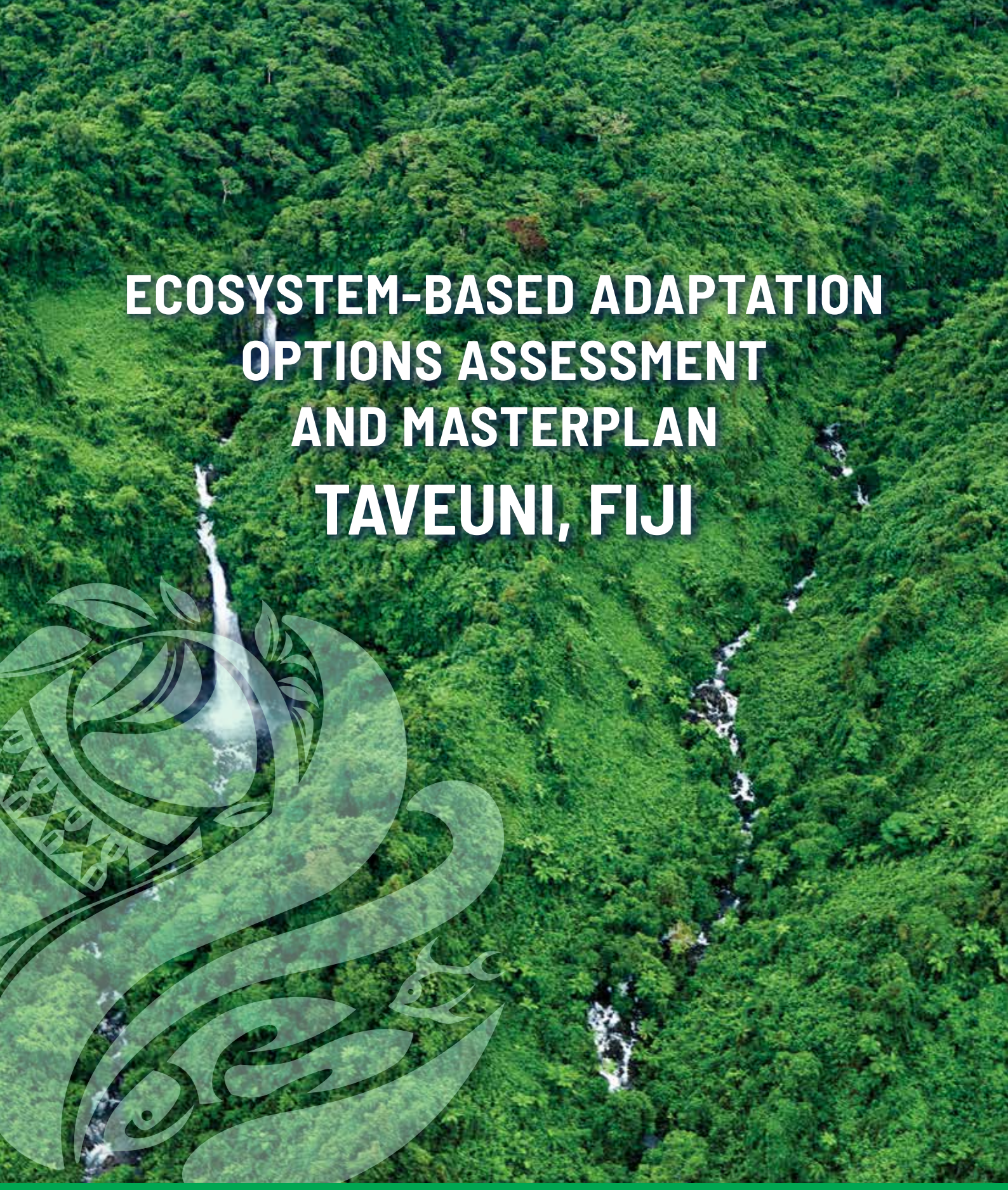

ECOSYSTEM-BASED ADAPTATION OPTIONS ASSESSMENT AND MASTERPLAN

TAVEUNI, FIJI

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

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ECOSYSTEM-BASED ADAPTATION OPTIONS ASSESSMENT AND MASTERPLAN

TAVEUNI, FIJI

A report prepared by the Pacific Ecosystem-based Adaptation to Climate Change Project (PEBACC)

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CONTENTS

ACRONYMS

BMU	German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
DFC	Desired Future Condition
EbA	Ecosystem-based Adaptation
ESRAM	Ecosystem and Socio-economic Resilience Analysis and Mapping
IKI	International Climate Initiative
LMMA	Locally Managed Marine Area
MPA	Marine Protected Area
NDVI	Normalised Difference Vegetation Index
NGO	Non-Governmental Organisation
NRM	Natural Resource Management
PEBACC	Pacific Ecosystem-based Adaptation to Climate Change
PPOA	Pacific Partnership on Ocean Acidification
SPREP	Secretariat of the Pacific Regional Environment Programme
TRTC	Tutu Rural Training Centre
YMST	Yaubula Management Support Team

GLOSSARY

Dalo	a starchy root crop, also known as taro (*Colocasia esculenta*)
Mataqali	traditional landowners, clans
Tabu	forbidden, usually with respect to use or approach
Vanua	traditional community chiefly structure also as it pertains to local community
Yaqona	a root crop also known as kava (*Piper methysticum*)

EXECUTIVE SUMMARY

This project identifies a range of Ecosystem-based Adaptation (EbA) options that support ecosystem function and the community's continued access to ecosystem services. The goal is to provide opportunities for the necessary organisation, planning, policy, capacity, and actions that help communities build resilience to the effects of climate change and non-climate-related forces of change, including mitigating the effects of current and historic land uses.

This document directly follows a background ecosystem and socio-economic resilience analysis and mapping (ESRAM) document that identifies key vulnerabilities associated with ecosystem services. This document serves to address those vulnerabilities in a range of considered options for Taveuni that can be implemented through time, with immediate recommendations to begin the third phase of implementing EbA options as part of the PEBACC project.

Ecosystem services under threat with considered EbA interventions include:

- forest health and extent – expand native forest into abandoned agricultural lands in high elevations;
- soil productivity – change agricultural and agroforestry practices to create diverse agroecological systems;
- riparian function – attenuate terrestrial run-off to the marine environment;
- biodiversity – expand forest conservation, native forest restoration and reforestation; decrease fragmentation; monitor invasive species and diversity in agricultural systems;
- storm surge protection – enhance coastal ecosystems, where appropriate, including expansion of mangroves;
- freshwater sustainability – protect and expand high elevation forests to slow run-off and increase cloud and rainwater infiltration to groundwater supply;
- sustained food supply – protect marine resources, improve habitats, realise potential for aquaculture and diversity of crops; and
- sustained income and independence – shift reliance on income from cash crops to diversified investment that enhances ecosystems.

A sustained effort to work with communities of Taveuni yielded a range of positive outcomes, including an organising structure for ridge-to-reef management involving watersheds and watershed stakeholder groups. These groups have networked with their local community members across ownerships to identify needs and priorities for improving ecosystem functions and delivery of ecosystem services through time. Through a stewardship approach, communities helped to identify EbA options in the following categories:

- organisational, policy and planning: ten EbA activities, ranging from youth programmes to developing markets for sustainably harvested products,
- training and pre-requisite activities for implementation: nine focused training and guidance applications that are practical for use in implementing different site-level interventions, ranging from agricultural enhancement and agroforestry to high-value and ecologically beneficial forest projects; and
- watershed-level actions: a wall-to-wall map of 15 primary and secondary implementation actions in 11 watersheds to be conducted over a range of elevations, ownerships and ecosystem types where intervention would create opportunity and build community and ecosystem resilience.

This report details the above EbA options in each category and provides a summary of watershed desired future conditions based on social and ecological needs. Priority criteria involving cost, benefit, timing, durability and feasibility are evaluated against all major EbAs, along with capacity needs and other known synergies, where applicable. The suite of EbA actions were evaluated by each watershed group to evaluate the status of 'readiness' to execute a plan that is guided, but in large part is self-derived, to implement active, field-based interventions to yield measurable results and eventual improvement in the supply and delivery of ecosystem services.

The PEBACC project has an implementation phase lasting approximately two years. A goal for this document is to evaluate and recommend a course of action for the PEBACC project. It will also serve as a guide for other donors and projects having similar objectives. Three scenarios are evaluated as to how funds can be deployed to best meet objectives, evaluating trade-offs of the three portfolios. A portfolio emphasising training and capacity is recommended, which would implement the following:

- creation of a Taveuni watershed coordination network to allow for financial support for a watershed coordinator position in each watershed and the opportunity for watershed groups to have quarterly meetings to discuss natural resource management issues, seek guidance and assistance, and review outside support from government, NGOs, or other organisations in executing watershed management plans;
- a youth stewardship programme with 'living classrooms' to provide curriculum development and materials to support local schools in learning about ecosystems and stewardship, with a plant nursery and 400 trees (~1 ha of forest), and the opportunity for youth to increase their connections with the environment at an early age;
- training in plant nursery construction and management with funds to build a central nursery for the school (above) and 12 more to be distributed throughout Taveuni's watershed communities;
- training in native plant seed collection with a specific interest in conservation of genetic and species diversity and building a network among watershed groups to source and distribute seed stock across the island;
- agricultural improvement and diversification trials to create a robust study plan and support a graduate student to run experimental trials to emphasise productivity and yield associated with different soil amendments and diversified cropping systems, including agroforestry options. Additional funds are allocated for an estimated 25 ha of agricultural improvement across Taveuni that can support the study;
- training for developing and managing agroforestry ecosystems involving a range of food-based crops as well as higher-value hardwoods;
- training for plantation management and certified sustainable products markets for both native- and non-native high-value hardwoods, and initiating potentials for value-added processing; and
- support for materials to plant trees to accommodate supplies needed for a minimum of 55 ha of agroforestry, plantation and native forest expansion EbA actions that feed into watershed group plans to plant self-grown trees.

With appropriate delegation of funds and monitoring implementation and effectiveness (where time and size permit), the options presented here offer a low-risk, performance-based strategy to deploy support towards increasing options for community members, and the breadth and magnitude of ecosystem services over time.

This EbA options assessment is designed to be a useful tool for other donor or implementing agencies to distribute capacity and resources to the broadest stakeholder groups possible, as well as increase depth and knowledge on important factors affecting resource management and policy.

1. INTRODUCTION

1.1 THE PEBACC PROJECT

Increased sensitivity of the Pacific Islands to environmental, social and economic change has prompted the need to seek and implement strategies that strengthen communities through interventions that buffer the supply and diversity of ecosystem services. The Secretariat of the Pacific Regional Environment Programme (SPREP) with funding from the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) through the International Climate Initiative (IKI) initiated a four-phase project to seek and implement a strategy to strengthen communities through ecosystem-based adaptation (EbA) and management activities. The Pacific Ecosystem-based Adaptation to Climate Change (PEBACC) project is focused to identify, prioritise and implement EbA strategies to meet critical needs in three countries (Fiji, Vanuatu and Solomon Islands) at different scales: national, provincial, urban and island scales.

The key objective of the PEBACC project is to identify what climate change factors and what suite of other circumstantial factors are limiting socio-economic resilience, particularly as it pertains to ecosystem services and the resilience of these services through time, and to prescribe a range of EbA actions that can broaden the range of possibilities for communities through the enhancement of ecosystem services.

There are five milestones of the five-year PEBACC project.

1. Ecosystem and socio-economic resilience analysis and mapping (ESRAM). Baseline studies to identify vulnerabilities in ecosystem services at different scales to identify needs for adaptation planning.
2. EbA options assessments. A range of EbA activities that would build resilience in targeted areas. Options are prioritised based on a range of criteria, including benefits, feasibility, durability and cost.
3. Implementation plans. A plan of action for deployment of funding and capacity support to be delivered at appropriate scales.
4. Implementation of EbA options. Commence activities according to the implementation plans, with monitoring and adaptation where appropriate.
5. EbA and policy implications. Synthesis of how EbA activities support community and ecosystem resilience, and what successful approaches should be considered for future policies for the host country and communities.

1.2 SUMMARY OF ESRAM STUDY

Deforestation, conversion to agriculture and abandonment over the past 100 years has had a profound effect on the ecosystems and supply of ecosystem services for Fiji as a country, and to its third-largest island, Taveuni. The landscape effects of land cover change from native forest to fallow grasslands and coconut plantations have contributed to fundamental changes in the surface water hydrology, species assemblages, and ecosystem responses of the landscape to attenuate land-based pollution to the neighbouring lagoons and reefs.

In the past 20–30 years, there has been an influx of small-scale farmers to Taveuni, many displaced from expired land leases or declines in the sugarcane market from Vanua Levu. Given that Taveuni has disproportionately high freehold land tenure compared with the rest of Fiji (approximately 33% vs. 8% nationally), and the strong demand for root crops dalo (taro) and yaqona (kava root), there was a rush on Taveuni lands for both local and displaced farmers to capitalise on short-term gains to meet the booming the market demand, especially for dalo export to New Zealand and elsewhere.

As is well documented and evidenced throughout the tropics, soil nutrient pulses from deforested lands allow for short-term productivity for agricultural uses, with the time of productivity depending on soil type and years and intensity of use. Intensive agricultural use most often depletes these nutrients in short timeframes, leaving degraded soils that can be difficult to rehabilitate without the re-establishment of nutrient-rich biomass and nutrient cycling.

For Taveuni, the dalo industry is the most documented example of the decline in productivity, serving as the local embodiment of the effects of the land conversion cycle on ecosystem function seen elsewhere in the world. From 1994 to 2004, dalo productivity on a per hectare basis dropped by 80% from 30 to 6.6 tonnes/ha. To meet continuing market demand for international export, and on seeing short-term success of the initial wave of farmers, the industry boomed. Nearly 12 times the land area entered cultivation, mostly through progressive movement upslope by small-scale farmers into intact and degraded forest lands, further repeating the cycle in short timeframes. Currently, productivity and total tonnes of dalo are in decline, leaving many farmers on small freehold parcels with unfertile soils and few options, causing migration into upper elevations (through formal lease agreements or not) to continue production, further changing the ecosystem. This cycle often begins with planting of high-value and shade-tolerant yaqona in shade break areas, followed by removal of the overstory trees within 1–3 years of planting yaqona, and dalo interplanted to (in many cases) eventual abandonment.

The effects of land uses on the marine environment, especially by sediment pollution run-off, have amplified vulnerabilities associated with subsistence fisheries and habitat health. There are local efforts under way that identify community fishing habits, with Taveuni communities producing periodic locally-managed no-catch tabu areas to relieve pressure on marine populations, although these are largely community-based and not formally enforced. Locally-based marine management areas and marine protected areas (MPAs) have been emerging, but local authorities do not have the capacity to enforce or otherwise manage them and require assistance with training and organisation. Taveuni is known as a marine tourism destination and community linkages

between habitat condition and revenue from tourism appears to be emerging. However, assistance with entrepreneurial planning and execution of conservation-based tourism in the hospitality industry is needed to increase success.

A few communities have capitalised on ecotourism as a conservation and income-earning tactic, particularly in the Wainikeli District of eastern Taveuni. This has resulted in a steady income for communities that host hiking and snorkelling tours, although TC Winston in 2016 largely disrupted the tours and destroyed infrastructure. This shifted community focus to rebuilding their homes and villages, causing a decline in tourism revenue.

Conservation efforts of the upper elevation forests in eastern Taveuni appear to be effective, although recent imagery (post cyclone, 2016) shows evidence of potential degraded conditions in the Ravilevu Nature Reserve and the Taveuni Forest Reserve areas (collectively known here as the Reserve), concentrated mostly in the upper elevations. This is thought to be due to storm damage. This, and the high prevalence of aggressive weed and vine species in surrounding areas, means there is a high risk that the largest primary forest of Taveuni (and one of the largest in the country) could be under increased threat of degradation, loss to biodiversity, fragmentation and forest biomass collapse. This is a serious threat, requiring focused national and international attention.

Industry on Taveuni is supported by a distributed network of hotels, guides and dive operators, as well as commercial-scale fruit, nut and vegetable farmers, and a few aquaculture farmers (pearls, giant clams, etc.). There are several non-governmental organisations (NGO) serving natural resource management objectives, including invasive species management, rural agriculture, and adult and youth training services.

For most communities on Taveuni, financial stress and razor-thin margins are deeply affecting livelihoods and choices people can make with respect to natural resource management. Dependence on short-term income, subsistence, increasing costs, and declining productivity are central features to Taveuni community life, and these circumstances are further stressed with even minor or short-term climate events, including damage through wind and storm surges, and prolonged drought conditions (as both were intensive in 2016). Dependence on a healthy environment by the Taveuni community cannot be understated, though conserving or investing in ecosystem services is a difficult value proposition when day-to-day needs are a struggle, even under normal conditions.

The PEBACC project goal during the ESRAM and EbA development process was to identify locally-based stakeholders to set priorities and a process for improving and buffering of ecosystem services. Stakeholders

identified 11 watersheds and key goals and priorities, with mechanisms for expanding a stakeholder base. Ecosystem-based adaptation mechanisms were derived for the whole of Taveuni's terrestrial, riparian, coastal and marine environments to strengthen key ecosystem services through a unified, stakeholder-based vision and investment of time, labour and capital to provide a buffer for communities to adapt to change. Key ecosystem services strengthened by the EbA options include but are not limited to:

- forest health and extent – expand native forest into abandoned agricultural lands in high elevations;
- soil productivity – change agricultural and agroforestry practices to create diverse agroecological systems;
- riparian function – attenuate terrestrial run-off to the marine environment;
- biodiversity – expand forest conservation, native forest restoration and reforestation; decrease fragmentation; monitor invasive species and diversity in agricultural systems;
- storm surge protection – enhance coastal ecosystems, where appropriate, including expansion of mangroves;
- freshwater sustainability – protect and expand high elevation forests to slow run-off and increase cloud and rainwater infiltration to groundwater supply;
- sustained food supply – protect marine resources, improve habitats, realise potential for aquaculture, and diversity of crops; and
- sustained income and independence – shift reliance on income from cash crops to diversified investment that enhances ecosystems.

2. DEVELOPMENT OF EBA OPTIONS

2.1 APPROACH AND OVERVIEW OF EBA DEVELOPMENT PROCESS

The central approach to developing EbA options for Taveuni involved community-based decision-making, where watersheds and priorities identified in the ESRAM were translated to activities that could increase the key ecosystem service potentials currently at risk, as well as build investments in ecosystem services for the future. Communities participated in the workshops and meetings as part of this process, which covered a progressive range of tasks over the course of a year. These tasks included:

- report of ESRAM findings;
- watershed delineation to identify connected landscapes;
- identification of stakeholder groups to help guide watershed management;
- development of key goals and values for each watershed;
- self-evaluation of natural resources within each watershed and outlets to identify vulnerabilities (e.g. marine and fisheries, freshwater, forest, agriculture, tourism, community leadership, infrastructure);
- prioritisation of key vulnerabilities needing to be strengthened through intervention;
- site visits, mapping locations and creating criteria for site placement;
- assessment of community capacity to carry out the work; and
- development of island-wide EbA options maps, based on the above and likely ecological trajectories as a desired future condition for Taveuni ecosystems.

This approach served as both a capacity-building exercise and also narrowed potential interventions to those that would be most feasible in social terms and within the community's capacity to reasonably achieve.

Stakeholder profiles began with the government at national, provincial and district scales to introduce the PEBACC project and solicit direction from different natural resource departments, including iTaukei affairs. The core of the approach for Taveuni involved the majority of landowners within their traditional community structure, or vanua. Their objective was to build on current strengths and abilities and define the appropriate level of engagement and the needs communities have for resilient livelihoods.

Workshops with the vanua in a central setting and later at the three district levels allowed a focus on ecosystem and community dynamics across Taveuni and within each district. This led to identifying specific sub-district boundaries in connected landscapes, where ecosystem service attributes, supply and demand were similar. Eleven watersheds emerged and workshops with community members focused on identifying stakeholders and defining a suite of stakeholder values and needs.

Working as watershed groups, stakeholders self-organised to undertake mapping activities. They discussed the current condition of resources in a sector-based way (agriculture, fishing and marine resources, forests, freshwater, community leadership, etc.) and identified vulnerabilities, strengths, opportunities and gaps. A working 'desired future condition' was formulated by these groups, with key priorities for meeting that future condition. Equipped with maps, watershed groups subsequently held community meetings and outreach activities with their broader group of stakeholders to solicit input and clarify the community vision, their priorities and their capacity strengths and needs.

A series of meetings with watershed groups followed to collect the maps with prioritised actions, and that information was consolidated to shape a desired future condition for Taveuni, involving EbA implementation options. Three major categories of EbAs emerged, with different implementation goals and spatial extent:

- broad-scale policy, coordinating activities or programmes that focus on resource resilience and benefits to communities as a whole;
- capacity building and training useful for specific implementation; and
- site-specific activities to be conducted by communities.

The above reflects the organising structure of the EbA options considered for this PEBACC Taveuni options assessment.

2.2 MAPPING GROUND-BASED EBA OPTIONS

A 'wall-to-wall' map was constructed, using a combination of workshop and meeting outcomes, ground truth surveys, recent Landsat imagery (2016), island elevation, reef location, land tenure, stream coverage, and aerial photo interpretation. The map delineates potential place-based EbAs for Taveuni to meet the desired future condition (DFC) identified by stakeholders and support ecosystem services within ecological boundaries. EbA actions were mapped in the GIS and assigned the following attributes:

- primary EbA activity or objective: the first prescriptive treatment for a given site. This is generally the tone of how the landscape would be utilised in the DFC;
- secondary EbA activity or objective: similar to the primary objective above, this prescribes secondary or the 'trajectory' of treatments to further refine the site in the DFC;
- key goals: the site-specific goals the EbA prescription is designed to achieve;
- prescription description: more specificity about the treatment and observations about the site that are helpful in refining site-specific implementation; and
- additional information about the site, where relevant.

Each EbA unit on the landscape was portioned to include the following:

- watershed name: one of 11 Taveuni watersheds in which the unit resides;
- project location: an aggregation of treatments according to topographic position – terrestrial, riparian, coastal, and marine;
- elevational band: range of elevational areas grouped into sea level, coastal terrace, lowland terrace, low elevation, mid elevation, high elevation sites;
- land tenure: the available information as to major ownership – iTaukei, private, and state lands – and the number of traditional (mataqali) are also indicated, where applicable; and
- maximum area affected: the GIS polygon area delineated, although the treatment area may be smaller, depending on project-specific constraints.

EbA options were located across the landscape and seascape to serve as the basis for decision support to identify areas, potential benefits, costs, distribution and magnitude of potential interventions for Taveuni.

2.3 EBA OPTION GOALS AND UTILITY FOR PARTNER ORGANISATIONS

While the PEBACC project aims to support EbA implementation for Taveuni, there are far more activities to be accomplished to meet island-wide desired future conditions than time or funding allow for this project alone. As such, EbA options presented here are designed to be useful and informative for other natural resource management agencies and funding organisations to support, especially those with the following mission objectives:

- food security;
- water security;
- avoiding desertification;
- avoiding deforestation and degradation;
- carbon offsets or sequestration;
- conservation of biodiversity;
- wetland conservation;
- invasive species management;
- certified sustainable timber supply;
- ecotourism;
- disaster risk management;
- marine conservation;
- aquaculture industry;
- non-timber forest products;
- sustainable product markets (cacao, virgin tree oils, handcrafts, certified timber, etc.);
- microfinance; and
- policy and law.

Potential projects are abundant for Taveuni and there is widespread willingness and awareness among community members to pursue EbA options. The significant barriers to execution are the funds and supplementary training necessary to create the infrastructure to proceed with priority projects. To be effective, it is important to approach projects in the context of balancing community opportunity cost in meeting basic daily needs (e.g. selling dalo at market today) with investment into desired ecosystem service outcomes of EbA implementation (e.g. high-value crops and improved soil fertility in ten years)—trading tangible (now) for the intangible (future) return. This is equally true for the marine ecosystem.

There is widespread support for conducting EbA activities where tangible outcomes can be visualised and realised. In nearly all cases, communities were more than willing to give their time and energy to implement a plan, thereby lowering costs for funding agencies and lowering the risk to investment in EbA activities. Most land-based EbA options listed in this report are labour-intensive but relatively inexpensive in materials, and are within the capacity of community members to execute.

Policy and planning EbA options are generally less tangible for stakeholders, as benefits may not be physical or immediate and hence may be difficult to visualise. While there are strong visionaries among Taveuni's community, it is important to make linkages between the EbA and eventual outcomes, affecting community choices and improvement in a straightforward and meaningful way.

2.4 STAKEHOLDER CONSIDERATIONS

2.4.1 Stakeholder inputs to EbA development process

Overall, community members were most focused on land-based activities that increased soil fertility, diversified income streams, supported freshwater availability (drinking, irrigation), and supported developing the capacity of communities to adapt to change. In general, these equated to 'hands on' activities that could be simplified to a range of actions in the terrestrial landscape, mostly prescriptive land treatments (e.g. tree planting, seed gathering, different crop rotations, etc.) with some infrastructural improvements. Actions such as these are well within the capacity of rural Taveuni communities.

Marine concerns related to fish populations and sustained harvest, with a long-term concern for viability. Communities recognised the largely unspoken but significant social challenges to changing subsistence behaviour and the demand for fish, at least locally. Aquaculture, including clams, pearls, and bêche de mer were all discussed as opportunities, along with coral farming/transplanting to enhance coral reef structures. The significant barriers to implementation of aquaculture projects also emerged from previous pilot project experience. In large part, the marine EbA actions focused on policy-driven concerns, including enforcement and capacity for locally-managed waters (rule-making and enforcement). Aquaculture options presented here are aimed at the root of socio-political barriers to investment and implementation.

