses of mangroves.

Communities still largely depend on traditional fishing sources for food and income. As in above table (Table 2), the major use of mangroves is cutting of mangroves for firewood and next to that is the use of mangroves for food harvesting. There is very little use of mangrove areas for farming and logging for commercial use. Thus, traditional uses of mangroves continue in coastal communities and will be a direct threat to mangroves given rising costs of living and lack of livelihood alternatives in the delta areas of Viti Levu.

5.2 Main Uses of Mangroves

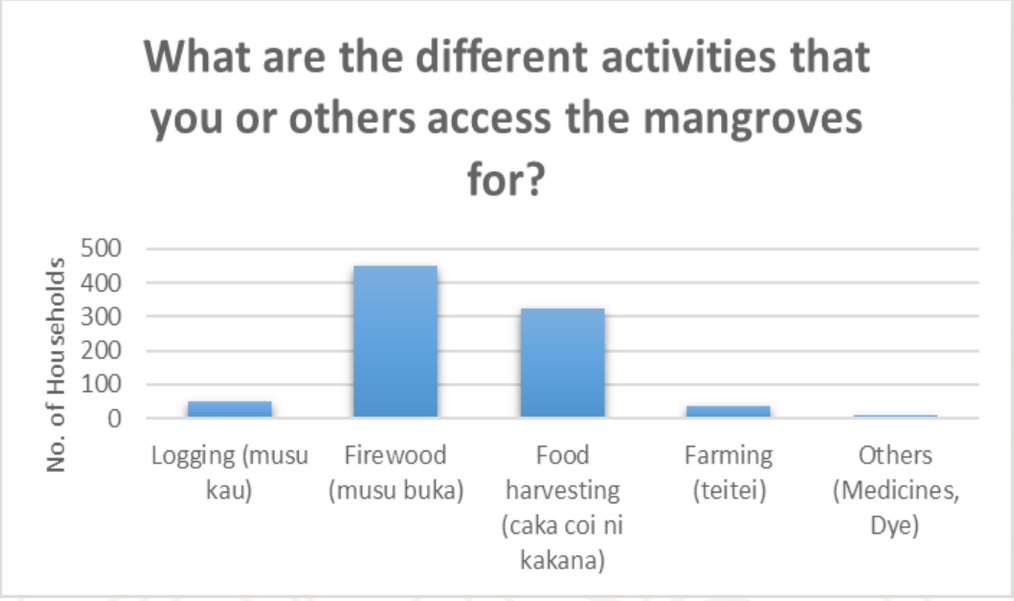


Figure 3: Main uses of mangroves

From Table 3, which looks at products from mangroves, the highest use of mangroves is firewood, followed by building materials, medicine, dye for masi making and commercial use and garlands.

[49] Greenhalgh S, Booth P, Walsh P, Korovulavula I, Copeland L, Tikoibua T. 2018. Mangrove restoration: An overview of the benefits and costs of restoration. Prepared as part of the RESCCUE-SPC Fiji project. University of South Pacific – Institute of Applied Sciences, Suva, Fij

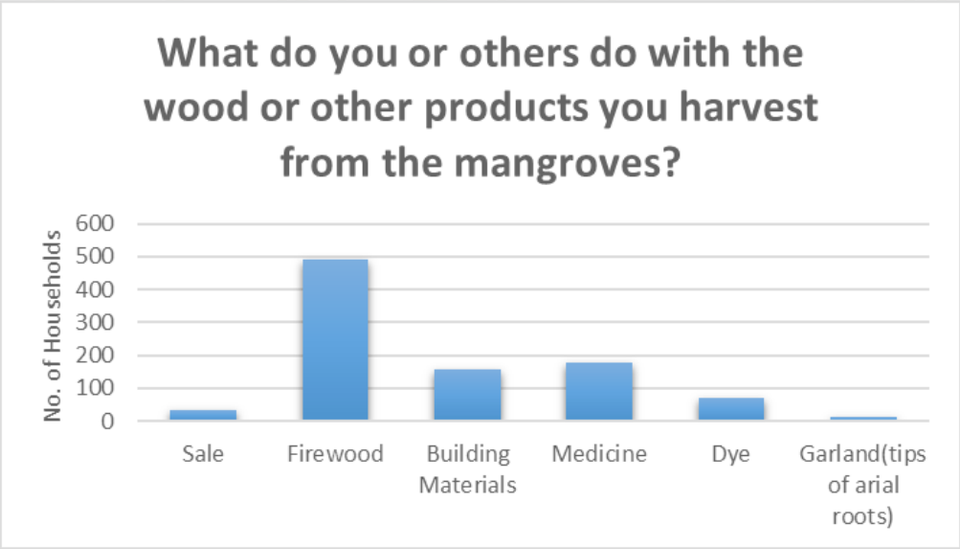


Figure 4: Uses of products from mangrove areas

Fishing Activities

Most fishing activities are in mangrove areas, followed by coral reefs, sand flats, outer reef areas for men and mudflats. Most of the fishing in mangrove areas, coral reefs, sand flats and mudflats are by women who glean and collect shellfish, crabs, octopus, oysters, fish and other species within the immediate coastal area**.** Women dominate fishing in the coastal zone area which include mangroves. Women glean, collect and hunt within the immediate coastal areas, including mangroves and this is for everyday home consumption needs. These activities target mangrove crabs, prawns and shrimps, mangrove lobsters, seashells, seaweed, sandfish and mangrove oysters**.**

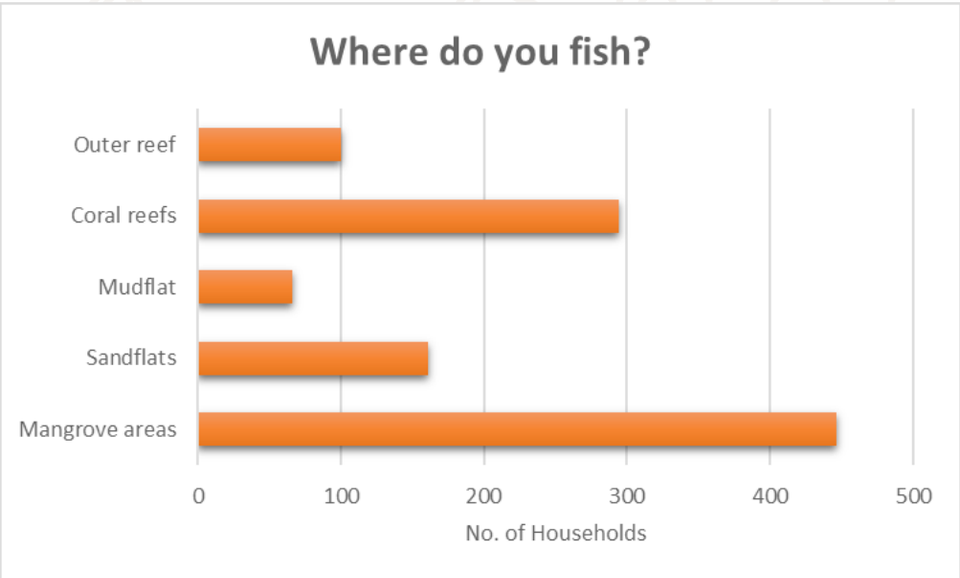


Figure 5: Fishing Areas.

Indigenous fishing practices and technologies used by both women and men reflect an intimate understanding of the aquatic food resources and their environments[50]. This is evident from the various ingenious traditional fishing methods like hand collection or reef gleaning, net fishing, spear fishing, hook and line, group fishing, fish poisoning, trap fishing, specialized targeted-species fishing, and other fishing methods and techniques reported throughout the Pacific, which testifies to the people's in-depth understanding of their natural world and how it works[51].

[50] Veitayaki, 2008. Veitayaki, J. 2008.. "Fisheries resource-use culture in Fiji and its implications," in *Culture and Sustainable Development in the Pacific*, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

[51] Foale,S 2006. The Intersection of scientific and indigenous ecological knowledge in coastal Melanesia.implications for comtemporary marine resources management. In Int. Soc. Sci.J 129-137.

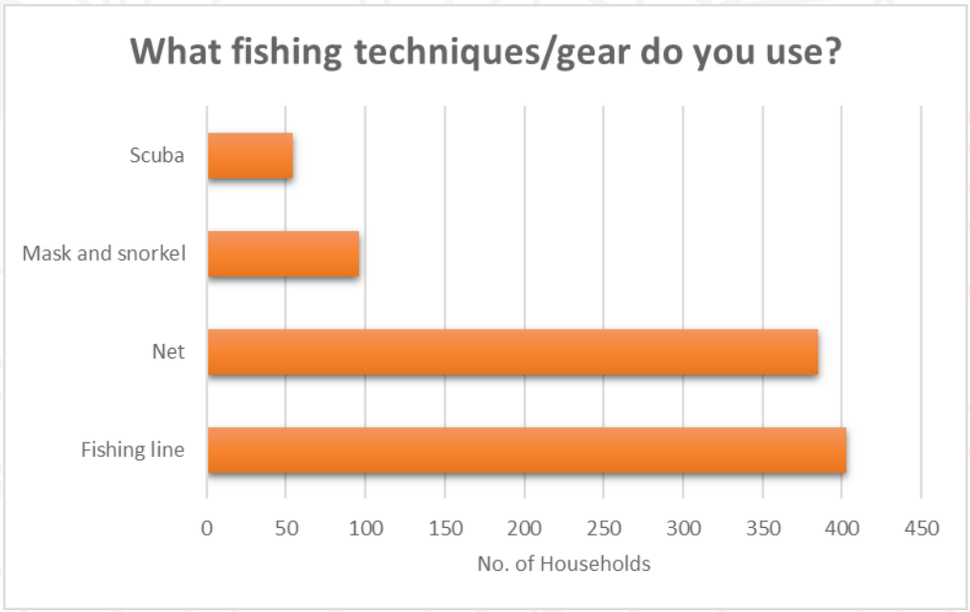


Figure 6: Fishing techniques

Most used fishing techniques are fishing lines, followed by the use of nets (small nets), mask and snorkel and scuba. Women's fishing techniques are still traditional and these include fishing lines, nets, crab traps, use of fish poison and gleaning using sticks or bare hand.

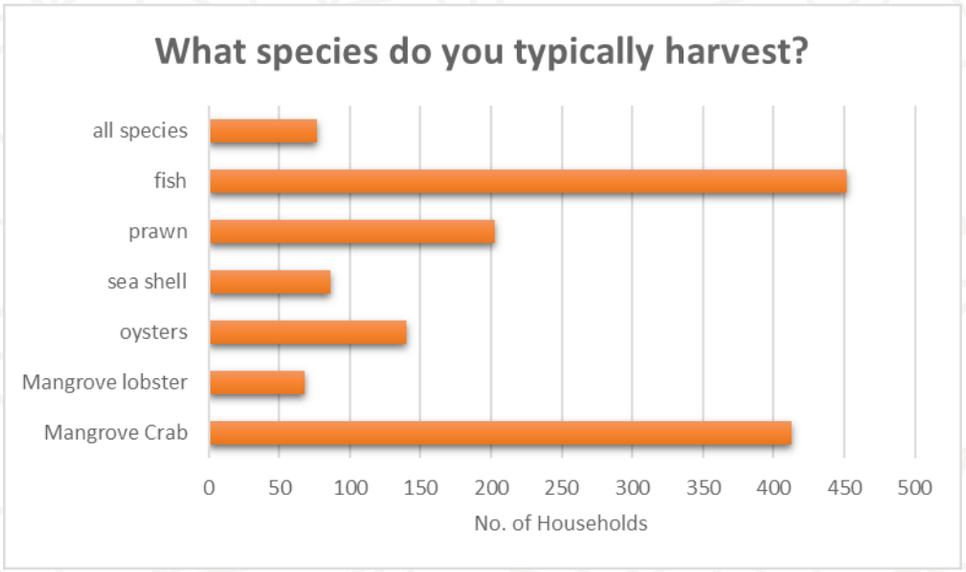


Figure 7: Species usually harvested

Species most harvested are fish species, mangrove crabs, prawns and shrimps, mangrove lobsters, seashells, seaweed, sandfish and mangrove oysters**.**

5.3 Development in Mangrove Areas

Infrastructure development

Apart from seawalls and footpaths in Nukui, Waicoka, Dravo and other areas there had very little been major developments within mangrove areas. Most of the communities visited in the Rewa and Tailevu areas had irrigation systems in place. Vertiver grass planting near shorelines by the Ministry of Forestry was evident in Waicoka, however this has not contributed much to stopping the saltwater intrusion and flooding of the village during higher tides. Flood gates had been discussed as not working in addressing

Thaman, B; Thaman,R; Balawa,A and Veitayaki, J.2017. The recovery of a tropical marine mollusk fishery. A transdisciplinary ommunity-based approachIn Navakavu, Fiji.J.Ethnobiol. 37:494.

flooding in the villages in the delta areas of Tailevu.

Sand Mining and Dredging
In the Ba Province dredging and black sand mining in the Votua district has had significant impacts on mangrove areas and fisheries resources. In addition to this industrial wastes and use of dynamite all related to the mining activities have been major drivers for deforestation and degradation. Dredging happened in some of the target communities in the Rewa delta in the 1980s and in the kast 10 years.

Disposal of dredging spoil
In Waicoka and some other locations in the Rewa delta, where this has been more recent dredging, the work is still on-hold, with evident dredging spoil dumped in mangrove close to the village area. Where there has been dredging major threats to mangroves were recorded as poorly conceived or implemented large scale mangrove reclamation, piecemeal or unsound development in peri-urban areas and pollution from dredging for flood mitigation

Aquaculture Development in Mangrove Areas
Aquaculture of either tilapia or prawns had been introduced to Muana I Cake, Natila, Waicoka,, Naivakacau and other communities in the Rewa Delta.

Informal Settlements
In the urban Rewa delta area, there had been shifting of settlements into mangrove areas and this has increased in the last few years. Encroachment of unregulated, informal residential settlements into mangrove areas within the Suva peri-urban areas has been on the increase in the past 10 years. This is in mangrove areas under the Rewa Delta. Mangrove extraction is localized especially cutting for daily firewood use, house posts and other building needs and dye for Masi making. Movement into informal settlements increased during COVID-19 when people lost homes or could not afford rent because of loss of jobs Associated increase in mangrove resources for firewood and fisheries resources also increased during this time. Apart from the impact of Covid, the trend in rural-urban movement of people will result in an increase in mangrove informal settlements.

5.4 Stakeholder Mapping

Stakeholder mapping was carried out during fieldwork to identify development that had taken place in communities and also to try and map stakeholders that have worked with them. This is also to avoid duplication of work already undertaken. These exercises were also to triangulate information collected in household interviews**.**

Eg. Sorokoba

YEAR	PROJECT	GOVERNMENT/NGO
1900's	Water Electricity -footpath -church Village hall and all its item Kindergarten	Government water supply/PWD FEA/energy Government infrastructure development -village project -village project -aid from overseas and village
2000's	Housing project Footpath/toilet livelihood Disaster awareness Tree planting	Habitat NGO Habitat NGO Provisional office -NDMO Forestry
2009	Water tank Mangrove planting. Community-based management work Research from USP	LDS USP-IAS USP-IAS USP-IAS

2022	Awareness on mangrove Training on baking, boat builders and screen printing	Ministry of fisheries FNU

Eg. Natunuku Village

Stakeholders Mapping

YEAR	PROJECT	GOVERNMENT/NGO
1993	Dredging -	Government
2007	Dredging Replanting mangrove	China railway
2012	Village hall	Government, JICA
2018	Disaster awareness	DISMAC
2021	Toilet (set of 12) -planting of fruit bearing trees	Ministry of Health Ministry of Forestry
2022	Awareness about youth and sports	Ministry of youth and sports

5.5 Social, Cultural and Economic Livelihoods

For coastal communities studied, mangrove areas are the primary source of social, cultural and economic livelihoods.

Women being the dominant fishers in mangrove areas, hold a wealth of knowledge of mangrove fisheries habitats, of the seasonality and abundance of fish and other marine species. Mangrove ecosystems support basic subsistence, commercial, and recreational fisheries in Fiji. Mangrove fisheries are a critical source of subsistence protein for the majority of households interviewed. They are also a significant source of cash income for coastal communities, especially in rural areas, with a range of mangrove-related species commonly sold at local markets. As stated by Lal et al. 1983, Lal, 1991, molluscs, crustaceans (crabs, mangrove lobsters, and prawns), and around 70 species of finfish are found or caught in mangrove waters. Main sources of income are from the sale of marine products with agricultural products, remittance and paid employment being secondary sources of income. After Covid 19 there has been increased reliance on mangrove resources for settlement (people moving into informal settlements) and for subsistence and economic livelihoods.

Figure 8: Commercial and Subsistence Use of Mangroves

Urban communities also utilise mangrove areas for subsistence and commercial purposes but not to the same extent as rural communities[52]. The main source of social, cultural and economic livelihoods for the different villages targeted in Rewa, Ba and Ra is fishing and mangrove for firewood. Mangrove is also still used for house building and other uses such as artefacts.

A few are employed in urban areas however for almost all communities and households visited the main source of income was from fishing activities and this is mainly through selling mud crabs, fish, shrimps and other mangrove species. People have over the centuries, developed an intimate knowledge of the river, the mangroves and associated seagrass beds and coral reef ecosystems and their ecology, biodiversity and economic, social and ecological importance to their cultural well-being and survival.

Subsistence and Economic livelihoods

The majority of households and people interviewed, stated that their communities were fishing dependent communities. with fisheries resources being the primary source of subsistence and economic needs. Farming in all communities focused on subsistence needs with the occasional sale of dalo, cassava and vegetables. With these communities being totally reliant on mangrove resources and surrounding reef areas for subsistence and economic livelihoods, there are little alternatives to meet social, cultural and economic needs given the geographical characteristics of the place.

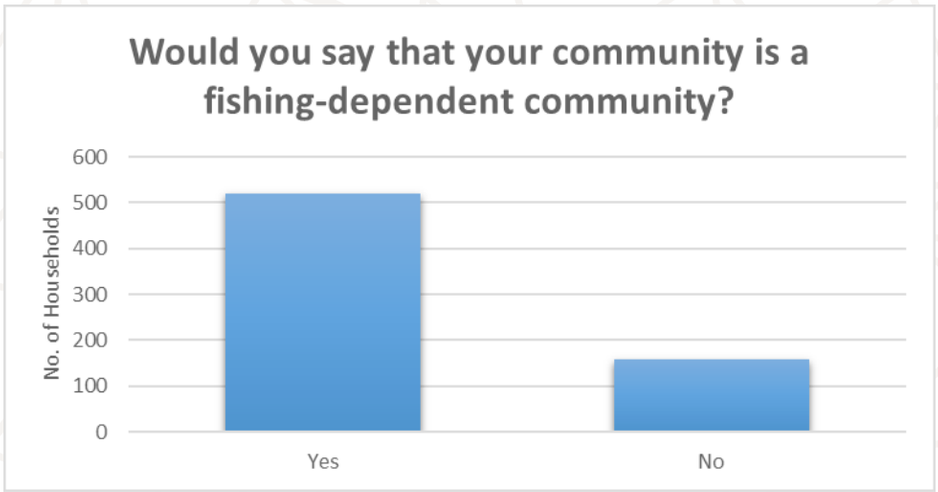


Figure 9: Community Reliance on Fisheries

Main source of social, cultural and economic livelihoods is fishing (Naro) Nuku) Naivilaca fishing and farming (Tavuya, Muyana I cake), Matamoli, Muana I Cake. In the communities visited, key people interviews and through participatory discussions, it was evident that there were limited alternatives for both subsistence and income generation for households. Rewa district representatives at the district level workshop emphasized the fact that people resorted to mangroves because of the lack of alternatives for both subsistence and economic livelihoods, and people will continue to use mangroves for firewood and fish in mangrove areas as this was the only resource available to them. In these discussions, climate change adaptation and the need to address inundation and both flood waters and high tides entering villages, the district representation highlighted the fact that relocation for example was not an alternative for them as they lived in large areas of flat land with no high grounds, thus discussions on addressing threats to mangroves to look at practical solutions/

[52] Thaman, B; Vunisea,A; Naikatini, ZA and Gaunavinaka,T. 2003.Background on Fiji's Mangrove Resources Mangrove Area and Distribution 2003.

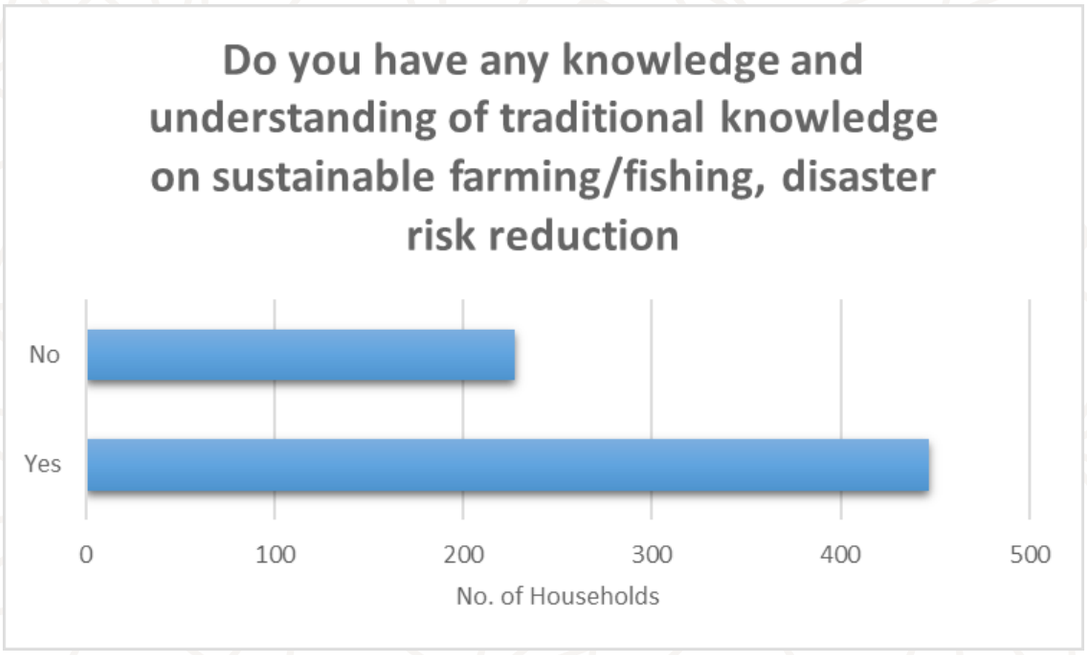


Figure 10: Traditional Knowledge

Traditional knowledge

For Ra, on traditional knowledge, 66% of households stated understanding and using traditional knowledge, traditional seasons, fallow systems and seasonal bans or taboos during a chief's death. Both men and women rely on their traditional knowledge and understanding of resources and mangrove habitats to fish within mangrove areas.

Fishing Practices

Fishing practices used include hand nets for fishing and nets for catching crabs which are used both for day and night fishing, Hand nets are used only by women, in the day to catch shrimps and fish. Fishing lines are used by women mostly along the mangroves and men use this in outer reef and deep-sea areas. Spear guns, spears are used by men and spear guns are used at night. Women mostly glean along the mangrove areas and mud and sand flats while search for crabs, mud lobsters and shrimps in the mangrove areas, thus women mostly use traditional fishing methods**.**

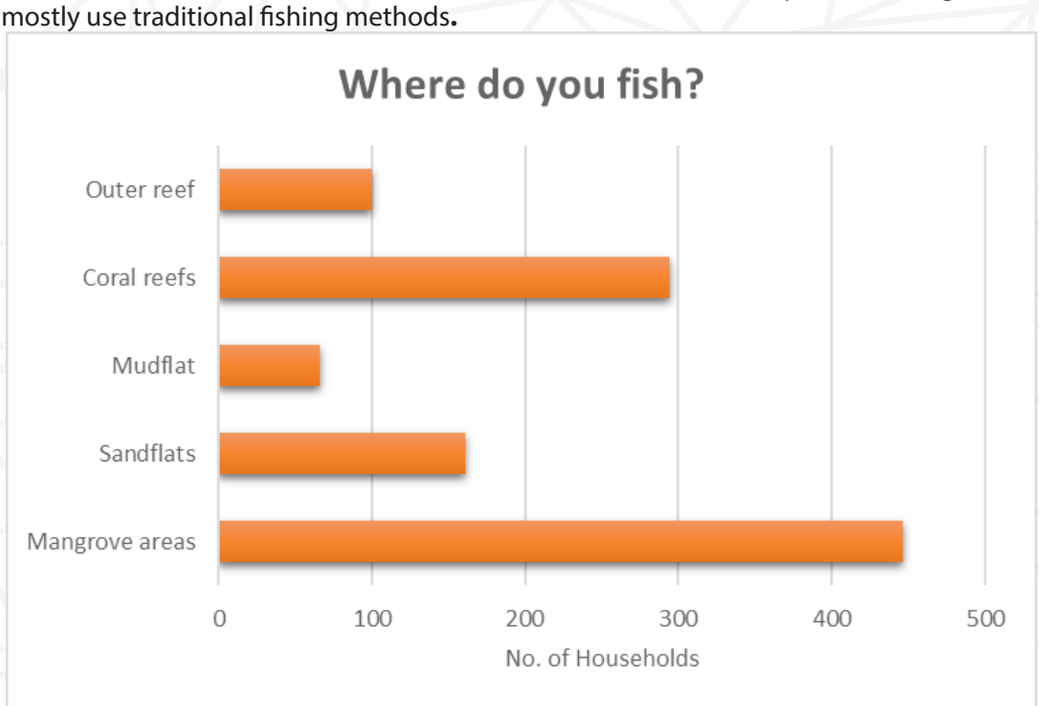


Figure 11: Fishing Areas

Crabs, mud lobsters, prawns and shrimps, kuka, kanace, salala, damu, nuqa, saqa, ika lka loa are species sold while Kurukoto, qitawa, ki, matu, damu, maleya,kaikai, damu, crabs are caught for subsistence. Because selling activities are mostly semi-subsistence most species caught for home consumption are sold when there is a surplus. There are however fishers who fish especially for selling at the municipal markets.

5.6 Gender Roles in Fishing

Men usually fish in the outer reefs, on the fringes of the mangrove areas, using nets, spears and spear guns, while women glean within the inshore areas for bivalves, sea cucumbers and seaweeds. Women also dominate fishing for crabs, land crabs, mud lobsters, bi-valves, fish, and shrimps within mangroves. Women use fishing lines, small fishing nets and glean using traditional fishing methods of collection in the mangrove areas. Most men and women interviewed were fishers (75%). Most men and women fished for both subsistence and commercial purposes (55%), while 43% fished only for consumption.

Table XX: Fishing Activities

Are you a fisherman/fisherwoman? O ni dau qoli beka?	Responses	Percentage
No (Sega)	106	25%
Yes (Io)	311	75%
Total	417	

Do you fish/collect marine resources for: (o ni dau qoli me):		
Subsistence only (vakayagataki ga e vale)	134	43%
Only fish occasionally (vagauna ga na laki qoli)	2	1%
Subsistence and commercial purposes (vakayagataki e vale ka volitaki talega)	171	55%
Process and sell fish/other species (volitaki ika kei na sasalu)	1	0%
sales	1	0%
Total	311	

5.7 Management

Development

There had been major developments in the Ba Delta in the past with mangrove areas converted to agricultural land for sugar cane in the early 1997 and this was due to the boom in the sugarcane industry, 81km squared of mangrove was converted to agriculture use[53]. One of the major developments is sand mining. Sand mining and dredging which affects the villages in Votua and surrounding areas and other communities in adjacent areas. There is associated coastal erosion and continued loss of mangrove and degradation of mangrove areas. There was an attempt at setting up nursery for crabs but this has not been successful. Dredging also took place in some of the target communities in the 1980s, 1990s.

Subsistence and Economic livelihoods

Main sources of for both subsistence and economic livelihoods is mostly fishing (80%) and farming (20%). Cane farming/cane cutting is also a source of income for those communities away from mangrove areas. Some are employed in the Ba town and some are casual workers in the dredging work for example in Natutu, others sell goods in the community. Men usually fish in the outer reefs, on the fringes of the mangrove areas, while women fish within the mangrove areas, mudflats, and sand flats. Main markets are the Ba and Lautoka markets and sell carb to the middle sellers. Mangrove resources targeted for income are mainly carbs and fish.

Impact of Covid 19

During lockdown, curfews and putting up of containment areas by government during Covid, resulted in closure of markets, thus no income, no movement of people in the target sites in Ba. Both men and women lost jobs and small canteens and income generating ventures in the communities closed. There

[53] Avtar,R et al 2021 Impacts of Changes in Mangrove ecosystems in the Ba and Rewa Delta.

was therefore total reliance on mangroves for food, firewood, and in some cases income.

Traditional Management

All respondents said they understood the use of traditional knowledge on farming and fishing. This knowledge is still being used and examples of these are tabus and seasonal ban on marine species (10) while 5 knew about traditional agroforestry and planting using the fallow method.

In recent years, there has been an increase in socio-economic management of mangroves that incorporate both traditional and scientific knowledge and recognizing the needs of local inhabitants in addition to implementing a biodiversity conservation agenda (Vierros et al., 2010; Pollard et al., 2015). These initiatives also provide a medium for documenting traditional knowledge and conservation methods, and promote local community, cultural and spiritual benefits (Thaman, 2002). In Fiji, native communities possess in-depth knowledge of coastal fisheries that provide baseline data for monitoring the effects of environmental degradation and efficacy of conservation initiatives[54] Any management work on mangroves should therefore include scientific and local knowledge. An appreciation of some of the traditional knowledge will provide an insight into how the people use and depend on their environment and its resources.

Considering the long history of sustainable traditional use of mangroves, traditional use rights of communities, and the demonstrated value of traditional and scientific ecological knowledge, a collaborative process and co-management arrangement to facilitate a bottom-up approach using traditional institutions, knowledge and practice should be considered as a viable alternative to reduce deforestation/degradation and improve conservation and sustainable livelihood outcomes[55]

There are no management interventions in all sites visited, however, specific mangrove regulations are in place in some communities. Logging is banned except for subsistence use and for traditional functions, but these rules are not really known to everyone.

From household questions, 43% said there was no traditional management in place at all in their communities, 35% said they knew of traditional management interventions that had taken place, while 22% said they did not know about traditional management (See table below). Responses can also be an indication of the gradual loss of traditional knowledge and the loss of the use of traditional management mechanisms.

[54] Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji

[55] Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in *Culture and Sustainable Development in the Pacific*, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

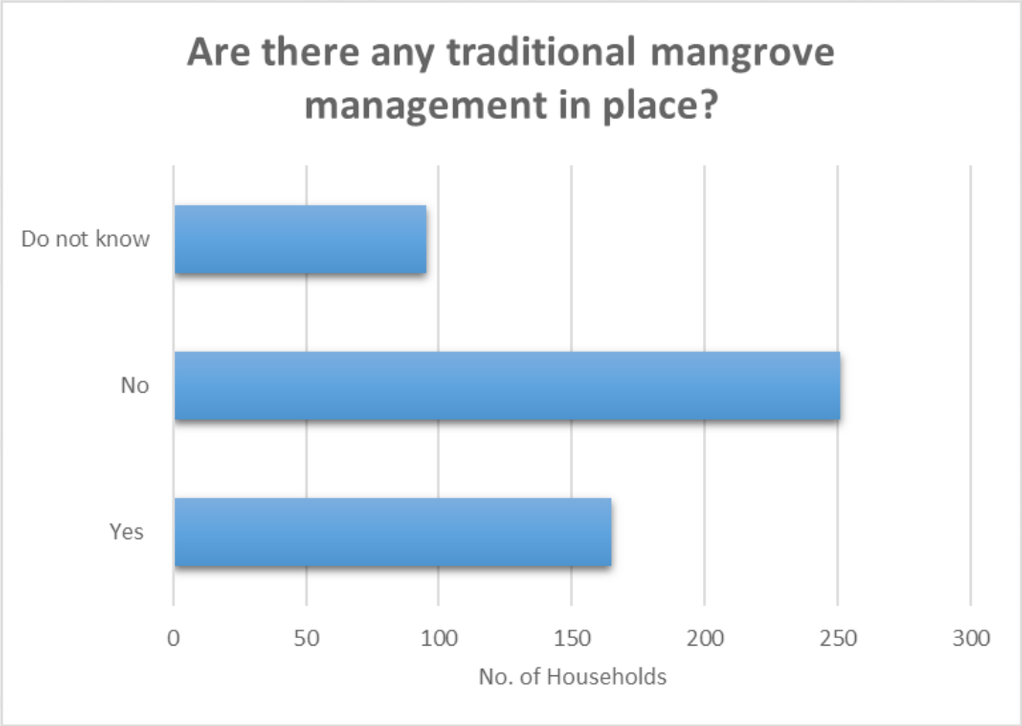


Figure 12: Presence of traditional mangrove management

Mangrove replanting has taken place in communities eg (Daku, Natila) ITTO, with the Department of Forestry and most of the communities undertake mangrove replanting as part of village projects.

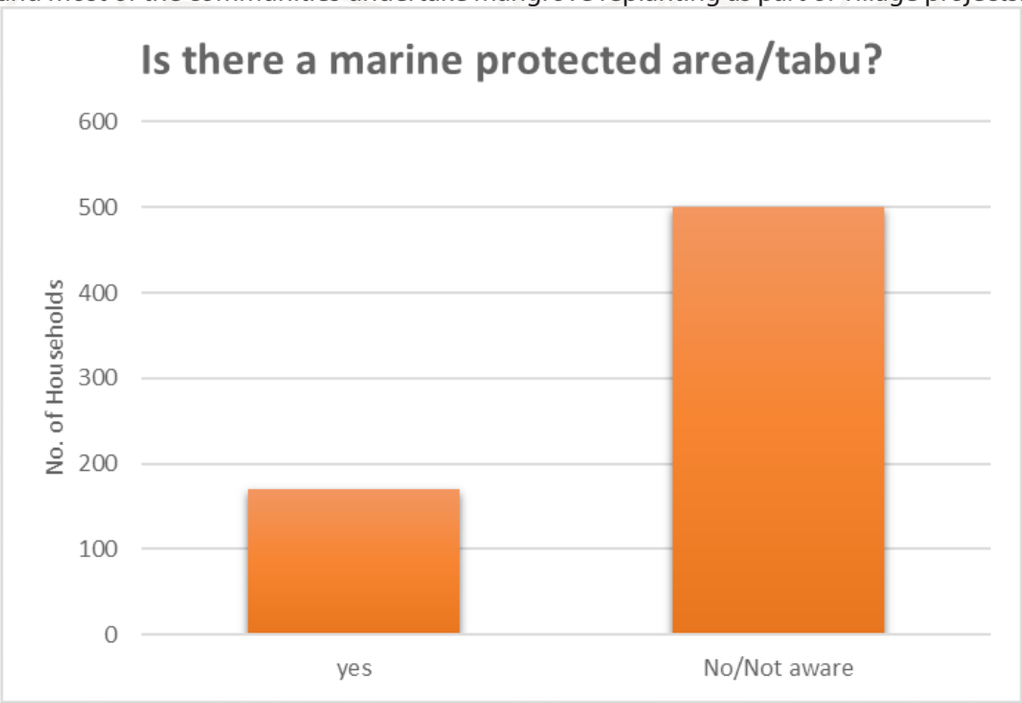


Figure 13: Presence of marine protected areas

5.8 Stakeholders Mapping

Stakeholder exercises was part of the participatory tools used to try and identify which organizations have done work in communities and what work has been done already.

Natila, Narocake, Kinoya, Waicoka, Matanamoli (Rewa)

YEAR	PROJECT	
1900s	Dredging, villages foreshore areas reclaimed and build up Floodgate	-MPI PWD
2000s	-virgin oil project(2015) -natural disaster Awareness before COVID -saving account(2021) -livelihood -mat weaving -awareness on littering nursery/prawn pond Nursery Awareness on disaster	-Government /MOIT -Women's group -NDMO FDB FNU Heritage and Art Waste Management Forestry ITTO
2014 2019	Mangrove rehabilitation Research on mangrove Prawn Farm, nursery set up, mangrove replanting	Conservation International MESCAL
2014-2019	Resource awareness/management	FLMMA
2020	breed oysters Village foreshore reclamation work	Ministry of fisheries Ministry of Waterways
2022	-awareness of conservation of mangroves -awareness about NEC Foreshore re-forestation	Fisheries NEC Ministry of Forests

Example. **Mataiwailevu, Ra**

Stakeholders engaged in the village for the past 10 years

STAKEHOLDERS NAME	OBJECTIVE OF WORK	YEARS WORKED
USP/IAS	Forest restoration Riparian restoration	2017-2018
FRA	Road Diversion Access	2019
Ministry of Forestry	Forest Restoration	2022
Ministry of Agriculture	Rice Planting Project	2022
Ministry of Disaster	Emergency Response	2016-Winston
Ministry of Humanitarian	Humanitarian purpose	2016-Winston
WaterAuthority of Fiji	Proposed Water Source Survey	2020

Sasa/Ba

YEAR	PROJECT	GOVERNMENT/NGO
1900'S	-water/electricity -road -hall/church -small business	Government Government -Village project -SPBD
2000's	-water tank/awareness -housing -community outreach -fishing ground awareness -small business -yasi/ coconut seedling distribution -distribution of baby stuff -family planning -voter registration -disaster awareness -extension of library -measles injection -	ANDRA -Government -ministry of health -Fisheries -SPBD Agriculture -Australian Aid -Australian Aid -election office -NDMO -family from abroad(villager) -ministry of health
2016	-Micro finance Training -food beverage -carpentry -electrician -flower arrangement -sewing. Etc livelihood annual checkup livelihood -	SPBD FNU ADRA Ministry of health -social welfare
2022	-socio-economic survey -Voter Registration Updates -COVID !9 vaccination campaign -Measles Vaccination -road upgrade	WW -FEO -MOH -MOH FRA
2021	Supply of water tank to the village Training and learning center for children	AD -FRA -SDA
	Agriculture	Lovolovo seed-cabbage -poultry -tools
	Mareqeti Viti	-protecting Fiji resources

	Ministry of health	-safe protection of children -livelihood -healthy living -business license -sardar clinic -
	forestry	No logging -source of income Only allowed if used to built a house
	Town council	Selling at the market -license to sell
	Service pro	Age and child care Porter -housekeeping -food and beverage

6. TRADITIONAL INFLUENCES ON DEFORESTATION AND DEFORESTATION

This section looks at traditional fishing methods, traditional use of mangroves and how these activities contribute to deforestation and mangrove degradation over time. With limited alternatives in delta areas where these communities are situated, there is very little access to other forms of timber for firewood and for house building, there is also little alternatives available for food sources. The main source of food and social livelihoods that people know and are familiar with are mangroves thus the continuous reliance on mangroves for economic, social and cultural livelihoods.

High focus on fishing, especially subsistence fishing in mangrove areas

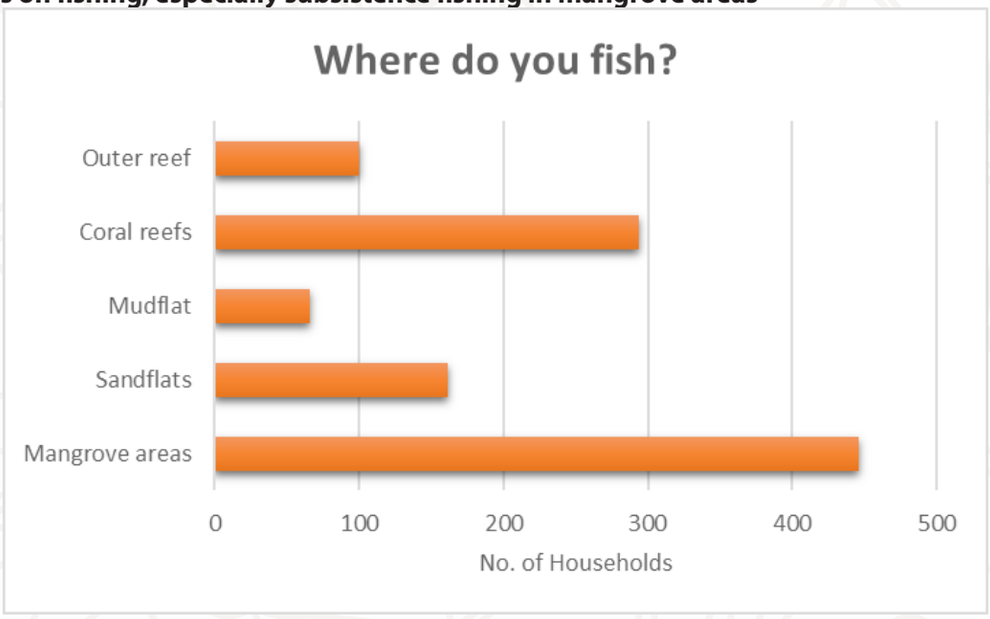


Figure 14: Areas Fished

As in table above, fishing is concentrated in mangrove areas, thus there will be a lot of cutting of mangroves and overfishing in mangrove areas close to communities given the high concentration on fishing in mangrove areas.

Unsustainable fishing methods

33% of respondents have seen some form of unsustainable fishing and these were all related to the use of duva with one relating to the use of dynamite. The use of duva is widespread and had been banned,

however this is still used in some places, as in this case. This unsustainable method of fishing is usually used by women in mangroves, reefs, mudflats and sand flats.

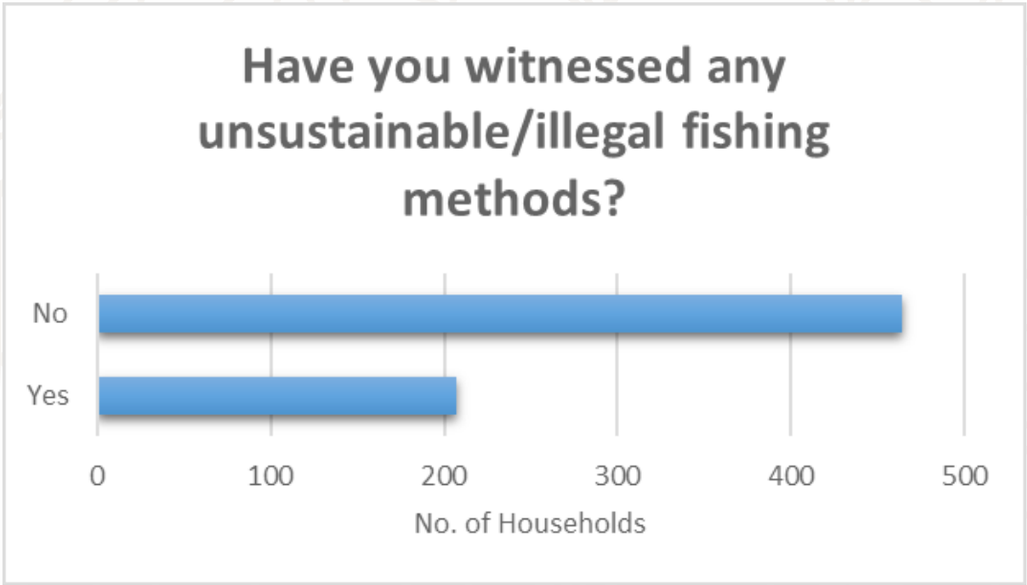


Figure 15: Unsustainable Fishing Methods.

Not much management interventions
Most are aware of management interventions (53%), however, there were not many management initiatives in place in sites visited and few mangrove management initiatives were in place. Some respondents were unaware of management practices that maybe in place, as most of these regulations are known only to those who are active fishers

Use of mangroves for firewood
From consultations in all three provinces the dominant use of mangroves is cutting for firewood. People that live in rural coastal communities have little access to other forms of fuel or energy for cooking, thus the high use of mangroves for firewood. Subsistence use of firewood is not closely monitored, however, everyday use of mangrove for firewood can be detrimental especially to areas easily accessible to communities**.**

Cutting of mangrove illegally from other village and outsiders
Because mangroves are communally owned and sometimes communities are on the coasts away from mangrove and mangrove swamps there is a lot of illegal cutting down of mangroves.

Open access –through Yavusa owned qoliqoli
User rights by communities means there is joint ownership by several villages, thus there may not be any monitoring or strategic interventions to ensure long term sustainability of mangrove resources.
Unsustainable Rubbish Disposal
One of the most commonly mentioned cause of degradation of mangrove areas was the indiscriminate and careless dumping of rubbish in mangroves. People view mangroves as wasteland and just dump all sorts of rubbish in mangrove swamps and in mangroves near to communities.

Shifting settlements into mangrove areas in peri-urban locations.
Because of rural urban drift, many households find it hard to rent or buy homes in urban areas. In the Rewa delta especially, there is a continuous building of settlements into mangroves in peri-urban areas.

Causes of mangrove loss are mostly climate related (climate change and rising sea level or high water intrusion, cyclones. These are factors that people have to adapt to and address.

6.1 Underlying cultural causes of Mangrove Deforestation and Degradation

Complexities of a dual governance system
The complex governance structure due to the dual systems of traditional tenure and westernized state

ownership means that while the state technically owns foreshore lands – where most mangroves grow – iTaukei coastal communities retain unalienable customary rights to the use of living resources in these areas[56]. This has historically been a beneficial arrangement for both parties, with the state's unofficial reliance on traditional communities as unpaid stewards resulting in their largely sustainable use for thousands of years[57]. However, given the changing socio-economic system for and increasing pressure on many rural communities, new initiatives will need to recognize and reward communities as major stewards of mangroves, as opposed to depending upon communities to protect mangroves out of tradition and self-interest alone.

Traditional fishing access and fishing rights
Coastal communities have fishing access rights to coastal habitats, known as qoliqoli, and serve as custodians for the conservation and management of these areas. Any development activity occurring in a qoliqoli area (e.g. tourism development, infrastructure, etc.) can only advance with formal approval from the indigenous iTaukei clans, or mataqali, that hold traditional rights to these areas. If a clan approves industrial or other activities in their qoliqoli area, they also formally and irreparably waive their traditional access rights. These rights however, do not mean authority or ownership over resources within mangrove areas.

Lack of passing on of traditional knowledge
Fewer older people holding traditional Indigenous fishing knowledge (IFK) have been fundamental to environmental, cultural and livelihood sustainability. This time-depth inter-generationally transmitted oral knowledge is, however, seriously threatened, its loss being seen as a major threat to the sustainable management of marine and freshwater fisheries resources.

Loss of traditional knowledge and skills
The time tested indigenous fishing knowledge of Fiji is seriously threatened due to the commercialization of fishing, breakdown of traditional communal leadership and oral tradition transmission systems, modern education and the movement of younger generation to urban areas. The loss of certain trees means the loss of the cultural heritage of tribes and clans (Cavuti) and their identity. Loss of knowledge and skills can mean loss of appreciation of associated traditional conservation traditions.

Lack of Alternatives
In a discussion with the district representatives one of the main concerns by those from the larger Rewa area was how adaptation plans for example are usually generalized, in this case relocation, when such alternatives are non-practical for those that live in the huge Rewa Delta area, and have no access to higher land they can relocate to.

Traditional activities in urban mangrove areas
People from coastal rural areas move into urban areas and build homes in informal settlements straight into mangrove areas. Thus, there is continuation of traditional reliance on mangroves and there will be higher use due to demands of living in urban areas. Health implications are severe, but settlements in mangrove forests provide protection against eviction.

Legal ownership of carbon
The legal ownership of carbon in mangrove and seagrass habitats has not been formally assessed. It is unclear whether the carbon stored and sequestered in mangroves and seagrasses is owned by the state or by the indigenous communities that serve as stewards to these critical ecosystems (CI, 2020). Ownership and benefit sharing from blue carbon will not be easy to determine given the complex nature of ownership and user rights of mangrove areas. User rights only to mangroves may mean communities may have no long-term commitment to management interventions put in place.

Climate Change Impacts
Most respondents were aware of climate change and climate change impacts and 68% of respondents referred to constant weather change, regular droughts, and more rain which affect agriculture and fishing activities and fish abundance. Climate change and coastal erosion was also mentioned by a few respondents as contributing to loss of mangroves and saltwater intrusion into communities.

Climate Change Impact at Household Level
At household level, there were no evident changes in farming and agricultural practices, or availability

[56] Watling, 2013. National Mangrove Management Plan. GoF
[57] Watling,D.2013. National Mangrove Management Plan for Fiji. GoF.

if products in the last 10 years. Farming patterns in the last 10, most did not know if any real change in agricultural practices and changes were a result of climate change. For river changes, 50% of respondents have seen no changes to the use of rivers and resources, while the other 50% stated they were catching lesser from rivers.

For changes to marine resources availability and access in the last 10 years, there had been no changes to access and abundance, although about half of all respondents said there were changes with the availability of resources. All respondents talked about unusual weather changes and these include more frequent flooding if village areas from salt water (100%), and this was associated with more rain, longer raining season. There was also mention of increasing occurrence of drought by some of the households.

6.2 Problem Solution Exercise

In this exercise, communities identify underlying causes of these problems and what the root causes of deforestation and degradation were. The exercise allowed the people to discuss what they saw as problems in groups and also identified what they perceived to be ways to address root causes of problems identified

Example: **SASA Community**

Table 12: Problem solution Exercises examples

CAUSE	ROOT CAUSE	SOLUTION
rubbish thrown into the sea**	-people are getting lazy, don't follow rules	-awareness about the sea and its resources/-mangrove
Harvesting of mangrove to sell for money	Lack of income	Need more awareness -
Using of dynamite during fishing Using duva during fishing	Easiest way food and money source	Ban using of dynamite/duva Enforce regulations on mangrove cutting
Flooding and sea water inundation, coastal erosion	Climate change	Seawall needed to be built
Difficulty to go fishing or get resources from the sea- -river crossing to get to the village	-sea level rise -no bridge	Need a bridge to help especially during rainy weather when the rivers are flooded

Example: **Votua**

CAUSE	ROOT CAUSE	SOLUTION
Coastal erosion	River are setting shallow Dredging and sand mining	Need proper seawalls
Using of dynamite during fishing	No fish warden, easy way to look for money	Ban dynamite
Sugar factories dumping their waste water on our river killing fish and resources	EIA and other regulations not enforced	Awareness should be done about dumping of waste water, should visit industrial area at FSC
Cutting of mangrove	Lack of awareness Dredging company cut a lot of mangrove	Enforcement of regulations to be strengthened. Enforcement to be strengthened
Amex-always put rubbish on the side of the river	Regulations not complied to by company	
Using of compressor	Using improved equipment for fishing- to earn income	Ban use of compressors
Crab net(Basei)	Easy way to find money -no fish wardens	Ban crab nets

Fishing license	Voice of the vanua/custodians no longer heard No respect for the vanua	Government should return the ownership of the Qoliqoli back to people/respect custodianship-user rights.
Flooding of village	Ba river mouth is too shallow	Ministry that look after Dredging can look into this

Sorokoba Village
Problem Solution Tree

CAUSE	ROOT CAUSE	SOLUTION
Using of dynamite during fishing	-easiest way to get fish And earn money	Ban dynamite
Issue of fishing license without the consent of the fishing ground owner	-bulldoze tactic of government	Awareness on how the fishing ground owners voice can be heard
Coastal Erosion	Climate change	Build seawalls
Dredging spoils left in mangrove areas	Amex limited mining and dredging	EIA regulations to be enforced

Kinoya
Problem Solving Trees

PROBLEM	ROOT CAUSE	SOLUTION
Road drainage	-drainage problem	Road authority to help dig drain
Pernix company-oil spill	-due to petrol spilling into the sea ,it destroy mangrove	Village awareness work
Flooding in the village	Due to incoming tides being higher than the culvert and drain	Need a floodgate
litter	They don't sort the rubbish	Village awareness on rubbish
Beach erosion	Doing some work in the upper Rewa river	Seawall to be built
Flooding of village and plantation	River getting shallow	Dredging to be done
Using of chemical to kill all type of fish	License to fish	Ban use of chemical
Promise to help the village but they never return	They never fulfil their promise	Ask them to come back and fulfil their promise
5) Rubbish Disposal (Kinoya outlet,	Rubbish from Suva coastal areas -Kinoya treatment plant outlet in the ocean	-stop indiscriminate rubbish disposal -raise issue of Kinoya treatment Plant
Illegal fishing -lawasua,taga moci,tavitavi	Many people Small area to fish	Enforcement of existing regulations
Increase in water level	Soil erosion	Seawall to be built
Mangrove cutting	Resource are scarce	Selective logging

6.3 Underlying Causes Of Deforestation And Degradation

Using the participatory tools, drivers, the root causes and underlying causes of deforestation and degradation of mangroves were discussed. Working in groups, men and women had to identify drivers and then find out the cultural and gendered root causes and underlying causes of deforestation and mangrove degradation.