Coastal ecosystems were evaluated both by community perception and a recent coastal shoreline survey conducted by the Water Institute of the Gulf and SPREP in July 2017. Coastal EbA opportunities targeting coastal erosion were identified in some areas, along with enhancement opportunities, particularly for mangroves and freshwater seeps. Infrastructure changes, particularly roads, may be required to mitigate the negative effects of climate and land uses in more challenging segments of coastline, as inspection and review of seawalls and other infrastructure functions on a case-by-case basis.

Approximately one third of Taveuni was identified to have some form of tree-planting activity, ranging along a gradient of agricultural and agroforestry systems (with focus on crop-based outcomes) to plantation management (with focus on long-term income from timber harvest) to expansion or restoration of native forest. Native forest areas and forested areas adjacent to native forest are also viable candidates for sustainable harvest of non-timber forest products. Along the coastline, mangrove enhancement to increase reef protection and local fisheries also emerged as a priority activity for watershed groups.

Other site-specific EbA activities include policy-driven mechanisms for adaptive management, including development of MPAs and aquaculture projects in marine areas. Infrastructural projects were also proposed, including intensive groundwater pumping stations (additional bore holes) and lower-cost development of springs for irrigation and domestic use, especially at the northern and southern ends of the island, where landforms favour groundwater seeps as opposed to surface water streams.

Three major concerns arose with respect to invasive species. The first involved relatively low inspection rates or awareness about bringing soil, animal and plant material on-island, which could threaten Taveuni's agricultural industry, forests, and marine life. Taveuni is currently dealing with invasion of the American iguana (*Iguana iguana*), which threatens biodiversity, human health and agriculture. Invasive species quarantine is especially important to consider in light of unregulated ferry travel from Vanua

Levu, with additional and routine inspections needed for air and ferry travel from Viti Levu. The second invasive species concern pertains to the invasive tree, African tulip, which is known to have small populations around the Matei airport, at a minimum. Of higher concern is that 18% of Taveuni had visible disruptions in canopy integrity over the forest reserves, indicating potential vine invasion and biomass collapse from cyclone damaged forest in the upper elevation forest reserves, threatening one of Fiji's largest contiguous forests.

2.4.2 Stakeholder inputs on implementation

Stakeholders were consulted and participated during the development of the EbA options. Key to the implementation perspective is the need to evaluate the overall approach in the types of EbA projects to implement (e.g. policy-driven, capacity-driven or action-driven), and face the realities of limited budgets for a master list of tasks. Community members were asked how they would prefer to manage EbA projects. The following summarises the majority community responses to moving forward with implementation.

- Communities are inclusive and would rather have more people involved across their communities in any project, regardless of project size.
- If only a small project could be implemented (e.g. an agroforestry site), they would prefer to share it among as many landownerships as possible (e.g. select an area that adjoins multiple owners).
- The capacity to conduct the projects autonomously is a priority, so they can learn from and replicate the work – communities seek building capacity through a 'learn by doing' approach.
- Community leaders seek opportunities to discuss natural resource management in a centralised fashion, to help guide the overall progress and influx of other organisations on Taveuni, as well as to solve current issues.
- Traditional owners identified the need to work with and be inclusive with all landowners in watersheds.
- Past projects have involved training and workshops but have not resulted in 'real change' – the perception is the higher and broader the involvement, the more minds will work together to solve common challenges.

In consideration of the above and balancing the need to integrate policy, training and community-driven actions to be most effective, two extremes were evaluated of how EbA options can be packaged into implementation plans:

Distributed implementation sites (stakeholder preferred alternative): Emphasise watershed-level actions that create at least one opportunity for each watershed group, to be distributed within their community as they plan, following their evolving stakeholder process. This emphasises the distribution of capacity and ability to pilot a small project among themselves, maximising the number of involved stakeholders in ecosystem-based adaptation. Ultimately the goal is to reach the broadest number of people to work through their prioritisation process and maximise engagement. Short-term ecological gains of a given site will likely be small, but distribution will be wide and long-term potential for expansion is high. This prioritises training and watershed-level actions over broader policy-related EbAs.

Central organisation, planning and policy: Emphasise larger EbA projects that explore deeper and more challenging policy, science, or industry issues and provide less focus on training and watershed-level actions. This would result in a few 'pilot areas', or 'demonstration sites' that would ultimately engage fewer stakeholders and fewer combinations of treatments and training. Capacity will likely involve fewer people and allow for fewer, but more involved organisational, planning or policy tactics to be considered. The use of pilot areas is likely to have fewer learning opportunities for broader networks of stakeholders, but information gained will emphasise longer-term shifts in resilience. Stakeholders commented that they have experienced this type of approach in the past and, unless directly involved, generally did not participate or gain from the experience. Short-term ecological gains related to land use changes are likely minimal.

An analysis of strengths, weakness, opportunities and threats to each of these implementation 'trajectories' is presented in Table 1.

TABLE 1. SWOT analysis for the two extremes considered for framing EbA implementation scenarios

	Distributed Implementation (10–20 projects) (Preferred Alternative)	Central Organisation, Planning and Policy (3–5 projects)
Strengths	▪ Broadest group of stakeholders engaged ▪ Training can be centralised ▪ Benefits distributed widely ▪ EbA intervention tangible for more communities ▪ More project types to test over range of challenges ▪ Lower barrier to success ▪ Direct environmental impact	▪ Projects more intensive and in-depth for a given issue ▪ Training can be centralised ▪ Less complex management and monitoring ▪ Can have long-lasting results affecting policy or decision-making
Weaknesses	▪ Smaller project size ▪ Limits high cost projects ▪ Direct benefits are smaller ▪ Small-scale environmental impact ▪ More complex management and monitoring	▪ Narrow stakeholder base ▪ Fewer to benefit ▪ Direct benefits likely not well distributed ▪ EbA less tangible to more people ▪ Less likely to visit project sites as learning opportunities ▪ Fewer projects to test ▪ Higher bar on success metrics ▪ Low direct environmental impact
Opportunities	▪ More apt to proliferate ▪ Training and infrastructure in place to expand at low cost ▪ More long-term environmental impact ▪ Widespread EbA adoption and management more likely ▪ Can influence policy by example, momentum, and case study approach	▪ High cost or profile projects can be attempted ▪ More topic-specific for long-term environmental impact ▪ Can fundamentally change trajectory of policy in government
Threats	▪ Project size small and individual projects could be vulnerable to force majeure and neglect ▪ Projects spread too thin among stakeholders to realise effective benefits	▪ Disenfranchisement of non-participating communities may warrant policy ineffective ▪ Widespread EbA plan implementation less likely ▪ Single projects more vulnerable (force majeure, neglect) to impact overall success

These approaches serve as ways of backstopping the allocation of resources for PEBACC implementation, but generally do not affect the EbA options that are identified in the master list of options (other than magnitude and scale to be implemented). Scenarios that emerged from these backstops for implementation are presented in Section 4.2.

2.5 EBA OPTION PRIORITISATION

A prioritisation process was established to identify those projects that have the highest likelihood of success, within the budget and timeframe parameters of the PEBACC project.

Projects that involve organisation, policy, planning or training were broadly evaluated, based on the following criteria:

- socio-economic benefits: how the project provides alternative choices to build family and community resilience;
- ecological benefits: the extent to which a project improves the quality and quantity of ecosystem services, or alters downward trajectories toward resilience;

- timing of delivery of benefits: the length of time required before tangible benefits are realised;
- duration of benefit delivery: the timeframe the project will provide or contribute to tangible benefits;
- durability of the project: the resilience of the project to social or environmental changes;
- cost of the project: categorical cost of implementation, on a per unit basis;
- feasibility to conduct: the capacity, stakeholder engagement, and external factors that constrain the project's success; and
- dependencies or prerequisites required to implement: infrastructure, training, policy, or engagement required before any action can be taken.

Where applicable and known, synergies with other projects or programmes is included as another factor. The prioritisation schema is presented in Table 2, and was used on all major EbA options involving organisation, policy, planning and training activities.

TABLE 2. Scoring matrix used to prioritise EbA projects for consideration centred on organisation, policy, planning or training

Prioritisation Criteria	Factors Considered	Evaluation Score		
Social-economic benefits	Project improves community wellbeing and builds high levels of resilience to environmental or market changes Protects important community or family resources Provides richness in choices and provides socio-economic buffers	High 1	Moderate 2	Low 3
Ecological benefits	Provides protection or enhancement of key ecosystem services Supports a range of ecosystem services	High 1	Moderate 2	Low 3
Timing of benefit delivery	Benefits are achievable within short timeframe	Near term (2020) 1	Mid-term (2020–2030) 2	Long term (>2030) 3
Duration of benefit delivery	Benefits are long-lasting with minimal inputs or maintenance	Long (>20 years) 1	Intermediate (5-20 years) 2	Short (<5 years) 3
Durability of project	Project is resilient to environmental and social change with little intervention required	Highly Resilient 1	Moderately Resilient 2	Sensitive 3
Cost of project	Combined factors of implementation, infrastructure required, ongoing management and maintenance	Low cost per unit (<$10K) 1	Moderate cost per unit ($10K–50K) 2	High cost per unit >$50K 3
Feasibility of implementation	Willingness to implement Few social barriers Within current capacity or current capacity growth Project is autonomous Project area is accessible	Ready to go 1	Some barriers 2	Many barriers 3
Project prerequisites or dependencies required	Few project dependencies or requirement exist prior to implementation	No dependencies 1	Dependencies low cost 2	Dependencies high cost 3

Action-driven EbA activities identified at the watershed-level were designed through the interaction of stakeholders, site visits, remote sensing and best principles. Watershed action plans and priorities were developed on the inherent basis of socio-economic and ecological benefits, and stakeholder capacity and scope to conduct the work. As such, watershed activities were evaluated based on readiness of each watershed group to successfully move forward toward project implementation. Evaluation criteria for watershed groups are presented in Table 3.

TABLE 3. Evaluation criteria associated with investing in Watershed action plan EbAs.

Prioritisation Criteria	Factors Considered	Evaluation Score		
Organised vision	Community has identified clear needs and vulnerabilities affecting ecosystem services Unified in approach to priorities within community	Very organised 1	Somewhat organised 2	Not well organised 3
Broad stakeholder involvement	Communities have involved stakeholders in development of needs and priorities Input and questions have been addressed	High 1	Moderate 2	Low 3
Participation in PEBACC process	Stakeholders/representatives have attended all workshops and activities Have completed and participated in follow-up activities to workshops Offered solicited and unsolicited feedback	High participation 1	Some participation 2	Low participation 3
Durability of process and implementation	The approach, vision, stakeholders and outcomes of managing for resilience are likely to persist after the PEBACC project is completed	Highly likely 1	Somewhat likely 2	Not likely or unknown 3
Feasibility of implementation	Willingness to implement with few social barriers Within current capacity or current capacity growth Stakeholders can be autonomous Project areas are accessible	Ready to go 1	Some barriers 2	Many barriers 3
Project prerequisites or dependencies required	Few project dependencies or requirement exist prior to implementation	No dependencies 1	Dependencies low cost 2	Dependencies high cost 3
Cost of priority projects	Combined factors of implementation, infrastructure required, ongoing management and maintenance	Low cost ^ner unit (<$10K) 1	Moderate cost per unit ($10K–50K) 2	High cost Per unit >$50K 3

3. ECOSYSTEM-BASED ADAPTATION OPTIONS

As outlined in Section 2.1, EbA options that emerged are best described in three major categories, each with different purposes at different spatial, socio-economic and ecological goals. The general activity categories are briefly described below.

Organisational, planning and policy activities. These EbA options involve the development of pathways that are linked to specific themes to improve the quality or mitigate the use of resources for sustainable options. They are designed to provide tangible results through planning or policy intervention rather than through direct physical change. Such activities include monitoring fishery harvest, establishment of protected areas, developing business plans for creative lease agreements that instil safeguards toward resilience, and developing new markets for products (agriculture, forestry, non-timber forest products).

Training and prerequisite activities. These EbA activities are stand-alone options that are designed to train and reinforce actions that are directly related to land and sea-based interventions (i.e. physical change) or correspond to land uses. They include training and guidance in designing and maintenance of agroforests and plantations, native seed collection, and construction and management of tree nurseries, as well as other prerequisite skills, knowledge and experience that are attached to watershed-based activities promoting physical change.

Watershed-based activities. These activities are the specific physical actions and interventions that change the landscape. Actions are directly linked to terrestrial, coastal, and marine ecosystems and involve materials and labour to achieve a per-unit metric (e.g. hectares planted, trials conducted, etc.). These activities are mapped according to ecological and socio-economic potential and needs (see Section 2.2).

The following sections provide summaries of EbA options for Taveuni, as well as master options lists in Table 4, Table 5 and Table 6 below.

TABLE 4. Master options list: Organisational, planning and policy EbA activities. Section numbers correspond to the narrative in this document.

Section	Name	Description	Activities	Benefits with Action	Threats without Action
3.1.1	Taveuni watershed coordination network	Support watershed coordinator positions; quarterly meetings maintain coordination through PEBACC tenure	Financial support for ten watershed coordinators Support Yaubula Management Support Team Forum for training and natural resource management engagement by government	Supports engagement of coordinators to overall Taveuni EbA goals Allows for watershed groups to work together to achieve similar goals New projects can be vetted with Taveuni watershed groups in open forum	Lack of coordination in NRM activities across Taveuni Potential for conflicting objectives Limited awareness across Taveuni communities
3.1.2	Navakawau watershed and economic improvement plan	Develop alternative land-based EbA investment through creative lease agreements with community and private landowners	Facilitate meetings with community and landowners to discuss options Identify attractive EbA treatments Cost planning for implementation	Increase in forest cover Increase in economic stability Reduces reliance on declining dalo and soil productivity Long-term investment in ecosystem services	Decline in production of dalo forcing economic crisis of Navakawau community Declining soil fertility and loss of future options to landscape
3.1.3	Locally managed marine areas (LMMA) implementation and enhancement	Support LMMA and enhance planning, monitoring and enforcement	Workshops in local villages to identify main local stressors Identify system of rotating closures, tabu areas, temporal reserves Develop local warden monitoring programme for fish, seagrass and coral reef areas	Reduces stressors from fishing, gleaning, coral mining, extraction Allows for population recovery Local empowerment to manage and locally enforce sustainable marine activities	Continued lack of information about marine use and population/ habitat health Human-caused stressors continue to contribute to marine resource decline

Section	Name	Description	Activities	Benefits with Action	Threats without Action
3.1.4	Youth stewardship programme: living classrooms	Create curriculum and activities in local schools with small EbA demonstration projects ('living classrooms')	Develop learning curriculum Establish plant nurseries in schools Conduct seed collections Monitor coral reefs	Building institutional capacity for stewardship and sustainability Active learning with highly visible demonstration projects at local schools	Less generational awareness of building ecosystem resilience 'Shifting baseline' to degraded resources as normal condition is generational threat
3.1.5	Feasibility study: establishment of conservation trust	Identify mechanisms for developing long-term, 3rd party trust to support EbA activities for Taveuni communities	Feasibility study of different mechanisms for collecting and distributing fees Recommendations for pilot options for Taveuni	Supports sustained activities that promote resilience Minimises dependence on revolving funds, providing more stable funding	No ability for communities to follow through after donor-funded projects are over Return to 'status quo' Return on investment for donor funds is low
3.1.6	Develop specialty markets for non-timber forest products	Training and activities for potential revenue sources from native forest conservation areas	Training in wildcraft collection, products, and marketing Linkages with Fiji Made branding and other programmes Establish market with conservation initiative for Taveuni (e.g. 'Taveuni Made')	Provides income for communities to support conservation efforts Couples with other forest activities, such as seed collection and ecotourism tours Provides value to conservation	Native forest is not valued for direct economic impacts Continued threat of deforestation and conversion to agriculture
3.1.7	Qamea and Laucala Island watershed coordination	Expand PEBACC objectives to communities on Qamea and Laucala communities to identify watersheds and EbA priorities	Support Taveuni communities to participate in EbA planning process with neighbouring island Initiate exchange with Laucala landowners Expand marine focus for large reef complex	Executes 'train the trainers' among community members Expansion of EbA goals to Qamea Addresses key issues (landslides, coastal erosion, sedimentation, etc.) Habitat improvement	Lack of support for EbA Eroding hillsides, sediment release Reef damage from sediment Native forest and mangrove degradation
3.1.8	Lake Tagimoucia Ramsar site evaluation	Support the process toward Ramsar candidate	Support Ramsar with necessary surveys and community outreach needs	Long-term conservation objectives met with rise in Fiji and Taveuni profile Conservation of biodiversity and central feature of Taveuni A 50% increase of current Ramsar area for Fiji	Lack of international awareness may lead to fewer protections Potential for degradation
3.1.9	Aquaculture development plan and legal framework pilot	Engage government, industry and community with concrete aquaculture development plan and legal framework to lower barriers to entry	Develop plan to identify tenure, time, rights, protection and benefit sharing Streamline system so projects and investment can proceed in reasonable timeframe Develop legal framework to protect all parties	Encourages business and jobs in aquaculture sector Encourages and safeguards investment Provides economic benefits to communities Promotes native invertebrates	Significant potential is not realised due to risk to investment Increased pressures to invertebrates by subsistence fisheries Lost opportunity for crops that build resilience to ocean acidification reefs
3.1.10	Taveuni primary forest health monitoring	Conduct survey and mapping of Taveuni upland forest areas to identify degradation magnitude, causes and any rehabilitation needed	Aerial mapping using Landsat imagery and drone Ground truth with field plot inventory in affected and non-affected areas Develop monitoring plan to address degradation	Knowledge of issues affecting large tracts of primary forest Interventions to avoid spread of degradation or rehabilitate over time	Degradation of native forest on Taveuni Loss of biodiversity Loss of buffering capacity Fragmentation and biomass collapse to vine and pioneer species

TABLE 5. Master options list: Training and pre-requisite EbA activities. Section numbers correspond to the narrative in this document.

Section	Name	Description	Activities	Benefits with Action	Threats without Action
3.2.1	Plant nursery construction and operation	Training and demonstration of low-cost plant (tree) nurseries to install and operate in communities for EbA implementation	Conduct training to build low-cost nurseries and other nursery options Identify appropriate locations and needed resources for communities Build on and support existing programmes and current nurseries Identify propagation and nursery techniques	Local capacity to grow trees to provide nursery stock for communities Lower barriers to implementing tree-planting EbA activities Will ease pressures and costs for sourcing plant material Provides means for local watershed groups to implement locally	Dependence on nursery stock from outside sources Barrier to implementation with no stock Disenfranchisement from autonomy in implementing EbAs Risk of EbAs not taking hold in favour of status quo
3.2.2	Native plant seed collection to enhance biodiversity	Develop native plant seed collection, including repository exchange and propagation programme	Training to gather seed stock from local native forests Establishment of nurseries in communities (or central nursery) to propagate native species Create network on Taveuni to distribute seeds and plants to aid reforestation	Collection of germplasm used for reforestation actions Increases value of native forest areas as sources of seeds Provides a steady supply of seed stock Conservation of biodiversity	Decreased value of biodiversity and native forest Lack of plant material to implement EbA projects, slowing potential momentum Creation of genetic bottlenecks without proper collection sampling
3.2.3	Riparian and wetland planting and management	Training in riparian and wetland enhancement and special considerations in species and site selection	Training to identify riparian zones and functioning Implementation strategies for ensuring proper species and care for rehabilitation Monitoring activities to ensure good establishment	Higher success with restoring riparian zones Attenuates risk of flooding Awareness of riparian and wetland function and impacts on the marine environment	Less success in restoring riparian and wetland areas Lower attenuation of surface water and adverse effects of degraded riparian systems Lower awareness of riparian and wetland areas
3.2.4	Agricultural improvement and diversification trials	Conduct science-based field trials for diversified crop systems with goal of improving soil fertility and crop diversity	Conduct field trials for different cropping systems, including agroforest options Conduct data-driven study to identify yield, soil nutrients and structure following different crop and cultivation practices Build on existing USP studies to address workable solution for building soil productivity	Alternatives to intensive dalo farming with indiscriminate fertiliser use Slow current trajectory of soil degradation Robust and statistically sound study to build on work completed to date and guide future treatments	Difficult to determine cause-effect relationships between treatment and result Lower overall knowledge of how EbA can improve soil issues for Taveuni Lack of coordination and inputs to adaptive management
3.2.5	Agroforestry Practices and Management	Training for establishing agroforestry systems and implementation guidance to landowners	Training on food-based tree crops Use of nitrogen fixing and other beneficial species Considerations and market with processed crops (e.g. cacao) Use of mixed hardwood with agroforestry systems	Expanded awareness of agricultural options to diversify income and improve soil conditions Potential for developing new markets, such as re-invigorating cacao industry Slow deforestation and expansion into forestlands	Fewer alternatives lead to more expansion of cash crops into forest zones Continued decline in soil resources Limited buffering of market forces

Section	Name	Description	Activities	Benefits with Action	Threats without Action
3.2.6	Plantation management and certified sustainable products	Training for establishing a range of plantation systems and implementation guidance to landowners	Training on mixed species and native hardwood plantations Expansion of existing forest fragments to obtain many ecosystem benefits Development of sustainably certified wood products Higher-value product production beyond sale of whole logs	Long-term increase in forest cover and functions High-value investment for communities through time Aides in restoring native forest through out-planting and creating shade Sustained income	Continued deforestation and limited reforestation/ rehabilitation Continued decline in forest ecosystem services including rainwater capture and biodiversity Limited long-term income generating potential
3.2.7	Native forest restoration and expansion	Community-based training in select locations for out-planting and other forest expansion techniques	Couple with plantation management and seed collection activities Training on low-cost and low technology approaches to expand native forest Engage communities in long-term restoration goals	Lower fragmentation in native forest; increase in forest cover Higher biodiversity and ecosystem resilience to storm and drought events Potential for expanded ecotourism options Benefits from non-timber forest products (NFTP) harvest and utilisation	Rely on natural regeneration only Increased fragmentation and degradation from land use pressures and natural disturbances Limited awareness of benefits from native forest, including NFTP markets
3.2.8	Invasive species detection and management	Develop training with low-tech tools for community to identify, monitor and report invasive species	Conduct outreach to watershed groups to monitor for high-risk species Develop mapping and identifying tools Work with communities to identify strategies to eradicate or isolate invasive species	Broader awareness of invasive species effects on ecosystem function Increased identification skills Reporting system to better monitor invasive species issues and potential actions	Limited centralisation of invasive species threats Lower awareness of presence/absence of invasive species Potential to spread inadvertently through other activities without awareness
3.2.9	Coral cultivation and transplanting in shallow coral reef habitats	Provide training and localised programme for coral rearing and transplanting	Identify locations where transplanting would be suitable Engage ecotourism operators in practice as an organised fee-for-service activity Train local youth and communities in cultivating small coral garden plots Training for identifying harmful terrestrial inputs	Broader awareness of coral conditions, including tourism sector Potential for creation of jobs to create organised activity Successful transplants may increase resilience to bleaching events Potential to expand aquaculture practices for communities	Current trajectory of reef decline does not change Expanded awareness of tourists is limited to scuba divers Lower potentials for income generation in tourism sector

TABLE 6. Master options list: Watershed-Level EbA actions. Section numbers correspond to the narrative in this document.

Section	Name	Description	Activities	Benefits with Action	Threats without Action
3.3.1	Lavena-Nacogai	Implement EbA Strategy: Diversified income, food security, coastal erosion protection	Agroforestry Plantation forestry/ reforestation Beach erosion mitigation Micro-hydro power Coral enhancement	Increased diversity in income Long-term harvest potentials for hardwoods and agroforestry crops Improved ecotourism quality Lower erosion risk to school and community from eroding beach Opportunity for low maintenance sustainable power Potential improved reef conditions	Degraded hillslopes and threat of additional deforestation for agriculture Potential loss to infrastructure Heavy reliance on fishing income persists—lower diversity with other uses Isolation from generator fuel during storm events lowers resilience
3.3.2	Naqeru	Implement EbA Strategy: Land rehabilitation, diversified long-term income	Rehabilitate reclaimed leased lands for agroforestry and high-value plantations Out-planting of native forest in upper elevations Mangrove enhancement Ecotourism opportunity Coastal erosion mitigation plan	Improved watershed function Expanded ecosystem service buffering of deforestation at highest elevations from neighbouring watersheds Income generation to finance planting through ecotourism site High-value plantations as tools for rehabilitation provide long-term income for conservation	Degraded landscapes are slow to recover Fewer options to sustained livelihoods Further degradation of upper elevation forest Water quality concerns in lagoon from terrestrial run-off persist
3.3.3	Naselesele	Implement EbA Strategy: Water security, diversified income through conservation, food security	Develop spring water sources and improve forest cover to protect springs Develop ecotourism site on lagoon and spring-fed pools Rehabilitate upper elevation farms with diversified crops (agroforestry, plantations) Minimise upper elevation deforestation threats Mangrove enhancement	Improved and sustained access to water from local sources Revenue generation through low-cost/ low-impact development of beach and spring site Diversified income through diversified farming Protection of watershed function through increased forest cover Increased habitat and coastal protection with mangrove expansion	Lost opportunity with low cost/ low impact and highly-visible conservation initiatives to provide income for future EbA projects Further degradation of soil and forest resources Complete conversion to non-forest landscape Improved habitat conditions along coastline
3.3.4	Welagi-Somosomo	Implement EbA Strategy: Water security, diversify income through reforestation and agroforestry, secure riparian function, stakeholder outreach	Reforest around spring sites Riparian planting Increase native forest through native plantation management and out-planting Agroforestry options Outreach with other stakeholders	Improved community discussions about priorities Increase resilience of spring areas to disturbances Rehabilitate upland deforested areas	Continued degradation of high elevation forests due to access of small farms Potential vulnerabilities to exposed springs Fewer economic options Terrestrial run-off pollution to nearby reefs
3.3.5	Lovonivonu-Tavuki	Implement EbA Strategy: Flood/pollution attenuation, restore upland degraded lands, engage stakeholders	Riparian planting and restoration Use of native plantations and out-planting to restore forest in upper elevation with road access Engage multiple stakeholders to determine long-term priorities	Visibility and community collaboration of riparian planting near town increases exposure and interest with stakeholders Rehabilitating upland area to avoid further degradation Stakeholder engagement to develop longer-term plan for increasing resilience	Lack of awareness in activities causing degraded landscapes and ecosystem function Lost opportunity for long-term income from plantations, agroforestry and NTFP Further degradation and losses of ecosystem services

Section	Name	Description	Activities	Benefits with Action	Threats without Action
3.3.6	Soqulu-Waica	Implement EbA Strategy: Engage stakeholders, identify watershed plan, increase awareness	Conduct stakeholder outreach and involvement with Cakaudrove communities, many on private lands Identify leadership and members of watershed group Build on opportunities to increase forest cover and riparian vegetation through healthy vegetation	Increased awareness of ecosystem based adaptation Improved options for decision making Slowing of degradation in high elevations Improved value of lands for private landholdings Improved ecotourism opportunities	Lost opportunity to build awareness of alternatives that have improvements in income and sustained benefits
3.3.7	Ura	Implement EbA Strategy: Food security, water security, ecotourism, income diversity, enhance biodiversity	Develop agroforestry options in lower elevation working farms Rehabilitate deforested uplands with native species plantations Increase native forest through out-planting Participate in forest health monitoring Participate in neighbouring watersheds in upper elevation restoration	Overall improvement of watershed function and ecosystem services Provides opportunities for new approaches Large-scale rehabilitation opportunities Long-term investment income with restoration of ecosystem services Improved site for ecotourism opportunities	Lost opportunity with current capacity to accomplish goals Continued degradation to soil and forest resources Missed opportunity to involve large landowners in linking EbA activities with income proposition
3.3.8	Delaivuna	Implement EbA Strategy: Diversify agricultural systems and income, improve soil resources, increase water security	Deploy agroforestry options in high, mid, and low elevations Conduct trials to improve soil fertility Plantation forestry on deforested slopes for long-term income Mangrove enhancement in lower reaches	Diversify crops to diversify income Reduces pressure on soil nutrients Increases forest cover Engaged stakeholders will help to determine range of effective methods	Continued decline in soil productivity Increase in soil and forest degradation Decreased options for land-based activities Decreased water supply from higher run-off Migration and abandonment
3.3.9	Vuna	Implement EbA Strategy: Water security, food security, diversified income, landscape rehabilitation	Reforest using high-value native trees in upper elevations Agroforestry and agricultural enhancement trials Establishment and improvement of water source Mangrove and coastline enhancement Marine management and coral transplanting	Improved income and resilience through diversity of crops Improvement in soil fertility Long-term investment in high-value trees improves forest functions and income (sustained harvest, NTFP) Improved wellbeing	Continued decrease in soil productivity Threatened livelihoods Reduced options for income and subsistence Increased susceptibility to droughts and storms
3.3.10	Navakawau	Implement EbA Strategy: Economic stability, food and economic independence, long-term rehabilitation of degraded lands, permanence	Rehabilitate iTaukei lands with high-value agroforesty and hardwoods Work with private landowners on alternative management plan (see EbA 3.1.2) Participate in agroforestry and agricultural improvement trials	Provide economic options on severely degraded iTaukei land Improve long-term viability for community Improve soil fertility and diversity of future options Community resilience to avoid abandonment	Livelihood dependent on agriculture is in peril Few options for alternatives Risk of abandonment Continued degradation on private lands to accommodate needs for dalo production
3.3.11	Ravilevu Reserve	Implement EbA Strategy: Forest health and risk of degradation, community outreach and management plan	Engage government to fill watershed coordinator role and participate with other groups Conduct forest health assessment (EbA 3.1.10) Engage community in opportunities near Navakawau and Lavena	Assures watershed is represented with rest of Taveuni Addresses key concerns affecting biodiversity, forest function, and seed sources of the forest Engages community to avoid degradation of forest reserve areas	Possibility of forest health concerns leading to widespread degradation Complacency that forest reserve is 'intact' and therefore requires no management or caretaking Opportunity lost for government to participate in EbA with watershed network

3.1 ORGANISATIONAL, PLANNING AND POLICY ACTIVITIES

3.1.1 Taveuni watershed coordination network (island-wide)

Through workshop activities, interviews and meetings, a central factor to building resilience for Taveuni is to create opportunities for community members to discuss, learn, share ideas and plan with a focus on natural resource management. Providing opportunities for community leaders to gather in a central location on a regular basis was identified as a top priority by Taveuni's traditional leaders, who further identified synergies with government and the Taveuni Yaubula Management Support Team to increase strength and collaboration with communities. Meetings on a quarterly basis were deemed sufficient and within the busy schedules of community members.

A second coordination activity involves stakeholder outreach through individual watershed coordinators. Although the PEBACC project involved significant community outreach in the planning phases, there are areas and stakeholders on Taveuni that had little or no involvement in the process or preferred to observe rather than participate. Recent interviews with communities showed a significant surge of interested stakeholders in the PEBACC implementation phase, with one watershed identifying over 50 freehold landowners and their priorities for EbA activities (agroforestry, agricultural enhancement and plantation forestry). In practical terms, feedback showed there was significant time and cell phone charges spent by watershed leaders to work out details with their stakeholders.

With regard to watershed-based EbA options (see section 3.3) approximately 14% of Taveuni (~6,000 ha) were areas identified as needing more community outreach, mostly on areas with freehold lands. These included the three watersheds in Cakaudrove district, with nearly half of the land area within Soqulu-Waica and Lovonivonu-Tavunki watersheds. Navakawau watershed in Vuna district also has a high proportion of freehold lands, with 43% of the watershed area identified for community outreach activities, especially regarding traditional communities leasing lands from private entities to farm dalo and yaqona, and the need to develop a robust watershed management plan for the area (see specific project in section 3.1.2 below).

As interest and engagement continue, it is important to support watershed leaders in this effort, both in their communities and coordinating with other watersheds across the island. This project includes the following activities:

- Financial support for one coordinator for each watershed (10)[1], one day per month for the duration of the PEBACC implementation phase (30 months)
- Financial support for quarterly meetings and transport for watershed coordinators (10 quarters)
- Financial support for communications, delivered as telephone top-up cards (1 every 3 months, total of 100)

Areas of Focus	Taveuni Watershed Groups
Scope	Watershed coordination, quarterly meetings, logistics support
Estimated budget	USD 8,000–10,000 for ten coordinators
Dependencies and engagements	Government representative for Reserve watershed
Synergies	PEBACC activities for 2.5 years

[1] The eleventh watershed (reserve) should include a government representative.

3.1.2 Navakawau watershed and economic improvement plan

Navakawau is one of the most vulnerable communities on Taveuni, with less than 300 ha of land for its ~200 inhabitants on an exposed coastline. Navakawau suffered significant damage from TC Winston in 2016. The main source of income for the community is cultivation of dalo and yaqona, and declines in productivity of their own lands has forced the community to farm on neighbouring freehold land owned by the Shangri La Group.

The current lease arrangement is that the lessees cultivate a set amount of dalo for the lessor in exchange for farm land for themselves – most recently this arrangement was planting an additional 300 dalo plants each month, and cultivating through harvest (six-month cycle). This is equivalent to farming labour and expenses of an additional ~25% of the average land lease of two hectares per year. This arrangement allows cash-poor farmers to operate at the cost of labour and materials, rather than rely on cash outlay for the leased land. Through interviews and cost estimates, the like-kind value of labour and materials for the land is nearly the same as a standard lease value (~FJD 1,000 per year). In exchange for use of the land, the freehold landowner has rights to the harvested dalo to sell on the open market, yielding substantially higher margins than typical agricultural leases yield (approximately four times the value).

Lowering of dalo productivity has also prompted increases in 'rents' of monthly planted dalo, and following widespread trends, the current intensive farming practice will not be sustainable. Encroachment into higher elevation areas is occurring, only to delay the inevitable need to shift crop focus to more diversified systems. In addition, the landowner may choose to sell or develop the property for another purpose at any time, thereby displacing the primary livelihood of the community.

Given the decline in dalo monocrop productivity, high dependence and risk to market forces, and vulnerability to storms and drought events, there is opportunity to work with the landowners to develop a long-term agreement that will support income growth and sustained ecosystem services. Income from current dalo sales by the lessor could be directed toward more lucrative investments that can be supported with the help of the community lessees. There is a need for a sound watershed management plan that will:

- engage freehold landowners in discussions to diversify crops and land products;
- seek solutions to creative land leases that move away from short-term gains (dalo) to longer term, more lucrative investment gains that provide more ecosystem services (e.g. high value agroforestry, plantation forestry, non-timber forest products);
- identify funding alternatives for reinvestment from dalo sales to support alternative land-use strategies for longer term, more profitable investment.

There are opportunities to team up with the Ura watershed group (on the opposite side of island with the same landowner group) to develop a more comprehensive plan for the private land holdings that moves towards sustainable livelihoods and long-term, dividend-yielding investment in the lands.

Initial consultation with landowners in proposing an alternative lease agreement toward land-use diversification will need support from PEBACC. Depending on the outcomes of these meetings, support and expertise may be needed to develop a working alternative management plan for Navakawau.

Areas of Focus	Navakawau (with Ura Watershed)
Scope	Scoping of watershed management plan
Estimated budget	USD 3,000 for facilitator role and develop plan scope Additional funds as needed for management plan
Dependencies and engagements	Shangri La Management
Synergies	Collaboration with Ura watershed group and landowners

3.1.3 Locally managed marine areas implementation and enhancement

The aim of this project is to improve the effectiveness of existing locally managed marine areas (LMMAs) around Taveuni and implement additional ones. Given the attractiveness of Taveuni as a tourism destination and the dependence of local communities on marine invertebrates and fish, increasing local management is suggested. This project would increase awareness and education about long-term sustainability of marine resources and increase the areal extent that is protected from extractive harvest. Taveuni reefs have suffered extensively from the past few coral bleaching events in the South Pacific, and shallow water corals have experienced devastating declines in many areas. While global threats cannot be mitigated by actions locally, reducing local stressors from fishing, gleaning, coral mining, land-based pollution and extractive activities can increase resilience of the marine systems nearshore, potentially allowing for recovery. The benefits of the project would be to:

- protect nearshore marine systems from extractive activities in a system of temporal and spatial marine protected areas;
- increase awareness of the local stressors contributing to decreased resilience of nearshore systems; and
- provide local governance and control of local resources.

The activities in this project would be replicated in several locations piloting various spatial and temporal approaches to marine protection. Specifically, the project would implement combinations of the following:

- workshops in local villages to identify the main local stressors and resources that local communities depend on in nearshore ecosystems;
- identify systems of locally managed marine areas protection that include rotating closures, temporal reserves and tabu areas that allow for recovery of marine invertebrates, fish and the habitats upon which they depend; and
- train local wardens in coral reef monitoring methods, including record keeping, determining harvest rates of local fish, assessing the health of critical seagrass and coral reef areas, and understanding local contributors to degradation.

Areas of Focus	Naseslesele, Qaleni, Waitabu, Lavena, Vuna
Scope	Workshops, Trainings for local wardens
Estimated budget	USD 20,000 - 30,000 for support role
Dependencies and engagements	Ministry of Fisheries and Forests, outside NGOs or procurement
Synergies	Fiji LMMA Network, SPREP PPOA Funded Project

3.1.4 Youth stewardship programme: 'living classrooms'

Increasing institutional capacity with youth is an important mechanism toward positive changes through the generations. Building ecosystem and community resilience for Taveuni will take time and better access to learning and opportunities, especially for young people. This project is aimed to augment the curriculum at local Taveuni schools to create 'living classrooms', where students are engaged in building stronger relationships with the ecosystems of Taveuni. Elements to explore as part of this project include:

- supporting in-class curricular materials emphasising coupled human and natural environments;
- field trips to learn about native forests and reefs;
- understanding threats and how different actions affect the environment;
- create working nurseries for native plants and marine invertebrates that can be cultivated for years;
- reinforce a sense of stewardship for Taveuni's natural resources;
- support youth-sponsored activities to engage with elders in their community in environmental efforts (seed collecting, clean-up, streamside tree planting, etc.) to learn about Taveuni's history and use;
- create opportunities for young entrepreneurs interested in developing non-forest timber products or similar sustainably harvested goods; and
- build capacity with older students to teach and conduct activities with younger grade levels ('train the trainers').

A format such as this can begin at the most basic levels to help identify the capacity and appetite for developing longer-term programmes with increasing depth.

Areas of Focus	Public and private schools of Taveuni
Scope	Develop pilot curriculum for all school ages
Estimated budget	USD 2,000–5,000 per school (2–5 schools, USD 10,000)
Dependencies and engagements	Taveuni schools, community members, leadership, Ministry of Education
Synergies	USP School of Education, Tutu Rural Training Centre (TRTC)

3.1.5 Feasibility study: Establishment of conservation trust

To meet the increasing demand generated by watershed groups for EbA activities across Taveuni, there is a need to establish a steady and secure funding source for investing in ecosystem services for the long term. While significant funding has and continues to cycle through Fiji via donor countries and implementing agencies to improve environmental and community wellbeing, funding from such sources is not sustainable in frequency, magnitude or scope, and cannot be relied on for methodical and institutional large-scale restoration or adaptation efforts that will take decades or longer to implement.

Many such funding mechanisms have been implemented elsewhere in the world, such as Palau's 'Green Fee' that was initiated to offset lost commercial fishing revenues in their marine EEZ. The fee was originally designed to provide revenue to the country for marine and wetland conservation purposes and was payable as a fee for tourists who wanted access to the marine park, and later was expanded to include a fee as part of the visitor departure tax at the airport. The fees have been used to support conservation efforts and to support their obligation to the regional Micronesian Challenge 2020 objectives.

One key threat to the collection of earmarked funds for conservation is the administration and distribution of funds in a timely and regular fashion. There are many examples of how funds are re-allocated or diverted to meet other needs, especially if the administrative organisation has other multiple objectives (such as a government ministry), leaving only a fraction of the funds available for planning and implementation purposes.

For Taveuni, opportunities exist to collect conservation-based fees from visitors at Matei Airport, via the ferry transit system, and through hotel fees. The challenge is to determine what mechanisms and opportunities exist to provide prolonged, sustainable funds to support watershed groups on Taveuni with expenses associated with watershed planning and implementation of EbAs. A design and feasibility study is therefore recommended to build on the EbAs recommended here to determine an independent, low-cost, and dedicated structure that could provide communities with small grants to help defray costs for conservation or training, and also provide an enduring mechanism for conservation. This could be achieved by visitor tax, microfinance mechanisms, lottery, or any combination of means, building on examples that have been implemented elsewhere in the world. With a stable and independent platform, the likelihood of larger, interest-bearing endowments to fuel conservation is a favourable mechanism to many international investment organisations.

Areas of Focus	Taveuni Island
Scope	Focused feasibility study for financing conservation efforts
Estimated budget	USD 20,000–40,000
Dependencies and engagements	National Trust of Fiji, GEF Green Climate Fund, World Bank
Synergies	Fiji Visitors Bureau

3.1.6 Develop specialty markets for non-timber forest products (NTFP)

Nearly all watershed groups have access to native forestlands, which are threatened by deforestation and degradation in conversion to agriculture. The use of native forest that can generate goods and services, as well as income, is not a new concept to Fijians – routine harvest of food, game, fibre, oils, medicinal products, and building materials is an historic practice. Several natural products made by Fijian communities are currently on the market and sold throughout Fiji and the world.

Development of a market for Taveuni-based NTFP is a natural transition for entrepreneurial Taveuni communities to generate funds from conservation and restoration efforts of native forest. The initial phases of this activity include:

- gathering interested parties and training in best NTFP harvest practices and exclusions;
- developing community cooperatives or expanding existing structures to work together in developing product lines;
- training in operating a small entrepreneurial business and cooperative;
- seeking funds for any needed processing equipment through microfinance or grant activities;
- working with national campaigns, such as Fiji Made, to identify markets, products and supply chains; and
- developing a Taveuni marketing 'story' that supports Taveuni's conservation efforts and helps to boost tourism and sales.

While this project is decidedly entrepreneurial, the goal is to identify means for achieving economic gains through conservation efforts. It is anticipated that outside assistance will be necessary to nurture participation and success.

Areas of Focus	Taveuni watershed groups
Scope	Training and develop trial product concepts
Estimated budget	USD 20,000–40,000 for training and first phases to pilot
Dependencies and engagements	Engagement with Ministry of Industry and Trade, Fiji REDD+ Programme, Ministry of Forestry, Investment Fiji
Synergies	Couples with native forest restoration EbA activities to gather source materials, where applicable

3.1.7 Qamea and Laucala Island Watershed Coordination

The neighbouring islands to Taveuni share history and are connected by the reef environment. Two villages in western Qamea are also part of Wainikeli District, just across from Qaleni and Waitabu communities. Although communities on Qamea Island were not included in the initial PEBACC project rollout, a SPREP project funded by New Zealand Pacific Partnership on Ocean Acidification (PPOA) and aimed at EbA associated with marine health and ocean acidification was initiated for the Taveuni area. Given the closeness of the project objectives with PEBACC, Qamea Island has emerged as a potential EbA implementation area to include the complex reef environment tied with eastern Taveuni.

In December 2016, severe rain events from Tropical Depression 04F caused approximately USD $5 million in damages to Fiji, and triggered several landslides on the steep terrain of Qamea Island, destroying community infrastructure and causing injuries. A rapid review showed severe influx of sediments into bays and onto reef environments, with sea level rise and coastal erosion prevalent in some areas, including areas where mangrove expansion would be a viable protection mechanism. Similarly connected by the reef ecosystem is Laucala Island, which is privately-owned and is home to an exclusive resort. Together with Qamea and eastern Taveuni, the large marine complex serves as one connected ecological unit.

The objectives of this project element are to expand the approach to generate and deliver EbA prescriptions for marine and terrestrial ecosystems for Qamea and Laucala Islands. Initial work to accomplish includes:

- outreach with Qamea Island communities and Laucala management;
- work with other Wainikeli community members from Taveuni in "train the trainers" approach to watershed management;
- assessment and mapping of terrestrial EbA options, including those involving landslide rehabilitation and potentials for mangrove expansion in vulnerable coastal zones;
- assessment of the marine environment, use and management strategies and mapping of potential EbAs in the area; and
- development of a supplemental ESRAM-EbA Options plan that will inform next steps.

Areas of Focus	Qamea & Laucala Islands and associated reefs
Scope	Outreach & Supplemental ESRAM-EbA Options plan
Estimated Budget (USD)	$30,000 – 40,000 exclusive of travel and personnel
Dependencies and Engagements	Engagement with Wainikeli Communities on Taveuni, seek collaboration with Laucala landowners
Synergies	SPREP-PPOA Project ongoing and funded for marine scope

3.1.8 Lake Tagimoucia Ramsar site evaluation

Lake Tagimoucia is formed from a volcanic crater at 800 m in elevation, in the upper reaches of the Lavena-Nacogai watershed, and is a popular tourist attraction. The environment is known for its biodiversity and presence of rare plants.

Taveuni experienced extreme weather events in 2016, including TC Winston in February and extended drought later in the year. Landsat imagery was captured in July, showing markedly low lake levels, threatening the biodiverse assemblage in the sensitive area.

FIGURE 1. Left: Landsat imagery of Lake Tagimoucia in 1996 during and after months of severe drought. Right: Same location, January 1999. Note brown area in left image is exposed soil from low lake levels.

Given the rich biodiversity, tourism interest, uniqueness and fragility of the site, there has been expressed interest in including the site in The Convention on Wetlands, an intergovernmental treaty initiated in 1971 and signed in Ramsar, Iran with the goal of promoting conservation and sustainable use of wetlands. As a member country since 2006, Fiji has 615 ha designated as one site on Viti Levu (Upper Navua Conservation Area). The Lake Tagimoucia area (as delineated here for EbA consideration) is approximately 300 ha in size, which would increase the effective wetland area for Fiji by 50%.

There are many conservation advantages to creating a Ramsar site, although it requires a process to complete. Currently there is a need to support the Ramsar organisation to conduct the necessary background steps, prior to advancing Lake Tagimoucia as a candidate. In general, the steps are:

- conduct a preliminary assessment of which of nine Ramsar criteria the area meets;
- conduct community consultations and, if in agreement, obtain support letters;
- map the boundaries of the site, including core zone and 'wise use' zones;
- conduct a survey, including detailed biodiversity information, physical attributes (hydrology, biogeography, soil, sediment, rainfall, etc.) and other relevant descriptive features;
- conduct a rapid assessment of the ecosystem services provided by the site; and
- identify threats to the ecosystem.

Following completion of the above, the nomination must be approved by the Fiji Government via the Ministry of Environment and eventual endorsement by Cabinet.

Areas of Focus	Lake Tagimoucia, Upper Lavena-Nacogai Watershed
Scope	Community consultations, biodiversity and other surveys, mapping support
Estimated budget	USD 5,000–10,000 inclusive of travel and personnel
Dependencies and engagements	Procurement of specialist, local NGO to conduct scope
Synergies	Ramsar Organization

3.1.9 Aquaculture development plan and legal framework pilot

Aquaculture is a resilient practice that can provide jobs, improve populations of native species, mitigate ocean acidification, and is generally resilient to storm events (as evidenced in a Taveuni pearl farm during TC Winston).

There is a very high potential for aquaculture in Fiji, although currently the industry is very small and represents ~100 people in only a small handful of private companies. There have been attempts from Fisheries to develop the industry through partnerships with coastal communities in commodities of seaweed, tilapia and prawn, but these were met with poor results, largely due to an untrained work force, and lack of financial resources and security on water tenure (e.g. guaranteed use of resource).

There is interest at the national and local levels to develop the aquaculture industry, and efforts have been made to seek assistance from Japan, Australia, New Zealand and Indonesia, with the recommendation that the Fiji Government address the following gaps:

- write a development plan for aquaculture; and
- put a legal framework in place to implement.

Key elements of the plan that have been identified by industry experts, including those operating on Taveuni, include the following:

- security on water tenure;
- undefined licensing and lease agreements, and agents (government and iTaukei);
- permitting and leases that allow for sufficient timeframe (i.e. they require five years to harvest first crop, depending on target species);
- legal protection for farmers with accountability;
- ownership of crops and intellectual property (technology, research, process); and
- a swift and efficient process to approval to determine when and where farming may occur to secure investment, including any regulatory documentation (EIA, leases, different government departments and slow and burdensome fee structures).

Addressing the above elements into a cohesive plan that can be translated into a legal framework is an impediment to investment within Fiji and from outside investors. This project would initiate with a development plan for Taveuni and Qamea Islands as test sites, followed by a legal framework that could be piloted for a significant period of time to stimulate a programme (e.g. 25 years) that would stimulate investment from current industry farmers that have been working with Taveuni and Qamea coastal community landowners.

Areas of Focus	Taveuni and Qamea Islands
Scope	Develop aquaculture industry development plan for Taveuni and Qamea as a pilot Develop legal framework to pilot
Estimated budget	Phased project: • USD 50,000 for scope and plan • USD 30,000 for legal framework
Dependencies and engagements	Department of Fisheries, Select Committee on Natural Resources (Parliament), Land Board, other government stakeholders
Synergies	SPREP PPOE Funded Project, private industry, Taveuni and Qamea community partnerships

3.1.10 Taveuni primary forest health monitoring

Recent aerial imagery acquired in 2016 (Landsat 8-band image) shows evidence of expanding clusters of vegetation index values that suggest high levels of degradation in the upper reaches of forests across the island, with particularly large areas in the Taveuni Forest Reserve area (Figure 2).

Anecdotal evidence has suggested that there are non-native species encroaching at upper elevations on the western side of the Taveuni ridgeline, mostly relegated to the small volcanic cone structures, and this appears to be confirmed during the ESRAM process (see EbA in Section 3.3.11). However, new evidence from the 2016 image shows a much more widespread distribution of degradation on both sides of the ridgeline. The images in Figure 2 were obtained four months after TC Winston, and as such could be indicating direct damage from the storm, although responses and recovery of forest health is needed to also safeguard against any invasion of non-native or invasive species.

There is a need for an assessment of forest health, including a basic forest inventory of affected and non-affected areas to best understand the forest structure, composition and any degradation to function that may be under way. It is critical to determine the current condition and trajectory of forest health declines to determine a proper course of action to limit further, and perhaps permanent degradation.