In the diagram below, drivers of deforestation were illegal cutting of mangroves, poaching in mangrove areas by fishers from other areas, mangrove cutting for subsistence purposes, increased flooding in villages and farming lands, waste disposal in mangrove areas, coastal development which include dredging, extending human settlement and traditional uses of mangroves.

Root causes of mangrove deforestation and degradation were attributed to loss of respect for tradition and existing laws, lack of awareness of existing regulations and laws relating to mangrove use, lack of appreciation of value of mangroves, the tragedy of the commons where people do not really look after communally owned and accessed resources, development and encroaching of settlements into mangroves and the lack of subsistence and income alternatives, thus continuing use of mangroves.

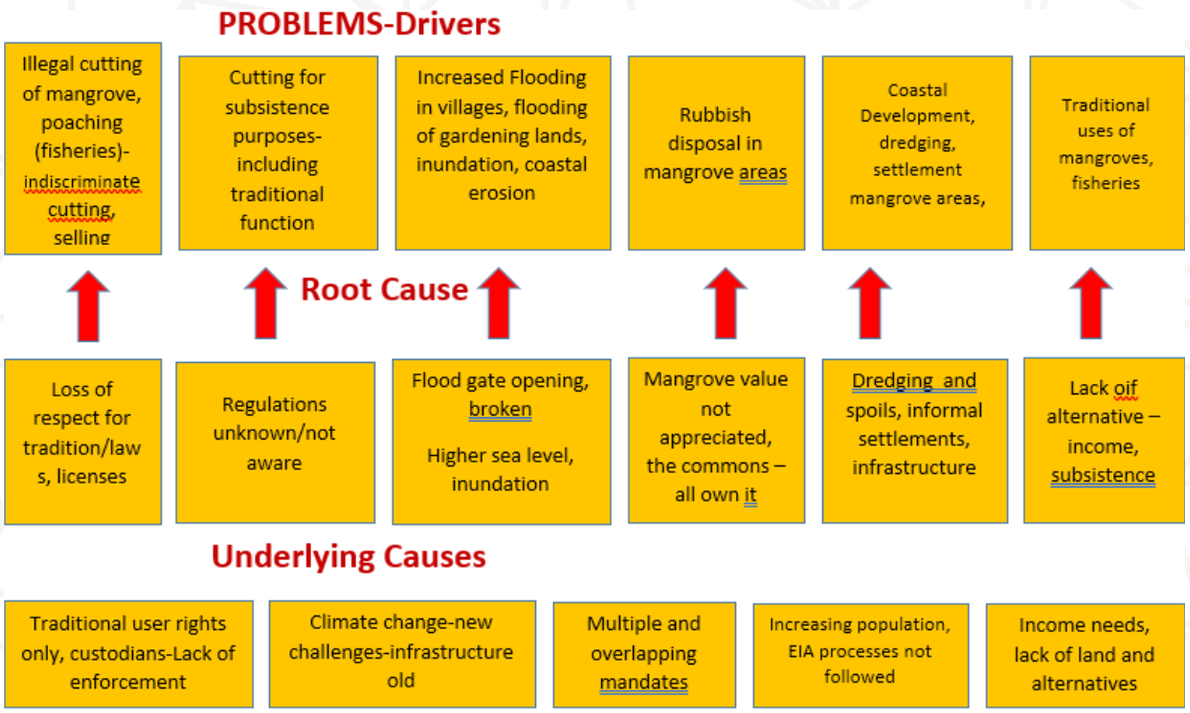


Figure 16: Underlying causes of deforestation

The underlying causes of deforestation and degradation include the lack of enforcement of existing regulations, people having user rights only, thus there is no ownership or accountability in use of resources, new challenges through increasing impacts of climate change and traditional ways of doing things cannot cope with the changes, overlapping mandates by Government Ministries in mangrove management and protection, and people are not familiar with these differing roles and responsibilities, increasing population and associated social and economic needs and the lack of alternatives in delta areas thus the high dependence on mangrove resources to sustain livelihoods,

7. MANAGEMENT

Many of those interviewed were familiar with different traditional management practices and bans and why these are imposed and leaving land to fallow, seasonality of crops and marine species, seasonal bans and agroforestry practices were well known. Some however, were not familiar with traditional management practices. Although people knew traditional management interventions, these were not seen to be in place at the time \this fieldwork was conducted.

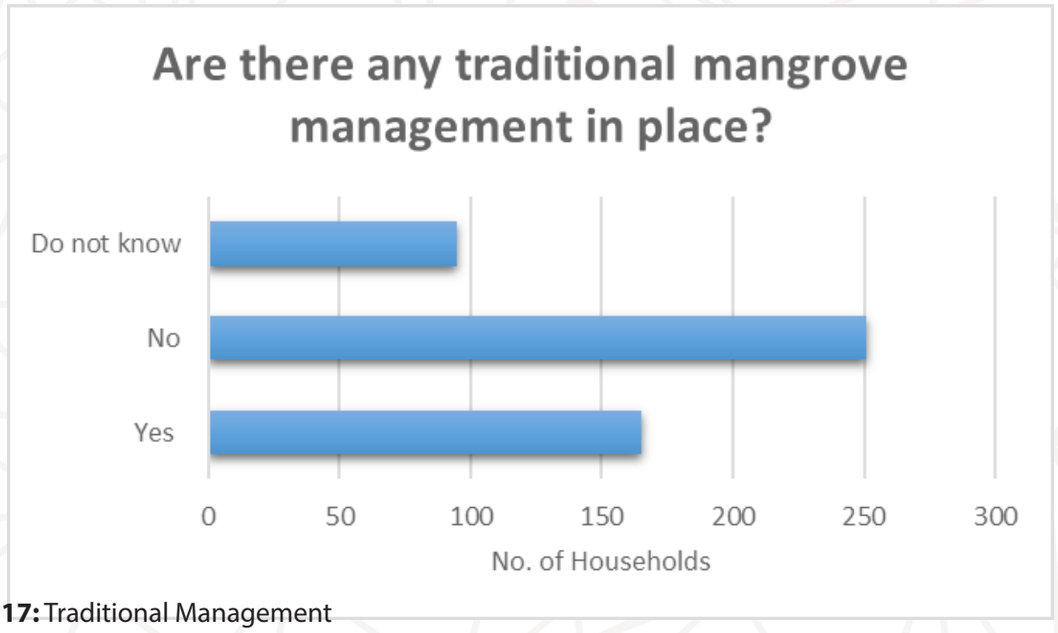


Figure 17: Traditional Management

There are no traditional management interventions in all sites visited. Traditional taboo usually put in place when a chief die for example and this would take 3 to 6 months of closure. Taboo can also be put in place when there is overfishing and the decline in Marine resources

Logging for commercial purposes is now banned, and this was a major driver of mangrove deforestation and degradation. Mangrove cutting for subsistence use is allowed, however, monitoring of how much is cut is a problem and there can still be indiscriminate cutting especially close to communities, because of lack of enforcement.

Mangrove replanting

There has been replanting of mangroves and this has been work done by NGOs, the USP and government (Ministry of Waterways) in Nailaga and Sorokoba districts. The University of the South Pacific (and FLMMA) have also worked in the Nailaga district especially in Votua on community-based mangrove management.

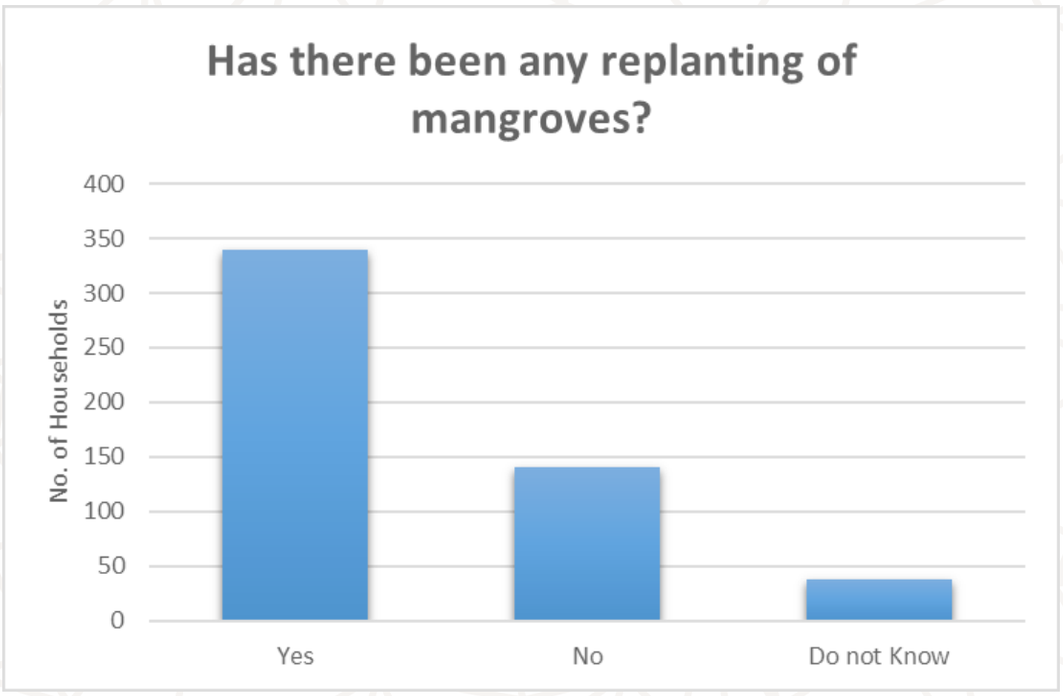


Table 18: Mangrove Replanting

8. DISASTERS

Lesson from previous disasters
There is need for better preparation, housing standards need to be improved, because the Rewa delta is easily flooded, people should relocate in time during disasters, there is need for better constructed evacuation centres, to withstand category 5 cyclones.

There are disaster committees (e.g. in Matamoli, Muana I cake, Naivilaca) and these committees should be trained and be well prepared before disaster or cyclone seasons. There is need to improve awareness at community level, and to have proper and safe evacuation centres. In most evacuation centres, in the Rewa Delta, there are no safe spaces for women and centres are not all disability friendly. There needs to be a lot of work on evacuation centres to have better facilities and to have community disaster committees to be better equipped to deal with disasters.

Evacuation Centres
There are minimal safe spaces for women in evacuation centres and evacuation centres are not disabled friendly, thus the need for better facilities at the evacuation centres. Most villages have evacuation centres, there are village and Tikina/district emergency committees, most of the evacuation centres are community halls or churches and do not yet have gender safety spaces, or disability friendly access. 80% of those interviewed had evacuation centres in their communities, and these were schools, churches, community halls and some used some homes in the community as evacuation centres. Most of these evacuation centres were not disability friendly and had no safe spaces for women as yet. A few respondents talked about their evacuation centres being up to Category 5 cyclone standard, while the majority did not know what "category 5 standard "meant and what the requirements for being certified as a Category 5 evacuation

9. BARRIERS AND OPPORTUNITIES

A few respondents said there were traditional management interventions in place, but many did not understand the regulations or management in place. Traditional management interventions in place included partial and total ban on mangrove cutting. These bans had been in place for more than 5 years. The bans were working and in only one case, the bans were lifted annually. For other management interventions, there had been replanting if mangroves in four of the sites visited. Closures when a chief die is also practiced and these usually last 3 months.

Root causes of deforestation and degradation also include the significant need for subsistence and economic livelihoods where there are limited alternatives for firewood, for income sources for example. Thus income generation needs and alternatives to mangroves dependence need to be considered.

Other initiatives undertaken in communities include mangroves replanting by the women's groups and as part of village initiative or supported by NGOs. These community-based replanting projects had been successful in almost all cases and these can be used as best practices where there is need for mangrove replanting.

10. SUMMARY

Traditional custodianship and access to marine spaces (qoliqoli) and resources mean that communities have an important role to play in the management and protection of mangroves, however, there has to be a balance in use and protection needs to ensure long-term sustainability of mangrove areas.
Drivers to deforestation and degradation are also highly influenced by traditional ways of harvesting, traditional practices and reliance on mangroves for primary livelihoods sources.

Traditional and cultural norms and nuances impact on women's roles in mangrove use and management. Although they are everyday users of mangrove resources, they are not usually opart of decision making processes in communities. Gendere roles in mangrove use and protection need to be included in mangrove interventions on development nd management.

Women as daily foragers and fishers within mangrive areas have a wealth of kn owlwdge and skills that could be capitaluized on when introducing interventions to protect and manage mangroves.

Underlying causes of deforestation is influenced by traditional user rights, the communal qolioli system and traditional ways of management of resources. Multiple government agencies working within mangrove areas with different mandates, also complicate existing understanding of user rights and mandates and responsibilities over resources.

With the increasing loss of traditional knowledge and skills and the new emerging challenges like shifting of settlements into mangrove areas within urban areas, the loss of traditional sites and practices, existing traditional knowledge needs to be documented and used with scientific and more morden ways of management and mangrove protection.

Sustainable and planned extension of settlements in mangrove areas, moving away from the use of mangroves as waste disposal areas should be addressed in any management intervention and awareness work introduced to mangroves communities.

Traditional institutions and structures and existing community groups are important pathways for ensuring awareness, protection and sustainable use of respources and these need to be capitalised on when working on management interventions.

Signifinatly impacting on mangrove degradation and deforestation is the high reliance of coastal communities on mangroves for subsistence and income generating needs. With limited alternatives available at the community level, there is need to look outside of the existing community resources for alternatives that could provide for subsistence and economic needs.

11. RECOMMENDATIONS

For women some of the potential consequences of a gender-responsive approach are increased food and water security, gained leadership and voice, improved health, security, education and skills development as well as improved livelihoods and income.

Although now the women continue to collect those products – through sensitisation, awareness raising and training for gender equitable management, women have become actively involved in the management and monitoring of the resources – contributing to sustainable harvests and securing a sustainable future for themselves as well as the park.

A gender integrative approach recognises women not as passive project beneficiaries, but as active drivers of change toward conservation, sustainable development and their own sustainable livelihoods.

Management or protection initiatives to be introduced to also provide a medium for **documenting traditional knowledge** and conservation methods, and promote local community, cultural and spiritual benefits.

In Fiji, native communities possess in-depth knowledge of coastal fisheries that provide baseline data for monitoring the effects of environmental degradation and efficacy of conservation initiatives[58] Any management work on mangroves should therefore include scientific and local knowledge. An appreciation of some of the traditional knowledge will provide an insight into how the people use and depend on their environment and its resources.

Considering the long history of sustainable traditional use of mangroves, traditional use rights of communities, and the demonstrated value of traditional and scientific ecological knowledge, a **collaborative process and co-management arrangement to facilitate a bottom-up approach** using traditional institutions, knowledge and practice should be considered as a viable alternative to reduce deforestation/degradation and improve conservation and sustainable livelihood outcomes[59]

Locally Managed Marine Areas (LMMAs) in Fiji are set up using the traditional knowledge of fishers merged with modern science to better manage the fisheries resources at the grassroots level. A portion of the fishing grounds is usually set aside as a no-fishing zone to safeguard the future sustainability of fisheries resources

[58] Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji

[59] Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in *Culture and Sustainable Development in the Pacific*, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

BIBLIOGRAPHY

Avtar,R; Navia, Miliana; Sassen,J; Fuji,M. 2021. Impacts of climate change in mangrove ecosystems in Ba and Rewa deltas, Fiji using multi-temporal Landstat data and social survey. Coastal Engineering Journal, Vol 63, issue 3

Bryant-Tokalau, J. 2018. Indigenous Pacific approaches to Climate Change, University of Otago
Becker, P., 2017. Dark Side of Development: Modernity, Disaster Risk and Sustainable Livelihoods in Two Coastal Communities in Fiji. Sustainability, 9(12)

Cameron, C; Maharaj,A; Kennedy, B;Tuiwawa,S; Goldwater,N'Soapi,K; Lovelock, c. 2021.Landcover Change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. In Environmental Challenges, Volume 2.

Chattier, P., 2015. Women in the House (of Parliament) in Fiji: What's Gender Got to Do with It?. The Commonwealth Journal of International Affairs, 104(2), pp. 177-188

Cooke, Andrew, and Kolinio Moce. "Current Trends in the Management of Qoliqoli in Fiji." Traditional Marine Resource Management and Knowledge

Conservation International, 2020.Selecting Blue Carbon Sites in Fiji, Conservation International

Dayal,S; Waqa-Sakiti, H; Tabe, T; Hodge,S.2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach. In Pacific Dynamics: Vol 6 (1) 2022 Journal of Interdisciplinary Research

Foale, S. 2006. The intersection of scientific and indigenous ecological knowledge in coastal Melanesia: implications for contemporary marine resource management. Int. Soc. Sci. J. 58, 129–137. doi: 10.1111/ j.1468-2451.2006. 00607.x (accessed February 2, 2020).

Greenhalgh S, Booth P, Walsh P, Korovulavula I, Copeland L, Tikoibua T. 2018. Mangrove restoration: An overview of the benefits and costs of restoration. Prepared as part of the RESCCUE-SPC Fiji project. University of South Pacific – Institute of Applied Sciences, Suva, Fij

GoF. (2017b). The Fiji National REDD+ Programme. Suva, Fiji: Government of Fiji / Ministry of Fisheries and Forests. Retrieved from http://fiji-reddplus.org/fiji-national-reddprogramme

Kitoleilei, S; Thaman, R:Veitayaki, J; Breckwoldt, A;Piavano, S. 2021. Na Vuku Makawa ni Qoli: Indigenous Fishing Knowledge (IFK) in Fiji and the Pacific. For Marine Consrvtuon and Sustainability

Kronen,M and Vunisea,A.2007. Women never hunt but fish. Highlighting equality for Women in Policy Formulation and strategic planning in the coastal fisheries sector in Pacific island countries. Women in Fisheries Bulletin, 17. SPC, Noumea.

Lal, P. N. (1990a). Ecological economic analysis of mangrove conservation: a case study from Fiji. Mangrove Ecosystems Occasional Papers No. 6. UNDP/UNESCO Regional Project for Research and its Application to the Management of the Mangroves of Asia and the Pacific (RAS/86/120). Lal, P.N. (1990b). Conservation of conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Center, Occasional Paper 11.

Lal, P.2003. Economic valuation of mangroves and decision-making in the Pacific Graduate Studies in Environmental Management and Development, National Centre for Development Studies, Australian National University, Canberra ACT 0200, Australia

MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

Pollard EM,Thaman R, Brodie G, and Morrison C. 2015. "Threatened Biodiversity and Traditional Ecological Knowledge: Associated Beliefs, Customs and Uses of Herpetofauna among the AreAre on Malaita Island,

Solomon Islands." Ethnobiology Letters, 6(1): 99-110

Pearson,J;McNamara,K;Nunn,P. 2019. Gender-specific perspectives of mangrove ecosystem services: Case study from Bua Province, Fiji Islands. Ecosystem Services, Vol.38.

Ruddle, Kenneth. "A Guide to the Literature on Traditional Community-based Fishery Management in Fiji." Traditional Marine Resource Management and Knowledge Information Bulletin 5 (1995): 7-15. Print

Tawake, A; Jupiter,S; Waqairagata, F; Clements,C; Vave, R. Rhe Effectiveess of Locally Managed Maine areas in Fiji. University of the South Pacific

Thaman RR, Balawa A, and Fong T. 2014. Putting ancient winds and life into new sails: indigenous knowledge as a basis for education of sustainable development (ESD) – a case study of the return of marine biodiversity to Vanuau Navakavu, Fiji. Pages 163-184 in M.'Otunuku, U. Nabobo-Baba, and S. JohanssonFua, editors. Of waves, winds and wonderful things: a decade of rethinking Pacific education. University of the South Pacific Press, Suva, Fiji

Thaman, B; Vunisea,A; Naikatini, ZA and Gaunavinaka,T. 2003.Background on Fiji's Mangrove Resources, Mangrove Area and Distribution 2003.

Thaman, B., Thaman, R., Balawa, A., and Veitayaki, J. (2017). The recovery of a tropical marine mollusk fishery: a transdisciplinary community-based approach in Navakavu, Fiji. *J. Ethnobiol.* 37:494. doi: 10.2993/0278-0771-37.3.494

Thaman, R., Lyver, P., Mpande, R., Perez, E., Carino, J., and Takeuchi, K. (2013). *The Contribution of Indigenous and Local Knowledge Systems to IPBES: Building Synergies With Science*. Paris: UNESCO/UNU

Thomas, A. and Waqairatu, S. 2021. Why they must be counted. Significant contribution of Fijian Women Fishers to Food security and livelihoods. Ocean and Coastal Management. Volume 265.

USP, 2001. Proceedings of the Pacific Regional Workshop on Mangrove Wetlands protection and Sustainable Use-June 12-16, 2001. The University of the South Pacific, Marine Studies Facility. Suva

Vierros M, Tawake A, Hickey F, Tiraa A, and Noa R. 2010.Traditional marine management areas of the Pacific in the context of national and international law and policy. UNU-IAS
Traditional Knowledge Initiative, Darwin, Australia

Veitayaki, Joeli 1994. Fisheries Development in Fiji: The Quest for Sustainability. Institute of Pacific Studies and the Ocean Resources Management Programme, The University of the South Pacific, 1994. Print

Veitayaki, J. (2002). Taking advantage of indigenous knowledge: the Fiji case. *Int. Soc. Sci. J.* 54, 395–402. doi: 10.1111/1468-2451.00391

Veitayaki, J. (2008). "Fisheries resource-use culture in Fiji and its implications," in *Culture and Sustainable Development in the Pacific*, ed A. Hooper (Canberra: ANU Press), 9. doi: 10.22459/CSDP.04.2005.09

Veitayaki, j. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies: linking local knowledge to science.

Vunisea, A.2014. Engagement of Women in the Fisheries Sector in Fiji. WIFN/SPC, Noumea,

Vunisea, 2016. Women Participation in the Fisheries Sector in Fiji. In WIF Bulletin, SPC, Noumea

Watling, 2013.Mangrove Management Plan for Fiji- Prepared for the National MangrOve Committee. MESCAL

WWF, (2020). How four communities value and protect their mangroves.

WCS, 2020. The Critical Contribution of Women Fishers to Food Security, WCS..

ANNEX VI:

SOCIO-ECONOMIC INFLUENCES ON DEFORESTATION AND DEGRADATION OF MANGROVES

Aliti Vunisea and Nikheel Sharma
Conservation International
2023

Table of Contents

Page No

Acronyms

CBD	National Convention on Biodiversity
CI	Conservation International
DFAT	Australian Government, Department of Foreign Affairs and Trade
DoDD	Drivers of deforestation and degradation
EIA	Environment Impact Assessment
FLMMA	Fiji Locally Managed Marine Area Network
GHG	Greenhouse gas
MoWEn	Ministry of Waterways and Environment
MoF	Ministry of Forestry
NDVI	Normalized Difference Vegetation Index
NGO	Non-Governmental Organization
PLA	Participatory Learning Activities
PRA	Participatory Rural Appraisals
REDD	Reducing emissions from deforestation and forest degradation
REDD+	REDD “plus” forest conservation, sustainable management of forests, and the enhancement of forest carbon stocks
TC	Tropical Cyclone
ToC	Theory of Change
UN	United Nations
UNDRIP	United Nations Declaration on the Rights of Indigenous People
UNFCCC	United Nations Framework Convention on Climate Change
WWF	World Wildlife Fund

EXECUTUIVE SUMMARY

This report is the result of the socio-economic consultations carried out in the mangrove areas of Ba, Rewa and Ra. The fieldwork included visits to selected sites from different districts in the Rewa/Tailevu mangrove areas, Ba Delta and Ra. A team comprising Department of Forestry Representatives, the Provincial office, field enumerators and Conservation International staff conducted the work over a period of 6- 8 weeks in communities.

Tools used included household questions conducted at random in Ra, key people interviews, and Participatory tools used in focus group discussions. A one-day district consultation was conducted in Suva, and this was mostly to triangulate information collected from the fieldwork.

Socio-economic dependence on mangrove by coastal communities is significant, and communities that are in these delta areas where most of these mangroves are found, have minimal alternatives for social and economic livelihoods. From consultations undertaken, it was evident that there has not been much development in the Rewa/Tailevu mangrove areas and the Ra mangrove areas, however in the Ba District dredging of sand mining in the Votua district has had significant impacts on mangrove areas and fisheries resources. In addition to this industrial wastes and use of dynamite which relate to the mining activities have been major drivers of deforestation and degradation.

Main sources of social and economic livelihoods are mangrove and coastal resources with women being the dominant fishers in mangrove areas. Main sources of income are from the sale of marine products with some selling of agricultural products. Remittance and paid employment in urban areas are secondary sources of income. There are not many direct mangrove management interventions in place and traditional management is put in place on the death of a chief or when there is evidence of overfishing. After Covid 19, there has been increased shift to mangrove areas for settlement (people moving into informal settlements) and for subsistence and economic livelihoods.

Outlets for mangrove resources are the municipal markets, middle sellers, roadside stalls and selling to neighboring communities.

The main cause of deforestation and degradation identified was cyclones and changes brought about by climate change, causing coastal erosion, saltwater intrusion and flooding of communities. The main socio-economic drivers of deforestation are small-scale logging or cutting of mangroves for firewood, house construction, and mangrove products like dye for masi making, traditional medicine, garlands. Although these are done at a small scale, the everyday use of mangroves for subsistence livelihoods, daily fishing for subsistence and economic needs, result in these minor uses culminating into continuous degradation and deforestation which with increase in coastal populations could have significant impacts.

Included in identified underlying causes of deforestation and degradation are the different mandates by Government departments over mangrove areas, which result in people trying to work within multiple policies and government agencies with different focus areas. People only hold user rights, thus clear strategies on protection and sustaining mangroves areas with the protection of their user rights is important. Policies that are developed has to take people's needs and livelihoods into account, for communities that depend on mangrove resources, hold rights to use but are expected to have the responsibility of protecting resources that they depend on. Government is removed from mangroves that is to be protected so a more collaborative approach by all Government Departments, NGOs and communities will help address the underlying causes of deforestation and degradation.

Practical strategic interventions to assist communities address some of the threats of climate change, of lack of income, of sustaining subsistence and economic livelihoods can help the work on addressing deforestation and degradation. This can be achieved by building production capacity, and improving market access for mangrove-dwelling communities.

Specific areas that could be addressed include the need to address these underlying causes of deforestation through thorough consultations with people who live in mangrove areas, and working in collaboration with government agencies that have authority over mangrove areas and NGOs, CSOs who already are doing work in communities.

The need for alternative sustainable livelihoods in mangrove dependent locations is a priority and there has to be alternatives that will ensure the shift of focus away from mangrove areas or post processing activities that will result in the more sustainable, smarter use of resources.

Working within existing traditional structures at community level, is important with customary management mechanism and traditional compliance mechanisms included in community-based management work, or protection work like mangrove replanting, building of seawalls and other such activities.

Rebuilding of sea walls and planting of mangroves where there is coastal erosion, economic livelihoods projects to be supported or developed, putting in place management interventions that are community-based and works with existing structures like the Yabula Management Committees at the district and community levels, and working on enhancing existing projects that target mangrove protection are some of the main suggestions from consultations undertaken.

There is also need for province wide, district level workshops and capacity building and awareness work targeting mangrove management and protection. All trainings should have documentation of traditional knowledge and skills as a component. Emergency preparations in all communities must be addressed in workshops to be conducted at community and district levels.

There need to be more strategic capacity building and awareness training on mangroves to enable men, women youths an all members of communities to value mangrove resources, to identify threats to mangroves to ensure more sustainable cutting of tress and use of sustainable fishing methods. Awareness work and training on mangrove management and protection to be held in all sites where this work was carried out- and awareness of policies and regulations relating to mangrove use, EIA processes, and management options that communities can be involved in.

1. INTRODUCTION

In partnership with the Government of Fiji, CI will consolidate an agenda of blue carbon trading and financing pathways for Fiji, to identify Fiji's options for blue carbon trading on voluntary or compliance markets, or both. This will also include developing an in-depth feasibility assessment for a potential blue carbon project in Fiji, as well as identifying recommendations related to carbon rights and benefits-sharing[1].

In addition to blue carbon markets, the project will identify alternative pathways and financing options such as to safeguard Fiji's management and restoration of mangroves. This includes strengthening sustainable livelihoods, building production capacity, and improving market access for mangrove-dwelling communities.

1.1 PURPOSE OF THE CONSULTATIONS

- To collect information on Mangrove deforestation and degradation.
- Collection of sex disaggregated data on resource use, livelihood sources dependent on mangroves.
- Identify the different uses and users of mangroves in the 3 target sites- Ba Delta, Rewa Delta and Ra.
- Establish socio economic factors affecting mangroves in the three sites.

FIELDWORK TARGET AREAS

Province	Villages
Rewa	Naivilaca, Narocake
	Matanimoli, Nasilai
	Muanaicake, Muanaira, Laucala, Kinoya Koro
Tailevu	Dravo, Daku, Naivakacau, Natila, Waicoka
Ba	Namoli, Sasa, Sorokoba,Votua. Nawaqarua, Natutu, Tavualevu, Natanuku
Ra	Nanukuloa,Nareseilagi, Barotu, Matawailevu, Navuniivi

Consultation Objectives

- to enhance awareness and understanding on mangrove degradation and deforestation issues;
- through participatory approaches and methods, information on mangrove uses, regulations, conservation management plans, coastal development and drivers of mangrove deforestation and degradation to be discussed with the different community groups.
- to ensure relevant stakeholders contribute to the development of proposed mangrove management interventions, activities and programs
- to contribute towards national development priorities on social inclusiveness, transparency and mangrove governance.

2. APPROACH AND METHODOLOGIES

Literature review

A literature review of reports on mangrove use in Fiji was conducted. The literature looked at cultural and socio-economic drivers of deforestation and degradation of mangroves in Fiji.

[1] CI, 2020.

Key People Interviews
Key people interviews were held with men, women, youth leaders at the community level. This included the turaga ni koro (village headman), mata ni Tikina (district representatives, and women group leaders).

Household Questionnaires
Household interviews were held randomly in communities in the Ra, Ba and Rewa delta areas.

Stakeholder Mapping
A stakeholder mapping exercise was carried out to identify Government agencies, NGOs, FBOs, CSOs, the Private Sector and community groups that used or relied on mangrove for the livelihoods, partners that work on development or management in mangrove areas and Government Agencies that work in mangrove and coastal areas. The Stakeholder mapping was also important in identifying agencies, groups or individuals to interview at community and National level.

Eg. Stakeholder Mapping

Resource Mapping-
This was to identify what resources/mangrove resources are there in the tikina, identify changes.

There are many variations of this activity. Maps that can show what the area was like 15 years before and what changes are today- in terms of mangrove areas.

Discussions on Resource Mapping to include:

- Identifying main subsistence and commercial resources-which of these are related to mangroves
- selling outlets, markets
- Main mangroves areas (areas remaining) and changes to mangroves
- Causes of loss of mangroves
- Species ranking- for both subsistence and commercial

Problem solution tree- identification of root causes/underlying causes
In this activity, people identify the main causes of mangrove removal; through discussions, causes of the main causes are discussed and root causes are isolated. The impacts and multiplier effects of problems are then also identified, by tracing what happens after various activities. This helps people see problems constructively, and by tracing causes and impacts they can put other community problems into perspective.

Finding the Root cause of problems

PROBLEM	ROOT CAUSES	SOLUTION
Mangrove logging	House construction-lack of income	Awareness work and capacity building on villages and at tikina level
Removing bark for dye	Income needs	Leadership training to be done

In this exercise the problem solution tree is used to identify indirect causes of mangrove loss and mangrove degradation Because it is in the shape of the tree, it is explained that for everything that happens at the trunk there is a root cause and every cause is rooted in some other factors. This session further analyses information from the problem analysis exercise.

3. THE CONTEXT

3.1 Administrative Boundaries

Administratively, the country is divided into Northern, Eastern, Central and Western divisions which are governed by a commissioner for the coordination of governmental activities at their respective regions[2] These divisions consist of 14 provinces, headed by Provincial Officers (Roko Tui) at the local government levels, which are operating under the direction of the Ministry of Local Government, Housing and Environment. However, the governance responsibilities of the i-Taukei or indigenous Fijian villages are linked to the Ministry of i-Taukei Affairs at the national level. Issues related to community management are firstly discussed by the village councils, followed by district council before reaching the provincial councils and Roko Tui's.

The total population, according to the 2017 Population and Housing Census, has reached 884,887 people, but the annual rate of growth has declined since 1986 due to low birth rates and migration[3] . Of the total population, 55.9%, or494,252 people lived in urban areas in 2017, and Ba province alone has 28% of the population with a growth of 36.7% since 2007[4]. The two main ethnicities in Fiji are the i-Taukei and Fijians of Indian descent, with i-Taukei's mostly belonging to various Christian denominations, while the latter groups share diverse traditions originating from Christian, Hindu, Muslim and Shikh traditions (ADB, 2016) along with indigenous practices.

4.FEEDBACK AND GRIEVANCE

It is necessary that there is feedback received from the iTaukei villagers once consultations and awareness takes place. There should be room at the end of consultations for feedback individually, through the Turaga ni Koro. Participatory discussions at the Tikina Level will build in feedback at the end of the workshop.

4.1 Social Safeguards

Issue/Challenge	How to address the issue
Expectations from the community for assistance, money, etc.	Be transparent and well informed on mangroves issues. Deliver the message/ ask questions as it is and do not include any other assumed or incorrect information Admit to knowledge gaps and revert with correct answers
There are unwritten rules of engagement in a community, thus the hierarchical structure and different designations of the people should be respected.	Use Participatory tools and facilitators to be aware of the dynamics within a community setting. Community's responses are taken and recorded as is and not corrected by the facilitator because it is their perspectives and they have to take ownership of the process[1].
People in communities are well versed with mangroves resources and have knowledge accumulated over generations of use.	Getting knowledge and direction from the community. Listen to their stories and their concerns.

[2] Ravuvu, A. (1988). *Development or Dependence: the Pattern of Change in a Fijian Village.* Suva, Fiji: University of the South Pacific, Institute for Pacific Studies.
[3] GoF. 2018.Fiji Bureau of Statistics. Fiji Statistics, 2018.
[4] Ibid, 2018

Be informed of the existing religious groups and the different religious beliefs that can raise different opinions on how they view REDD+	Get information about communities, tikinas from the provincial office before community consultations
Women cannot speak freely in certain groups.	Ensure group work separates men from women, and elders to enable women and youths to voice concerns and speak freely
Be mindful of the internal conflicts and disagreements that exist within iTaukei village communities	Consult with the respective Provincial office to identify the existing internal conflicts and disagreements prior to carrying out consultations
Be informed of traditional relationships that can be a barrier to open discussions	Consult with the respective Provincial office to be aware of traditional relationships prior to carrying out consultations
Not everyone will be interested in the consultations	Consultations should also be awareness sessions where the youth, women and other marginalized groups can be informed of regulations, etc.
Women are not always present at such consultations	Have the consultations at time convenient or women- make sure there is at least 25% participation by women.
Other groups in the community to be part of the consultations	FBOs, women and youth groups to be included
Other ethnic groups who may have access to mangroves	Identify other users and they can be included in key people interviews/HH interviews

5.FINDINGS, SURVEY RESULTS

5.1 General Background

The total number of coastal communities and districts included in the Rewa survey were 52. This included sites not specifically visited but are within the districts where the household questionnaires were carried out. The target sites for Rewa and Tailevu were Daku, Dravo,Natila, Waicoka. Matanimoli , Muana I Cake, Naivilaca, Nukui and Kinoya with questions on mangrove covering more than 52 coastal communities.

The communities have easy access to schools and medical facilities. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centers and community dispensaries are accessible to all communities.

In the Ba area, Nawaqarua, Votua, Nasoagania, Carotoga, Natutu (Nailaga District), Tavualevu (Tavua District) Sorokoba, Natunuku, Sasa, Natalakcake were communities studied.

The communities have easy access to schools but there is need for Health dispensaries to be set up for those far from hospitals. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centers and community dispensaries are accessible to all communities.

In the Ra mangrove communities studied, communities have easy access to schools and medical facilities. Most of the schools close to communities are primary schools and secondary and tertiary institutions are in urban areas. Health centers and community dispensaries are accessible to all communities.

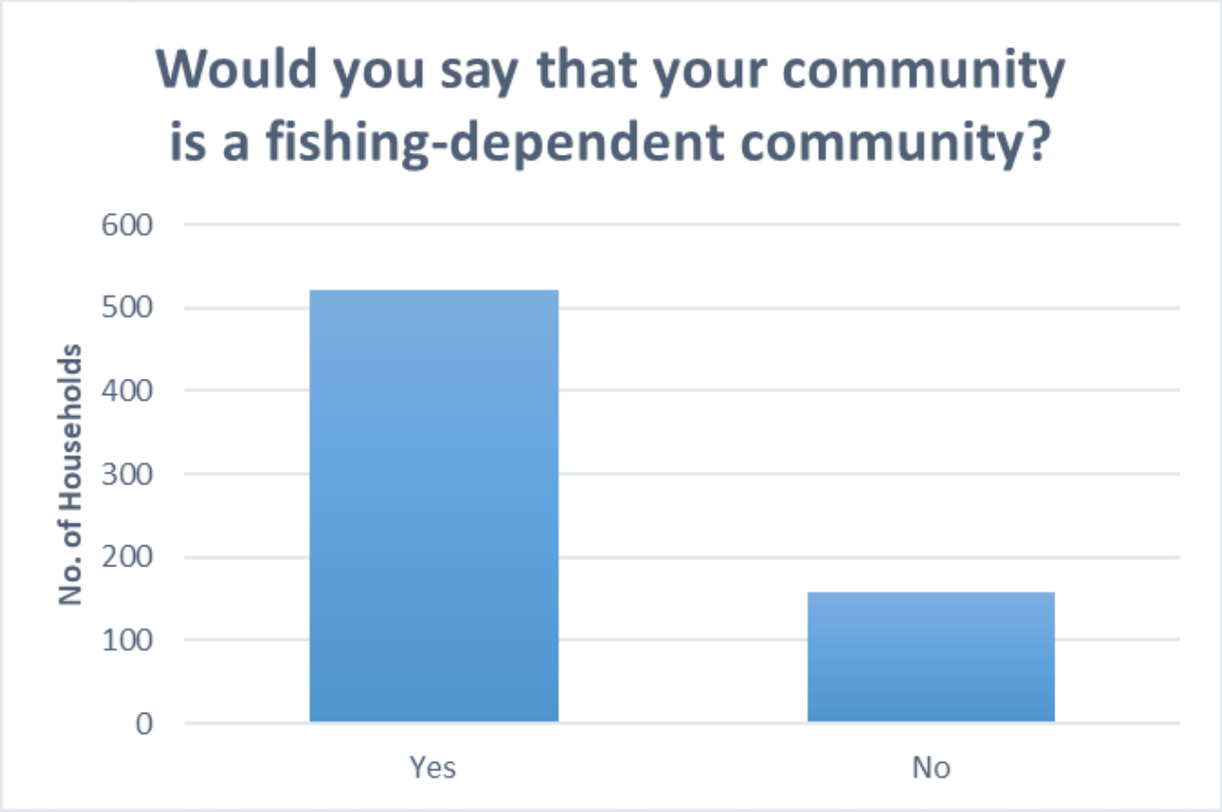
80% of respondents in communities had attended workshops that related to natural resource use and management and these were mostly by government (80%), 15% of workshops conducted were by environmental NGOs and 5% were workshops on Humanitarian work, DRR and preparedness. Workshops covered a wide range of issues, and workshops that people found useful were on livelihood sources and sustaining or managing resources and environment protection, disaster preparedness and responses and

climate change impact and adaptation

5.2 Livelihood survey

In all mangrove sites visited, 90% of those interviewed were fishers. Thus as shown in the table below, most communities were fishing dependent communities.

Table 1: Dependence on Fisheries



Almost all fishers were both subsistence and commercial fishers. Numbers of fishers ranged between two to six per household with men and women equally participating in fishing activities. Fishing activities mainly focused on mangrove areas and mudflats while most men fished in and outside reef areas. Target species in mangroves included crabs, shrimps, oysters, fish and gears used for fishing included nets and fishing lines. Most of the respondents questioned and through participatory discussions, the consensus was that most regarded their communities as fishing dependent. This is because the primary source of food and income is through fishing activities.

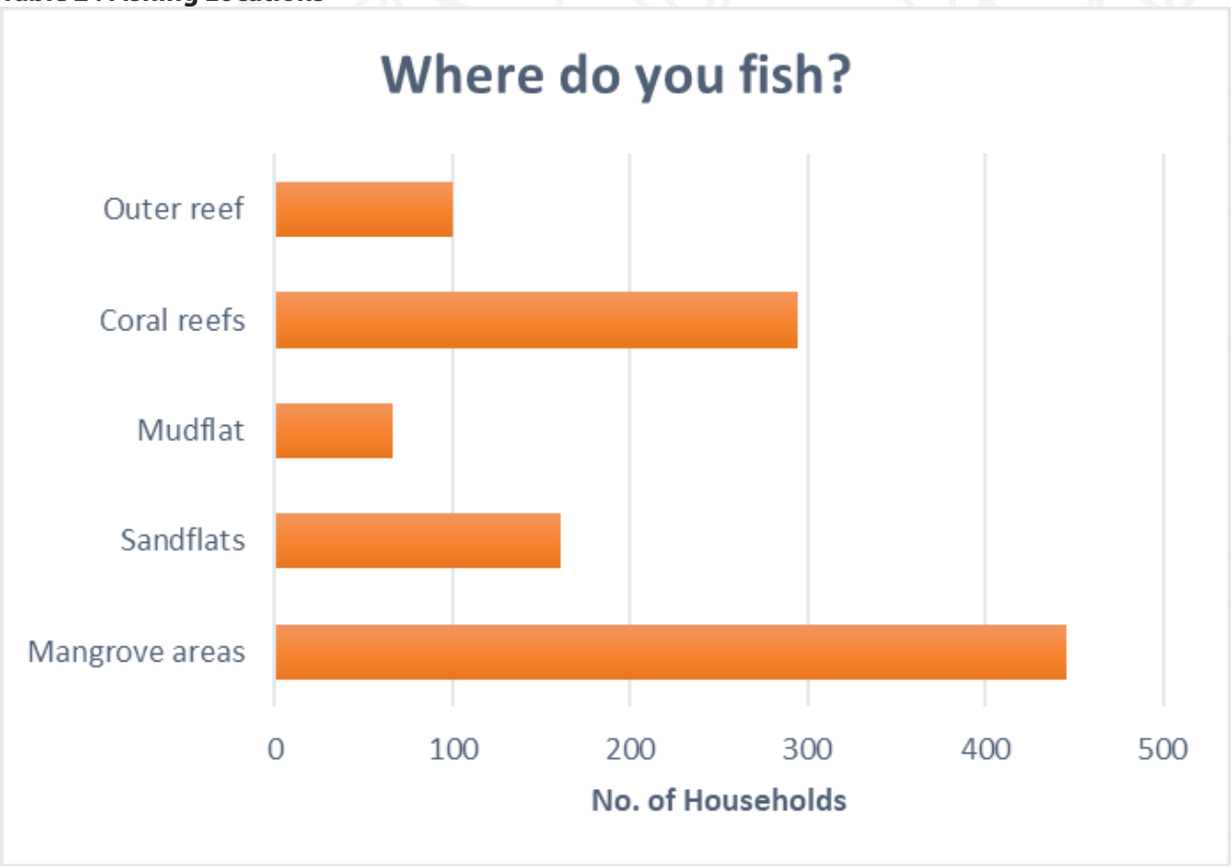
MANGROVE USES

The main uses of the mangroves for 100% of target communities was for collection of firewood for domestic use, materials for house building, especially kitchen construction and fence posts, traditional medicine and fisheries resources. Other uses like collection of dye for masi making, making if garlands, cutting of mangrove for firewood for functions depended on demand.

Reliance on mangroves

Number of crabs, oysters and other target species were not easily established as most catches were between 4 to 5 or 10 to 12 for daily. In weight, catches ranged widely from 2kg, to 5 to 10 kg a month to 20 to 30 kg. Thus catches depended on different needs and expertise of the fishers. The majority of the respondents said their communities were fishing dependent communities.

Table 2 : Fishing Locations

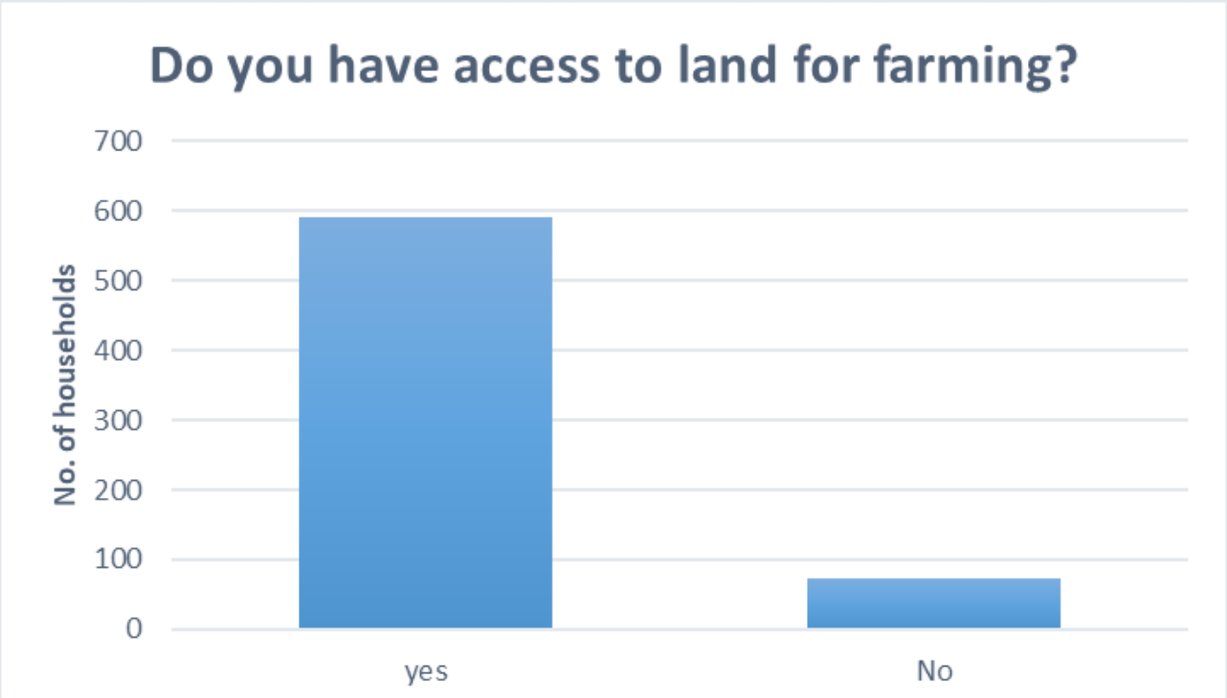


In the Rewa/Tailevu mangrove communities visited, main sources for both social and economic livelihoods is fishing with farming practiced in all target communities. Agriculture is basically focused on subsistence needs with the occasional sale of dalo, cassava and vegetables. With these communities being totally reliant on mangrove and coastal resources, there is little other alternatives to meet socio-economic needs given the geographical characteristics of delta areas where mangroves are dominantly found.

In group discussions with the district representatives one of the main concerns by those from the larger Rewa/Tailevu area was how adaptation plans for example are usually generalized, in this case relocation, when such alternatives are non-practical for those that live in the huge Rewa Delta area, and have no access to higher land where they can relocate to. The same could be said of resources, as there is little alternative social and economic resources.

As is evident from access to land for farming for coastal communities in all sites, most have access to communal farm land and most farm for subsistence use.

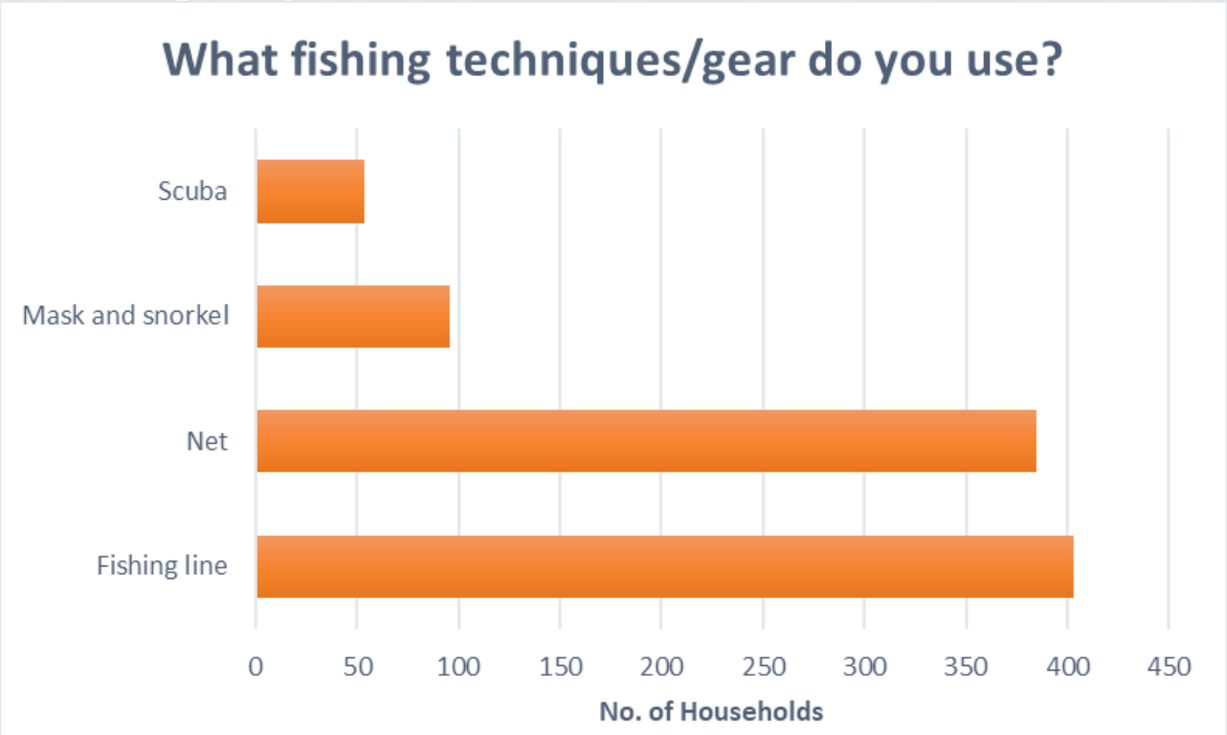
Table 3: Access to land for farming.



Fishing activities

Men usually fish in the outer reefs, on the fringes of the mangrove areas, using nets, spears and spear guns, while women glean within the inshore areas for bivalves, sea cucumbers and seaweeds. Women also dominate fishing for crabs, land crabs, mud lobsters, bi-valves, fish, and shrimps within mangroves. Women use fishing lines, small fishing nets and glean using traditional fishing methods of collection in the mangrove areas as in table below.