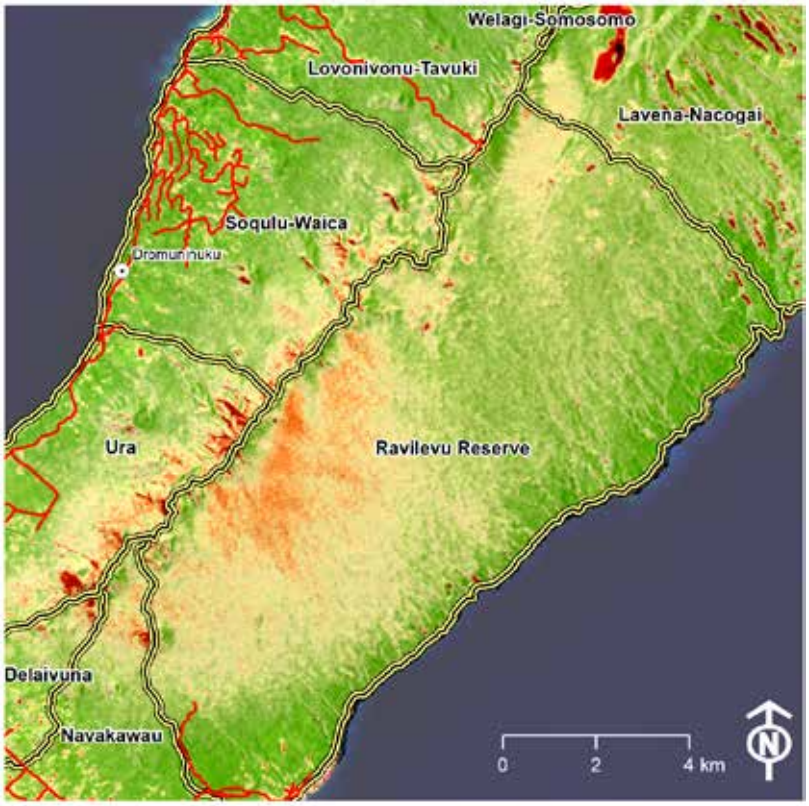


FIGURE 2. Vegetation NDVI analysis of the reserve area. Red colour (white arrow) indicates unhealthy or senescing vegetation. Green colour indicates full photosynthesis and water cycling, such as intact forest or crops at peak growth. Yellow is intermediate and stressed for a native forest (black arrow). This image was taken in July 2016 under drought conditions following TC Winston four months before.

Areas of Focus	Upper Elevation Primary Forests of Taveuni
Scope	Assessment of forest health with forest inventory
Estimated budget	• USD 10,000 for mapping and analysis support • USD 12,000 for field work support
Dependencies and Engagements	Department of Forestry, Fiji REDD+ Programme
Synergies	Fiji National Forest Inventory team, REDD+ objectives

3.2 TRAINING AND PRE-REQUISITE ACTIVITIES FOR SITE-BASED EBA IMPLEMENTATION

This section identifies dependencies for conducting the EbA options presented in section 3.3, Watershed-level EbA activities. These options should be implemented on an as-needed basis and can involve all relevant stakeholders (i.e. centralised training and activities), thereby pooling resources to improve efficiencies. Each EbA training here would involve a point of contact for expertise during the implementation phase of the project.

3.2.1 Training and action: Plant nursery construction and operation

Many of the recommended EbAs require a steady source of plants (trees, agricultural plants, etc.) to transplant onto the landscape. Sourcing locally native material is a desired option, especially for native tree species. Nurseries are important resources for propagating large numbers of healthy and robust plants in an efficient manner. It is desirable, in response to disaster management, to have quick and ready access to seedlings to rehabilitate farms and forests. In addition, nurseries can provide a means of generating income – something that is currently under way on a small scale on Taveuni.

Generally, nurseries can be constructed using locally-sourced materials at relatively low cost. Access to water, planting media (soil or variant), shelter from sun and rain, and diligent management are pre-requisites to success. Overall, there are several approaches to nursery design and management, as described below.

Large-scale commercial nurseries. Built of hard infrastructure in a central location with full-time staff, these facilities are designed for high production, maximising germination, growth and finishing rates. Typical examples are 50 x 50 m in size, capable of 150,000 or more seedlings with annual outputs of 80,000–100,000 finished trees, depending on how the nursery space is allocated and managed. Plants for agricultural uses require less space and time to mature, and therefore have a much higher throughput.

Community based nurseries. These are small nurseries made of locally-sourced and durable materials and are in a central location, with a community-supported means for caring for the plant material. Sizes can vary from a single bench (~2 x 10 m) to a modest-sized cluster of benches (~6 x 6 m). Costs are much lower for entry, although throughput is ~600–1,200 trees per year for small units, depending on management and needs.

On-site nurseries. Also considered 'temporary' nurseries, these are built from locally available materials at lowest overall cost. Typically, these are managed by a few people for a specific purpose, and plant management and success depends on the operator. These vary in size but due to typically more remote locations, they are smaller and output ~100 trees/year.

Guidance is needed to assist watershed groups choose the best option(s) to suit their needs and to train them in the construction and management of the nursery process, as well as nursery-related issues associated with virus, disease and maintaining nursery health. It is suggested that this workshop is a hands-on approach to build a community nursery by participants that would support the Youth Stewardship Programme in a central area, such as the school grounds in Somosomo Village (see EbA in Section 3.1.4).

Areas of Focus	Taveuni Island Watershed Groups
Scope	Training for construction and management of plant nurseries (farm and forest)
Estimated budget	USD 3,000 plus materials costs to build one nursery (~USD 3,000)
Dependencies and engagements	Ministry officers from Agriculture and Forestry, FAO
Synergies	Current pilot project under way on Taveuni (Forestry), FAO

3.2.2 Training: Native plant seed collection to enhance biodiversity

Seed stock is likely to be a limiting factor in restoration efforts. Importing plants is costly and problematic due to quarantine issues. Collection of seed stock, particularly native forest species, requires careful consideration to preserve the biodiversity components of species and genetic diversity. Example criteria to consider in seed collection include:

- species selected;
- timing of seed collection – maintaining a range of flowering times to maximise phenology spectrum;
- diversity of shapes and sizes of the same species – sometimes the seeds that are easiest to harvest do not make the highest quality plants;
- areas sampled – a range of elevations and areas from around the island that have adapted differently or are different genotypes;
- careful identification and quality control of seed stock – maintaining clean seeds to prevent the spread of invasive species and loss to mould; and
- mapping of collections to trace genetic lineage.

While many communities have conducted seed collections in the past, it is important to maintain training and awareness of preserving biodiversity (species, genetics, phenology) to avoid future bottlenecks.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Seed collection to enhance biodiversity training
Estimated budget	USD 3,000 in support funds
Dependencies and engagements	Ministry of Agriculture/ Forestry
Synergies	Ongoing Forestry nursery pilot projects

3.2.3 Training: Riparian and wetland planting and management

A major activity in all watersheds is the protection and management of riparian corridors and protection of wetlands (upland, where observed, and coastal, such as mangroves). Planting of appropriate species assemblages and identification in the field of potential hazards are of critical importance in enhancing these ecosystems. Typically, these plants require access to more water, at the appropriate times, and active restoration efforts require different techniques and levels of effort.

Training in identifying current and potential riparian zones, flood prone areas, and wetland areas (i.e. relation of land to water and periodic flooding), and implementing and caring for plantings is important for successful EbA implementation.

This training should contain an element of plant collection and propagation, and should produce a small demonstration in a common area, such as the river systems near Waiyevo in the Lovonivonu-Taveuki watershed.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Riparian and wetland planting training and practicum
Estimated budget	USD 5,000 in support funds
Dependencies and engagements	Ministry of Forestry
Synergies	Unknown

3.2.4 Training: Agricultural improvement and diversification trials

With the understanding that widespread and intensive dalo production is not a sustainable option for Taveuni, there is a need to improve diversity of crops and explore other markets, as well as conduct trials to improve soil tilth and productivity through time. Research from USP on soil health and dalo production for Taveuni documents nutrient limitation issues; the Ministry of Agriculture has also contributed to the body of work.

Current efforts under way by Teitei Taveuni (local NGO) have worked to create organic nutrient mixes, and have participated in farm-based trials across the island. Supporting these efforts and with a specific goal to increase crop diversity (e.g. alley cropping, firewood trellis/vine, row crops, etc.), mulching and rotation is vital to the current and future agricultural industry and subsistence of the Taveuni farming community.

It is suggested that a graduate student or focused researcher be supported to conduct a robust study of different cropping systems over 2.5 years in order to develop and repeat new systems and measure treatment responses to soil tilth and economic yield. Given that farmers will have opportunity costs to participate in trials (i.e. may not have product to sell, or have less earnings), it will be important to support their efforts to participate in the programme.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Training and field trials for multiple crop systems with goal of improving soil fertility and crop diversity
Estimated budget	USP 15,000–20,000 support
Dependencies and engagements	Ministry of Agriculture, USP
Synergies	Teitei Taveuni (SPREP funded 2016), commercial farmers, USP research and graduate students, Tutu Rural Training Centre

3.2.5 Training: Agroforestry practices and management

A major EbA consideration among watershed groups was to incorporate or shift to agroforestry options on declining farms. Agroforestry options identified for Taveuni include:

- agroforestry and agricultural enhancement – the use of wide-spaced food-based tree crops (e.g. fruit and nut trees, nitrogen-fixing trees) with in-row companion crops (alley cropping);
- agroforestry – growing fruit, spice, beverage, staple foods and hardwood crops for sale or value-added processing; and
- agroforestry (native and mixed species plantations) – similar to the agroforestry prescriptions, with more emphasis on native and non-native hardwoods.

Agroforestry options are generally prescribed in lower and mid-elevation deforested areas to serve an overall function of providing diversified and high-value income streams, improve soil health, increase biodiversity and watershed function, and assist as a precursor to native forest regeneration activities.

Training and assistance are needed to provide watershed groups with selecting and implementing useful strategies on the landscape to meet landowner objectives, as well as in identifying potential markets for the different products. A consulting expert is required to initiate trials and provide guidance to landowners.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Training for establishing agroforestry systems and implementation guidance to landowners
Estimated budget	USD 10,000–30,000 depending on level of input required
Dependencies and engagements	Ministry of Forestry, FAO, NGOs, outside consultant
Synergies	Nabogiono Farm

3.2.6 Training: Plantation management and certified sustainable products

Plantations targeting high-value native and non-native hardwoods are useful tools for generating long-term income, for enhancing biodiversity, improving a wide range of ecosystem services. They are also a mechanism to encourage native forest rehabilitation and expansion (e.g. 'out-planting', see section 3.2.7). These treatments are generally prescribed in upper elevations, near to the native forest interface, or areas that are less limited by rainfall:

- **plantation forestry (mixed species)** – specific treatments for growing high-value hardwoods (e.g. teak, mahogany), including native species (e.g. sandalwood, vesi); and
- **plantation forestry (native species)** – high-value hardwoods that focus on native species, or in areas where the ultimate goal may be native forest restoration with selected harvest.

Plantation management requires site and species selection, along with periodic treatments to encourage growth to meet the landowners' end-product objectives (e.g. emphasis on growth form and harvest size). Typically, these treatments take ten or more years to an initial thinning, depending on the objectives, species choice and site selection. Rotation of fast-growing species for earlier harvest can also encourage undergrowth of slower species (providing shade environment) and can hasten the process and lower the overall costs, allowing for some early revenue generation.

Development of specialised markets for sustainably grown and harvested woods is well known in Fiji and internationally, and support from the Smartwood/Forest Stewardship Council for sustainable certification is needed to explore those markets.

Training and coordination are needed to implement these projects on Taveuni. This includes species selections, early cultivation (tipping, weed control, thinning), harvest methods, certification, markets, etc. There is a range of resources available in Fiji to accommodate these skillsets, from government, NGOs and private industry.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Training for establishing a range of plantation systems and implementation guidance to landowners
Estimated budget	USD 10,000–USD 30,000 depending on level of effort required in early phases of training and implementation
Dependencies and engagements	Ministry of Forestry, FAO, Sustainable Forest Industries Limited, FSC, Fiji REDD+, World Bank Forest Carbon Partnership Facility, others.
Synergies	NatureFiji – Member of Forest Stewardship Council, Ministry of Forestry

3.2.7 Training: Native forest restoration and expansion

At the native forest/degraded lands interface, mostly located in the higher elevations, there is opportunity to expand native forest fragments into adjacent lands to meet the objectives of minimising forest edge and increasing the overall resilience of the forest environment.

Native forest species regeneration can be done at relatively low materials cost but high labour inputs. Techniques used are site- and objective-specific, and can incorporate any of the tree-planting EbA interventions listed in this section to increase shade on the outside edges of native forest fragments to allow for native species to be established underneath. This forest 'out-planting' technique provides income from harvest of plantation trees (or allows native trees to continue growing) as other forest species encroach and increase site biodiversity and ecosystem function.

Another technique that involves far less effort and materials costs is additions of granular fertiliser around native forest fragment edges to encourage natural expansion of forest edges. Some success has been made in this regard on degraded soils in Palau, where granular fertiliser was spread around native tree 'islands' to encourage outgrowth.

Additional training and coordination are needed to identify low-cost, successful approaches for expanding native forest. This is best accomplished through community-based activities, including seed gathering and tree planting, and can be incorporated with other training prescribed in this section.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Community-based training in select locations for out-planting and other forest expansion techniques.
Estimated budget	USD 5,000
Dependencies and Engagements	Ministry of Forestry, FAO, conservation groups
Synergies	Coordinate with other EbA activities and training as an add-on activity

3.2.8 Training: Invasive species detection and management

Invasive species on island environments cause dramatic shifts in ecosystem function and can cause irrevocable harm to ecosystem services and community health. Increasing the capacity of community members to identify invasive plant and animal species and organising an easy way of documenting and mapping their presence is well within the community's capacity. Development of durable flashcards or playing cards that can be distributed to communities is one mechanism to help build capacity to identify invasive species.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Invasive species detection training, tools and mapping solution
Estimated budget	USD 20,000
Dependencies and engagements	Government ministries, NGOs
Synergies	NatureFiji, National Trust of Fiji


C.Goosen

3.2.9 Training: Coral cultivation and transplanting in shallow coral reef habitats

The aim of this project is to increase the resilience of shallow coral reef habitats at locations where upstream effects from water quality degradation have been minimised. The purpose would be to establish a nursery of potential coral reef transplants of species that are resistant to increasing water temperatures. Corals of various genotypes with bleaching resistant properties would be cultivated in small-scale farms in shallow waters at locations around the island. The benefits of the project would be to:

- increase awareness of the threats (global and local) to coral reef health;
- provide economic opportunities to local communities through the creation of jobs, and developing local ecotourism for tourists who want an engaged community participation project while on vacation; and
- increase coral reef health by cultivating bleaching resistant cultivars for transplanting onto local reefs.

The activities of this project would be to:

- identify partner ecotourism operators to provide income and revenue from tourists to visit the transplanting project;
- provide training to local youth to transplant and cultivate corals in small garden plots;
- provide training to identify suitable habitat and harmful inputs from terrestrial sources; and
- identify transplant locations to degraded nearshore reefs that have been decimated from coral bleaching.

Areas of Focus	Taveuni Island Watershed Groups
Scope	Training for coral transplanting
Estimated budget	USD 10,000 excluding materials
Dependencies and engagements	NGOs, Department of Fisheries
Synergies	SPREP PPOA Funded Project

3.3 WATERSHED-LEVEL EBA ACTIVITIES

This section describes site-based prescriptions for improving ecosystem services. A wall-to-wall map of Taveuni and reef environments has been created with prescriptions and known land tenure (Figure 3 and Figure 4). Primary EbA activities are summarised according to elevational band (Table 7). Each watershed group has identified priorities, and preferred prescriptions are highlighted to reflect these priorities.

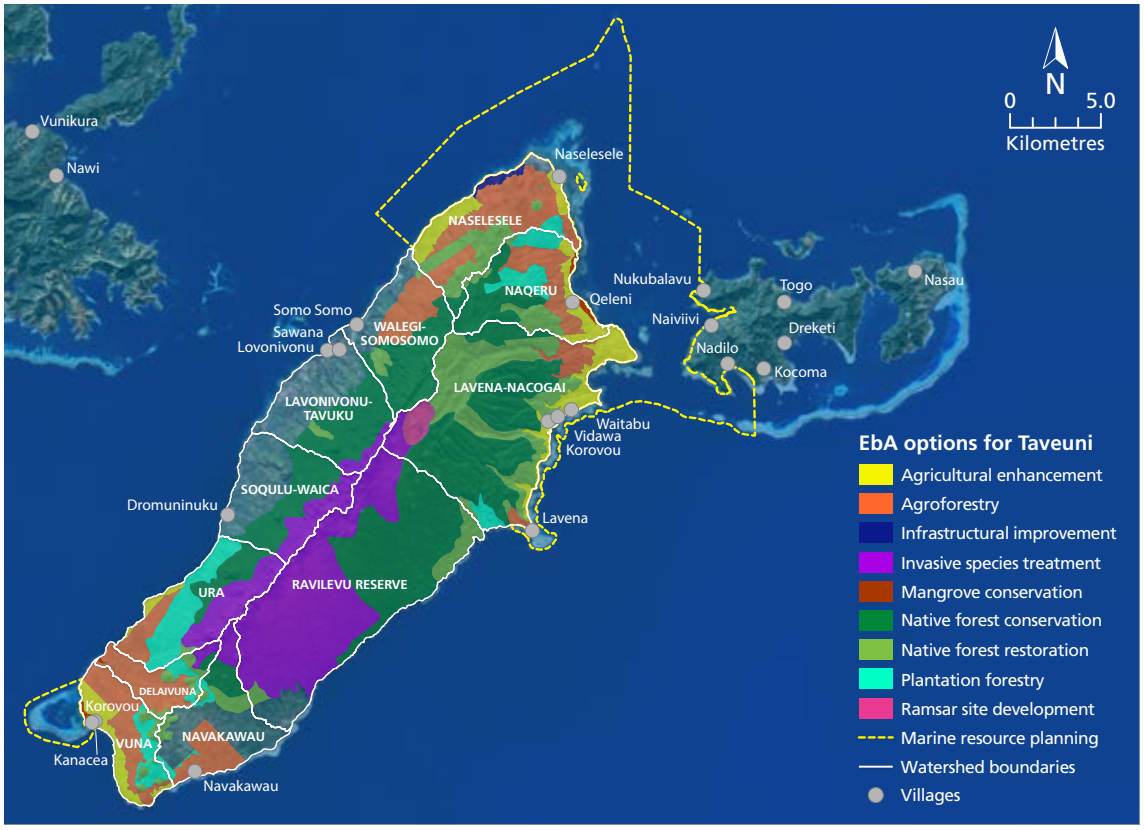
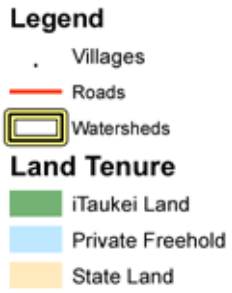


FIGURE 3. Overview of EbA Options for Taveuni Island and surrounding marine areas.



Number of *mataqali*	122
ITaukei Land	54%
Private freehold	33%
State land	13%
Number of watersheds	11
Island area (ha)	43,600

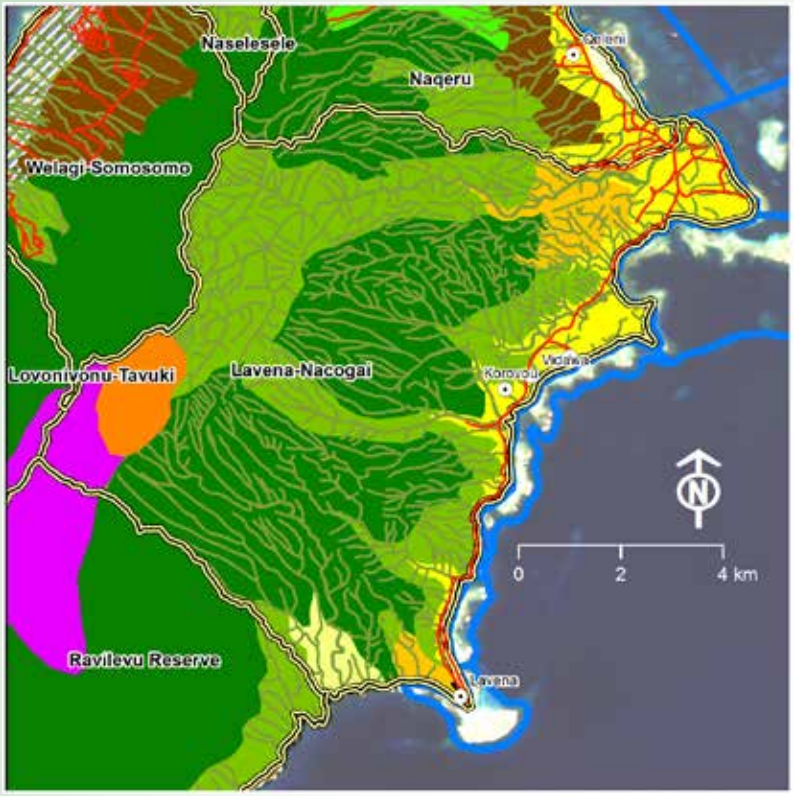
FIGURE 4. Overview of land tenure for Taveuni Island.

TABLE 7. Breakdown of primary EbA activities for Taveuni Island by elevational band. Area is expressed as maximum treatable area (ha) and not all areas can be treated.

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agricultural enhancement	2,048	5%	666	994	231	140		
Agroforestry	3,140	7%	281	583	1,409	867		
Agroforestry (mixed plantations)	2,444	6%		13	289	942	735	464
Biocontrol	91	0%	42	48	0			
Ecotourism	8	0%	4	0				
Infrastructural improvements	143	0%	66	76	0			
Invasive species monitoring and treatment	7,640	18%	2	10	35	143	385	7,066
Mangrove protection, planting and enhancement	100	0%	95	3				
Native forest conservation	11,984	27%	3	29	150	1,015	1,280	9,508
Native forest restoration	3,889	9%	8	45	368	741	923	1,803
Plantation forestry (mixed species)	467	1%	7	21	46	388	6	
Plantation forestry (native species)	1,698	4%	14	27	163	708	613	173
Ramsar site development	295	1%						295
Riparian	5,198	12%	331	426	649	1,239	853	1,697
Stakeholder outreach	4,498	10%	362	551	813	1,474	640	623
Total	**43,642**	**100%**	**64**	**1,879**	**2,824**	**4,153**	**7,658**	**5,435**

Marine Area: 13,872 ha

3.3.1 WAINIKELI: LAVENA-NACOGAI WATERSHED



Legend

- Villages
- Roads
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Agricultural Enhancement
- Agroforestry
- Agroforestry (Plantations)
- Plantation Forestry (Mixed Species)
- Plantation Forestry (Native Species)
- Native Forest Restoration
- Native Forest Conservation
- RAMSAR Site Development
- Stakeholder Outreach
- Mangrove Protection, Planting & Enhancement
- Invasive Species Monitoring & Treatment
- Marine Protected Area
- Infrastructural Improvements

PRIORITY ACTIONS

- Enhance agricultural areas to include agroforestry
- Reforest in lowlands areas near villages
- Mitigate beach erosion on southern coast near school
- Native forest restoration through tree planting and to increase NTFP access
- Riparian treatments to avoid flooding and run-off
- Micro-hydropower in Lavena with water source
- Coral enhancement potential at Lavena Point

Number of *mataqali*	33
ITaukei land	83%
Private freehold	15%
State land	2%
Watershed area (ha)	8,259

The Lavena-Nacogai watershed is a very rugged landscape that has largely been kept as primary forest in the highest elevation areas. Freshwater resources are abundant and deemed a low risk for communities. Communities in this watershed have been actively engaged in ecotourism projects that have promoted mostly land-based activities (hiking, swimming in freshwater pools), with seaward activities in the Waitabu marine protected reef area.

Communities were greatly affected by TC Winston in 2016. Wind, flooding and storm surges caused widespread damage to infrastructure and the single access road that ends in Lavena Village. Vulnerabilities associated with infrastructure and transportation are high.

Agricultural uses are greater in the northern coastal areas, with a very large commercial farmer (freehold land) as well as smaller village subsistence farms. In the southern section, near Lavena, land areas are very rugged and only a small amount of subsistence foods are grown. The northern section along the coastline is dominated by the Waibula River valley that transitions to a large coastal terrace that is predominantly under commercial farm use, which may contribute to lower water quality in lagoons on either side of the outlet. Upriver, there are opportunities to provide more flood mitigation and buffer areas in the riparian zones with

agroforestry and plantation treatments on the side-slopes, and riparian planting concentrated in the canyon bottoms. Native forest areas in the upper slopes are generally degraded, opening opportunities for restoration using creative applications of out-planting through riparian treatments and native tree planting downgradient toward the streams. Small-scale land-use activities are visible in some of the canyon bottoms, which are likely causing additional degradation. The use of higher-value plantations or agroforestry in these areas may provide balance between income and conservation of ecosystem services.

TABLE 8. Land-based EbA interventions for the Lavena-Nacogai watershed by elevational band. Area is expressed as the maximum areas (ha). Marine area for this watershed zone is 2,018 ha.