Table 4: Fishing techniques



5.3 Economic livelihoods

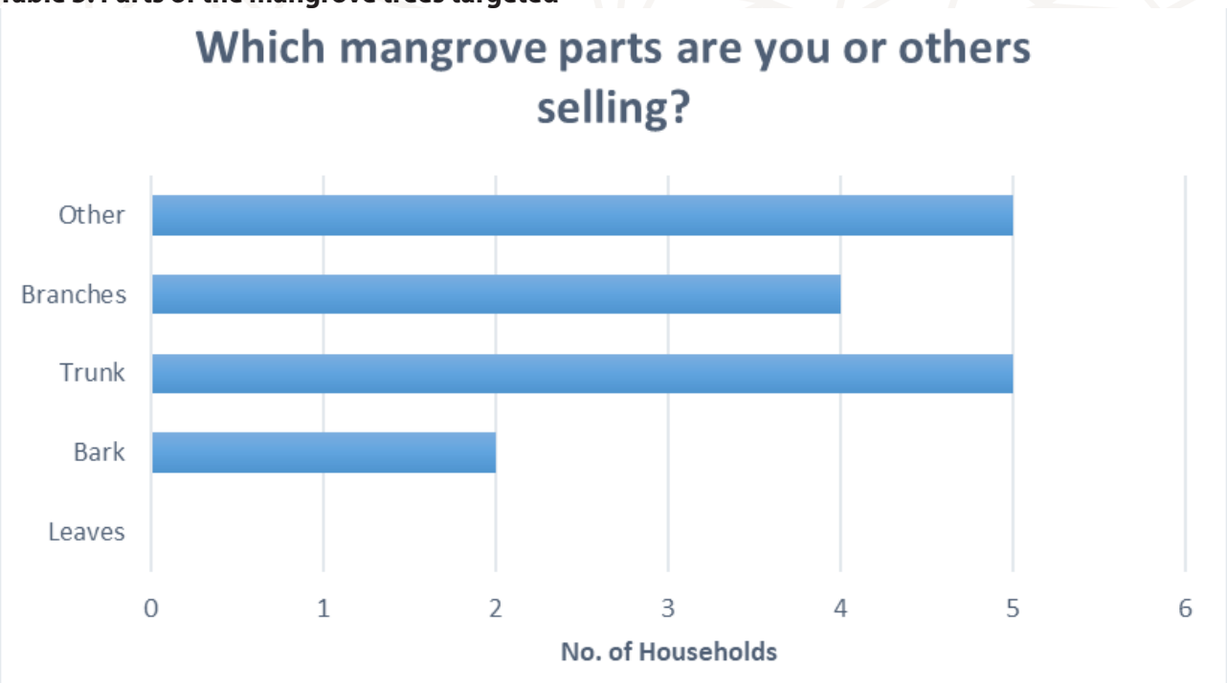
The other main sources of income are from marketing of marine products like fish and mangrove associated species like mud crabs, sea cucumbers, seaweed and sea grapes, prawns, anadara and other bi-valves. Other sources of income include selling of mats, brooms, fans (from Daku) and other handicrafts employment in urban areas, selling of cooked food and remittance received from relatives in urban areas or overseas based workers.

For the Rewa delta and communities in Tailevu province, the main markets are the Nausori and Suva markets with some selling products at the Bailey Bridge in Vatuwaqa. Marine products are also sold within the village or to neighboring villages. Buyers also buy from communities on order, for example fish, crabs and fans (Daku). Middle-sellers buy fish from most of the target communities and these are sellers from the Nausori and Suva markets. Most middle sellers are Indo-Fijians and most sellers at the markets on weekends are women.

Local markets, road selling, selling within communities are all outlets for the fisher's sources. There is minimal traditional exchange of products and this was a platform used during Covid 19 by almost all the target communities, to get agricultural products, and household necessities, bartering of food and other necessities.

Cutting mangroves for selling is happening in all three provinces and there is mostly selling of trunks and branches with the bark is used to make dye to sell. Most cutting down of trees for both subsistence and commercial purposes was done weekly while cutting for traditional functions was on special occasions only. Parts of the mangrove tree most targeted are the trunks and the branches.

Table 5: Parts of the mangrove trees targeted



For Subsistence and Economic livelihoods in the Ba Mangrove areas, main sources of for both subsistence and economic livelihoods is mostly fishing (80%) and farming (20%). Cane farming/cane cutting is also a source of income for those communities away from mangrove areas.

Some are employed in Ba town and some are casual workers in the dredging work for example in Natutu, others sell goods in the community. Men usually fish in the outer reefs, on the fringes of the mangrove areas, while women fish within the mangrove areas, mudflats, and sand flats. Main markets are the Ba and Lautoka markets and sell carb to the middle sellers. Mangrove resources targeted for income are mainly carbs and fish.

There are some buying of crabs and fish at source, and middle sellers from the Lautoka and Ba markets. One of the main outlets for crabs and fish are roadside stalls and middle sellers also buy from the communities and sell at roadside stalls.

Income range

Income range was between $100 to $200.,00 weekly so the majority of households lived on whatever they could get locally, thus the high use of mangrove resources. Most income depended on fishing and catches and if it was good weather they would make more money.

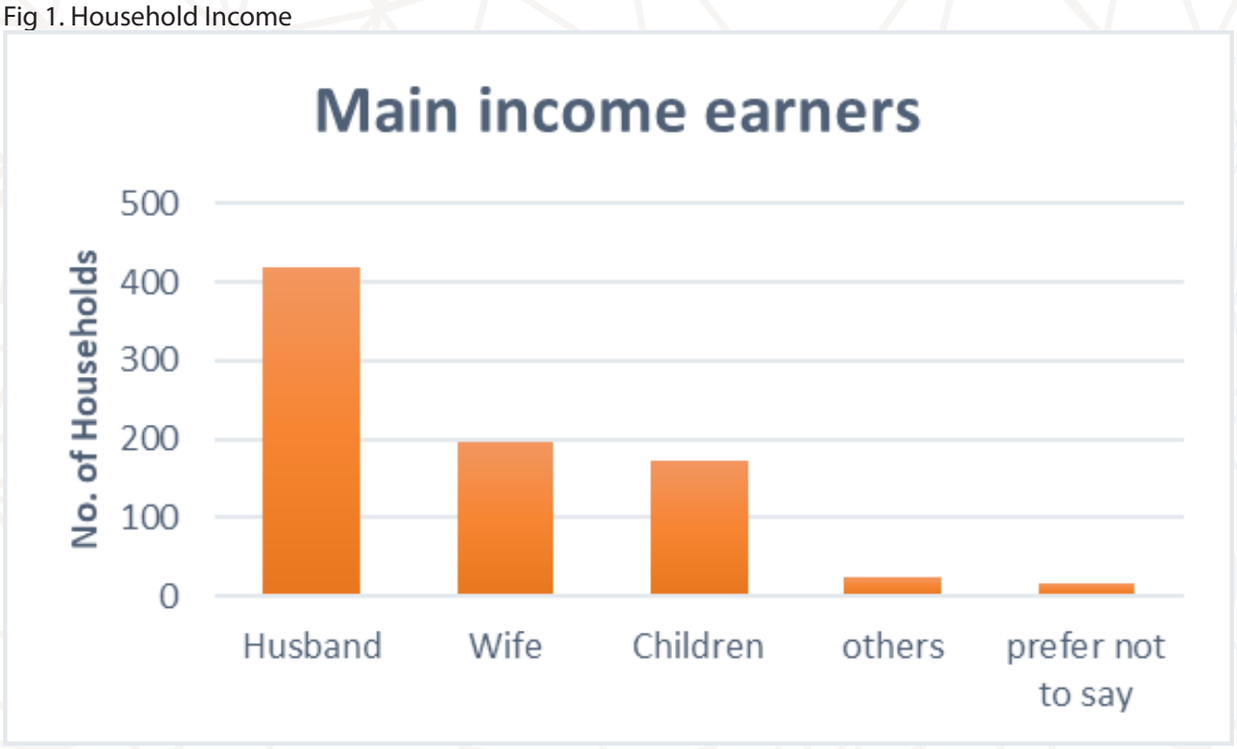
Savings accounts

53% had a bank account or had some savings, while 47 % had no bank account or savings. Only 27% of those households interviewed made between $100.00 to $200 or above weekly thus not many had the capacity to save money as all they earned paid for household needs.

For the Ra Mangrove communities, Average household numbers was 4 and a few had more than 8 household members. Most members of household had finished secondary education, and only 5% had finished tertiary education. Reasons for not completing higher education was hardships faced in accessing quality education. For all villages along Navitilevu Bay (Toki, Roborobo, Navunibitu, Nasereilagi, Tokio, Rokonoko, Nukuloa, Matawailevu, Navuniivi, Nailawa, Mataveikai all households have access to land for farming and have shared marine area access (qoliqoli cokovata). Some households in Naunukuloa, Nasereilagi, Rokorojo, Nalawa stated they had no land, and accessed land leased for subsistence use. Those without land maybe those who are not originally from the communities.

From households interviewed, main income earnings were husband and wife income and the main sources of income were from fishing activities, followed by selling of agricultural products, some had permanent jobs and remittances. Secondary source of income was fishing, agriculture and remittance, while some relied ion casual work in dredging companies and road construction. Main sources of subsistence livelihoods were fishing and agriculture.

Fig 1. Household Income

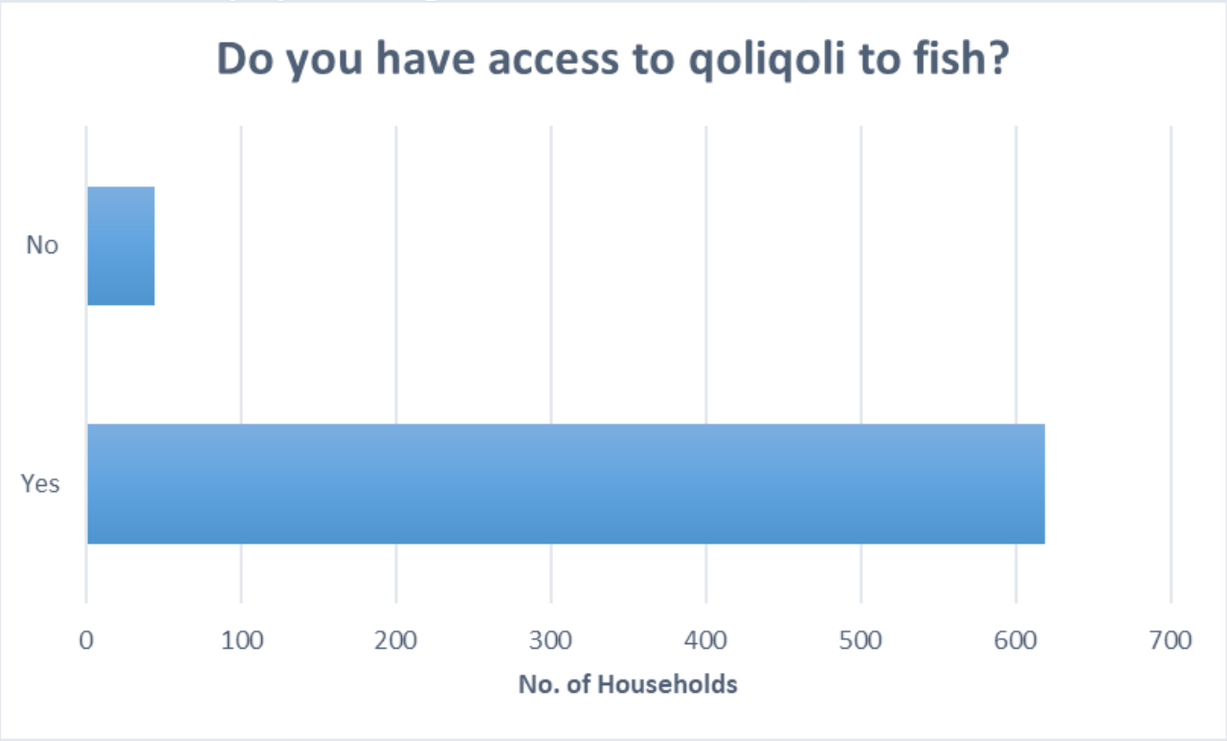


Household Finances

66% of households made between 50 to 100 dollars a week in income, while 20% made more than 100 dollars. The remaining did not respond to the question on earnings. Food needs, water, education and health needs were the primary expenses and other household costs were electricity, community or church obligations. 46% of households received remittances and this was mainly locally and only a few households received money from overseas based relatives.

As is the case in the Rewa and Ba Delta areas, the majority of households have access to qoliqoli areas. Those that do not have access are those that lease land close to mangrove and coastal areas and have to seek permission to fish or use resources in mangrove areas.

Table 6: Access to qoliqoli or fishing areas



5.4 Impact of Covid 19

In the Rewa Delta Area, during the COVID 19 lockdowns, curfews and putting up of containment areas by government during Covid, resulted in closure of markets, thus no income, no movement of people. Both men and women lost jobs and small canteens and income generating ventures in the communities closed. There was therefore total reliance on mangroves and other fisheries products for food, firewood, and in some cases income.

In the Ba Delta area, during lockdowns, curfews and putting up of containment areas by government during Covid, resulted in closure of markets, thus no income, no movement of people in the target sites in Ba. Both men and women lost jobs and small canteens and income generating ventures in the communities closed. There was therefore total reliance on mangroves for food, firewood, and in some cases income.

The same happened in the Ra Mangrove communities, where Covid 19 impacted households because of the borders and containment areas set up where people could bot market products, had no access to urban centers and there were also restrictions on going to the farms and fishing. Small canteens in the villages closed, and most relied on fishing and farming to survive. There was restriction on those from the village living outside of communities for work re-entering the village, thus there was also no means of getting assistance from relatives outside of the communities.

6.DEVELOPMENT

Rewa Mangrove Communities

Little development has happened in the mangrove areas in communities visited. Aquaculture of either tilapia or prawn farming had been introduced to Muana I Cake, Natila, Waicoka,, Naivakacau. Apart from seawalls and footpaths in Nukui, Waicoka, there has very little been major developments within mangrove area.

Encroachment of unregulated, informal residential settlements into mangrove areas within the Suva peri-urban areas has been on the increase in the past 10 years. This is in mangrove areas under the Rewa Delta. Mangrove extraction is localized especially cutting for daily firewood use, house posts and other building needs and dye for Masi making. Movement into informal settlements increased during COVId when people lost homes, or could not afford rent because of loss of jobs Associated increase in mangrove resources for firewood and fisheries resources also increased during this time. Apart from the impact of Covid, the trend in rural-urban movement of people to will result in an increase in mangrove informal settlements.

Dredging happened in some of the target communities in the 1980s except for Waicoka, where this has been more recent, with the work on-hold, with evident dredging spoil dumped in mangrove close to the village area. Vertiver grass planting of shorelines by the Ministry of Forestry was evident in Waicoka, however this has not contributed much to stopping the salt water intrusion and flooding of the village during higher tides. Flood gates had been discussed as not working in addressing flooding in the villages in the delta areas of Tailevu.

BA MANGROVE COMMUNITIES

There had been major developments in the Ba Delta in the past with mangrove areas converted to agricultural land for sugar cane in the early 1997 and this was due to the boom in the sugarcane industry, 81km squared of mangrove was converted to agriculture use[5]. One of the major developments is sand mining. Sand mining and dredging which affects the villages in Votua and surrounding areas and other communities in adjacent areas. There is associated coastal erosion and continued loss of mangrove and degradation of mangrove areas. There was an attempt at setting up nursery for crabs but this has not been successful. Dredging also took place in some of the target communities in the 1980s, 1990s.

RA mangrove communities

Except for road construction near mangrove areas, and in some places into mangrove areas, there has not been any major development in mangrove areas. There is no major movement of settlements into mangrove areas, except for small activities in mangroves by those who live within mangrove areas like Barotu. Black sand mining was supposed to start near Namuaimada but have since stopped. There has been mangrove replanting along the Nanukuloa, Namuaimada and Nasereilagi mangrove areas.

Stakeholder mapping show what type of development has taken place in communities and which stakeholders they had work with. Below are some examples of stakeholder mapping.

[5] Avtar,R et al 2021 Impacts of Changes in Mangrove ecosystems in the Ba and Rewa Delta.

6.1 STAKEHOLDERS MAPPING

NAROCAKE

YEAR	PROJECT	GOVERNMENT/NGO
1990's	Water -pit toilei Roads(1992) Electricity(1993) Landline phone Floodgate Training on how to breed bees Community awareness	PWD Committee of healthy living Government FEA Telecom PWD Government Ministry of health
2000's	Flush toilet Footpath Nursery/prawn pond Awareness on resources Training , sewing(5 sewing machine) Community disaster awareness -Nursery Awareness on disaster	LDS Red Cross Forestry Flamma Forestry Red Cross Women Project ITTO Dismac
2014	Mangrove Replanting Farming-vegetable	CI -Ministry of Agriculture
2015	Pine -Black sand mining	 SEEP
2014-2019	Resources Awareness	FLAMMA/IAS
2022	Community Police	Police
2022	Tree Planting	Ministry of Forestry

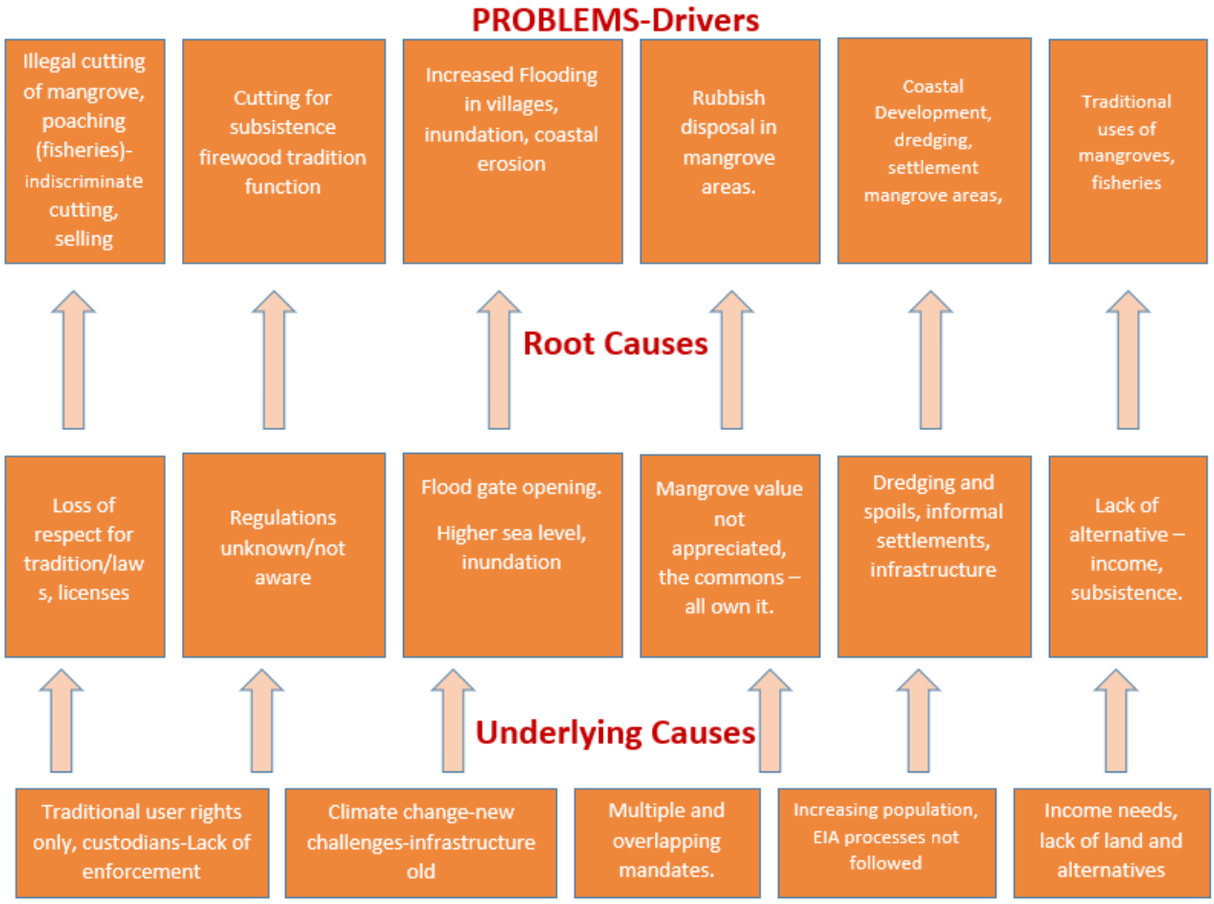
NAVILACA VILLAGE

SHAREHOLDERS MAPPING

YABAKI	PROJECT	TABANA NI MATANITU&NGO
1900s	seawall	RURAL DEELOPMENT
	WATER	PWD
	ELECTRICITY	ENERGY&EFL
	FOOTPATH WAVU VAKAVALE	RURAL DEVELOPMENT
1982	SEAWALL	MPI
1995	Road construction	PWD
2000S	FOOTPATH& Bridge to the village	RURAL DEVELOPMENT
	FOOD&BEVERAGE , HOUSEKEEPING	SERVICE PRO
	Business training	SPBD
	Resource management training	FLMMA
2007	CHURCH	S.D.L
2009	Seaweed plating	FISHERIES

2019	Community-based marine management	FLAMMA
2022	Awareness on mangroves reforestation, replanting	ITTO, Fisheries Department

Main drivers identified and root causes, underlying causes



How do we address these issues?

Skills training (TVET)- boat repair, waste management programs, work on protection of mangroves, community-based management of mangroves, awareness work on climate change and impacts and adaptation and mitigation work, work with the different government agencies on harmonizing regulations and joint trainings at Tikina and community level, awareness on existing policies and regulations and traditional user rights, institutions, structures and traditional compliance mechanisms.

PROBLEM SOLUTION EXERCISE

These exercises were done through focus group discussions and problems and root causes identified by the communities. The groups also discussed ways of addressing the problems. As shown in the table above, community exercises came out with basically similar concerns and root cause of problems.

Problems were mostly related to coastal erosion, flooding and inundation, indiscriminate rubbish disposal, overfishing and use of unsustainable fishing methods, continuous cutting of mangroves for firewood and other traditional uses, and non-compliance with existing laws.

In the District consultations that was held, some of the root causes of the problems identified were the basic lack of understanding of regulations relating to mangrove use and fishing in coastal areas, the need

for income and home and lack of available alternatives resulting in overfishing and use of harmful fishing techniques. Indiscriminate rubbish disposal and using of mangroves as rubbish dump was also seen as a consistent problem. There is also misunderstanding in ownership and user rights over mangroves and coastal areas by the state and traditional users/owners which result in people not adhering to regulations. Traditional understanding of ownership of resources result in indiscriminate use of mangroves and people from adjacent communities who have traditional rights to use do not need to request for use of resources. Thus the conflict in dual ownership, user rights, need to be made aware through consistent training and working with mangrove communities.

In this exercise, communities identify what they see as their problems and what underlying causes of these problems are**.**

NATUTU VILLAGE

CAUSE	ROOT CAUSE	SOLUTION
Litter in mangrove area	People are throwing rubbish carelessly everywhere	Awareness on litter Should dig more rubbish hole
Overfishing (crab)	Nawaqarua and Votua village are going past their fishing ground into ours	Awareness on sustainable fishing, use of resources
Mangrove are dying	Dredging	Look into dredging work
Selling of green mangrove	Need for income	Awareness about rules involving mangroves
Beach erosion	Force of water during flooding	Need a seawall
Overfishing	Licenses which are given	Need to relook about the fishing license
Using of dynamite during fishing	Easy way to catch fish	Ban dynamite

Muana I cake

Problem	Root Cause	Solution
Beach erosion	Deforestation and farming in the upper Rewa river	Build seawall
Flooding of village and plantation	River getting shallow	Dredging
Using of chemical to kill all type of fish	License to fish	Ban use of chemicals
Rubbish dumping	Rubbish from suva -kinoya treatment plant outlet in the ocean	Raise issue of Kinoya treatment Plant Awareness work needed
Illegal fishing **-lawasua,taga moci,tavitavi**	Overfishing	Enforce laws, place some areas on tabu
Increase in sea level	Coastal Erosion	Build Seawall
Continous Mangrove cutting	Resource are scarce	Sustainable cutting to be introduced, follow regulations

Votua,Ba

CAUSE	ROOT CAUSE	SOLUTION
Coastal erosion	River are setting shallow Dredging and sand mining	Need proper seawalls
Using of dynamite during fishing	No fish warden, easy way to look for money	Ban dynamite
Sugar factories dumping their waste water on our river killing fish and resources	EIA and other regulations not enforced	Awareness should be done about dumping of waste water, should visit industrial area at FSC
Cutting of mangrove	Lack of awareness	Enforcement of regulations to be strengthened.
Amex-always put rubbish on the side of the river	Dredging company cut a lot of mangrove Regulations not complied to by company	Enforcement to be strengthened
Using of compressor	Using improved equipment for fishing- to earn income	Ban use of compressors
Crab net(Basei)	Easy way to find money -no fish wardens	Ban crab net
Fishing license	Voice of the vanua/custodians no longer heard No respect for the vanua	Government should return the ownership of the Qoliqoli back to people/respect custodianship-user rights.
Flooding of village	Ba river mouth is too shallow	Ministry that look after Dredging can look into this

SOROKOBA VILLAGE

PROBLEM SOLUTION TREE

CAUSE	ROOT CAUSE	SOLUTION
Using of dynamite during fishing	-easiest way to get fish And earn money	Ban dynamite
Issue of fishing license without the consent of the fishing ground owner	-bulldoze tactic of government	Awareness on how the fishing ground owners voice can be heard
Coastal Erosion	Climate change	Build seawalls
Dredging spoils left in mangrove areas	Amex limited mining and dredging	EIA regulations to be enforced

7. AGENTS, DRIVERS AND UNDERLYING CAUSES OFMANGROVE DEFORESTATION, DEGRADATION

7.1 Direct drivers of deforestation and degradation.

Many respondents did not understand the difference between deforestation and degradation and said that both must be caused by the same drivers. **The highest cause of mangrove deforestation or degradation in the last 15 years in all sites studied has been damage caused by cyclone.** Causes of mangrove loss are mostly climate related (climate change and rising sea level or high water

Tropical Cyclone Winston in 2016 destroyed large areas of mangroves and people from the joint fishing grounds in Ra for example, have been cutting down dead mangroves for firewood in the last 6 years[6].

100% of households in Rewa, Ra, referred to logging of mangroves for firewood as the main direct drivers of mangrove deforestation and deforestation. 90% of those questioned cut down entire trees while 10% cut the trunks only. Total number of trees would be 5 and pieces of wood people expected to get out of each tree was 5 pieces of wood. 90% also stated that they harvested a few days every week for household use and for community use it a day every week. Amount harvested according to most respondents would be equal to a quarter of a rugby field while a few talked of logging of larger areas.