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agricultural enhancement	650	8%	325	285	35			
Agroforestry	298	4%	17	12	127	142		
Infrastructural improvements	8	0%	7	1	0			
Invasive species monitoring and treatment	216	3%						216
Native forest conservation	2,725	33%	0	2	26	516	508	1,672
Native forest restoration	1,725	21%		4	266	290	206	959
Plantation forestry (mixed species)	121	1%	7	21	41	50	3	
Ramsar site development	295	4%						295
Riparian	2,220	27%	134	129	209	423	313	1,012
Totals	**8,258**		**490**	**454**	**704**	**1,421**	**1,030**	**4,154**

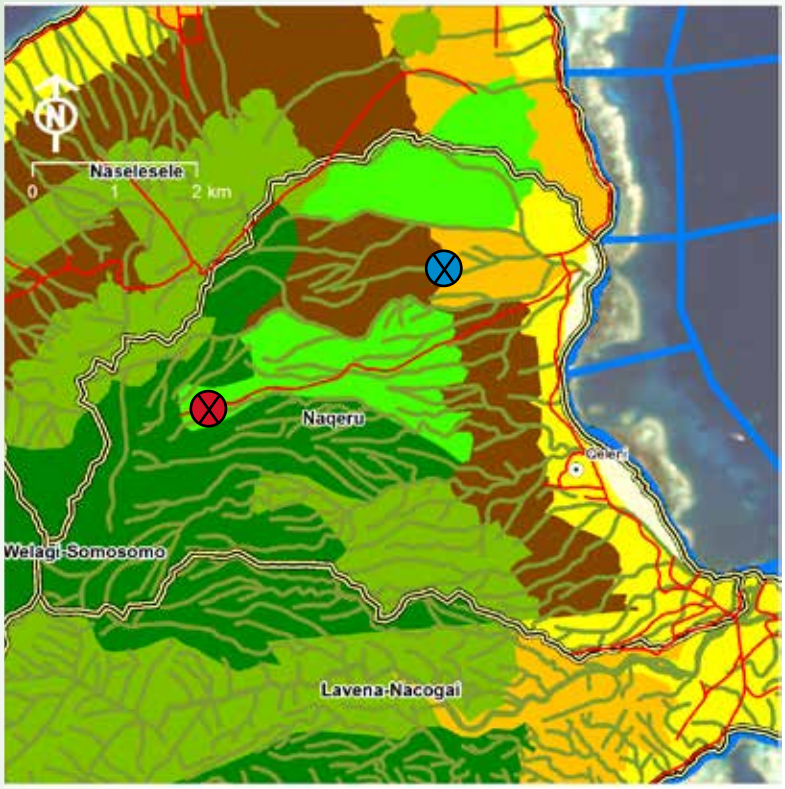
Fishermen at the lagoon and outer reef at Lavena Point provide Taveuni Island with substantial fisheries products for sale, especially for village events (weddings, funerals, chiefly functions, etc.). Fishing in this area is very important to the local economy, and interviews suggest there are no formal records or catch management in place. A priority identified by the community for the marine environment was to improve coral health by coral transplanting. Lavena may be a candidate location due to the relative isolation, lack of terrestrial pollution run-off and relatively high ocean mixing. The community did not directly identify fishing pressure as a vulnerability, although interviews related to population sizes and level of fishing effort show resource decline. Further outreach is needed to identify promoting sustained yield for the Lavena area. Waitabu lagoon and reef recently (2017) established two tabu areas as no-take areas for fisheries and has had active management in place with good Fiji-based technical support available.

Steep beach eroding to the Lavena village edge. Coastal plantings ~20–30 m inland is a potential mitigation. Agroforesry and plantation options are on the adjacent slopes.

Riparian planting and agroforestry areas just above Korovou.

Waitabu Marine Protected Area and central ecotourism area. A steep beach and limited vegetaton is present in the village area, potentially at risk of erosion.

3.3.2 Wainikeli: Naqeru Watershed



Legend

- Villages
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Agricultural Enhancement
- Agroforestry
- Agroforestry (Plantations)
- Plantation Forestry (Native Species)
- Native Forest Restoration
- Native Forest Conservation
- Mangrove Protection, Planting & Enhancement
- Marine Protected Area

PRIORITY ACTIONS

- Rehabilitate and reclaim expired lease lands (blue marker)
- Use of agroforestry and plantations for high-value hardwoods and products to aide in rehabilitation (red marker)
- Native forest restoration, particularly through out-planting in strategic locations (red marker)
- Riparian planting and rehabilitation
- Mangrove expansion in areas where mangroves are prolific
- Coastal zone is vulnerable and requires in-depth assessment
- Ecotourism site in upper watershed (red marker)

Number of *mataqali*	22
ITaukei land	95%
Private freehold	5%
State land	0%
Watershed area (ha)	3,138

The Naqeru watershed has had large, long-term agricultural leases that converted the landscape to coconut for copra production in the early 20th century. Lands have been returned to the community in recent decades and a key priority is to determine how to rehabilitate the lands, with a focus on building long-term income and sustainability. The area transitions from narrow lagoons to an upslope leading into native forest, with most of the lands dominated by vines, grasses and decadent coconut agroforest fragments. There is high interest and participation in these communities in developing ground-based EbA options that increase forest cover and rehabilitate lands from past leases. Many opportunities exist in this watershed for EbA implementation.

Two major sites were vetted by the community and appear to have the access and support for terrestrial-based EbA implementation (see blue and red markers on the map above). Both have been under intensive copra management for nearly 70 years until abandonment in the late 1990s. The resultant landscape is fragmented and degraded forest fragments, with heavy vine and grasses, especially in the lower elevations. Use of agroforestry with agriculture and some hardwood production is recommended in the lower elevation site (blue marker). In the upland site (red marker), ferns and less aggressive grasses and higher rainfall would promote the use of native species out-planting and high-value native tree plantations for sustainable yield harvest.

The upper elevation site has many advantages, including a large remnant native forest fragment in the highest elevations, abundant birds and a gazetted road that allows access. The road is a particular advantage as, with government collaboration, it can be re-graded to allow access to conduct high elevation rehabilitation, working downhill to extend forest to the mid-elevations. This site also presents an excellent ecotourism opportunity for people seeking a forested retreat with wildlife viewing, hiking, waterfalls and horse trails (e.g. birdwatchers, backpackers, etc.), with perhaps an active tree-planting role to assist in the restoration effort.

The coastal zone is experiencing active erosion; the lagoon substrate in large part has very little sand, leaving bedrock and small cobbles, after an apparent movement of sand several years ago. There is also a small jetty that appears to be blocking substrate flow down-gradient. Coastal erosion protection will require further study, as there are complexities associated with infrastructure and coastal dynamics, where options may be limited without major intervention. Several healthy mangrove patches at the outlets of several rivers and seeps are present and present opportunities for expansion to include coastal protection, but the low sediment budget may prove to be a challenge in some areas.

The Naqeru community, through agreement and tribal relations, shares reef resources for fishing with the Naselesele community (Section 3.3.3). This largely drives the community to the more productive Naselesele reef to the north for fishing, although subsistence fishing is also common in this area. The community did not identify any clear priorities for the marine environment, although needs exist, if only for tracking fisheries harvest.

TABLE 9. Land-based EbA interventions for the Naqeru Watershed by elevational band. Area is expressed as the maximum areas (ha).

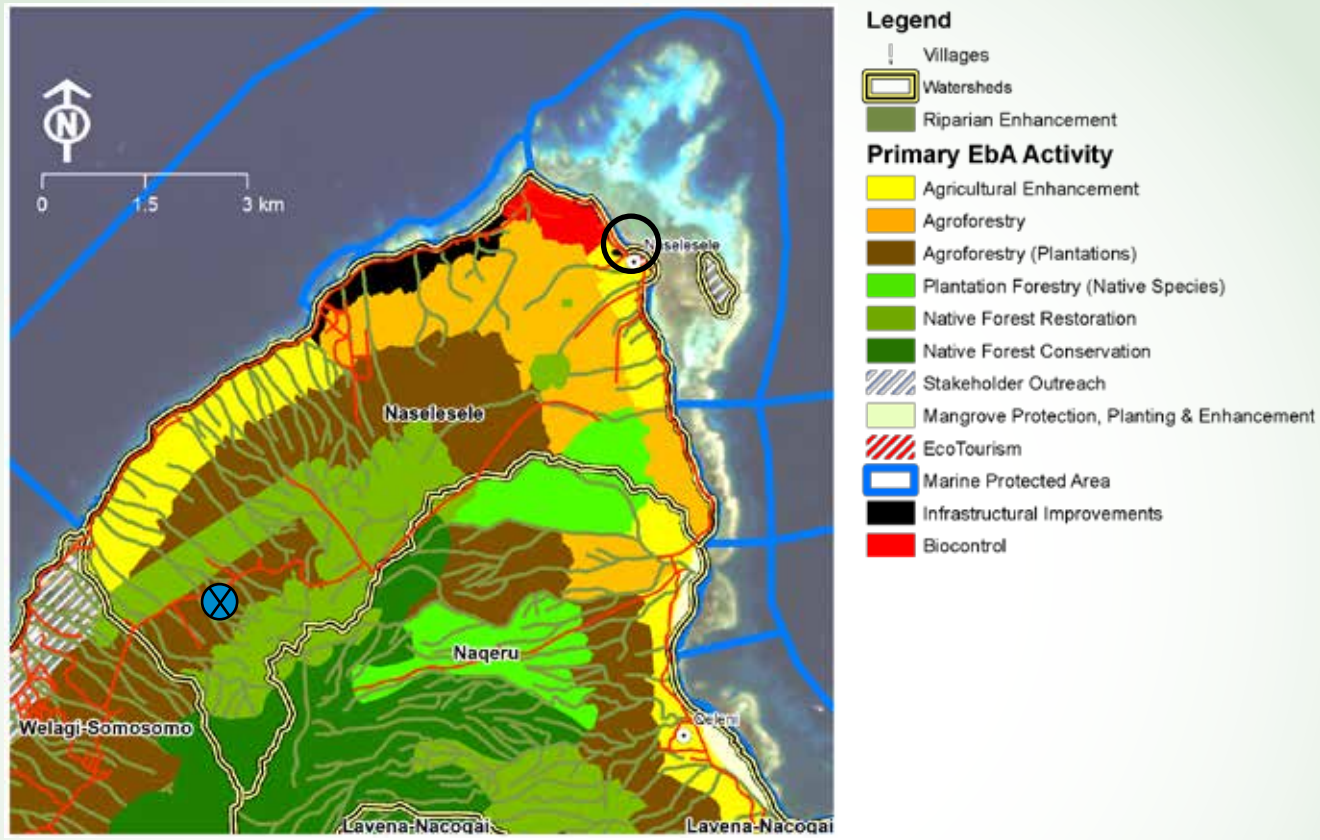
Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agricultural enhancement	330	11%	116	152	37	25		
Agroforestry	88	3%	4	18	29	37		
Agroforestry (mixed plantations)	467	15%		9	142	185	105	26
Mangrove protection, planting and enhancement	66	2%	63	2				
Native forest conservation	715	23%				12	48	655
Native forest restoration	298	10%				71	104	123
Plantation forestry (native species)	449	14%		0	40	153	165	91
Riparian	724	23%	43	43	72	147	159	260
Totals	**3,137**		**226**	**224**	**319**	**631**	**581**	**1,155**

Mangrove patches along the coastline near Qaleni. Sands are gone in this area, which may prove to be a challenge for out-planting.

Higher elevation forest rehabilitation through agroforestry, native tree plantations and native forest out-planting is a challenge in a grass/vine dominated environment (red marker).

Location of priority low and mid elevation agroforestry and agricultural enhancement sites in Naqeru (blue marker).

3.3.3 Wainikeli: Naselesele Watershed



Circled area = spring and ecotourism priority area. Blue marker area has safeguards by landowners to require lessees to plant native trees.

PRIORITY ACTIONS

- Develop spring water sources and improve forest cover to protect springs
- Develop ecotourism site on lagoon
- Improve tree cover through agroforestry, mixed plantations and native species plantations
- Work with community and neighbouring areas to minimise deforestation in upper elevations

Number of *mataqali*	24
ITaukei land	21%
Private freehold	36%
State land	43%
Watershed area (ha)	3,503

The Naselesele watershed is the gateway for tourists arriving to Taveuni by air, and is split between hotel infrastructure, small landholdings, leased farmers, and rural subsistence. The Naselesele lagoon is very wide with a productive seagrass community and some mangrove patches. Naselesele sits at the base of a large dome descending from the ridgeline of the island, has few streams and many springs, especially along the coastline in areas under 20 m in elevation.

Land-use activity in Naselesele is very high and has led to widespread deforestation and degradation of the few remaining upland forests (approximately 3% remains in fragmented native forest), with continued pressures from dalo and yaqona farmers leasing lands in the high elevations of the leeward side (upslope of the blue marker area). This has led to high vulnerabilities in rainfall and cloud capture at upper elevations. There is widespread community perception, especially after the extended drought of 2016 that the decline in forest cover has led to lower water tables in existing pumping stations for the community, which required water to be delivered by truck during the water stress period. Groundwater dynamics are not well known for this area, though there are many low-elevation springs that went dry during the drought events, suggesting low residence times.

For terrestrial systems and improving ecosystem services, the consensus of action is to reforest the landscape with a range of high-value agroforestry cropping systems in the lower elevations, planting native and mixed tree species to increase forest cover and forest function. In riparian zones (while intermittent), the goal is to plant appropriate species to increase cover and relative humidity, and promote groundwater infiltration and attenuation of land-based sediment pollution to the lagoons. Lower elevations, having had dalo and yaqona farms for many years, would benefit from the change to agroforestry systems, in particular the use of nitrogen-fixing trees and plants and mulching to build soil tilth. Vine and grass in fallow areas present a significant management challenge in land recovery and re-establishment of forest.

As denoted by the blue marker on the map, community members in the neighbouring Welagi-Somosomo watershed (Welagi Village) purchased freehold land that is located just downhill from small communities of non-traditional farmers (mostly homes and small gardens), who also lease lower elevation areas to farm. As part of the lease agreement, the Welagi village owners of the property are mandating a 'tax' for lessees to reforest a rectangular area at the top of their leased lands to restore native forest. Solutions involving fast-growing nitrogen-fixing trees interplanted with slower-growing native hardwoods may be a tool to improve soil conditions, create shade and re-establish forest fragments (currently it is deforested, dominated by grasses and vines). An important point of support in this area is that the community has instigated safeguards to ensure that the land improves over time and does not further degrade. Integration of Welagi Village (a Cakaudrove District community) into the Naeselesele watershed group should be strengthened to address reforestation issues.

Water availability is a challenge for these planting projects. It will be especially important to grow sturdy and healthy plants in the nurseries prior to transplanting in the field, and selecting areas with substrate having soils (versus rock and boulder) in site selection.

TABLE 10. Land-based EbA interventions for the Naselesele Watershed by elevational band. Area is expressed as the maximum areas (ha).

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agricultural enhancement	425	12%	58	124	126	116		
Agroforestry	672	19%	42	75	337	217		
Agroforestry (mixed plantations)	807	23%				330	326	150
Biocontrol	91	3%	42	48	<1			
Ecotourism	8	<1%	4	<1				
Infrastructural improvements	111	3%	42	68	<1			
Native forest conservation	96	3%						96
Native forest restoration	661	19%			2	67	109	484
Plantation forestry (native species)	92	3%		1	76	15		
Riparian	514	15%	23	52	83	119	92	144
Stakeholder outreach	27	1%						
Totals	**3,504**		**210**	**369**	**624**	**864**	**527**	**873**

Marine Area: 8,252 ha

The spring system on Naselesele provides many opportunities for development of natural springs for domestic use and for supporting dispersed nurseries. The most notable example with the highest potential at low cost is at the western edge of Naselesele Village, where deep pools form from a distributed groundwater seep, extending ~200 m inland from the road. There are locations where a small weir and pumping system could be installed to gather water for emergencies, irrigation for a central nursery on the village grounds, or domestic use at relatively low cost. The community has requested this from the government, but has not had success.

The spring-fed pools themselves, coupled with a nearby coastal strand sandspit (see circled area on map) is a prime candidate for an ecotourism and restoration/enhancement site. The site is very accessible for local tourists and provides the above freshwater pool and saltwater lagoon for swimming, snorkelling and beach experience.

The beach area is currently in coconut cover with some mangrove area, and has a small stream running through it.

Enhancement of this coastal strand and neighbouring mangrove areas will be a source of continued ecosystem services to Naselesele lagoon, as well as a beach and swimming destination for tourists, which will generate some income for the community to focus on restoration efforts.

Coastal strand with mangroves slated as a potential ecotourism site and mangrove expansion.

Mangroves can be expanded from coastal strand along the seawall area in front of the village to enhance sealife and buffer water quality.

Spring-fed pool adjacent to Naselesele village presents good opportunity for water infrastructure and ecotourism.

The Naselesele lagoon and outer reef is a key feature for EbA activities. Mitigating terrestrial run-off, modifying fishing behaviour and increasing awareness and understanding of population dynamics in the area are critical.

Terrestrial run-off mitigation for this area is best done through reforestation methods and planting in areas where road erosion is occurring and is connected to the lagoon by a channel.

Mangrove enhancement in all areas around the coastal zone will help to trap sediment and protect freshwater seeps, providing an important rearing habitat for fish and shellfish. Additional EbA specific to the Naselesele lagoon and reef are found in section 3.1.3.

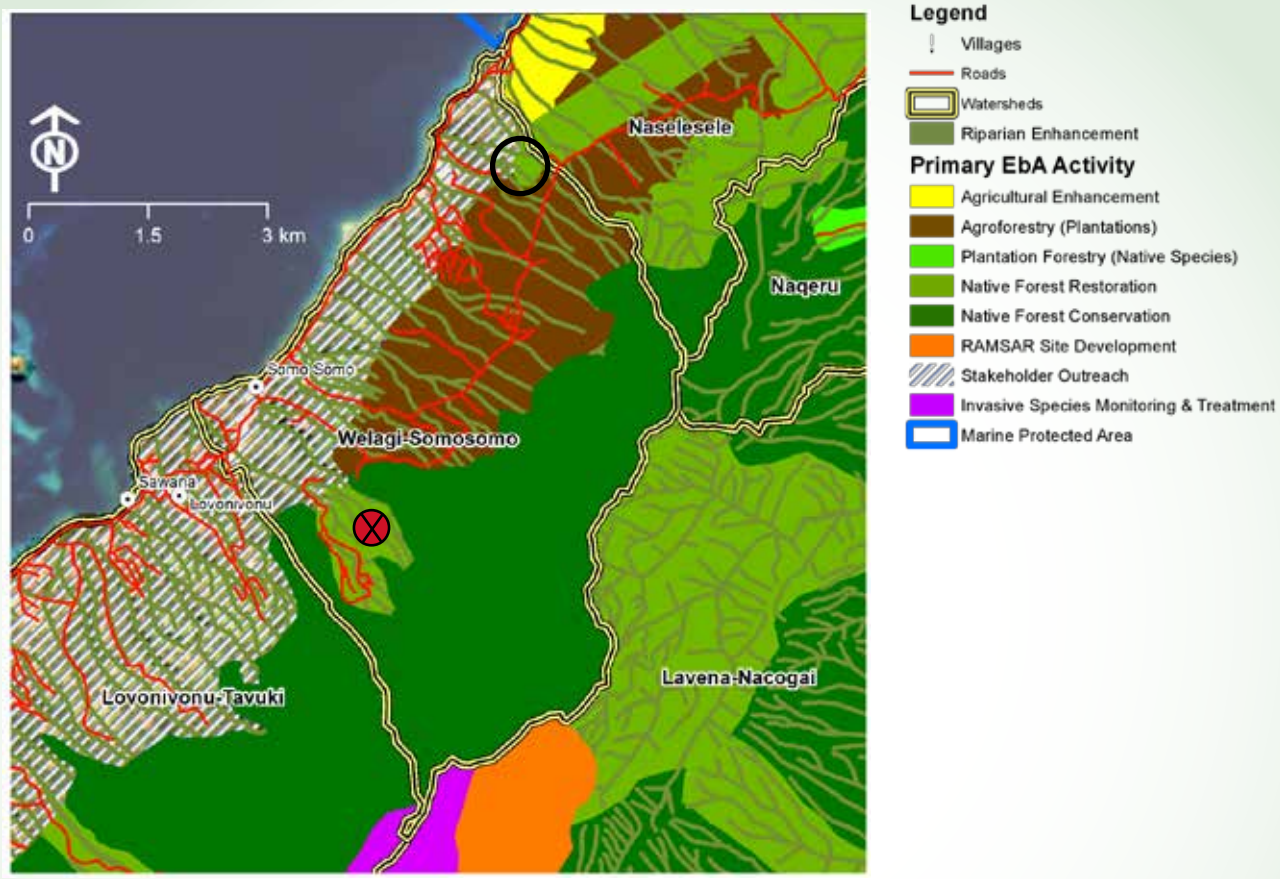
Spring location adjacent to Naselesele Village. A small weir is in place, where community members collect water in buckets during times of emergency.

Low and mid-elevation sites for converting dalo farms to more diverse agroforestry and alleycropping systems.

Special project considerations:

- Naselesele spring development at Naselesele Village. This involves water quality monitoring, engineered design for a weir and pumping station. Prior to any action, engagement and approval must be sought with government.
- Ecotourism and coastal strand enhancement. This EbA requires the development of a plan that includes low-footprint infrastructure for tourists and a site-specific plan for vegetation and streamside enhancement.

3.3.4 Cakaudrove: Welagi-Somosomo



Red marker denotes riparian and native forest enhancement to expand native forest. Black circle is area near spring to reforest.

PRIORITY ACTIONS

- Reforest around spring sites (black circle)
- Riparian planting
- Increase native forest though native forest restoration and plantation management (red marker)
- Outreach with other stakeholders
- Expand agroforestry and plantations in mid-elevation developed areas

Number of *mataqali*	32
ITaukei land	84%
Private freehold	16%
State land	0%
Watershed area (ha)	2,957

The Welagi-Somosomo watershed is transitional to the leeward side of Taveuni, with steep slopes and home to Taveuni's central village of Somosomo. A road network extends upslope to accommodate small farms on private and leased lands, which has contributed to deforestation up to ~400 m in elevation. The remaining forest is quite large, although road access will undoubtedly allow for more forest entry and remains a threat to forests from additional deforestation and degradation.

With assistance from the Chinese Government, the Somosomo Hydro Electric Power Station was built to benefit more than ten villages. Located near the island crest above Somosomo Village, it was opened in March 2017. Road access has promoted access by local farmers, and there is direct evidence of new forest conversion in the area. Water quality associated with this hydroelectric project is a mentioned concern for communities, though no water quality monitoring data are known to be collected.

The coastal zone has little or no lagoon formations, and the coastal ecosystem is most affected by the major (tar-sealed) road, located in some cases adjacent to the coastline, with little to no buffer area. Seawall structures are intermixed with intact sea cliffs along most of the coastline. In Somosomo Village, there is a ~350 m coastline reinforcement formed by gabion baskets near the school, and community members have expressed concern about further erosion along this section. Currently this is a focal area for wave modelling by The Water Institute of the Gulf to increase understanding and lead to possible recommendations for mitigating coastal erosion in this location, as well as informing other coastal areas on Taveuni.

This watershed group provided a few site-specific priority areas, with the caveat that they had more stakeholder outreach to conduct with the diverse community within the area. Two project areas emerged, both with the similar objective of increasing native forest cover. The first involves protection of water sources near Welagi (see black circle on map) by planting native trees in this area. The use of native trees and transitions to agroforestry would also be a viable option to increase forest cover in higher elevations and provide alternatives to dalo/yaqona farming that threaten the native forest. The second project is a rehabilitation, beginning in the riparian zones in a large canyon formation that starts at the confluence of main stem Naqara Creek and Malaua Creek (red marker on map). This involves riparian planting and extending native forest down to the creeks to slow erosion and maintain riparian function.

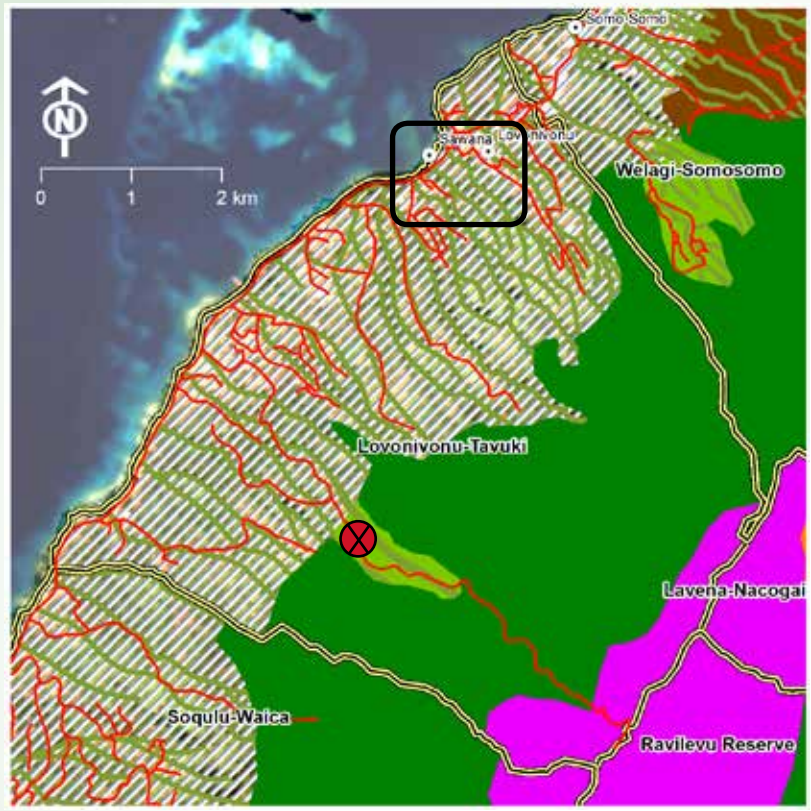
Tree planting opportunities in riparian zones are plentiful for this watershed, and can be coordinated with the above projects with the local schools–the school area in the centre of Somosomo Village is a prime locale for the Living Classroom EbA proposed in Section 3.1.4. There is opportunity for public exposure for implementing ecosystem enhancement EbA activities in this watershed. The Welagi community also operates a small nursery in the area, further strengthening the capacity of the community to implement planting projects.