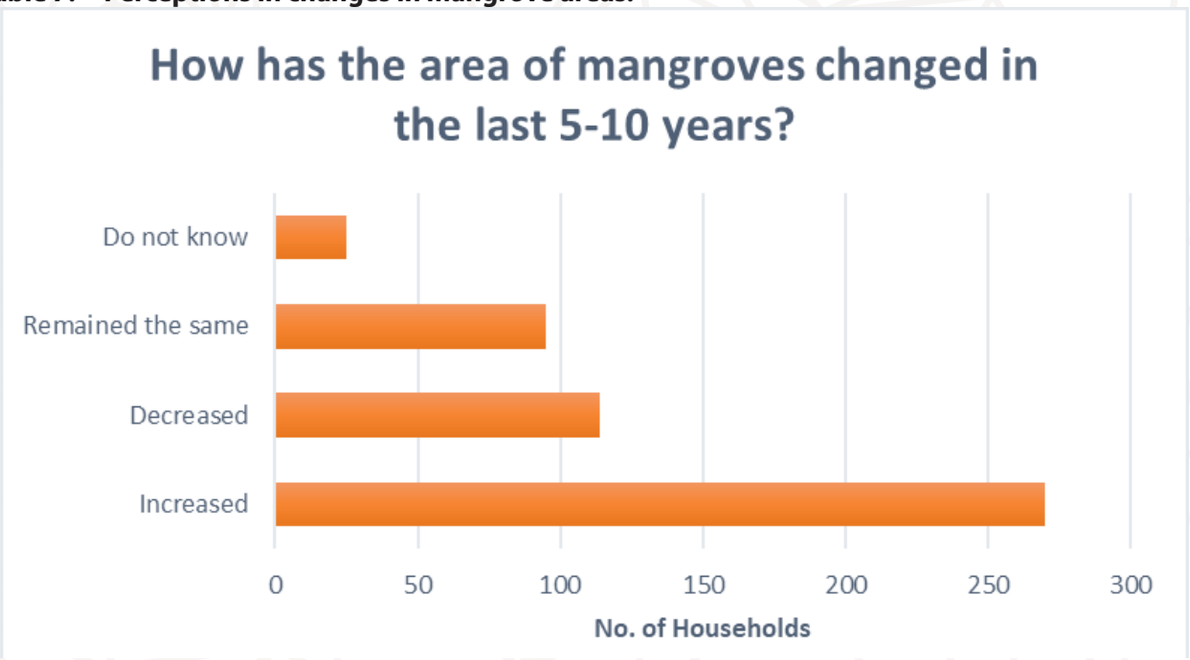
In the Ba area, the main socio-economic cause of deforestation are black sand mining, use of dynamite and dredging. The main drivers of mangrove loss is sand mining and dredging by Amex Company. Because of the mining and dredging, there has been significant coastal erosion especially around Nawaqarua and Votua communities. Other communities within the lower Ba river, including Sorokoba, are affected by the sand mining and dredging by Amex Company. The dredging spoils left in mangrove areas also degrade mangroves (from 2018).[7]

Logging of mangroves for firewood

Most households in mangrove locations are in rural, coastal areas with limited opportunities to find alternatives to fuel wood, and could not afford gas or kerosene, thus the high dependence on mangrove for firewood. In addition to this there is cutting of mangrove for housebuilding, cutting to sell, fishing activities within mangrove areas, removal of bark of whole trees for dye and other uses for cultural artefacts like garlands. Some parts of certain mangrove species are also collected from traditional medicine. The inter-tidal areas and areas around estuarine locations and inland swamps where there are mangroves are the most targeted for socio-economic uses.Through key people interviews and PRA sessions, in the last 15 years there has been marked decrease in mangroves in areas around the villages where there is mangrove removal for subsistence use. From household questions, people have the perception that there is nothing wrong with mangroves and most stated that there has been an increase in mangroves. According to the Table below, most stated an increase in mangroves. Thus conflicting perception can result in the lack of urgency to address the problem of deforestation and degradation of mangroves.

[6] Esler, S. (2016). *Post-Disaster Needs Assessment: Tropical Cyclone Winston, February 20, 2016.* Suva, Fiji: Government of Fiji.
[7] DoF. (2011). *Fiji REDD-Plus policy: reducing emissions from deforestation and forest degradation in Fiji.* Suva, Fiji: Government of Fiji / Ministry of Primary Industries - Department of Forestry & Secretariat of the Pacific Community. Retrieved

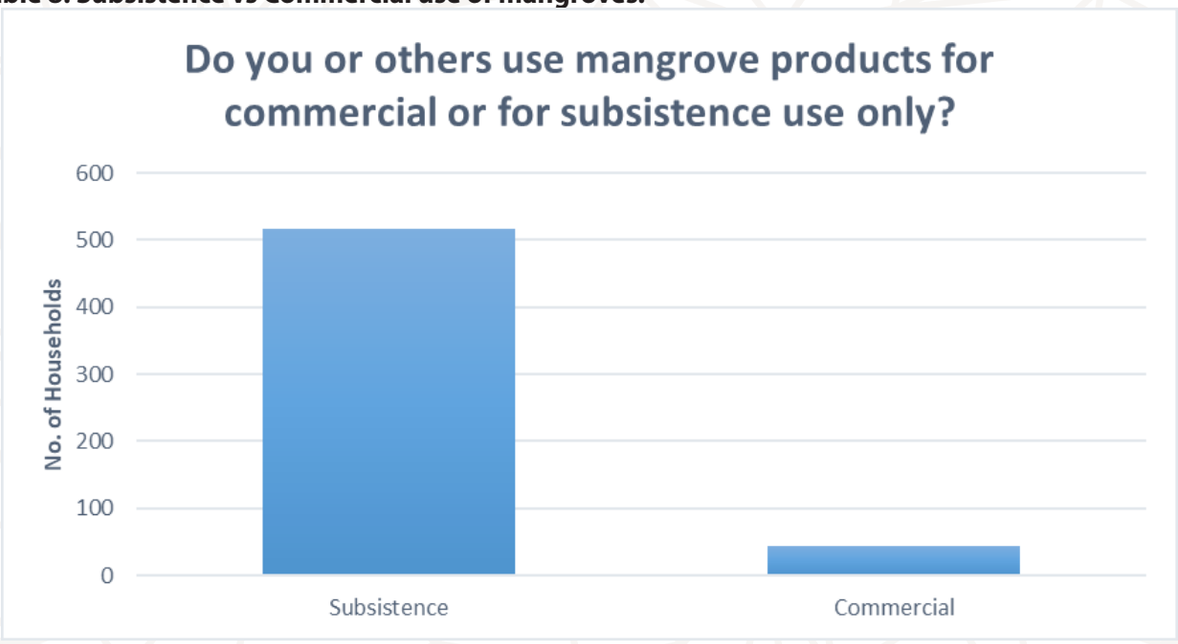
Table 7: Perceptions in changes in mangrove areas.



OVER-UTILISATION OF MANGROVES NEAR TO VILLAGES

While commercial harvesting activities conducted by communities require a license, small scale subsistence harvesting is not generally monitored. This results in poorly managed extraction activities conducted by communities and adjacent settlements to gather mangrove wood for funerals (as fuel during cremations), and to produce a red dye used for handicrafts from the colored mangrove sap (CI, 2020). In a survey on mangrove use in the Rewa Delta, it was obvious that villagers were generally aware of sustainable practices, but it was also evident that mangroves near the village were degraded, with visible signs of logging, bark removal, sapling damage, discarded domestic waste, and domestic animals grazing freely[8]. According to the table below the highest use of mangroves is for subsistence use and these activities will concentrate around the immediate community's areas.

Table 8: Subsistence vs Commercial use of mangroves.



[8] Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach

Subsistence use of mangrove as in the table below is weekly, thus it is on-going and will need measures to ensure that these cutting activities are sustainable and can sustain the mangrove areas in the long term.

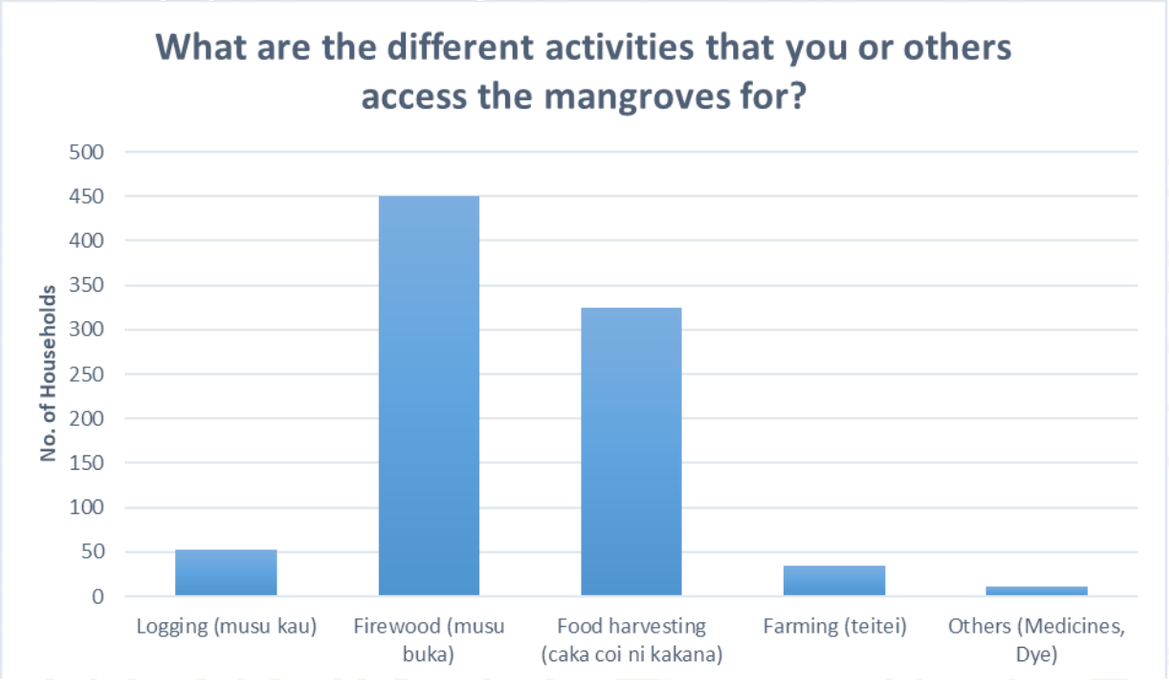
Table 9: Frequency of Cutting of Mangroves
Cutting of mangroves

Row Labels	
Biweekly	3
Daily	26
Every two weeks	4
Monthly	41
N/A	48
Occasionally	32
Only as needed	18
Rarely	25
Twice per year	2
Weekly	200
(blank)	10
Grand Total	**409**

Poorly Managed Extraction Activities
Direct causes for the continuing losses are poorly managed extraction activities conducted by communities and adjacent settlements to gather mangrove wood for funerals, weddings, fundraising activities (as fuel during cremations), and to produce a red dye used for handicrafts from the colored mangrove sap.

Small scale subsistence harvesting and fishing do not require a license
Commercial harvesting activities conducted by communities require a license, small scale subsistence harvesting is not generally monitored by the state. As in the table below subsistence use of mangrove is still significant when compared to other uses. Without licenses, mangrove use and removal can result in subsistence activities being uncontrolled and not monitored. When there are certain fish, seaweed or other species in season people will be tempted to sell products because of the availability and abundance of resources and these can be done on roadsides, in villages and to other people living in urban areas using the social media platform for example.

Table 10: What people harvest from mangrove areas



Illegal users of Resources

Main socio-economic cause of deforestation are illegal cutting from other villages and other users in peri-urban areas, firewood collection, dredging high firewood (Muana I cake), illegal cutting from other villages (Naivilaca) footpaths and other small scale construction into mangrove areas. Other threats are coastal erosion (Natilam Narocake), flooding and salt water intrusion into village (Natila, Matamoli, Waicoka, Nukui, Narocake) and higher sea level and salt water intrusion- Nukui & Tavuya

For other users of mangrove resources, illegal use by those that are not part of communities, is a rising threat, however, because of the communally owned nature of the I qoliqoli areas, there can be very wide disbursement of users and no way of tracking who should be using resources and who should not. The rights to use is for all within a yavusa, which is a collection of communities within one or several districts. Other people who are not from communities, but may live in settlements, some ask but most just use resources. Mangrove areas in the greater Suva perp-urban area for example, come under the traditional jurisdiction of the Rewa province, but the people and traditional regulations they have may not be applicable at all in these new settlements- because of distance, and lack of proper traditional enforcement mechanisms.

Rubbish Disposal

Mangrove areas are also extremely important to Fiji's sewage treatment program. Almost all of Fiji's municipal sewage plants are associated with mangroves, which are used as oxidation ponds, areas where solids are trapped and where effluent is discharged[9]

However, 100% of respondents from Nasilai indicated they use the mangrove for dumping domestic waste[10]. Overall, in a study done in the Rewa Delta recently found that deterioration of the mangrove forests caused by human activities was more obvious than the damage caused by the impacts of climate change[11]. All communities that were part of this study referred to rubbish disposal in mangrove areas as a major problem.

In the Ba Delta, when there is a major cyclone however, impact on mangrove areas is huge. The use of mangroves for subsistence use and house construction is also seen as contributing deforestation and

[9] Watling, 2013. Ibid.

[10] Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach

[11] Dyal, et al.2022 ibid

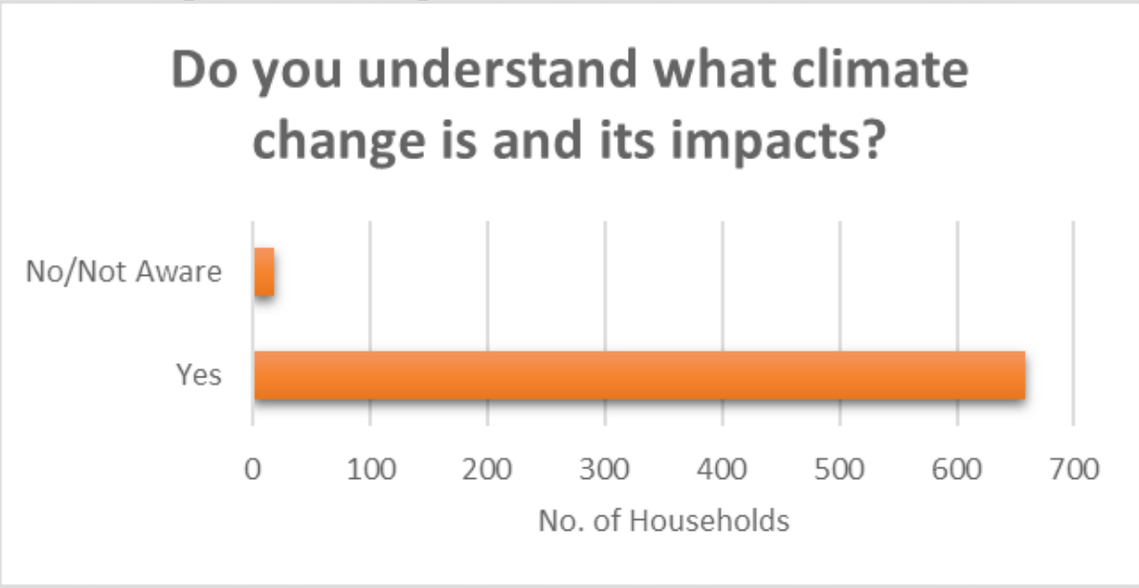
degradation. Illegal mangrove removal is also an ongoing challenge. There is also illegal fishing and use of unsustainable fishing methods by poachers.

Underlying causes of illegal mangrove cutting and illegal fishing is the lack if awareness of regulations, and the weak enforcement of mangrove regulations. Because qoliqoli areas are yavusa owned (custodianship) there is wide access to mangrove areas of those from Nailaga, residents who reside outside of the community.

7.2 Climate Change impact on mangroves

Salt water inundation of coastal areas, and coastal erosion. The most significant impact on mangroves has been Cyclone Winston (2016). Climate change impact on coastal communities has been flooding of village, during high tides

Table 11: Knowledge of Climate Change



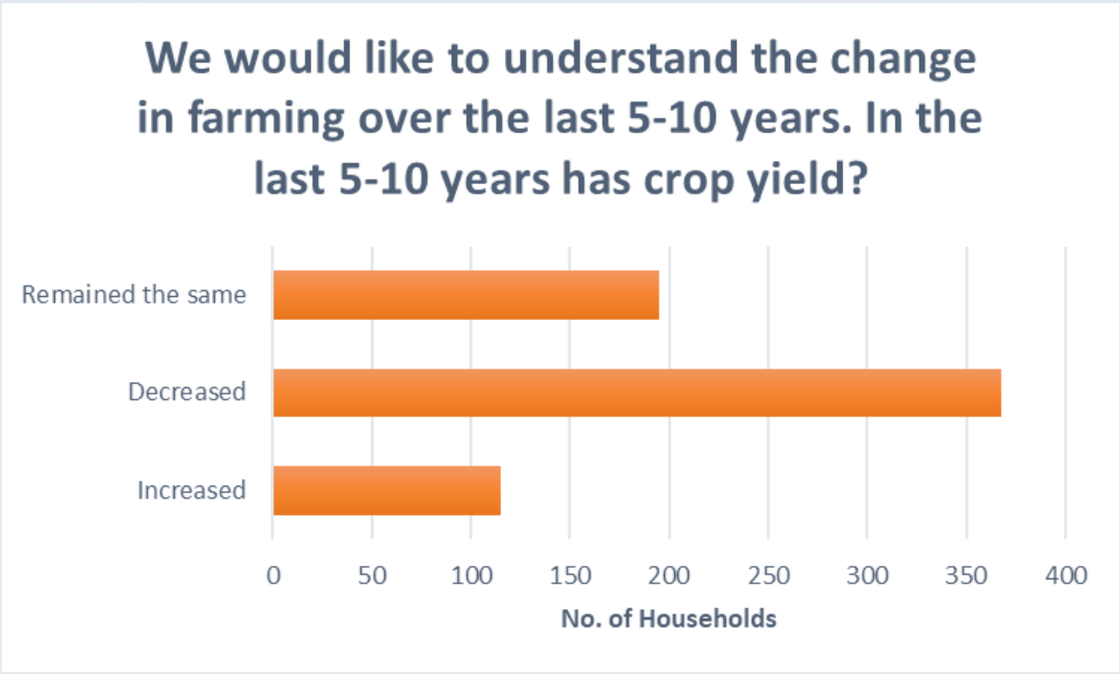
Most respondents were aware of climate change and climate change impacts and 68% of respondents made reference to constant weather change, regular droughts, and more rain which affect agriculture and fishing activities and fish abundance. Climate change and coastal erosion was also mentioned b y a few respondents as contributing to loss of mangroves and salt water intrusion into communities.

Climate Change Impact at Household Level

At household level, there were no evident changes in farming and agricultural products, farming patterns in the last 10-15 years, most did not know if any real change in agricultural practices and changes as a result of climate change. For river changes, 50% of respondents have seen no changes to the use of rivers and resources, while the other 50% stated they were catching lesser from rivers. For changes to marine resources availability and access in the last 10 years, there had been no changes to access and availability, although about half of all households said there were changes with the availability of resources. All households talked about unusual weather changes and these include more frequent flooding if village areas from salt water (100%), and this was associated with more rain, longer raining season. There was also mention of increasing occurrence of drought by some of the households.

For changes to marine resources availability and access in the last 10 years, there had been no changes to access and abundance, although about half of all households said there were changes with the availability of resources. All households talked about unusual weather changes and these include more frequent flooding if village areas from salt water (100%), and this was associated with more rain, longer raining season. There was also mention of increasing occurrence of drought by some of the households.

Table 12: Change in farming in 5- 10 years



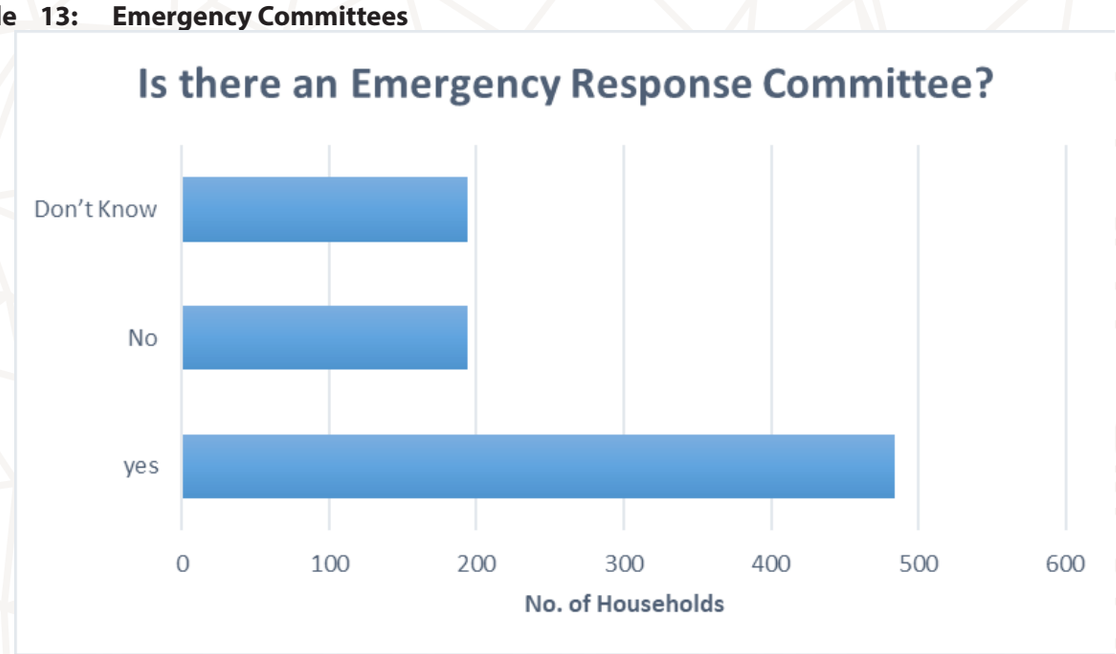
Changes witnessed by people that are perceived to be caused by climate change include rise in sea level, more rainfall, saltwater intrusion, longer dry season or droughts, higher tides. These have in fact caused coastal erosion, flooding in communities, loss of marine species or decrease in catches.

7.3 Disaster Risk Emergency Preparation

Communities were also consulted on the different types of preparation undertaken during disasters. Those living in coastal areas and within mangrove areas are some of the most affected during cyclones and natural disasters, thus the questions on emergency preparations.

There is an emergency response committee and most respondents know there is one in their different communities. All communities have evacuation centers, although not all are up to Category 5 standard.

Table 13: Emergency Committees



There have been evacuation drills undertaken in communities, but there are some respondents who have

no idea what these are.

Lesson from previous disasters
There is need for better preparation, and the need for a good evacuation center and health dispensaries in communities. There is need for cyclone proof standards on houses to be built, as communities suffer a lot of loss from sub-standard housing. There I also need for training for the Community Emergency (DRR) committees, to be better equipped to deal with disasters.

Evacuation Centers
There is minimal safe spaces for women in evacuation centers and evacuation centers are not disabled friendly, thus the need for better facilities at the evacuation centers.

Other drivers that contribute to deforestation and degradation of mangroves – from Participatory exercises that were held in communities.

Emergency Plans for Communities

Some people interviewed were aware of emergency plans for communities and some had undergone training on evacuation procedures. A very little number of households in communities were aware of there being emergency plans for the village, while half of households interviewed knew of Disaster committees in communities and the other half did not know of these committees or had no committees in the community. 80% of those interviewed had evacuation centers in their communities, and these were schools, churches, community halls and some used some homes in the community as evacuation centers. Most of these evacuation centers were not disability friendly and had no safe spaces for women as yet. A few respondents talked about their evacuation centers being up to Category 5 cyclone standard, while the majority did not know what "category 5 standard "meant and what the requirements f**or** being certified as a Category 5 evacuation center.

8.UNDERLYING CAUSES OF DEFORESTATION AND DEGRADATION

Lack of awareness
Collection for cremation has stopped but as discussed at the district level meeting, there is a lack of awareness of regulations that exist, for example the ban on cutting for commercial purposes, thus indiscriminate cutting continues even through this can be at a small scale, increase in population and informal settlements population can place pressure on these resources[12].

Lack of Enforcement of Regulations
There is a lack of enforcement of regulations for mangrove felling for commercial purposes (Watling, 2013) and the absence of an effective implementing agency for mangrove management and the MMP is a fundamental constraint to sustainable management of Fiji's mangroves.

Marine reserves have been established with environmental management plans but enforcement is clearly lacking because of lack of resources, lack of skilled labor, and unclear institutional arrangements

Overlapping mandates
Multiple mandates of Government Ministries over mangrove areas in Fiji, could be an underlying cause because with so many different agencies responsible, there is confusion and gaps that end up leading to deforestation and degradation. Legal enforcement mechanisms have also not changed attitude to mangrove use. Watling [13] made reference to the fact that the Environmental Management Act (2005) and its EIA Regulations (2007) appear to have had no positive impact at all on sustainable management of the mangrove resource, rather poor EIA preparation and review has enabled unsustainable mangrove management. Loss of small areas of highly conspicuous mangrove in urban and peri-urban areas to

[12] FTC. (2017). *Biodiversity Conservation and Protected Area Management: Training Program for Practitioners and Policy Developers.* Suva, Fiji: Government of Fiji / Ministry of Forests - Forest Training Center.
[13] Watling, D. (2013). *Mangrove Management Plan for Fiji.* Suva, Fiji: Mangrove Management Committee & MESCAL Fiji Project. 112

squatting and ill-conceived reclamations continues and galvanizes public concern[14].

High dependence for social livelihoods and income/lack of alternatives

Mangroves, lagoons and coral reefs are important sources of fish for subsistence and sale in Fiji (Zann and Vuki, 2000). In addition, most of the urban centres and a vast majority of villages are located on the shore, along with much of the population, agriculture, industry and commerce. Income from tourism and fisheries is directly tied to the condition and productivity of critical ecosystems and shoreline features such as coral reefs, beaches, seagrass beds and mangroves[15].

Thus, the dependence on food security and livelihoods will continue to accelerate given rapidly rising populations and expanding settlement and urban areas. Make the connection to mangroves: This fact will likely have implications for mangroves due to the products and foods extracted from them.

Mangroves, lagoons and coral reefs are important sources of fish for subsistence and sale in Fiji[16]

Expanding settlement/informal housing in urban/peri-urban areas

In addition, most of the urban centres and a vast majority of villages are located on the shore, along with much of the population, agriculture, industry and commerce. Income from tourism and fisheries is directly tied to the condition and productivity of critical ecosystems and shoreline features such as coral reefs, beaches, seagrass beds and mangroves[17]. Thus, the dependence on food security and livelihoods will continue to accelerate given rapidly rising populations and expanding settlement and urban areas. Make the connection to mangroves: This fact will likely have implications for mangroves due to the products and foods extracted from them.

Proximity of villages to mangrove areas

Where human habitation is close to, or within, the forests, over exploitation of mangrove resources can be evident on a local scale, with degradation occurring due to over harvesting of timber, the presence of non-native or non-mangrove plant species, dumping of domestic waste, and large amounts of plastic waste deposited along river channels and by tides[18] [19] This underlying cause is linked to urban expansion of informal settlements into mangrove areas.

High Rate of unemployment

In a study on drivers of deforestation and degradation in 2020, one of the main factors revealed in the Ba and Rewa delta was that the rate of unemployment was relatively high in both deltas, 71% in the Ba delta and 67% in the Rewa delta. Fishing, crab catching, and firewood collection were the main sources of income, with some secondary activities, including livestock rearing and the collection of medicine[20]). Although the dependency on mangrove resources differed in Ba and Rewa, the sale of goods was still an essential activity for the communities in both areas.

Illegal cutting and fishing activities

Main socio-economic cause of deforestation are illegal cutting from other villages and other users in peri urban areas, firewood collection, dredging high firewood (Muana I cake), illegal cutting from other villages (Naivilaca) footpaths and other small scale construction into mangrove areas. Other threats are coastal erosion (Natila Narocake), flooding and salt water intrusion into village (Natila, Matamoli, Waicoka, Nukui, Narocake) and higher sea level and salt water intrusion- Nukui & Tavuya. The problem of illegal users had been highlighted by Cooke[21] on his study on qoliqolis in Fiji. In this study, it was highlighted that mangrove degradation near to the villages is primarily due to human activities such as over-harvesting, bark removal, and dumping of domestic waste, and fishing activities. Illegal use of mangrove resources by nearby villages,

[14] Ibid, Watling, 2013.
[15] Thaman, R. R., Thomson, L. A., DeMeo, R., Areki, F., & Elevitch, C. R. (2006). Intsia bijuga (vesi). In C. R. Elevitch (Ed.), *Traditional Trees of Pacific Islands: Their Culture, Environment and Use.* Holualoa, Hawai'i, USA: Permanent Agriculture Resources
[16] Lal, P.2003. Economic valuation of mangroves and decision-making in the Pacific Graduate Studies in Environmental Management and Development, National Centre for Development Studies, Australian National University, Canberra ACT 0200, Australia
[17] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.
[18] Fiji Government. Ministry of Economy. 2018. Fiji Low Emission Development Strategy 2018–2050. Government of Fij
[19] Cameron et al, 2021. ibid
[20] Avtar et al, 2021
[21] Cooke, A., & Moce, K. (1995). *Current trends in the management of qoliqoli in Fiji.* Suva, Fiji: Secretariat of the Pacific Community

those from settlements and those from outside, has contributed to unregulated, uncontrolled removal and unsustainable use of trees. As stated by Veitayaki,[22] people's use of resources will continue to increase, thus management interventions need to be in place

Shift from subsistence to commercial

Mangroves around urban areas are particularly at risk from unsustainable harvesting, overexploitation, pollution, waste disposal, dredging, and development such as housing and industry, infrastructure for tourism[23]. Urban development and increasing informal settlements are underlying factors that can lead to unsustainable harvests, waste disposal and other associated threats to mangroves.

Another underlying cause of deforestation is predominantly the shift from a subsistence-based economy to a commercial (market-driven)/industrial-based economy. Population growth and social change (rural-urban drift, accelerating the removal of mangrove areas for settlement/development), increased demand for livelihood sources, economic growth and development, poverty, and unequal access to land[24]

Table 14: Awareness training Conducted

Removal of Mangrove- removal of buffer zones

Natural mangrove forests acting as buffer zones were removed during the construction phases, which also affected livelihoods of locals as fish disappeared from the area[25].

8.1 AGENTS OF CHANGE

Agents of deforestation and degradation

- The availability if markets distribution outlets and middle sellers who make selling of mangroves and mangroves product more feasible and more accessible.
- The market economy infiltrating rural coastal communities through middle sellers and those who set up purchasing schemes with communities.
- Changing food preferences – younger people have shifted focus from traditional food sources to imported and processed foods which at most times are far cheaper than traditional food. Thus

[22] Veitayaki, j. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies: linking local knowledge to science

[23] MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

[24] Veitayaki, J. (2002). Taking advantage of indigenous knowledge: the Fiji case. *Int. Soc. Sci. J.* 54, 395–402. doi: 10.1111/1468-2451.00391

[25] Bernard, K. & Cook, S., 2015. Luxury tourism investment and flood risk: Case study on unsustainable development in Denarau island resort in Fiji. *International Journal of Disaster Risk Reduction,* Volume 14, pp. 302-3011.

crabs and mangroves species which are a delicacy most urban dwellers has provided that niche for income generation- thus the continuous and consistent selling of mangrove products.

- Need to send children to school and modernisation in general has pushed people into activities outside of subsistence activities to just meet home consumption.

8.2 ACTORS AND AGENTS

Local populations/indigenous communities

I Taukei communities, who have inherent communal rights to use mangrove forest resources in traditional activities, such as the harvesting of firewood, collection of produce, and medicinal purposes.

People who reside in villages on the fringes of mangroves are the everyday users of mangrove forests

Land owners

Fiji recognizes customary land ownership as enshrined in the Constitution. The rights flowing from customary land ownership, including traditional forest use, are regulated in the legislation. Traditional forest use rights for subsistence and customary purposes include harvesting of wood for firewood and other traditional uses, the collection of forest produce for food and medicinal purpose

MoF, whose role is to regulate, develop, and enforce restrictions within mangroves. The Department of Environment, who is required to conduct an EIA for any commercial development in or within mangrove areas.

The Department of Lands and Department of Fisheries, who together – along with the MoF and Department of Environment – manage Fiji's mangrove resources. Department of Land for native logging in State Land as well as the establishment of Protected Areas in foreshore areas.

Local population, whose growth requires building materials and cleared land for expansion.

TLTB, whose consent is required for licenses to harvest timber on iTaukei land.

Buyers of wood and timber, who place increased demand on timber production for international markets. The Ministry of Tourism, along with hotels and tourism agencies, whose growth has placed increased demand on Fiji's energy production and transportation infrastructure.

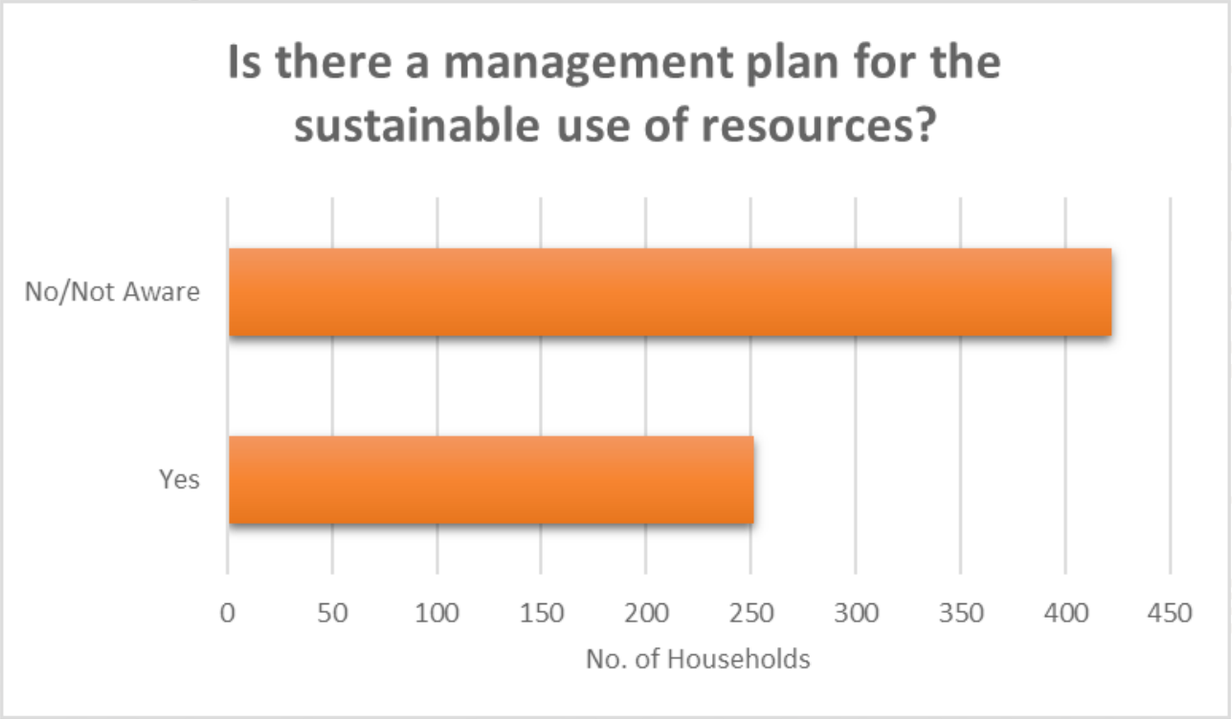
The Department of Environment, who is required to conduct an EIA for any development proposals, and also to enforce environmental codes and standards.

Forest Project under the 30 million trees in 15 years initiative which also focuses on mangrove restoration

9. MANAGEMENT

In all three provinces, there are some form of management interventions in all sites visited, half of those interviewed knew of any management interventions in place while some did not know if there were any management intervention in place (see Table 13 below). Logging is banned except for subsistence use and for traditional functions, but these rules are not really known to everyone. The management of mangroves within the Rewa Delta is regulated through a moratorium enacted in 2013 which prohibits commercial logging but allows for subsistence extraction by local communities, with predominately Bruguiera gymnorrhiza extracted for use as timber in community housing and squatter settlements. In this study, it was highlighted that mangrove degradation near to the villages is primarily due to human activities such as over-harvesting, bark removal, and dumping of domestic waste, and fishing activities. Illegal use of mangrove resources by nearby villages, those from settlements and those from outside, has contributed to unregulated, uncontrolled removal and unsustainable use of tress

Table 15: Management Plans



Mangrove replanting has taken place in communities eg (Daku, Natila) ITTO, with the Department of Forestry and most of the communities undertake mangrove replanting as part of village projects

In the Ba area, there were no management interventions in all sites visited. Mangrove cutting for commercial purposes is now banned, and this was a major driver of mangrove deforestation and degradation. Mangrove cutting for subsistence use is allowed, however, monitoring of how much is cut is a problem and there can still be indiscriminate cutting especially close to communities, because of lack of enforcement.

Mangrove replanting

There has been replanting of mangroves and this has been work done by NGOs, the USP and government (Ministry of Waterways) in Nailaga and Sorokoba districts. The University of the South Pacific (and FLMMA) have also worked in the Nailaga district especially in Votua on community-based mangrove management.

Barriers and Opportunities.

A few respondents said there were traditional management interventions in place, but many did not understand the regulations or management in place. Management interventions in place included partial and total ban on mangrove cutting. These bans had been in place for more than 5 years. The bans were working and in only one case, the bans were lifted annually. For other management interventions, there had been replanting if mangroves in four of the sites visited.

Other initiatives undertaken in communities include mangroves replanting by the women's groups and as part of village initiative or supported by NGOs. These community-based replanting projects had been successful in almost all cases

10. SUMMARY AND RECOMMENDATIONS

They is very high dependence on mangrove resources for social and economic livelihoods. People have user rights to these resources, they have a wealth of knowledge and skills relating to mangrove resources, thus will continue to use that right and the knowledge they have to use resources for economic needs.

Many of the regulations on mangrove use, fisheries and general resource use are not known to those who are users of resources at the community level, thus the non-compliance in many areas. There is no legislations to monitor subsistence use of mangroves and its resources and this could lead to unsustainable use when there are traditional functions or when traditional relationships are used to access and use resources.

Most of the information collected through key people interviews, the participatory focus group discussions and the household questionnaires mace out with the same socio-economic drivers and underlying causes of deforestation and degradation. Mangrove cutting for firewood and subsistence uses like fishing is the primary socio economic driver. Direct causes for the continuing losses are poorly managed extraction activities conducted by communities and adjacent settlements to gather mangrove wood for funerals, weddings, fundraising activities (as fuel during cremations), and to produce a red dye used for handicrafts from the colored mangrove sap.

In the District consultations that was held, some of the root causes of the problems identified were the basic lack of understanding of regulations relating to mangrove use and fishing in coastal areas, the need for income and home and lack of available alternatives resulting in overfishing and use of harmful fishing techniques. Indiscriminate rubbish disposal and using of mangroves as rubbish dump was also seen as a consistent problem. There is also misunderstanding in ownership and user rights over mangroves and coastal areas by the state and traditional users/owners which result in people not adhering to regulations. Traditional understanding of ownership of resources result in indiscriminate use of mangroves and people from adjacent communities who have traditional rights to use do not need to request for use of resources. Thus the conflict in dual ownership, user rights, need to be made aware through consistent training and working with mangrove communities.

Underlying causes of deforestation include the lack of awareness of regulations that exist, for example the ban on cutting for commercial purposes, the lack of enforcement of regulations, overlapping mandates. With mmultiple mandates of government Ministries over mangrove areas in Fiji, could be an underlying cause because with so many different agencies responsible, there is confusion and gaps that end up leading to deforestation and degradation. Legal enforcement mechanisms have also not changed attitude to mangrove use. High dependence for social livelihoods and income/lack of alternatives, which continue to accelerate given rapidly rising populations and expanding settlement and urban areas. Rural urban shift, expanding settlement/informal housing in urban/peri-urban areas and increasing demand for food and employment push people to exploit mangrove resources. In addition mining and extraction activities are not well managed, people do not usually access EIA reports and dredging spoils plus mining impacts are not monitored with mitigation measures put in place.

RECOMMENDATIONS

There is need to address these underlying causes of deforestation through thorough consultations with people who live in mangrove areas, and working in collaboration with government agencies that have authority over mangrove areas and NGOs, CSOs who already are doing work in communities.

The need for alternative sustainable livelihoods in mangrove dependent locations is a priority and there has to be alternatives that will ensure the shift of focus away from mangrove areas or post processing activities that will result in the more sustainable, smarter use of resources.

Working within existing traditional structures at community level, is important with customary management mechanism and traditional compliance mechanisms included in community based management work, or protection work like mangrove replanting, building of seawalls and other such activities.

Rebuilding of sea walls and planting of mangroves where there is coastal erosion, economic livelihoods projects to be supported or developed, putting in place management interventions that are community-based and works with existing structures like the Yabula Management Committees at the district and community levels, and working on enhancing existing projects that target mangrove protection are some of the main suggestions from consultations undertaken.

There is also need for province wide, district level workshops and capacity building and awareness work targeting mangrove management and protection. All trainings should have documentation of traditional knowledge and skills as a component.

Emergency preparations in all communities must be addressed in workshops to be conducted at community and district levels.

BIBLIOGRAPHY

Avtar, R et al 2021 Impacts of Changes in Mangrove ecosystems in the Ba and Rewa Delta.

Bernard, K. & Cook, S., 2015. Luxury tourism investment and flood risk: Case study on unsustainable development in Denarau island resort in Fiji. *International Journal of Disaster Risk Reduction,* Volume 14, pp. 302-3011.

Cooke, A., & Moce, K. (1995). *Current trends in the management of qoliqoli in Fiji.* Suva, Fiji: Secretariat of the Pacific Community.

Cameron, C; Maharaj,A; Kennedy, B;Tuiwawa,S; Goldwater,N' Soapi,K; Lovelock, c. 2021.Landcover Change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. In Environmental Challenges, Volume 2.

Chattier, P., 2015. Women in the House (of Parliament) in Fiji: What's Gender Got to Do with It?. The Commonwealth Journal of International Affairs, 104(2), pp. 177-188

Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach

Dayal, S; Waqa-Sikiti,H; Tabe,T; Hodge, S. 2022. An integrated evaluation of mangrove health and ecosystem value to local inhabitants: a blended ecological and sociological approach

Esler, S. (2016). *Post-Disaster Needs Assessment: Tropical Cyclone Winston, February 20, 2016.* Suva, Fiji: Government of Fiji.

Fiji Government. Ministry of Economy. 2018. Fiji Low Emission Development Strategy 2018–2050. Government of Fij

Lal, P.2003. Economic valuation of mangroves and decision-making in the Pacific Graduate Studies in Environmental Management and Development, National Centre for Development Studies, Australian National University, Canberra ACT 0200, Australia

GoF. (2017b). *The Fiji National REDD+ Programme.* Suva, Fiji: Government of Fiji / Ministry of Fisheries and Forests. Retrieved from http://fiji-reddplus.org/fiji-national-redd-programme

MESCAL, 2013. Review of Policy and Legislation Relating to the Use and Management of Mangroves in Fiji, IUCN.

Ravuvu, A. (1988). *Development or Dependence: the Pattern of Change in a Fijian Village.* Suva, Fiji: University of the South Pacific, Institute for Pacific Studies.

Thaman, B; Vunisea,A; Naikatini, ZA and Gaunavinaka,T. 2003.Background on Fiji's Mangrove Resources, Mangrove Area and Distribution 2003.

Thaman, R. R., Thomson, L. A., DeMeo, R., Areki, F., & Elevitch, C. R. (2006). Intsia bijuga (vesi). In C. R. Elevitch (Ed.), *Traditional Trees of Pacific Islands: Their Culture, Environment and Use.* Holualoa, Hawai'i, USA: Permanent Agriculture Resources

GoF. 2018.Fiji Bureau of Statistics. Fiji Statistics, 2018.
CI, 2020.

Veitayaki, j. 2004. Building bridges: the contribution of traditional knowledge to ecosystem management and practices in Fiji Bridging scales and epistemologies: linking local knowledge to science

Veitayaki, J. (2002). Taking advantage of indigenous knowledge: the Fiji case. *Int. Soc. Sci. J.* 54, 395–402. doi: 10.1111/1468-2451.00391

ANNEX VII

ASSESSMENT OF CARBON STANDARDS AND METHODOLOGIES FOR THE PACIFIC BLUE CARBON PILOT PROJECT IN FIJI

Dr Clint Cameron
Conservation International
2023

This report (1.) summarizes the mangrove forest carbon offset interventions which are being designed for each location under the Pacific Blue Carbon Pilot Project (the 'Project'), and (2.) assesses each against relevant voluntary carbon market standards and methodologies. It then (3.) provides a preliminary recommendation as to which standard and methodology to adopt.

Summary of forest carbon offset interventions planned under the Project.

The differing drivers of landcover change coupled with the relative spatial extent of mangrove forests suggest several options for implementing management activities under the Pacific Blue Carbon Pilot Project.

Table 1: Potential interventions for blue carbon projects for Fiji. Adapted from Cameron *et al.* (2021).

Intervention types	Location	Description
Afforestation, reforestation, revegetation (ARR)	Ba Delta, Viti Levu Bay	ARR combines some or all of the three elements of afforestation, reforestation and revegetation. It covers activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (REDD Desk 2020). Afforestation involves establishing vegetative cover on lands that were not previously vegetated. In the context of blue carbon in Fiji, for instance, ARR projects could involve the restoration of mangroves degraded by activities such as agriculture (e.g. conversion to sugarcane), clear-felling, dredge spoil placement, or damaged by tropical cyclones (i.e. reforestation or revegetation). The damage incurred from tropical cyclones within the Ba Delta and Viti Levu Bay may present an opportunity to develop interventions focused on augmented or assisted recovery under an ARR framework.
Avoided deforestation	Rewa Delta	This project type includes activities that reduce net GHG emissions by stopping or reducing planned or unplanned deforestation or degradation on forest lands (REDD Desk 2020). For instance, this might involve cancelling a clear-felling logging concession for planned activities on state land, or working with communities to reduce the level of unplanned deforestation activities like illegal and ad-hoc logging. For mangrove restoration projects, the 'enhancement of forest carbon stocks' part of REDD+ is most relevant as it fits within a restoration ambit through, for example, restoring degraded mangrove forests for sustainable timber harvesting where such activities lead to an overall enhancement of carbon stocks.
Improved forest management	Rewa Delta	Forest management activities which result in increased carbon stocks within forests and/or reduce greenhouse gas emissions from forestry activities when compared to business-as-usual forestry practices (REDD Desk 2020). For instance, this might entail shifting from clear-felling of forests to selective logging which would result in net carbon gains.

Voluntary carbon market standards and methodologies

A voluntary carbon market standard refers to the complete set of rules, procedures, and methodologies according to which certified carbon credits are generated and issued. Carbon standards are developed and governed by various organizations, typically in the form of international non-governmental organizations (NGOs) which consist of a standard-setting arm, a regulatory arm, and validation and verification bodies (VVBs) usually outsourced to independent third-party auditors (Climate Focus 2022). The standard provides a set of project design, monitoring, and reporting criteria against which carbon offsetting activities and/or projects environmental and social co-benefits can be certified or verified. In the voluntary markets, a number of competing standard organizations have emerged with the intent to increase credibility in the marketplace. More recently, national and sub-national regulated markets have also designed standards specific to regional needs for voluntary use (Ecosystem Market Place 2022), such as the Woodland Carbon Code in the United Kingdom and the Thailand Voluntary Emission Reduction Program (Climate Focus 2022). Carbon standards certify both carbon projects and facilitate the trade of carbon credits. Standards issue one credit for each metric ton of GHG emissions avoided, reduced, or removed, as measured in tons of carbon dioxide equivalents (tCO_2e). In this way, the standards convert certified GHG emission reductions and removals into tradable carbon credits. To obtain certification and be issued carbon credits to trade,

voluntary carbon market projects and programs must comply with the processes, rules, safeguards and apply methodologies approved by the standards. Projects also need to provide evidence of compliance generated by activity managers and reviewed by an independent third-party auditor. Carbon standards use registries to track all credits generated, transfer tradable credits, and trace transactions between buyers and sellers (Climate Focus 2022).

A methodology provides the requirements for calculating emissions reductions and removals for specific categories of forest carbon projects (e.g. the carbon calculation requirements for a REDD+ project differ from those of a reforestation project). Voluntary offset standards each have a list of approved methodologies that they accept. Note that selection of a particular standard does not necessarily preclude the use and application of the carbon assessment frameworks from other methodologies. For example, Plan Vivo enables a project to devise their own methodology for calculating emissions reductions, whereas the VCS is much more prescriptive and requires a specific assessment framework to be followed for estimating emissions reductions and removals using one of their methodologies. However, you are still able to apply the rigor for assessing emissions reductions and removals which the VCS requires to a Plan Vivo project. For example, the Vanga Project in Gazi Bay, Kenya, is a Plan Vivo Project that uses the VCS's VM0033 as its main methodology for assessing emissions reductions and removals. It is worth noting that Verra also allows methodologies to be developed where no existing methodology addresses specific needs[1].

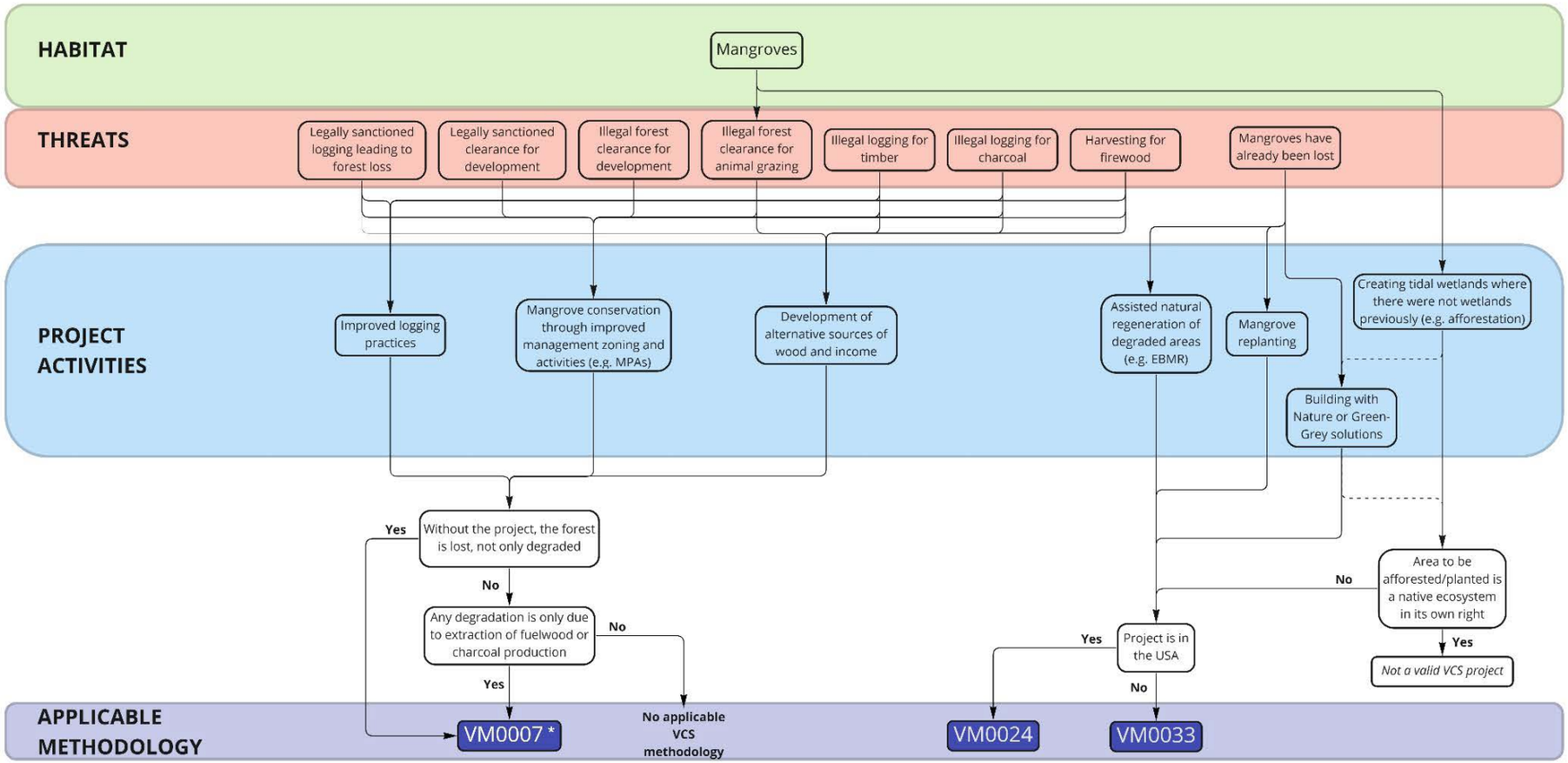
Of importance, there are also standards that certify contributions of voluntary carbon market activities to Sustainable Development Goals (SDGs). SDG standards complement carbon standards by adding additional certifications for projects that generate economic, social, biodiversity, or other benefits in addition to climate change mitigation. These standards establish requirements and methodologies for designing, monitoring, verifying, and validating contributions to SDGs. Some SDG standards offer sustainable development labels to attach to carbon credits that demonstrate SDG benefits, and some standards allow projects to issue sustainable development credits that can be traded independently from carbon credits. For example, Verra, administers the Climate, Community and Biodiversity Standard (CCB). Most CCB projects relate to sustainable land management with a focus on improving livelihoods and creating employment opportunities, protecting traditional cultures and endangered species, securing land tenure to lands and access to resources, and increasing ecological resilience. The CCB Standards can be applied to any land management project and standard, not just those under the VCS (Thomas 2020). Verra also administers the Sustainable Development Verified Impact Standard (SD VISta) labels, while the Gold Standard has developed the Global Goals (GS4GG). SD VISta and GS4GG issue tradable credits that represent project contributions to the SDGs (Climate Focus 2022). Of importance, if mangrove carbon projects are able to quantify the full range of benefits provided (e.g. biodiversity, food provisioning, and water quality benefits) and are certified to holistic schemes such as the CCB Standards or the Plan Vivo Standard, this may help with attracting a premium from potential private and public sector carbon offset investors and purchasers. It means that even relatively small-scale projects are potentially economically feasible from carbon offset funding perspective (Cameron *et al*. 2019). Plan Vivo, for example, had the lowest share by volume in the voluntary market as of 2021 (0.7 M credits issued compared to 125.6 M for the VCS) but attracted the highest purchase price on average (USD $11.58 per credit compared to USD $4.17 for the VCS. Table 3), although there can be significant variation in price among different project types and standards[2].