TABLE 11. Land-based EbA interventions for the Welagi-Somosomo watershed by elevational band. Area is expressed as the maximum areas (ha).

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agroforestry (mixed plantations)	602	20%				109	205	288
Native forest conservation	1,385	47%				26	51	1,308
Native forest restoration	90	3%				21	36	32
Riparian	363	12%	18	31	50	100	73	90
Stakeholder outreach	516	17%	70	112	178	150		
Totals	**2,956**		**88**	**144**	**228**	**407**	**365**	**1,718**

Left: Typical matrix of upland areas, with coconut, mixed trees and grasses at the forest interface
Right: Upper elevations have housing leases and small farms. Unpaved roads and deforested areas intersect with streams and are a source of erosion.

3.3.5 Cakaudrove: Lovonivonu-Tavuki Watershed



Legend

- Villages
- Roads
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Agroforestry (Plantations)
- Native Forest Restoration
- Native Forest Conservation
- RAMSAR Site Development
- Stakeholder Outreach
- Invasive Species Monitoring & Treatment

Number of *mataqali*	23
Itaukei land	70%
Private freehold	24%
State land	6%
Watershed area (ha)	3,374

PRIORITY ACTIONS

- Riparian planting in lowland areas around Waioru and Navure Creeks at Lovonivonu and Sawana (Waiyevo), and upslope (black square)
- Restoration of native forest in upland zone with road access near Naraniamata Creek (red marker). Use of native tree planting and high-value plantation management are mechanisms to restoration.
- Monitor for invasive species in highland forest areas
- Extend community outreach to develop community-level EbAs, including NTFP
- Engage Tutu Rural Training Centre to extend activities

Outside the lowland areas, road networks allow for entry into upper elevation areas throughout the watershed and support many dispersed land holdings by iTaukei in the upland areas. Encroachment into the native forest environment has persisted, with localised clearing to support small-scale subsistence of crops in addition to yaqona and dalo. Deforestation and conversion has occurred up to and beyond 400 m elevation, leaving small forest fragments throughout, intermixed with grass/vine persistent areas. Forest fragments can be used as loci for forest expansion via out-planting, plantations or agroforestry.

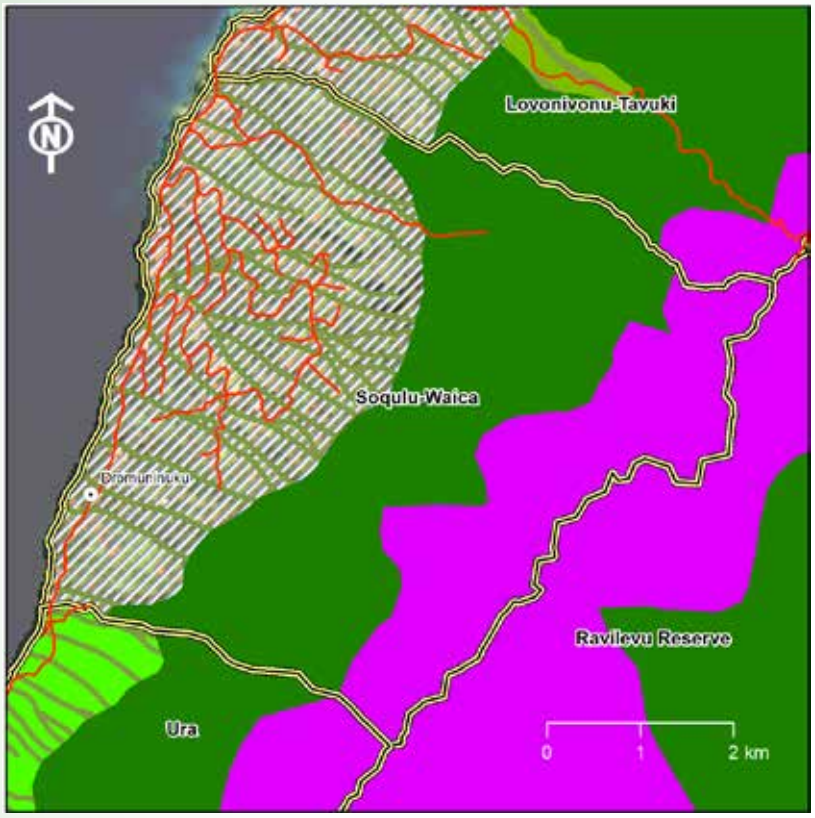
This watershed is relatively steep and has many narrow sub watersheds and stream systems that flow directly downhill. Run-off from high rainfall events is not well attenuated (i.e. a 'flashy system') and can flow with destructive force as water reaches the coastal terrace. Riparian zones are typically narrow and canyonlike, with riparian vegetation not often removed when neighbouring areas have been cleared. Stream channels are mostly bedrock with large boulders and cobbles, indicative of the stream power during high flow events.

There has been some community engagement and interest in EbA, and Cakaudrove District leaders are working to improve levels of engagement. Two project areas emerged for this watershed. The first is riparian planting in and around the low elevation to coastal terrace zones (less canyonlike formations), with a focus around the Waiyevo area (black square on map) in a high-profile area. The second project is very important for mitigating run-off and forest degradation from fragmentation in a cleared area in the upper reaches of Naraniamata Creek (red marker). Out-planting from native forest fragments, using high-value native hardwoods is one mechanism, along with expanding riparian zones upslope to reduce erosion and degradation of the forest edges. Considerations in community engagement include developing non-timber forest product markets, as access in this area to native forest is high, and increasing the value of these important forest remnants will contribute to conservation efforts. This watershed also has some evidence of invasive species or other modifications of forest health that should be investigated in the high elevation forest (see EbA described in section 3.2.8).

TABLE 12. Primary EbA interventions for land areas in the Lovonivonu-Tavuki watershed by elevational band

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Invasive species monitoring and treatment	224	7%						224
Native forest conservation	1,372	41%				4	17	1,351
Native forest restoration	45	1%						45
Riparian	372	11%	41	37	47	97	67	83
Stakeholder outreach	1,358	40%	181	159	206	339	213	257
Totals	3,371		222	196	253	440	297	1,960

3.3.6 Cakaudrove: Soqulu-Waica Watershed



Legend

- Villages
- Roads
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Plantation Forestry (Native Species)
- Native Forest Restoration
- Native Forest Conservation
- Stakeholder Outreach
- Invasive Species Monitoring & Treatment

Number of *mataqali*	7
ITaukei land	35%
Private freehold	63%
State land	2%
Watershed area (ha)	3,275

PRIORITY ACTIONS

- Conduct stakeholder outreach and involvement with Cakaudrove communities
- Engage landowners to increase forest cover and riparian function through healthy vegetation
- Agroforestry and ecotourism options can be explored or supported
- Engage key stakeholders such as Tutu Rural Training Centre to extend activities

Most of this watershed is in private landholdings, with a range of small subdivision and large freehold properties. A subdivision with 0.25–0.5 ha lots for sale has resulted in clearing of land with tar-sealed roads, although the area is only sparsely developed. The Tutu Rural Training Centre (TRTC) is in this watershed and the neighbouring Lovonivonu-Tavuki watershed, and offers a strong nexus for stakeholder engagement.

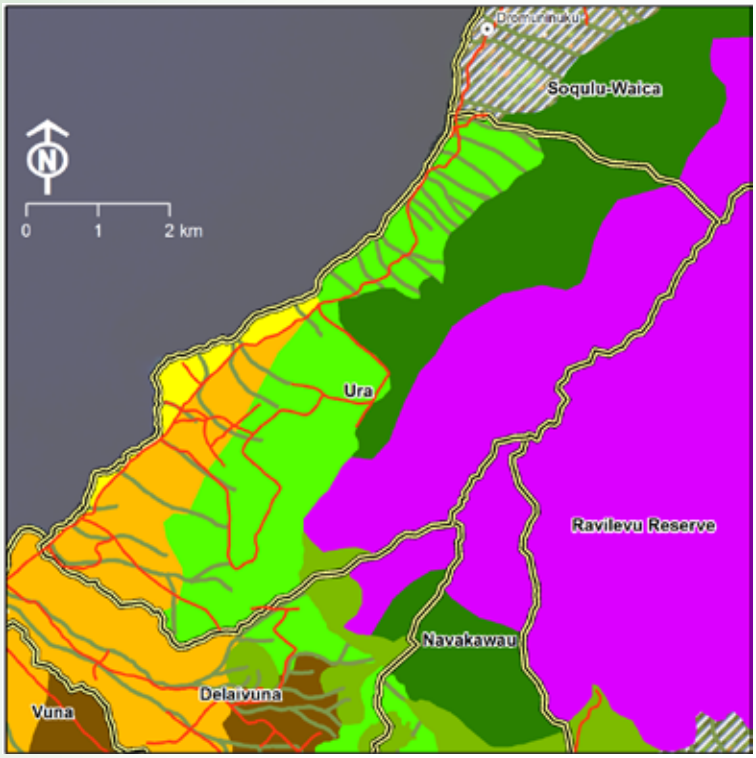
Stakeholder engagement was lowest in this area, with a distributed network of mostly freehold lands and a dispersed and low population. Deforestation in this area extends above 400 m, leaving very little native forest below 300 m (only 12 ha mapped, Table 13). Furthermore, the potential forest health concerns are quite apparent in the upper elevation forest, particularly the topographically diverse peaks and valleys at the ridgeline. There is evidence this may be extending downslope, and this should be investigated with the other affected watershed areas.

In addition to having the upper elevation forest health concerns addressed with other watersheds, the primary EbA activity recommended for this area is engagement and support of the TRTC, specifically their Young Farmers Course, to be deployed in this and other watersheds and to emphasise the need for increasing forest cover to improve ecosystem service benefits.

TABLE 13. Primary EbA interventions for land areas in the Soqulu-Waica watershed by elevational band

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Invasive species monitoring and treatment	712	22%						712
Native forest conservation	1,187	36%				2	10	1,175
Riparian	239	7%	7	11	21	46	52	101
Stakeholder outreach	1,135	35%	42	84	132	268	242	366
Totals	**3,273**		**49**	**96**	**152**	**317**	**303**	**2,355**

3.3.7 Vuna: Ura Watershed



PRIORITY ACTIONS

- Develop agroforestry options in lower elevations
- Rehabilitate deforested lands with plantations of native species
- Increase native forest areas via out-planting
- Participate in native forest health monitoring in upland areas
- Participate in with neighbouring watersheds in upper elevation restoration activities

Number of *mataqali*	3
ITaukei land	39%
Private freehold	61%
State land	0%
Watershed area (ha)	3,154

The Ura watershed is bisected both in ownership and topographic features; the northern half is iTaukei owned, has more rugged and restrictive landscapes, and has less deforestation than the southern half, which is owned and operated as working farms with a large landowner presence. The native forest shows clear evidence of potential forest health issues, with reflectance from Landsat (2016) imagery showing signs of

potential invasion by invasive or pioneer species, requiring monitoring and assessment. Most of the area is used for rotating farm plots, with fallow grasses and vines and interspersed trees in uncultivated areas. The coastal ecosystem is largely vertical cliffs with no associated lagoons.

There is an active group of stakeholders, most affiliated with a large private landownership, that are utilising old copra plantation areas for many commercial agricultural uses, noting declines in productivity and losses in ecosystem services for the area—primarily water, biodiversity and soil resources. There is strong interest and capacity (with infrastructure, knowledge and autonomy) to participate in reforestation and enhancement interventions that improve soil resources, offer an array of income-producing options, and improve overall ecosystem services, including improving water catchment for upper elevations that can be of benefit to Vuna District.

Focused treatments involve the whole elevational gradient with upper land native forest conservation and invasive species monitoring (>300m) to high-value native plantations (100–300 m elevation) to mixed agroforestry and agricultural enhancement in the lower elevation and terrace zones (Table 14). There is capacity within this group to accomplish any of these goals.

TABLE 14. Primary EbA interventions for land areas in the Ura Watershed by elevational band.

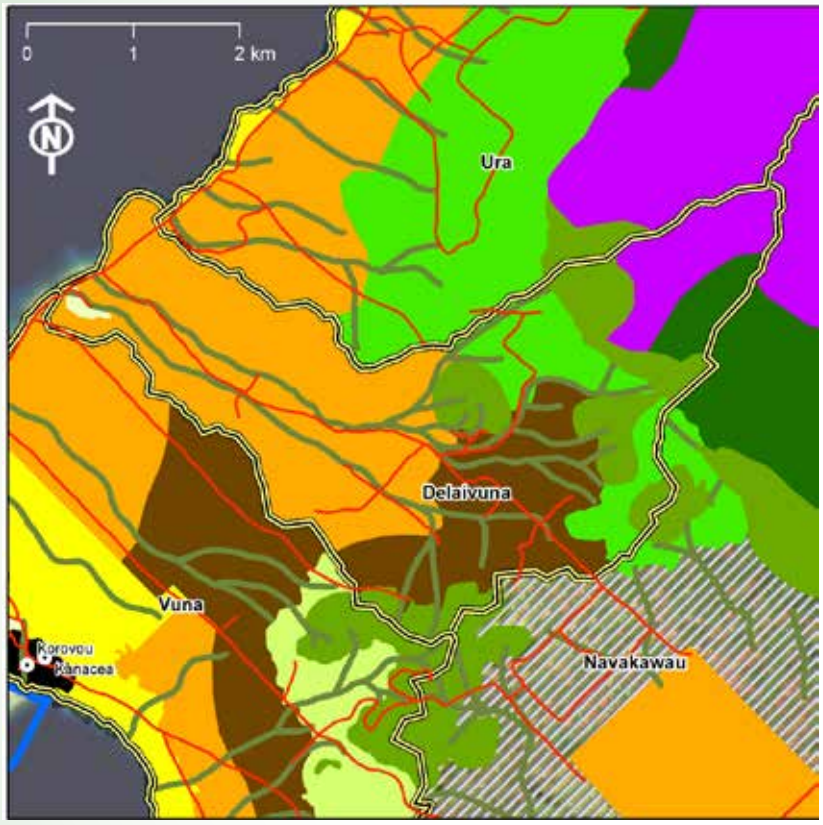
Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agricultural enhancement	115	4%	60	47	4			
Agroforestry	372	12%	22	140	203	8		
Invasive species monitoring and treatment	949	30%						949
Native forest conservation	583	19%				9	49	525
Native forest restoration	33	1%					0	32
Plantation forestry (native species)	935	30%	14	26	47	488	280	79
Riparian	164	5%	15	33	39	52	21	3
Totals	**3,151**		**111**	**246**	**293**	**557**	**350**	**1,588**

Aerial view of northern section of Ura watershed, displaying the deforestation and land conversion to elevations ~400 m

One of many volcanic peaks spread across the western side of Taveuni Island with native forest fragments adjacent to land clearing

Westward view of the southern section of Ura watershed, mostly operated as a managed commercial farm on freehold lands. Note intact vegetation within riparian corridors that provide opportunities for out-planting into cleared areas.

3.3.8 Vuna: Delaivuna Watershed



Legend

- Villages
- Roads
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Agricultural Enhancement
- Agroforestry
- Agroforestry (Plantations)
- Plantation Forestry (Mixed Species)
- Plantation Forestry (Native Species)
- Native Forest Restoration
- Native Forest Conservation
- Stakeholder Outreach
- Mangrove Protection, Planting & Enhancement
- Invasive Species Monitoring & Treatment
- Marine Protected Area
- Infrastructural Improvements

PRIORITY ACTIONS

- Diversify agricultural systems
- Increase soil productivity
- Build income resilience with ecosystem services
- Increase water holding capacity

Number of *mataqali*	2
ITaukei land	<1%
Private freehold	91%
State land	9%
Watershed area (ha)	1,355

Nearly all the lands within Delaivuna are freehold, many are ~3–6 ha in size, and are managed as single-family farms or communities of small farms. Most of the Delaivuna landscape has been deforested to favour agriculture and subdivided from historic copra plantations and active farming as freehold lands. The landscape is best described as a narrow valley with low to gentle slopes in most elevations, with abrupt and steep volcanic formations in the upper reaches before extending upward to the island's southern terminus ridge. Forest lands are mostly on state lands, but are fragmented and degraded from expansion of small farms and land clearing, and what appears to be forest health concerns in the native forest areas above ~350 m. Deforestation and conversion to agriculture continues to occur in the forested zones. In the lowland areas, there is a small mangrove patch near the outlet of Navaka Creek that may be expanded or protected.

This community has a high relative population density for Taveuni's rural environments due to small land parcel sizes and active farming activities. This area is the epicentre for Taveuni's dalo industry boom by small-scale farmers, and is experiencing severe reductions in productivity and capacity to earn steady incomes. Water availability is a serious challenge in this area; a pumping station is installed at Qarawalu, about half-way up the watershed, but capacity is low to variable (including dry) and farmers resort to purchasing water through truck delivery and a desalination plant at the base of the watershed at high costs. Given these challenges, there is a need to develop more cost-effective and long-term solutions for these communities to build a sustainable livelihood.

Community leadership and interest is very high for implementing EbA projects that would support sustainable livelihoods, with an organisation of over 50 stakeholders interested in applying new approaches to land management. Given the reliance of this community on commodities, it is important to focus EbA activities on building soil resources, having less reliance on irrigation water, and diversifying incomes to avoid market and environmental bottlenecks.

While there is broad interest in implementing agroforestry-based systems, such as alley cropping and inclusion of nitrogen-fixing plants and organic fertiliser trials, the landowner distribution on fixed parcels makes it difficult to reach many stakeholders in a single implementation trial. The community watershed group anticipated this with a process to determine locations for trials based on 'landowner clusters' that cross multiple boundaries in order to maximise the trial size and landowner participation. The community has the capacity and motivation to participate in straight-forward land-based treatments, and easy access provides relatively low-cost barriers to implementation.

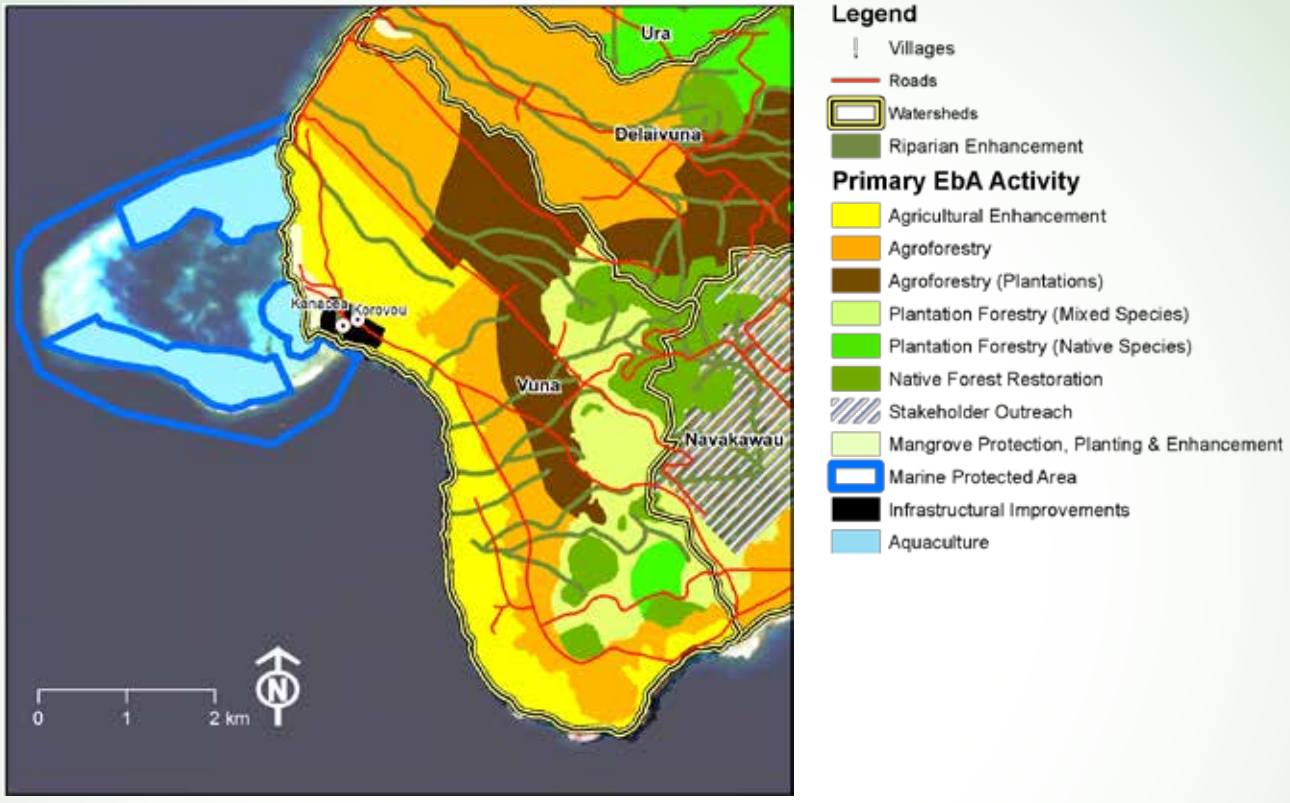
TABLE 15. Primary EbA interventions for land areas in the Delaivuna watershed by elevational band

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agroforestry	500	37%	82	75	143	200		
Agroforestry (mixed plantations)	229	17%				129	99	
Invasive species monitoring and treatment	111	8%						111
Mangrove protection, planting and enhancement	5	0%	5					
Native forest conservation	49	4%						49
Native forest restoration	194	14%				14	87	92
Plantation forestry (native species)	132	10%				17	114	1
Riparian	136	10%	10	8	16	69	33	0
Totals	**1,356**		**97**	**83**	**159**	**429**	**333**	**253**

Aerial view, looking east of the Delaivuna watershed.

View from typical farm.

3.3.9 Vuna: Vuna Watershed



Aquaculture area: 280 ha; Marine area: 900 ha

PRIORITY ACTIONS

- Reforest using high-value native trees in upper elevations
- Increase forest cover in degraded lands
- Agroforestry and agricultural enhancement
- Establishment and improvement of water source
- Mangrove and coastline enhancement
- Marine management and coral transplanting

Number of *mataqali*	28
Itaukei land	54%
Private freehold	45%
State land	0%
Watershed area (ha)	2,093

The Vuna watershed is at the southern extreme of Taveuni and has a low elevational gradient outside small volcanic peaks in the eastern and southern watershed boundary areas. Overall, the iTaukei community relies on subsistence and small farms for sale of crops. Water shortages are common and extended farming and deforestation have severely limited productivity in some areas, resulting in fallow or low-value crops. There are a few peaks where forest remnants still exist and these are identified as a valued resource for the community. Private lands are large parcels that are a legacy from early colonists, with diverse farm operations, including an operational copra mill and coconut oil extraction facility, cattle production, and land-based gravel mining.

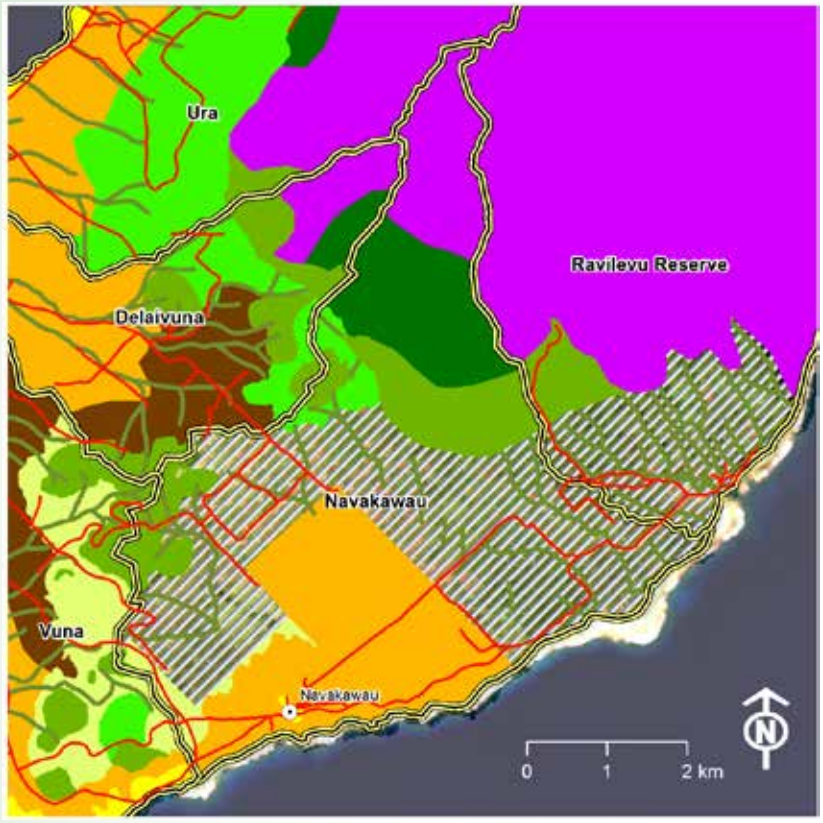
Like the other communities in the Vuna District, there is high motivation to improve soil tilth and increase ecosystem services through diversification of income and farming practices. Increased plantation forestry with native forest restoration, with low elevation and terrace agricultural improvements, including agroforestry and diversified commodities, are recommended. The iTaukei community is in the greatest need of intervention; private landowners have working farms and capital investment, although further engagement to expand alternatives, especially infrastructure (water and power), is needed. The coastal communities are mostly cliff structures, with small areas of mangrove just below the base of the villages. The lagoon is used as a tourism dive site and for subsistence fisheries. Marine protected area enhancement and support are

also recommended (see section 3.1.3 on page). The community identified coral transplanting as another mechanism for Vuna Lagoon. Water infrastructure for Vuna District communities is needed and involves large-scale investment, through groundwater wells or larger infrastructure from upper elevation sources.