The most relevant voluntary market standards and methodologies for mangrove restoration and conservation projects are summarized in Table 2 and Table 3, while Table 4 summaries mangrove forest carbon projects from around the world. Of the 19 mangrove forest carbon projects that have been developed or are undergoing development to date, most (14) use Verra VCS as the requisite standard while VM0007 (REDD+ Methodology Framework) and AR-AM0014 (Afforestation and reforestation of degraded mangrove habitats) are the most popular methodologies. While a number of projects employ a mix of both reforestation and conservation (avoided emissions) activities, the reporting documents associated with these projects often do not differentiate either the spatial scale (ha) or emissions reductions and removals (tCO_2e) generated from these different activities, which makes it difficult to draw robust comparisons (e.g. tCO_2e ha from reforestation activities). Figure 1 provides a decision tree to help guide project proponents as to which VCS methodology to select.

[1] The following website provides more detail: https://verra.org/project/vcs-program/methodologies/develop-a-new-methodology/

[2] Blue carbon Verified Carbon Units, for example, under Verra often attract a much higher price (>USD $25 per VCU. Amy Schmid pers. obser).

Figure 1: Decision tree to guide selection of appropriate VCS methodologies for mangrove restoration projects. Source: Leah Glass, Blue Ventures / Silvestrum.



* If the project's host country includes mangroves in their definition of forests AND the mangroves are not growing on peat AND the change in the soil carbon pool due to project activities is insignificantly small (*de minimus*), then methodologies VM0006, VM0009 or VM0015 can theoretically be applied to mangrove conservation projects. The tidal wetland (mangrove, seagrass and saltmarsh) conservation components from VM0007 are in the process of being migrated to VM0033. Once this is completed and validated by Verra, VM0033 will serve as the sole methodology needed for tidal wetland projects.

Table 2: Overview of carbon standards and methodologies of relevance for mangrove restoration projects.

Standard	Summary of the Standard	Methodologies and relevance for mangrove restoration projects
Verified Carbon Standard (VCS)	The VCS, administered by Verra, was founded by key players in global carbon markets including the International Emissions Trading Association, the World Business Council for Sustainable Development, The Climate Group, and the World Economic Forum (Thomas 2020). The majority of VCS projects are in renewable energy and forestry (Thomas 2020). Link: https://verra.org/project/vcs-program/	The VCS has developed a number of methodologies of relevance for mangrove restoration and avoided emissions projects, including: • VM0007 REDD+ Methodology Framework (REDD+MF), v1.6 • VM0024 Methodology for Coastal Wetland Creation, v1.0 • VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v1.0 • VM0010 Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.3 Verra also administers AR-AM0014: Afforestation and reforestation of degraded mangrove habitats (Version 3.0), which was initially approved in 2013 under the (now superseded) Clean Development Mechanism, although new projects will not be able to register using this methodology after August 2022[3]. Additionally, Verra are developing a new methodology for biochar[4] which could be applicable for mangrove ecosystems. The organization will also serve as the independent standard setter for a 'Seascape Carbon Initiative' which incorporates other blue carbon ecosystems such as kelp and activities such as sustainable fishing and seabed management.
Gold Standard (GS)	Gold Standard was established in 2003 by WWF and other international NGOs to ensure projects that reduced carbon emissions featured the highest levels of environmental integrity and also contributed to sustainable development. In total, Gold Standard has issued 191 million carbon credits from projects based in more than 98 different countries around the world (Gold Standard 2022), with the majority (98.2 M) of carbon credits generated from Southeast Asia followed by Africa (36.2 M). The Gold Standard does not issue carbon credits for REDD+ projects due to concerns about environmental integrity, including the ability to control leakage (when deforestation activities move to another area) and risks for overestimation of credits due to baseline uncertainty. Link: https://www.goldstandard.org	Gold Standard has had an approved methodology for the certification of mangrove Afforestation/ Reforestation (A/R) projects since 2013 which is based on the much broader 'Gold Standard A/R Requirements'. The changes for mangrove A/R Projects are that 90% of the planting area needs to be planted with mangrove species, and that an additional 1.8 tCO_2 ha^{-1} $year^{-1}$ can be accounted for soil organic carbon accumulation in the first 20 years. The methodological requirements are much less scientifically rigorous than the VCS. They are currently exploring opportunities to develop new methodologies for innovative blue carbon approaches, including a Sustainable Mangrove Management Methodology (Forliance is the developer). The methodology will include innovations in the remote sensing and geographic information sectors combined with the participatory stakeholder engagement to address the sustainable management of the mangrove ecosystem. This innovative methodology will incorporate alternative monitoring and reporting approaches to overcome the increased complexity and risk

[3] Verra is phasing out AR-AM0014 (https://verra.org/verra-replaces-cdm-ar-am0014-and-ar-ams0003-methodologies-with-vm0033-methodology-for-tidal-wetland-and-seagrass-restoration-v2-0). Projects that are not listed or starting the validation process by August 2022 will not be eligible to use AR-AM0014 anymore (and must use VM0033 or VM0007).

[4] Biochar is a carbon-rich material derived from biomass, such as agricultural and forestry residues, by pyrolysis in a closed container with either limited or no oxygen. The application of biochar in soil creates environmental and ecological benefits, such as reducing greenhouse gas emissions, acting as an environment-friendly adsorbent to reduce nutrient leaching, enhancing nutrient retention, and improving the chemical and physical properties of soils (Be *et al*. 2021).

		associated with in-person monitoring (Forliance 2022). https://globalgoals.goldstandard.org/standards/PRE-GS4GG-AF/ar-guidelines-mangroves.pdf
American Carbon Registry (ACR)	The American Carbon Registry (ACR), a nonprofit enterprise of Winrock International, was founded in 1996 as the first private voluntary greenhouse gas registry in the world. In both the regulated and voluntary carbon markets, ACR oversees the registration and verification of carbon offset projects following approved carbon accounting methodologies or protocols and issues offsets on a transparent registry system. Each offset represents the reduction or removal from the atmosphere equivalent to one metric tonne of carbon dioxide. The offsets products are specific to ACR's distinct operations in the California compliance market, International Civil Aviation Organization, and the global voluntary carbon market. In the voluntary market, ACR oversees the registration and independent verification of projects that meet ACR's science-based standards and follow ACR-approved carbon accounting methodologies. Link: https://americancarbonregistry.org/	ACR registers offset projects from a range of project types of relevance to mangrove restoration, including: • Afforestation and Reforestation (A/R) of Degraded Lands; • Improved Forest Management (IFM); • Restoration of Pocosin Wetlands; and • Restoration of California Deltaic and Coastal Wetlands. Note that offset projects do not have to be based in the USA, but (like all other Standards) projects need to follow an ACR approved methodology.
Climate Action Reserve (CAR)	CAR began as the California Climate Action Registry, which was created by the State of California in 2001 to address climate change through voluntary calculation and public reporting of emissions. CAR serves as the registry for California's Cap and Trade Program. CAR is also running a pilot emissions trading system in Mexico from 2020-2023. Link: https://www.climateactionreserve.org/about-us/	CAR has established the Forest Protocol (FP), which provides guidance for the development of forest carbon projects. The FP addresses eligibility and accounting requirements for the calculation of emissions removals and reductions associated with: • Improved forest management, and • Avoided conversion projects. Forest Protocol projects must be within the U.S, although Avoided Conversion projects may also be within U.S. Territories (e.g Guam). CAR have also developed the Forest Carbon Protocol for Mexico, and there are two projects that use this methodology (Manglares Ursulo Galvan and Manglares San Crisanto).
Plan Vivo	Plan Vivo was developed in 1994 through a desire to help communities plant trees in Chiapas, Mexico. The project, called Scolel'te, is a collaboration between the University of Edinburgh, El Colegio de la Frontera Sur, and other local partners, with the first voluntary carbon markets credits issued in 1997. The Plan Vivo Standard is a set of requirements used to certify smallholder and community projects in developing countries based on their climate, livelihoods and environmental benefits. It is the longest-standing carbon standard in the Voluntary Carbon Market, with 20 projects actively issuing credits (Climate Focus 2022, Plan Vivo 2022). Of importance, V5.0 of the Plan Vivo Standard has just closed (as of July 2022) for public consultation. Among several other changes from the 2013 version of the Standard are new *methodological* and *verification* requirements. Under the 2013 version of the Plan Vivo Standard projects could submit their own	There are three mangrove projects currently registered with Plan Vivo: Tahiry Honko in Madagascar, and Mikoko Pamoja and Vanga in Kenya. Mikoko Pamoja (Gazi Bay, Kenya) is the world's first blue Carbon project and receives Plan Vivo Certificates for the conservation of its mangrove forests (see Case Study 4.5). The project has now expanded to include a new site nearby, Vanga, which is currently under development. While Plan Vivo had the smallest share of the voluntary carbon market as a standard as of 2021, conversely it attracts the highest price per credit. This is largely due to the emphasis on co-benefits (aside from carbon) and represents a good option for small scale mangrove restoration projects.

	bespoke 'Approved Approaches' to estimating climate benefits or apply a generalised Approved Approach that had been reviewed and accepted by the Plan Vivo Foundation. Under the new version of the Standard, projects may only apply methodologies that meet the criteria outlined in the Methodology Requirements and that have been prior approved by the Plan Vivo Foundation (Plan Vivo 2022). In other words, Plan Vivo are tightening up the rigor on how projects measure and report carbon offsets. The other major change concerns the scale of a project and whether independent third-party verification is required or not. Projects with the capacity to generate climate benefits of less or equal to 10,000 tCO_2 annually are considered microscale, and those above10,000 tCO_2 annually are considered macroscale. Whether a project is considered macroscale or microscale will influence the routes by which a project can be audited. Specifically, macroscale projects must undertake validations and verifications using Validation & Verification Bodies (VVBs), whilst microscale projects can complete validations and verifications through the Internal Validation and Verification Process. The objective of of this change is to minimise the financial pressure of the auditing process on the smallest of projects, whilst also maintaining a high level of quality assurance to buyers (Plan Vivo 2022). Link: https://www.planvivo.org	
Architecture for REDD+ Transactions, the REDD+ Environmental Excellence Standard (ART/TREES)	ART/Trees is a new standard launched in 2020. ART/TREES formulates and administers standardized procedures for crediting emission reductions and removals from government-sponsored national or large sub-national programs for Reducing Emissions from Deforestation and Degradation Plus (REDD+). ART/TREES is geared to certify large volumes of GHG emission reductions and removals. The first Letters of Intent for transactions involving jurisdictional credits certified under ART/TREES were signed in November 2021 (Climate Focus 2022).	When ART/Trees is approved it may have relevance for large scale mangrove restoration projects such as those planned in Pakistan and Indonesia, provided 'restoration' fits within the ambit of REDD+ via the 'enhancement of forest carbon stocks' (see Section 2.6).

Table 3: Summary of market volumes, geographical and sectoral scopes of the main voluntary market standards. Adapted from Climate Focus (2022) with data sourced from Ecosystem Market Place (2022), Plan Vivo (2022), and Fair Carbon (2022).

Standard	Market volume (M = million)*	Market price (USD $)**	Name of credits issued	Geographical scope	Sectoral scope	No. mangrove projects registered or under development
Verified Carbon Standard (VCS)	125.6 M	$4.17	Verified Carbon Units	1,792 registered projects in 82 countries. VCS is dominant in developing countries	Covers all project classes	14
Gold Standard (GS)	5.2 M	$3.94	Verified Emission Reductions (VERs)	1,313 registered projects in 80 countries. Credits are purchased especially by buyers in the European Union.	Covers most project classes, but excludes project-level REDD+. After 2025, will only cover credits backed by corresponding adjustments[5].	0
American Carbon Registry (ACR)	2 M	$11.37	Emission Reduction Tons (ERTs)	156 projects in the United States	Covers industrial processes, land use, land use change and forestry, carbon capture, and waste.	0
Climate Action Reserve	4.9 M	$2.12	Climate Reserve Tons (CRTs)	26 projects in the USA, 2 in Mexico.	Covers agriculture and forestry, energy, waste, and non-CO2 GHG abatement (e.g. methane reductions from livestock).	2
Plan Vivo	0.7 M	$11.58		20 projects registered around the world.		3

* Market volume of registered credits in 2021 (up until August). Sourced from Ecosystem Market Place (2022).

** Average purchase price of carbon credits as of August 2021 (USD $). Sourced from Ecosystem Market Place (2022).

[5] Corresponding adjustments are applied to balance accounting under the Paris Agreement. For example, an emission reduction is removed from the accounts of the selling country and added to the accounts of the buying country. Corresponding adjustments ensure that governments reporting under the Paris Agreement meet good accounting principles and that no GHG reduction or removal is accounted for twice (Climate Focus 2022).

Table 4: Summary of attributes for mangrove projects listed on voluntary carbon markets.

Project Name	Location	Site area (ha)	Activities implemented	Website	Standard	Methodology	Project progress	Annual credits issued
Tsimipaika Bay Mangrove Carbon Project	Tsimipaika Bay, NW Madagascar	5,077 ha	Conservation and reforestation		Verra VCS	VM0007	Under development	12,500
Tahiry Honko	Madagascar	1,230 ha	Conservation (establishment of protected area, sustainable timber harvesting), reforestation of mangroves in deforested areas, improved forest management (establishment of alternative timber plantations)	https://www.planvivo.org/Handlers/Download.ashx?IDMF=39070798-4292-4797-9ab2-7db77a9afe63	Plan Vivo	Tahiry Honko technical specifications	Accredited and available	1,371
Mikoko Pamoja	Gazi Bay, Kenya	117 ha	Reforestation	https://aces-org.co.uk/mikoko-pamoja-project/	Plan Vivo	Custom	Accredited and available	2,000
Vanga	Gazi Bay, Kenya	460 ha	Afforestation/Reforestation, Avoided deforestation	https://www.planvivo.org/vanga	Plan Vivo	VM0033, CDM tool AR-Tool14, IPCC (2013) Guidelines for National Greenhouse Gas Inventories: Wetlands	Under development	5,019
Community based avoided deforestation project in Guinea-Bissau	Guinea-Bissau	145,698 ha (mixed mangroves / terrestrial)	REDD+ (avoided deforestation in two national parks, including the 74,700 ha Cacheu Mangrove National Park)	https://registry.verra.org/app/projectDetail/VCS/2324	Verra VCS	VM0007	Accredited	90,330
Livelihoods Senegal	Casamance, Senegal	10,414 ha	Reforestation of degraded mangroves	https://livelihoods.eu/portfolio/oceanium-senegal/ https://registry.verra.org/app/projectDetail/VCS/1318	Verra VCS	AR-AM0014	Accredited	30,000

Senegal and West Africa Mangrove Programme (SWAMP)	Sine Saloum, Senegal	42 ha restoration, 1,700 ha conservation	Restoration and conservation (REDD+)	https://registry.verra.org/app/projectDetail/VCS/2406	Verra VCS	VM0007	Under development	Estimated at 2,547
Manglares Ursulo Galvan	Tabasco, Mexico	1,200 ha	Reforestation and conservation (development of channels to lesson risk of fire)	https://www.facebook.com/search/top?q=ejido%20%C3%BArsulo%20galv%C3%A1n	Climate Action Reserve	Forest Protocol for Mexico	Under development	Unknown
MarVivo	Baja California Sur, Mexico	22,000 ha + 137,000 ha (potential MPA area)	Protection of mangroves	https://marvivo.earth/project-areas/magbay/	Verra VCS, Verra CCB, SD VISta	Unknown	Under development	Unknown
Mangroves of Sinaloa Mexico	Mexico, Sinaloa	49,387 ha (unclear size of reforestation area vs. avoided deforestation)	Reforestation and conservation (avoided unplanned deforestation and degradation under REDD+) – reduce deforestation caused by shrimp farming	https://registry.verra.org/app/projectDetail/VCS/2518	Verra VCS	VM0007	Under development	Estimated at 3,123,836
Manglares San Crisanto	Yucatan, Mexico	691.5 ha	Removal of impediments for natural regeneration, hydrological restoration	https://thereserve2.apx.com/mymodule/reg/TabDocuments.asp?r=111&ad=Prpt&act=update&type=PRO&aProj=pub&tablename=doc&id1=1428	Climate Action Reserve	Forest Protocol for Mexico	Accredited	Unknown

Bonos del Jaguar Azul	Yucatan, Mexico	5,060 ha	Restoration (active), restoration (passive), conservation of intact mangroves	https://registry.verra.org/app/projectDetail/VCS/2500	Verra VCS	VM0033	Under development	48,518
Mangrove Restoration and Sustainable Development in Myanmar	Ayeyarwady, Myanmar	4,500 ha	Restoration of degraded mangroves	https://registry.verra.org/app/projectDetail/VCS/2088 https://wif.foundation/ongoing-projects	Verra VCS	AR-AM0014	Under development	Estimated at 403,831
Thor Heyerdahl Climate Park	Ayeyarwady, Myanmar	2,100 ha	Restoration of degraded mangroves	https://wif.foundation/ongoing-projects	Verra VCS	AR-AM0014	Accredited and available	12,413
Livelihoods Yagasu	**Aceh and North Sumatra, Indonesia.**	11,000 ha	Restoration of degraded mangroves (planting)	https://livelihoods.eu/portfolio/yagasu-indonesia/ https://registry.verra.org/app/projectDetail/VCS/1493	Verra VCS, Verra CCB	AR-AM0014, CCB First Edition	Accredited	124,706
Zhanjiang Mangrove Afforestation Project	Guangdong, China	400 ha	Afforestation	https://www.climateimpact.com/global-projects/mangrove-reforestation-china/	Verra VCS, Verra CCB	AR-AM0014	**Accredited**	5,880
Delta Blue Carbon	Indus Delta, Pakistan	350,000 ha	ARR	https://registry.verra.org/app/projectDetail/VCS/2250	Verra VCS, Verra CCB	VM0033, CCB Third Edition	Undergoing validation	2,407,629
Vida Manglar	Columbia	7,561 ha (project area). Area of reduced forest loss = 5,381 ha	REDD+	https://registry.verra.org/app/projectDetail/VCS/2290	Verra VCS, Verra CCB	VM0007, CCB Third Edition	Accredited	31,310
India Sundarbans Mangrove Restoration	India	4,403 ha	Reforestation	https://registry.verra.org/app/projectDetail/VCS/1463	Verra VCS	AR-AM0014	Accredited	51,249

CONCLUSIONS AND RECOMMENDATIONS

The size, scale, and potential volume of carbon offsets able to be generated under the Pacific Blue Carbon Pilot Project[3] is likely to be relatively small when compared to other mangrove restoration and conservation projects (Table 4) designed for the voluntary forest carbon market (median project size: 4,452 ha; median volume of credits per year: 30,000; median credits per ha^{-1} per $year^{-1}$: 5.9). At this stage it is also uncertain if an avoided deforestation and / or improved forest management project is warranted for the Rewa Delta. However, and as noted in section 2, smaller scale carbon projects may still be feasible and economically justifiable if co-benefits are measured and reported against standards such as Plan Vivo or the CCB Standards as they tend to attract a premium price from credit purchasers. The project should also be framed in terms of helping Fiji meet climate change mitigation and adaptation targets. Additional, tangible outcomes would include capacity building and education opportunities which are important for long-term sustainable management.

For the planned project interventions under the Pacific Blue Carbon Pilot Project, either Plan Vivo or Verra VCS (along with certification to CCB and SD VISta) appear to be good options as accrediting standards, provided there is a strong, robust methodology in place for assessing community and biodiversity benefits (as there is planned for assessing carbon offsets). Plan Vivo is undergoing changes to methodological and verification requirements (see Table 3) which will improve authenticity but likely increase costs given the higher technical reporting 'bar' to meet, while methodological and verification requirements under Verra VCS are already the most rigorous of all standards. The Gold Standard, CAR, and ACR do not seem particularly suited for Fiji owing to the geographical scope of their project. These standards have a project market which is focussed on Europe (Gold Standard) and the USA and Mexico (ACR and CAR), whereas Verra VCS and Plan Vivo are more predominant in developing countries. In terms of methodologies, the recently released VM0033 is of most relevance for an assisted or augmented recovery project in the Ba Delta and Viti Levu Bay, while VM0007 and VM0010 will provide guidance for an avoided deforestation and improved forest management project in the Rewa Delta respectively (pending assessment of viability).

Table 5: Options for developing mangrove carbon offset projects in Fiji.

Intervention type	Location and extent (ha)	Description	Recommended standard	Recommended Methodology
Afforestation, reforestation, revegetation (ARR)	Ba Delta, Viti Levu Bay	Assisted or augmented recovery of mangrove forests damaged by tropical cyclones.	Either Plan Vivo or Verra VCS, along with CCB (3rd Edition) and SD VISta.	VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v1.0
Avoided deforestation	Rewa Delta*	Regulate unplanned reforestation from unsustainable extractive use of mangrove resources to avoid carbon emissions.		VM0007 REDD+ Methodology Framework (REDD+MF), v1.6
Improved forest management	Rewa Delta*	Improving the sustainability of extractive use of mangroves to result in net carbon gains.		VM0010 Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.3

* Pending the outcome of upcoming studies to assess the extent and degree of deforestation within the Rewa Delta. This will determine whether an avoided deforestation and / or improved forest management project is warranted and viable.

[3] The project size for initial pilot restoration activities is ~68 ha in the Ba Delta and ~40 ha in Viti Levu Bay, while the Rewa Delta is 7,100 ha in extent with avoided deforestation / improved forest management activities modelled across 4,362 ha of interior mangroves. Using modelling reported in the 'Fiji Blue Carbon Site Selection Report' (Conservation International 2020), this equates to 1,890 credits per year from the assisted or augmented recovery of the Ba Delta and Viti Levu Bay pilot sites (108 ha total, 17.5 tCO_2e ha^{-1} $year^{-1}$) and 18,434 credits per year (4.2 tCO_2e ha^{-1} $year^{-1}$) from avoided deforestation and / or improved forest management in the Rewa Delta.

REFERENCES

Be, S., Vinitnantharat, S., & Pinisakul, A. (2021). Effect of Mangrove Biochar Residue Amended Shrimp Pond Sediment on Nitrogen Adsorption and Leaching. *Sustainability*, *13*(13), 7230.

Cameron, C., Maharaj, A., Kennedy, B., Tuiwawa, S., Goldwater, N., Soapi, K., & Lovelock, C. E. (2021). Landcover change in mangroves of Fiji: Implications for climate change mitigation and adaptation in the Pacific. *Environmental Challenges*, *2*, 100018.

Climate Focus. (2022). What is the role of carbon standards in the voluntary carbon market? Accessed June 2022 from: https://vcmprimer.org/chapter-7-what-is-the-role-of-carbon-standards-in-the-voluntary-carbon-market

Climate Action Reserve. (2019). Forest Project Protocol V5.0. https://www.climateactionreserve.org/wp content/uploads/2019/10/Forest_Project_Protocol_V5.0.pdf

Conservation International (2020).Fiji Blue Carbon Site Selection Report.

Ecosystem Marketplace. (2022). Carbon market summary. Accessed June 2022 from: https://data.ecosystemmarketplace.com

Fair Carbon (2022). Accessed June 2022 from: https://faircarbon.org/content/fc/projectmap

Forliance. (2022). Sustainable Mangrove Management Methodology. Accessed June 2022 from: https://forliance.com/news/2021/09/14/forliance-is-developing-a-sustainable-mangrove-management-methodology-with-gold-standard

Gold Standard. (2022). Accessed June 2022 from: https://www.goldstandard.org

Plan Vivo (2022). Accessed June 2022 from: https://www.planvivo.org/

The REDD desk. (2020). Accessed June 2022: https://theredddesk.org

Sapkota, Y. & White, J. R. (2020). Carbon offset market methodologies applicable for coastal wetland restoration and conservation in the United States: A review. *Science of The Total Environment*, 701, 134497.

Thomas, S. (2020). Introduction to climate finance and carbon markets. In: *Costal blue carbon training for policy makers*. Coral Triangle Centre, Bali, Indonesia 2020.

Lal, P. (1990). Conservation or conversion of mangroves in Fiji: An ecological economic analysis. Environment and Policy Institute, East-West Centre. Occasional Paper No. 11. Honolulu, Hawaii.

Watling, D. (1985). A mangrove management plan for Fiji. Government Press, Suva. pp. 67.

Pillai, G. (1985). Mangrove of Fiji their uses and management. In Field C. D., and Dartnall, A. J., eds., Mangrove Ecosystems of Asia and the Pacific, pp. 150-160. Australian Institute of Marine Science, Townsville.

Tuiwawa, M., Pene, S. and Tuiwawa, S. (eds.) (2013). A Rapid Biodiversity Assessment, Socio-Economic Study and Archaeological Survey of the Rewa River Mangroves, Viti Levu, Fiji. IUCN Oceania.

Avtar, R., Navia, M., Sassen, J. and Fujii, M. (2021). Impacts of changes in mangrove ecosystems in the Ba and Rewa deltas, Fiji using multi-temporal Landsat data and social survey. Coastal Engineering Journal 63(3): 386-407.

Conservation International – Fiji
2024

ISBN 978-982-101-715-2