TABLE 16. Primary EbA interventions for land areas in the Vuna watershed by elevational band

Primary EbA Activity	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
			0–20 m	20–50 m	50–100 m	100–200 m	200–300 m	>300 m
Agricultural enhancement	522	25%	107	381	29			
Agroforestry	532	25%	102	137	282	10		
Agroforestry (mixed plantations)	339	16%		4	147	189		
Infrastructural improvements	24	1%	17	7				
Mangrove protection, planting and enhancement	29	1%	27	1				
Native forest restoration	161	8%			2	44	111	5
Plantation forestry (mixed species)	288	14%			1	284	3	
Plantation forestry (native species)	34	2%				34		
Riparian	160	8%	16	32	41	62	10	
Totals	2,083		269	561	501	622	124	5

3.3.10 Vuna: Navakawau Watershed



Legend

- Villages
- Roads
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Agricultural Enhancement
- Agroforestry
- Agroforestry (Plantations)
- Plantation Forestry (Mixed Species)
- Plantation Forestry (Native Species)
- Native Forest Restoration
- Native Forest Conservation
- Stakeholder Outreach
- Invasive Species Monitoring & Treatment

Number of *mataqali*	4
Itaukei land	10%
Private freehold	90%
State land	0%
Watershed area (ha)	2,842

PRIORITY ACTIONS

- Rehabilitate iTaukei lands with high-value agroforestry options
- Diversify forest plantings to yield high-value hardwoods
- Develop sustainable watershed management plan for leases between iTaukei and private landowners

The Navakawau watershed is located on the exposed windward side of Taveuni, with a single community of iTaukei residents and farmers. Most of the land area is owned by a corporate landowner (freehold lands). Land-use practices have resulted in deforestation and degradation of soil resources over time. This is due to past copra plantations and recent intensive dalo/yaqona farming that have depleted soil resources to severely limit productivity, to the point of fallow in some cases. The iTaukei community's land (~300 ha) has been farmed extensively, which has forced the community to seek land leases with the neighbouring private landowners, where farm practices are resulting in the same outcome. An EbA to address this concern is presented in section 3.1.2.

Most of the landscape is deforested, with a continuous fragment shared with neighbouring Delaivuna and the Reserve above 200–300 m. This fragment comprises ~25% of the Navakawau watershed – forest health in these fragments is likewise exhibiting concern for degradation to invasive species (226 ha, Table 17).

Solutions for landowners in Navakawau and greater Vuna include the development of a watershed management plan (as per section 3.1.2) to seek sustainable solutions that generate income and rehabilitate ecosystem services. For iTaukei lands, high-value agroforestry and forest plantations are recommended to rehabilitate low production farm areas and fallow lands through use of nitrogen-fixing plants and practices that build on soil structure (such as forest environments). There is high capacity and engagement with the Navakawau iTaukei community and there is interest in engagement with the corporate landowner agents to rehabilitate and determine new trajectories for the Navakawau watershed.

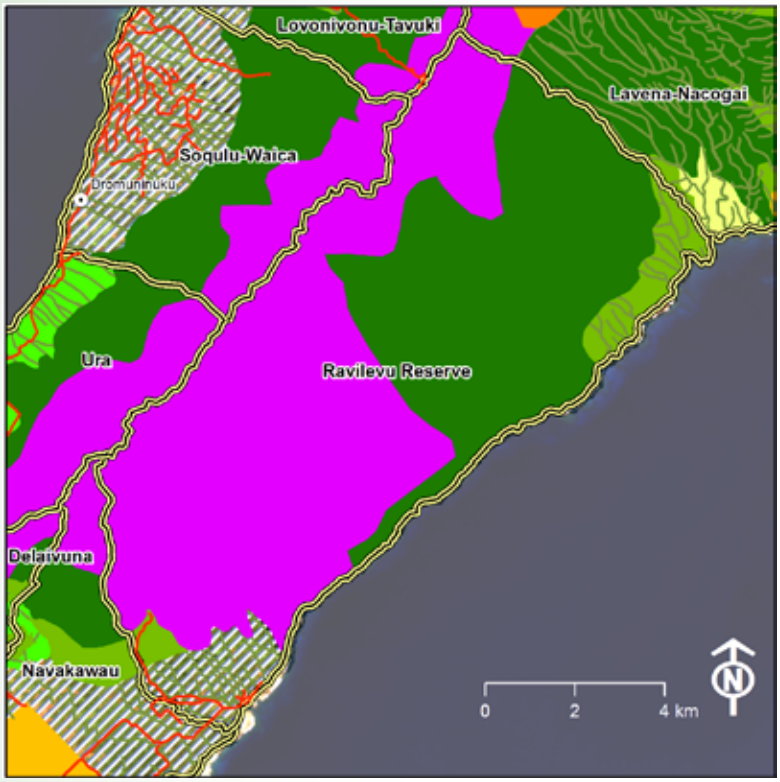
TABLE 17. Primary EbA interventions for land areas in the Navakawau Watershed by elevational band

	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
Primary EbA Activity			**0–20 m**	**20–50 m**	**50–100 m**	**100–200 m**	**200–300 m**	**>300 m**
Agricultural enhancement	5	<1%		4	1			
Agroforestry	679	24%	13	125	288	253		
Invasive species monitoring and treatment	226	8%						226
Native forest conservation	287	10%					76	210
Native forest restoration	296	10%				72	195	29
Plantation forestry (mixed species)	57	2%			4	53	0	
Plantation forestry (native species)	55	2%					54	1
Riparian	121	4%	7	11	14	58	30	1
Stakeholder Outreach	1,114	39%	45	123	179	583	184	
Totals	2,840		66	263	486	1,019	540	466

Aerial view of Navakawau community land holdings. Most of the land is in fallow or coconut, and provides opportunities for rehabilitation through agroforestry or high-value plantation management.

Aerial view of Navakawau village.

3.3.11 Vuna: Ravilevu Reserve Watershed



Legend

- Villages
- Roads
- Watersheds
- Riparian Enhancement

Primary EbA Activity

- Agroforestry
- Plantation Forestry (Mixed Species)
- Plantation Forestry (Native Species)
- Native Forest Restoration
- Native Forest Conservation
- RAMSAR Site Development
- Stakeholder Outreach
- Invasive Species Monitoring & Treatment

Number of *mataqali*	6
Itaukei land	43%
Private freehold	17%
State land	39%
Watershed area (ha)	9,712

PRIORITY ACTIONS

- Engage government as watershed coordinators
- Stakeholder outreach with *mataqali* and private lands
- Conduct study and mapping of forest health concern
- Engage neighbouring landowners for forest restoration or solutions to increase ecosystem services

The 'Reserve' watershed was identified as a separate unit due to the dominant management objectives. Overall it is managed as a forest reserve with objectives to conserve and enhance biodiversity. However, several factors are at play that are of concern. In the lower elevations at both ends of the watershed, there is land use that has converted forestlands to agriculture and in the southern section there are mapped tracks with access to the inner forest. Outreach with these user groups was not obtained during the early PEBACC phases; outreach to discuss EbA options and how to avoid degradation observed elsewhere on Taveuni is critical.

Of paramount concern, and expressed in other watersheds connected by the forest, is the presence of degraded vegetation at high elevations. There is visible degradation of forest to a vine-shrub dominant structure, as shown in Figure 5. Use of aerial imagery shows the extent and intensity of the issue, including a large degraded or partially degraded signal emerging from the centre of the Reserve areas (see Figure 2 on in Section 3.1.10).

The degradation may be attributed to cyclone damage and adaptation of primary forest to a state of constant disturbance. At issue is the deforestation and degradation in surrounding areas, including access roads leading into the forest. This will cause non-native pioneer species to become established and permanently convert the native forest to a state of permanent degradation. This would be a major blow to biodiversity for Taveuni and Fiji, as well as dramatically lower the quality and quantity of forest cover of the country, affecting a wide range of ecosystem services.

An island-scale EbA to conduct a forest health assessment is found in section 3.1.10 which includes direct involvement of government management to assess the magnitude and scale of the issue, and to identify possible solutions (active or passive management) to protect forest health and function.

TABLE 18. Primary EbA interventions for land areas in the Reserve watershed by elevational band.

	Total Area (ha)	Percent Area	Coastal Terrace	Low Terrace	Low Elevation	Mid Elevation	Upper Elevation	High Elevation
Primary EbA Activity			**0–20 m**	**20–50 m**	**50–100 m**	**100–200 m**	**200–300 m**	**>300 m**
Invasive species monitoring and treatment	5,201	54%	2	10	35	143	385	4,626
Native forest conservation	3,585	37%	3	26	124	446	520	2,466
Native forest restoration	387	4%	8	42	98	162	75	3
Riparian	185	2%	16	37	59	66	5	2
Stakeholder outreach	349	4%	23	73	119	134	<1	
Totals	**9,707**		**52**	**188**	**434**	**951**	**985**	**7,097**

FIGURE 5. Left: Aerial view of forest degradation on high peaks of the central ridge of Taveuni (western side). Right: a normalised difference vegetation index map derived from 2016 Landsat 8-band imagery, indicating vegetation health (red = degraded or poor health, yellow = intermediate, green = high productivity). Arrows indicate GPS locations surveyed.

4. PRIORITISATION FOR IMPLEMENTATION

4.1 PRIORITISATION OF PROJECTS

Organisational, policy, planning and training EbAs were evaluated, based on the prioritisation scheme presented in Table 2 according to eight criteria categorising benefit attributes and project constraints. Priorities were assigned a ranked order for two of the three major categories of EbA actions: organisational activities, and training and pre-requisite actions. These were ranked separately because of differing objectives and are displayed in Table 19 and Table 20.

The size, distribution and number of watershed-level actions are variable, as execution depends largely on funding and training; most actions were prescribed based on ecological and social benefits, as well as the community's capacity to execute the treatment. Social concerns also emerged as part of the watershed group outreach and workshops, and were accounted for in the prescription. As such, watershed-level action priorities were evaluated differently, to assess the 'readiness' of the watershed groups to proceed with their priorities (where defined). Larger, more involved projects, such as water and energy, were not included in the watershed evaluation as they far exceed expected capacity. An evaluation of watershed group readiness is presented in Table 21.

It is important to recognise that, while all watershed groups (excepting the Reserve) participated in the EbA development process, the overall ranking shows Wainikeli and Vuna District watersheds in the highest state of readiness, as their community groups had strong stakeholder input, high participation, and have known capacity to move forward with implementing their plans. Cakaudrove District had representation and conducted meetings, although due to the nature of the watersheds (more urban, broader stakeholder base, more dispersed), there remained a need to focus on stakeholder outreach and refinement prior to larger investment for on-the-ground activities, especially for Soqulu-Waica watershed stakeholders. The Reserve watershed is best represented by government, and should be pursued with urgency; stakeholder outreach to the communities is also needed for adaptive management. As such, EbA activities are limited to addressing forest health concerns (see Section 3.1.10) and stakeholder outreach to form a watershed group in the Reserve watershed, with government representation.

TABLE 19. Evaluation of organisational, policy and planning EbA activities

			Benefit Attributes				Project Constraints				Priority		
Section	Name	Description	Socio-Economic	Ecological	Timing	Duration	Durability	Cost	Feasibility	Needs	Total	Rank	Est. Cost (USD)
3.1.1	Taveuni watershed coordination network	Support watershed coordinator positions and quarterly meetings maintain coordination through PEBACC tenure	1	2	1	1	2	1	1	1	10	1	10,000
3.1.2	Navakawau watershed and economic improvement plan	Develop alternative land-based EbA investment through creative lease agreements with community and private landowners	1	1	2	1	2	2	2	2	13	3	3,000
3.1.3	Locally managed marine areas implementation and enhancement	Support LMMA and enhance planning, monitoring and enforcement	1	1	2	1	3	2	3	2	15	4	30,000
3.1.4	Youth Stewardship Programme: living classrooms	Create curriculum and activities in local schools with small EbA demonstration projects ('living classrooms')	1	2	1	1	2	1	2	2	12	2	10,000
3.1.5	Feasibility study: establishment of conservation trust	Identify mechanisms for developing long-term, 3rd party trust to support EbA activities for Taveuni communities	1	2	3	1	3	3	3	3	19	7	40,000
3.1.6	Develop specialty markets for non-timber forest products	Training and activities for potential revenue sources from native forest conservation areas	1	2	2	2	3	2	2	2	16	5	40,000
3.1.7	Qamea and Laucala Island watershed coordination	Expand PEBACC objectives to communities on Qamea and Laucala communities to identify watersheds and EbA priorities	2	1	1	2	2	2	2	3	15	4	40,000
3.1.8	Lake Tagimoucia Ramsar site evaluation	Support the process toward Ramsar candidate	3	1	2	1	2	3	3	3	18	6	10,000
3.1.9	Aquaculture development plan and legal framework pilot	Engage government, industry and community with concrete aquaculture development plan and legal framework to lower barriers to entry	1	3	2	1	3	3	3	3	19	7	80,000
3.1.10	Taveuni primary forest health monitoring	Conduct survey and mapping of Taveuni upland forest areas to identify degradation magnitude, causes and any rehabilitation needed	2	1	3	1	3	3	3	3	19	7	22,000

TABLE 20. Evaluation of training and pre-requisite EbA activities

			Benefit Attributes				Project Constraints				Priority		
Section	**Name**	**Description**	**Socio-Economic**	**Ecological**	**Timing**	**Duration**	**Durability**	**Cost**	**Feasibility**	**Needs**	**Total**	**Rank**	**Est. Cost (USD)**
3.2.1	Plant nursery construction and operation	Training and demonstration of low-cost plant (tree) nurseries to install and operate in communities for EbA implementation	1	2	1	2	1	1	1	2	11	1	6,000
3.2.2	Native plant seed collection to enhance biodiversity	Develop native plant seed collection, including repository exchange and propagation programme	2	1	1	1	2	1	1	2	11	1	3,000
3.2.3	Riparian and wetland planting and management	Training in riparian and wetland enhancement and special consideration in species and site selection	2	1	2	2	3	1	2	2	15	4	5,000
3.2.4	Agricultural improvement and diversification trials	Conduct science-based field trials for diversified crop systems with goal of improving soil fertility and crop diversity	2	1	2	3	2	2	2	2	16	5	20,000
3.2.5	Agroforestry practices and management	Training for establishing agroforestry systems and implementation guidance to landowners	1	1	1	1	2	1	2	2	11	1	30,000
3.2.6	Plantation management and certified sustainable products	Training for establishing a range of plantation systems and implementation guidance to landowners	1	1	3	1	1	1	2	2	12	2	30,000
3.2.7	Native forest restoration and expansion	Community-based training in select locations for out-planting and other forest expansion techniques	2	1	3	1	2	1	2	2	14	3	5,000
3.2.8	Invasive species detection and management	Develop training with low-tech tools for community to identify, monitor and report invasive species	3	1	1	1	3	1	3	2	15	4	20,000
3.2.9	Coral cultivation and transplanting in shallow coral reef habitats	Provide training and localised programme for coral rearing and transplanting	3	1	3	2	3	2	3	3	20	6	10,000

TABLE 21. Evaluation of execution of watershed group's priority list of projects. Water and energy development projects are excluded as they transcend the capacity of a stakeholder-based watershed group, although they are considered needs in larger activities involving government leadership.

Section	District	Watershed Name	Strategy Priorities	Vision	Stakeholders	Participation	Durability	Feasibility	Dependencies	Cost	Total	Rank
3.3.1	Wainikeli	Lavena-Nacogai	Diversified income, food security, coastal erosion protection	1	1	1	1	1	2	1	8	1
3.3.2		Naqeru	Land rehabilitation, diversified long-term income	1	1	1	1	1	2	1	8	1
3.3.3		Naselesele	Water security, diversified income through conservation, food security	1	1	1	1	2	2	1	9	2
3.3.4	Cakaudrove	Welagi-Somosomo	Water security, diversify income through reforestation and agroforestry, secure riparian function, stakeholder outreach	2	3	2	2	1	1	1	12	3
3.3.5		Lovonivonu-Tavuki	Flood/pollution attenuation, restore upland degraded lands, engage stakeholders	2	3	2	2	3	2	1	15	4
3.3.6		Soqulu-Waica	Engage stakeholders, identify watershed plan, increase awareness	3	3	3	3	3	2	1	18	5
3.3.7	Vuna	Ura	Food security, water security, ecotourism, income diversity, enhance biodiversity	1	2	1	1	1	1	1	8	1
3.3.8		Delaivuna	Diversify agricultural systems and income, improve soil resources, increase water security	1	1	1	1	2	2	1	9	2
3.3.9		Vuna	Water security, food security, diversified income, landscape rehabilitation	1	1	1	1	1	2	2	9	2
3.3.10		Navakawau	Economic stability, food and economic independence, long-term rehabilitation of degraded lands, permanence	1	1	1	1	1	2	1	8	1
3.3.11	Govt	Ravilevu Reserve	Forest health and risk of degradation, community outreach and management plan	3	3	3	3	3	2	1	18	5

4.2 ALLOCATION OF FINANCIAL RESOURCES

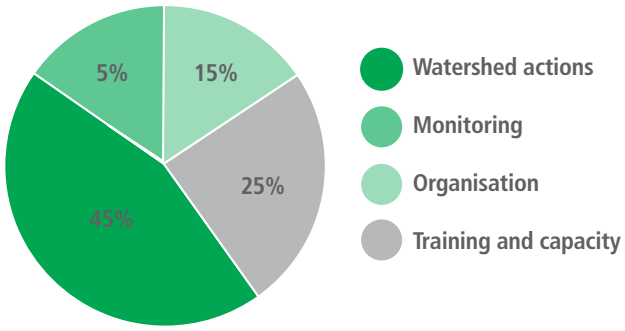
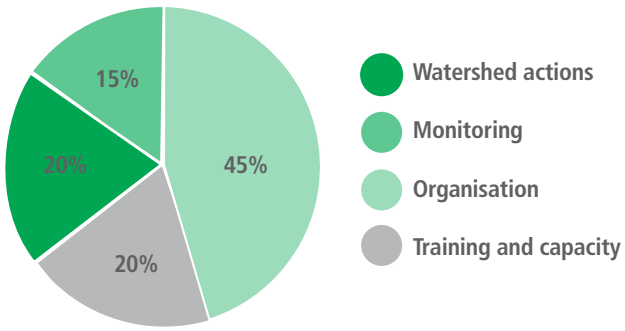
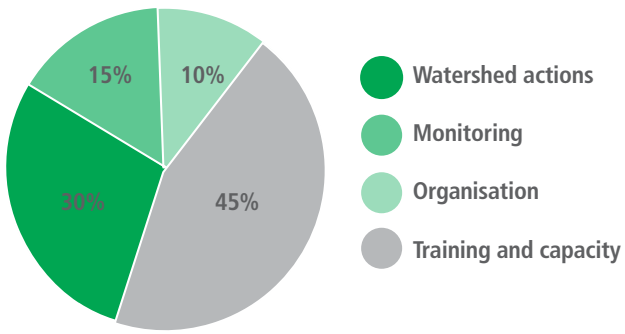
4.2.1 Scenarios considered

Overall, there are four major categories associated with the implementation budget. The budget is defined as the allocation necessary for conducting the EbA activities and monitoring; allocations for administrative support are not included. The working assumption is a budget of USD 200,000 for total deployment to implement EbAs, distributed in the following four categories.

1. Organisational EbA Activities (see Table 4)
2. Training and pre-requisite EbA activities (see Table 5)
3. Watershed-based EbA actions (see Table 6).
4. Project monitoring (see Section 4.2.3 below)

Given the outreach and stakeholder input pertaining to implementation approaches (see Stakeholder considerations in Section 2.4), there is a need to balance the three categories of EbAs described above to achieve different objectives. Three funding scenarios were considered to meet different combinations of emphasised goals. A description of each scenario, its objective and approximate allocation is presented in Table 22.

TABLE 22. Scenarios considered for funding under the PEBACC implementation phase.

Objective	Scenario Description	Budget Allocation
Scenario 1: Emphasise ground-based activities	Emphasises activities that directly result in land-use and land-cover change with the broadest stakeholder base, with focused training to support those activities.	
Scenario 2: Emphasise organisational, policy and planning activities	Draws deeper focus onto several issues involving planning and policy, with less emphasis on ground-based activities or training, and involves only selected groups of stakeholders.	
Scenario 3: Emphasise training and capacity-building activities	Maximises broader training for communities and stakeholders with some correspondence to a few ground-based activities through small pilot projects and minimal policy-related activities.	

4.2.2 Cost assumptions and match

For organisational, policy, planning and training EbAs considered (Sections 3.1 and 3.2), costs were determined based on soliciting outside assistance or supporting government programmes. Additional meeting support and other factors were considered as part of cost, where PEBACC funds would have discretion to carry out necessary logistical support. Administrative and logistical support by PEBACC staff was not factored into the cost estimates.

For watershed-related EbA activities, most actions were factored on a per-unit basis, and most were within the current capacity or capacity growth of stakeholders performing the implementation labour and management.

The assumptions listed below were made for each of the watershed-level activities (i.e. physical outputs to be deployed according to site specificity of the prescription).

Nursery development. Cost estimates were based on prior work accomplished in Fiji (AusAid 2010) with updated prices in 2017 and interviews in the industry. Assumptions include:

- nursery sizes were estimated to be ~2 x 10 m with covered shade cloth and readily accessible materials (angle iron, wire mesh, etc.);
- includes cost of materials for life of PEBACC programme (maintenance);
- nurseries are easily expandable and can be built with minimal expertise or specialised tools;
- output of ~660 one-year-old trees per year, with covered space for germination and rearing;
- operational equipment purchases are limited and are meant to augment what farmers currently use;
- cost of labour to source and construct nurseries is assumed as match;
- nursery placement is intended to be in local communities to ensure broadest involvement and care by stakeholders;
- tree planting densities are estimated at 6 x 4 m grid, or 417 trees per ha, or ~1.6 ha per nursery after the first year of tree output as a conservative estimate of area planted;
- can be used for any EbA activities involving plants, including agricultural crops; and
- coupled with EbA training projects in Sections 3.2.1 and 3.2.2: nursery development and seed collection.

Planting costs. This item involves the materials (labour match) involved in preparing land for planting and maintaining trees for two years. Specific actions include:

- preparing fallow lands for planting (clearing) and spot herbicide (glyphosate) application for planting where necessary;
- digging holes on 6 x 4 m spacing (417 per ha, will vary) with addition of organic fertiliser, excluding cost-matched labour;
- planting trees – costs are USD 3.50 per yearling if trees are purchased from commercial nurseries, thereby showing two cost scenarios depending on number of nurseries funded;
- fertilising at six months to one year;
- weed maintenance with costs factoring spot herbicide application annually for two years, excluding cost-matched labour;
- tipping and pruning trees up to two times in two years, excluding cost-matched labour; and
- couple with EbA activities involving plantations or agroforestry. Agroforestry would likely have less density plantings, allowing for more land to be treated.

Agricultural enhancement costs. This assumes costs for a quiver of items, depending on treatments:

- organic fertiliser;
- drum composter and manure digester (low-cost construction);
- bucket-drip irrigation line delivery systems;
- acquisition of plants for crop trials;
- offset for lost revenue to protect farmer's livelihood, where applicable and necessary;
- actual hectares treated will vary depending on final treatments, although estimated budgets allow for flexibility in trials; and
- coupled with agricultural field trials for a science-based approach (Section 3.2.4), although can also operate independently.

Water development projects. Two types of projects were identified: spring development (lower cost) and large waterworks to create large infrastructural improvement (not outlined here). For spring development, costs include:

- engineered design;
- construction of weir with screen;
- submersion pump;
- solar power station;
- piping and storage tank;
- pump to village main water holding tank, or distribution directly to village needs;
- permitting and government approval; and
- work to be conducted by contractor or government, with labour assistance from stakeholders.

Village scale micro-hydro power plant. Assumes a 50–100 kW power generation, and costs vary according to the current status of water source infrastructure (piping, flow, gradient, pressure, etc.). In areas where water is currently sourced from higher elevations and transmitted via piping at appropriate drop, costs are much less than developing sources straight from springs or creeks. Costs include:

- engineered design;
- creation of weir (if necessary) with screen;
- piping and routing from source to appropriate 'drop' in elevation and rise in pressure;
- installation of pelton wheel generator or similar design;
- battery bank and electricity conveyance; and
- tailrace for expended water.

Costs for materials with estimated labour match are presented in Table 23. Maintenance and supplies needed for 2.5 years of PEBACC funding are included. Costs will vary, depending on treatments applied, although these estimates represent the best available from interviews, published data, experience and current pricing of materials. Labour costs were estimated on time required and daily manual labour rates (FJD 30/day); per-unit labour costs were factored at current market rate (e.g. hole digging, fertilising, etc.). Communities would assume all labour costs, with provisions made if a participant's income is severely disrupted by time or displacement of a particular treatment (i.e. opportunity cost results in lower economic condition).

TABLE 23. Materials, maintenance and labour costs associated with implementing on-the-ground projects.

Name	Description of Activity	Materials Cost (USD) (PEBACC)		Labour Cost (USD) (Community Match)		Total Cost (USD)
Nurseries	Materials for constructing and operating a small nursery, capable of producing 600-700 yearling trees per year	3,035	98%	75	2%	3,110
Planting cost (no trees purchased) per ha*	Cost of materials associated with planting trees generated by self-managed nurseries	379	22%	1,332	78%	1,711
Planting cost (trees purchased) per ha†	Cost of materials associated with planting purchased trees from commercial nurseries	1,109	45%	1,332	55%	2,441
Agricultural enhancement per ha	Cost of materials for organic farming additions and other materials to improve soil health and yield	500	27%	1,350	73%	1,850
Village scale micro-hydro power	Engineering, permitting and installation of a micro-hydro power plant (~50-100 KW)	50,000–100,000	100% or match	Minimal		50,000–100,000
Small scale spring development	Engineering, permitting, materials purchased for developing small springs for local water supply	30,000	91%	3,000	9%	33,000
Large waterworks development	Large-scale water development projects to service Taveuni Island	Variable	Outside of budget	Minimal		1–10 M

Additional cost matching is possible with a SPREP project funded by the New Zealand Government with similar objectives, focusing on marine degradation and mitigating effects of ocean acidification (SPREP-PPOA). Priority projects that would emerge as priorities are indicated in the prioritised scenario lists for the three categories of EbA options in Table 24 (organisation, planning and policy), Table 25 (training) and Table 26 (watershed-level actions) below.

TABLE 24. Organisational, policy and planning EbA activities allocated to budget by scenario.

			Project Evaluation			Scenario 1: Ground Based		Scenario 2: Organization Based		Scenario 3: Training Based	
Section	**Project Name**	**Suggested Collaborators or Sources for Expertise**	**Total**	**Rank**	**Est. Cost (USD)**	**Units**	**Total Cost (USD)**	**Units**	**Total Cost (USD)**	**Units**	**Total Cost (USD)**
3.1.1	Taveuni watershed coordination network	PEBACC	10	1	10,000	1	10,000	1	10,000	1	10,000
3.1.2	Navakawau watershed and economic improvement plan	PEBACC and outside consultant	13	3	3,000	1	3,000	1	3,000		
3.1.3	Locally managed marine areas implementation and enhancement	Outside consultant, PPOA	15	4	30,000	*	*	*	*	*	*
3.1.4	Youth Stewardship Programme: living classrooms	Experienced local teachers, TRTC	12	2	10,000	1	10,000	1	10,000	1	10,000
3.1.5	Feasibility study: establishment of conservation trust	Outside consultant, National Trust of Fiji	19	7	40,000			0.5†	20,000		
3.1.6	Develop specialty markets for non-timber forest products	Outside consultant	16	5	40,000			1	40,000		
3.1.7	Qamea and Laucala Island watershed coordination	Outside consultant, PPOA	15	4	40,000	*	*	*	*	*	*
3.1.8	Lake Tagimoucia Ramsar site evaluation	Local NGO, Ramsar	18	6	10,000	1	10,000	1	10,000		
3.1.9	Aquaculture development plan and legal framework pilot	Industry consultant, Attorney PPOA	19	7	80,000	*	*	*	*	*	*
3.1.10	Taveuni primary forest health monitoring	Forestry, Government, IUCN	19	7	22,000						
	Total allocations					**4**	**33,000**	**5.5**	**93,000**	**2**	**20,000**

* Funding considered with SPREP PPOA project that has similar objectives to PEBACC for marine EbAs.

† Note partial funding was issued where budget did not allow for full funding.

TABLE 25. Training and pre-requisite EbA activities allocated to budget scenarios.

			Project Evaluation			Scenario 1: Ground Based		Scenario 2: Organization Based		Scenario 3: Training Based	
Section	**Name**	**Suggested Collaborators or Sources for Expertise**	**Total**	**Rank**	**Est. Cost (USD)**	**Units**	**Total Cost (USD)**	**Units**	**Total Cost (USD)**	**Units**	**Total Cost (USD)**
3.2.1	Plant nursery construction and operation	Forestry	11	1	6,000	1	6,000	1	6,000	1	6,000
3.2.2	Native plant seed collection to enhance biodiversity	USP, Forestry	11	1	3,000	1	3,000	1	3,000	1	3,000
3.2.3	Riparian and wetland planting and management	Forestry, local consultant	15	4	5,000	0.5	2,500				
3.2.4	Agricultural improvement and diversification trials	Teitei Taveuni, TRTC, Agriculture	16	5	20,000			0.25†	5,000	1	20,000
3.2.5	Agroforestry practices and management	Outside consultant, Forestry	11	1	30,000	1	30,000	1	30,000	1	30,000
3.2.6	Plantation management and certified sustainable products	Outside consultant, Forestry	12	2	30,000					1	30,000
3.2.7	Native forest restoration and expansion	Forestry, REDD+ Programme, consultant	14	3	5,000	1	5,000				
3.2.8	Invasive species detection and management	Biosecurity, USP	15	4	20,000						
3.2.9	Coral cultivation and transplanting in shallow coral reef habitats	Industry consultant	20	6	10,000	*	*	*	*	*	*
	Total allocations					**4.5**	**46,500**	**3.25**	**44,000**	**5**	**89,000**

* Funding considered with SPREP PPOA project that has similar objectives to PEBACC for marine EbAs.

† Note partial funding was issued where budget did not allow for full funding.

TABLE 26. Tangible costs associated with watershed-level EbA actions. Values are reported as units delivered. Total land area treated is summarised for each scenario.

					Scenario 1: Ground Based		Scenario 2: Organization Based		Scenario 3: Training Based	
Name	**Description of Activity**	**Suggested Collaborators or Sources for Expertise‡**	**Rank**	**Est. Cost (USD)**	**Units**	**Total Cost (USD)**	**Units**	**Total Cost (USD)**	**Units**	**Total Cost (USD)**
Nurseries	Materials for constructing and operating a small nursery, capable of producing 600–700 yearling trees per year	Watershed groups, Nursery training	1	3,000	9	27,000	3	9,000	12	36,000
Planting cost (no trees purchased) per ha*	Cost of materials associated with planting trees generated by self-managed nurseries	Watershed groups	1	400	21.4	8,547	7.1	2,849	28.5	11,396
Planting cost (trees purchased) per ha†	Cost of materials associated with planting purchased trees from commercial nurseries	Watershed groups, Commercial nurseries	2	1,100	45.5	50,050	14.5	15,950	1	1,100
Agricultural enhancement per ha	Cost of materials for organic farming additions and other materials to boost soil health	Watershed groups	1	500	10	5,000	10	5,000	25	12,500
Village scale micro-hydro power	Engineering, permitting and installation of small micro-hydro power plant (~50-100 kW)	Contractor, FEA	4	100,000						
Small scale spring development	Engineering, permitting, materials purchase for developing small springs for local water supply	Government, watershed groups	3	30,000						
Large waterworks development	Large-scale water development projects to service Taveuni Island	Government, contractor	5	$1 – 10M						
Total Hectares Treated and Total Cost					**76.9**	**90,597**	**31.6**	**32,799**	**54.5**	**60,996**

‡ See Training EbAs for relevant crossovers (Section 3.2).

* Costs associated with land clearing, fertiliser, supplies and maintenance. Labour is not included in cost. Planting density is assumed 6 x 4 m, or 417 trees/ha.

† Assume budget for 1 ha will be allocated to the 'Living Classrooms' programme (EbA section 3.1.4).

4.2.3 Project monitoring

The PEBACC project implementation phase of 2.5 years (December 2019) is a reasonable period to implement the three types of EbA projects presented in this options assessment. Monitoring tasks will include annual and semi-annual assessments of the *implementation* metrics (i.e. was the EbA implemented as planned?) and in some cases, early *effectiveness* metrics will also be possible to measure (i.e. did the EbA help to solve or overcome a vulnerability to ecosystem services?).

A list of monitoring criteria based on anticipated tasks for all EbA options is presented in the Appendix, Table 28. It is anticipated that semi-annual reviews will be conducted as part of the monitoring aspect. The current budget allocation is 15% of total (USD 30,000) inclusive of travel, accommodation, and reporting for a recommended three monitoring points during implementation.

Overall, the monitoring aspects will require coordination with all ongoing projects to prepare appropriate documentation. In some cases, early effectiveness monitoring may be valid (e.g. annual crop yield, etc.). Effectiveness monitoring may require additional or reallocation of funds for determining some quantitative values, such as soil structure and nutrient information to build baselines and trajectories following treatment. Collaboration with government will be important to instil long-term monitoring for EbA effectiveness across all sectors. Monitoring outcomes can be used as performance-based financing for community groups and EbA providers.

4.3 EBA SCENARIO SUMMARY

A summary of detail from this section is presented in Table 27, which outlines the number of EbA projects funded and estimated land area improved by treatments indicated in the detail from Table 24 (Organisational EbAs), Table 25 (Training EbAs) and Table 26 (Watershed Action EbAs) above.

It is important to note that actual treated land area may not correspond to the reported values here for a variety of reasons, including prescriptive changes that require fewer or more trees per hectare for agroforestry or plantation projects. This is especially true with prescriptions that are mixed agriculture and agroforestry solutions, where wide spacing may be the best site solution for the given crop mix. Also, a factor is that the desired output for self-sourced plant material grown in proposed nurseries (at reduced cost) may over- or under-achieve goals based on availability of seed stock, capacity and timing to collect material, or *force majeure*. As such, the land treatment area presented below should be used as a relative guide, with refinement during the finalisation of prescriptions, updated though monitoring activities.

TABLE 27. Summary of the three EbA deployment scenarios based on EbA type and major objective

Project Delivery	Scenario 1: Ground Based		Scenario 2: Organisation Based		Scenario 3: Training Based	
	Units	Total Cost (USD)	Units	Total Cost (USD)	Units	Total Cost (USD)
Organisational, policy and planning EbA programmes	4	33,000	5.5	93,000	2	20,000
Training and prerequisite EbA programmes	4.5	46,500	3.25	44,000	5	89,000
Tree nurseries distributed	9	27,000	3	9,000	12	36,000
Land area improvement (ha)[1]	76.9	63,600	31.6	23,800	54.5	25,000
Monitoring events (15%)	3	30,000	3	30,000	3	30,000
Total cost[2]		200,100		199,800		199,995
Total cost/ ha treated		2,603		6,318		3,670

1Land area improvement is based on nursery and purchased tree outputs and are conservative estimates.

2Note costs are approximate to a target of USD 200,000 overall budget.

The process of prioritisation has been conducted at multiple levels in this options assessment. The following summarises goals and potential outcomes for each scenario.

Scenario 1: Ground-based activities emphasis. This scenario at its base provides a balance of EbA activities that benefit Taveuni stakeholders in the immediate term (by project end) with a means to continue programmes into the future for most watershed groups. Some groups, particularly those requiring more outreach, will have full access to training but will have less inclusion or access to direct implementation in favour of select planning activities. Most groups in the highest 'readiness' will be able to distribute resources more deeply within their communities (i.e. larger ground-based projects than the other scenarios). Direct policy-driven actions that would cascade to government levels are low (other than supporting the Ramsar initiative), although this scenario provides a widespread distribution of on-the-ground project implementation capacity to provide island-wide 'case studies' to inform policy. On the metric of total cost to area influenced, this scenario provides the broadest benefit at lowest cost.

Scenario 2: Organisational and policy emphasis. This scenario focuses effort on building networks, extending new and invigorate existing markets, and tackling difficult political challenges to an unknown outcome. Like the other scenarios, benefits are also provided for stakeholders by way of training and the creation of some pilot sites involving land-use change and improving overall ecosystem function and performance. Tangible outcomes from this strategy are the lowest of the three, reflected by the cost to the area influenced, although the development of policy and new markets could have expansive opportunity for Taveuni if participation follows and community follows policy. For the short-term, this is likely to have the lowest direct stakeholder involvement as their primary concerns are not directly addressed except in a few focused areas.

Scenario 3: Training and capacity-building emphasis. This scenario focuses on Taveuni stakeholder capacity, which is specific to improving options for socio-economic benefit through direct action. This scenario focuses on coordination and the youth of Taveuni and does not extend into other policy or planning matters, making this scenario more of a Taveuni-centric 'case study' example in policy-making, reaching a broad range of capacity and implementation needs that the communities have determined to be priorities. However, local policies will be informed by this scenario in identifying safeguards for lease agreements, and other transactional outcomes with likely higher awareness of cause-effect of land use on ecosystem services. This scenario aims to provide the broadest possible distribution of action-based EbA activities that have basic design, are low cost, low risk, and self-managed. The training is designed to build and reinforce a broad and specific set of skills to provide more options for communities in the future, while slowly increasing ecosystem services and realising direct benefits. This scenario is best thought of as a training-action plan to 'certify' community members in the field to implement future EbAs and to teach others. Cost per hectare of land-use change is moderate due to the number of training sessions.

4.4 RECOMMENDED STRATEGY AND FUNDING CONSIDERATIONS

4.4.1 Recommended portfolio: Scenario 3

At the island-scale, the PEBACC project objectives are to address vulnerabilities with community stakeholders, and assist with tools that will result in alternative decision-making choices that will improve resilience to climate and non-climate events. This is done through short-term interventions that ideally will allow for a buffer for communities to adapt to longer-term resource use that builds ecosystem services.

There is also a unique opportunity to team with a parallel project focusing on Taveuni marine issues (SPREP-NZ PPOA project), to deploy funding on the priority marine-based EbAs presented in this document, which mostly address capacity associated with marine management and monitoring (policy and planning outcomes).

Given the above, and coupled with organisational, planning and policy focus for the PEBACC Macuata Province EbA Options Assessment, a strong approach for Taveuni would favour stakeholder involvement and equip communities with the necessary tools and practices to make meaningful change on the landscape. As such, Scenario 3 is recommended with the training, capacity-building and land treatment portfolio.

Scenario 3 offers communities the ability to network and it funds a youth programme for local schools, as well as core infrastructure and training funding for communities to design treatment, collect seeds, grow plants, and test different agricultural treatments, and install nearly 55 ha of agricultural, agroforestry, plantations and native forest areas. An important caveat is that the funds are only enough to purchase trees for one hectare, as the demonstration site for the school programme. Hence, the success of the treatments will rest squarely on the capacity and motivation of stakeholders to execute the implementation plan.

4.4.2 Quality assurance and performance-based financing

Stakeholders have been consistent in expressing their willingness to conduct the work necessary to make changes on the landscape. The focus on training and implementation is straightforward and requires investment from the stakeholders to succeed. There are several milestones that are step-wise and consistent with the planning process over the past year; each provides a point to evaluate the expenditure of funds:

- Watershed groups organise a guided first quarterly meeting to discuss project implementation distributions and make recommendations to PEBACC.
- Stakeholders develop a watershed plan that would confirm their priority project locations through their individual watershed group meeting process. Each watershed will be allocated a set number of hectares for treatment (or specific projects, etc.). Groups will fill out documentation similar to workshops done in the past that describe roles, responsibilities and timelines. PEBACC could evaluate the magnitude of projects based on their plan and capacity (as also evaluated in Table 21). Progress reports will be made at the quarterly watershed coordinator meetings.
- Select core training needs for each watershed group and organise appropriately scaled workshops. These workshops should involve in-field meetings at specific sites, and may be periodic rather than single events, such as group seed collections. Selection of experts to assist with the training would be done via PEBACC coordination and selection.
- Participation in the training workshops could be mandatory for named individuals in the watershed plan to receive project funding. Inclusion of a broad base of stakeholders would add to project implementation success.
- Deployment of funds to develop tree nurseries could also be dependent on seed collections or source material for agricultural treatments. Metrics such as number (or mass of) seeds, diversity of species, collection documentation, etc. can be used for quality assurance purposes.
- Inspections of completed nurseries in their construction and intended use assures that funds are implemented properly.
- Materials for planting and maintenance could be issued step-wise with inspections at set times. PEBACC

would control expenses by purchasing materials directly. Guarantees would be required to ensure materials are used for intended project purposes.

- Monitoring site attributes through time, both informally through monthly site visits and formally through implementation monitoring, provides measurable outcomes for project implementation and (where allowable) effectiveness.

A key consideration in this process includes the involvement of PEBACC with the quarterly watershed group meetings and visits to watershed groups on at least a monthly basis. Ideally PEBACC would also be present at locally-managed meetings pertaining to the projects.

Performance-based financing based on a stepwise procedure, as shown above, limits risk of capital and provides incentives for stakeholders to execute their plan. Because the plans to be executed will in large part be autonomous with measured guidance, there are practical incentives to include more of the community in carrying out the labour and activities required, which will provide longer-lasting and broader capacity and knowledge to the stakeholders. In addition, investment in time and energy by stakeholders to achieve their goals will focus efforts to ensure the desired measured outcomes. For example, seeds collected, grown and planted by the community will have higher value to that community than trees purchased and delivered on a single day.

The PEBACC project does not have the funding to 'complete' any large-scale EbA projects (e.g. 3,000 ha of agroforestry projects), but it can support an approach that matches capacity with practical and measurable outcomes to ultimately help support widespread project implementation that can continue with self-financing into the future.

4.4.3 Next Steps

An implementation plan of the EbA portfolio for Taveuni will be made, outlining specific outcomes and timing associated with each action for the selected portfolio. Preparation for implementation will take place in September 2017, with the need for a clear PEBACC presence participating on Taveuni Island.

5. APPENDIX: MONITORING CRITERIA

Monitoring criteria associated with EbA options are presented in Table 28 below.

TABLE 28. Monitoring criteria of tasks that are considered with each EbA project. Monitoring is to be done on an inspection basis annually with reports from project leads.

Section	Project Name	Monitoring Criteria of Tasks Considered
3.1.1	Taveuni watershed coordination network	▪ Attendance at quarterly meetings with minutes ▪ Watershed coordinator summary of activities ▪ Level of collaboration among watersheds ▪ Lessons learned and adaptive decision-making outcomes
3.1.2	Navakawau watershed and economic improvement plan	▪ Outcome from organisational meeting ▪ Planning document or agreement
3.1.3	Locally managed marine areas implementation and enhancement	▪ Attendance and identification of key issues ▪ Training completed ▪ Fish wardens trained ▪ Government involvement in meetings and decision-making ▪ Gathering of population and catch data
3.1.4	Youth Stewardship Programme: living classrooms	▪ Identification of teachers to participate in pilot ▪ Curriculum on ecosystem services important to Taveuni life ▪ Training and activities completed (e.g. seed collection, reef habitat mapping, tree planting) following curriculum ▪ Establishment of living gardens (reef, plant or both) ▪ Student tracking over 2.5 years on knowledge and awareness (testing, interviews, etc.) (effectiveness)
3.1.5	Feasibility study: establishment of conservation trust	▪ Identify collaborators and establish MoU ▪ Review of conservation trusts in a range of countries ▪ Identification of viable mechanisms and legal issues ▪ Establish working groups with communities and government to review options ▪ Feasibility of options and pre-requisites to launch and present to appropriate stakeholders/ government
3.1.6	Develop specialty markets for non-timber forest products	▪ Identify industry expert and establish MoU ▪ Number of community members engaged ▪ Measure of market demand and products ▪ Training to develop products ▪ Linkages with distributor networks ▪ Revenue generation from sales
3.1.7	Qamea and Laucala Island watershed coordination	▪ Outreach to communities to solicit interest ▪ Workshops and attendance of EbA process ▪ Identification of project areas ▪ Training to implement projects by community ▪ Land/marine area implemented
3.1.8	Lake Tagimoucia Ramsar site evaluation	▪ Identify local NGO and establish MoU ▪ Vegetation survey completed and evaluated ▪ Workshop and outreach attendance and level of interest ▪ Completion of Ramsar application ▪ Establishment of Ramsar site

Section	Project Name	Monitoring Criteria of Tasks Considered
3.1.9	Aquaculture development plan and legal framework pilot	▪ Identification of government, industry, community task force to support project ▪ Workshops to identify key issues, plan review, law review and parliamentary presentation. ▪ Development of aquaculture plan and law review ▪ Submittal to parliament ▪ Investment from industry to support process
3.1.10	Taveuni primary forest health monitoring	▪ Government engagement in short-term ▪ Mapping of hot-spots and plot design for inventory ▪ Field inventory report ▪ Options report and action plan ▪ Increased presence of government interest and investment in reserve areas
3.2.1	Plant nursery construction and operation	▪ Attendance at workshops and training ▪ Number of species included in priorities ▪ Conveyance of disease identification and management ▪ Conveyance of seed germination, transplanting, and finishing
3.2.2	Native plant seed collection to enhance biodiversity	▪ Attendance at workshops and training ▪ Identification of site criteria ▪ Conveyance of species and genetic diversity concepts to participants ▪ Conveyance of sustainable harvest techniques and conservation ▪ Identification of island-wide network for seed dispersal and collection
3.2.3	Riparian and wetland planting and management	▪ Attendance at workshops and training ▪ Conveyance of riparian function ▪ Conveyance of planting techniques and species choices ▪ Practicum completion in public area ▪ Monitor flooding events and vegetation health
3.2.4	Agricultural improvement and diversification trials	▪ Establish partnerships and MoU where necessary ▪ Identify student, timeline and literature review ▪ Attendance and participation at workshops to identify committed partners ▪ Identify key questions and experimental design ▪ Progress reports with data and moving statistics ▪ Reports on trial outcomes (effectiveness)
3.2.5	Agroforestry practices and management	▪ Workshops and training on developing or reinvigorating agroforest industry ▪ Attendance and interest at workshops ▪ Guidance of species mixes, propagation, care, planting and harvest techniques ▪ Site-level practicums for watershed groups engaged ▪ Identify sustainable plant sources for expansion ▪ Conveyance of techniques, monitoring, weed control, long-term care ▪ Short-term cost/ revenue reporting (within 2.5 years, early effectiveness)
3.2.6	Plantation management and certified sustainable products	▪ Workshop and training attendance ▪ Conveyance of species mixes, ground preparation, spacing, care and maintenance ▪ Conveyance of site-specific parameters for highest success for species mixes ▪ Conveyance of certified sustainable products and number of participants to enter programme ▪ Field practicum and review of existing plantations as learning tool ▪ Conveyance of thinning and harvest techniques, disease prevention, weed control, and wood markets ▪ Conveyance of processing of sustainable products
3.2.7	Native forest restoration and expansion	▪ Workshops and training attendance ▪ Site location choice for conducting practicum ▪ Conveyance of techniques, monitoring, weed control, long-term care ▪ Conveyance of role of native forests in ecosystem services

Section	Project Name	Monitoring Criteria of Tasks Considered
3.2.8	Invasive species detection and management	▪ Establish partnerships with relevant partners and watershed groups ▪ Workshop and training attendance ▪ Development of identification tool to build capacity and awareness of invasive species, such as flashcards, photographic playing cards or other techniques for passive learning ▪ Training on appropriate management tools for invasive plants and animals ▪ Development of mapping or low-tech communication tool for communities to identify invasive species ▪ Implementation of fun learning activities (such as 'Invasive Hunt') for youth to increase capacity ▪ Delivery of mapping and awareness results at end of PEBACC project (effectiveness)
3.2.9	Coral cultivation and transplanting in shallow coral reef habitats	▪ Workshops and training attendance ▪ Conveyance of identifying terrestrial pollution ▪ Conveyance of coral bleaching and ecosystem services of corals ▪ Conveyance of techniques to cultivate corals ▪ Establish coral garden as pilot
Watershed Level Actions	Nurseries	▪ Participants with completion of nursery training ▪ Participants and range of areas represented ▪ Nursery care plan to deliver species mixes, responsibilities, needs and costs ▪ Completion of nursery design ▪ Timing and number of full germination, full rearing and plants ready to plant ▪ Frequency of disease, mortality and other nursery issues
	Tree planting (agroforestry, plantation, native forest expansion)	▪ Participants and range of areas represented ▪ Prescription design for life of project ▪ Quality of plants obtained: heartiness, size, condition ▪ Number, species of trees and supporting plants planted, or hectares matching prescription ▪ Monitoring of mortality, successes, challenges ▪ Response of canopy cover, density and area in use (early effectiveness) ▪ Cost and income earned, as appropriate (early effectiveness)
	Agricultural enhancement	▪ Participants and range of areas represented ▪ Number of hectares treated; number hectares not treated (control) ▪ Integration with Agricultural Field Trials study, if implemented (Section 3.2.4) ▪ Longevity of participation ▪ Prescription design (crop mixes) and repeatability ▪ Innovations in infrastructure – composters, irrigation, etc. ▪ Cost effectiveness and income generated (early effectiveness) ▪ Improvements in soil bulk density, nutrient holding capacity, and other metrics (effectiveness)
	Village scale micro-hydro power	▪ Assessment of need and supply ▪ Approved design with permitting ▪ Installation effectiveness ▪ Load output and maintenance required (effectiveness) ▪ Community use and offset value (effectiveness)
	Small scale spring development	▪ Assessment of need and supply including water quality ▪ Approved design with permitting ▪ Installation effectiveness ▪ Output and source integrity (effectiveness) ▪ Community use and offset value (effectiveness)
	Village scale micro-hydro power	▪ Assessment of need and supply ▪ Approved design with permitting ▪ Installation effectiveness ▪ Load output and maintenance required (effectiveness) ▪ Community use and offset value (effectiveness)

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