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Rapid Resource Assessment Report of the

Waimanu River Catchment, Fiji

December 2021

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Rapid Resource Assessment Report of the **Waimanu River Catchment, Fiji**

December 2021

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Conservation International

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Reviewed by George Naboutuiloma, Samasoni Sauni, Fononga Vainga Mangisi-Mafileo, Aliti Vunisea, John Carreon and Jose Antonio.

Editing Support: Seema Deo, Footprints in the Sand consultancy

Conceptual Design: Navneet Lal, Pacific Community (SPC)

Layout and Design: Sailesh Sen, Tanisha Graphics

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www.spc.int | spc@spc.int

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Abbreviations

ADB	Asian Development Bank
BMI	Benthic Macroinvertebrates
CBRM	Community Based River Monitoring
CE	Critically Endangered
CITES	Convention on International Trade in Endangered Species
COVID-19	Coronavirus disease 2019
CSO	Civil Society Organisation
CSA	Climate Smart Agriculture
dbh	Diameter at breast height
DPSIR	Drivers, Pressure, State, Impact, Response mechanism
EBA	Ecosystem-Based Approach
EBM	Ecosystem Based Management
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EN	Endangered Species
ESB	Ecosystem Service Beneficiaries
ESP	Ecosystem Service Providers
EU	European Union
FHI	Freshwater Health Index
GADRI	Global Alliance of Disaster Research Institutes
GGF	Green Growth Framework
Ha	Hectares
IBA	Important Bird Area
ICM	Integrated Catchment Management
IRBM	Integrated River Basin Management
IUCN	International Union for Conservation of Nature
IWRM	Integrated Water Resource Management
LoU	Land Owning Unit
MEA	Millennium Ecosystem Assessment
NCCP	National Climate Change Policy
NGO	Non-Governmental Organisation
PABITRA	Pacific-Asia Biodiversity Transect
PLR	Policy, Law and Regulations
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RRA	Rapid Resource Assessment
SDG	Sustainable Development Goal
SPREP	Secretariat of the Pacific Regional Environment Programme
SPU	Service Providing Units
TEEB	The Economics of Ecosystem and Biodiversity
TLTB	iTaukei Lands Trust Board
UNDP	United Nations Development Programme
UNHSP	United Nations Human Settlements Programme
USP	University of the South Pacific
VU	Vulnerable Species
WAF	Water Authority of Fiji
WL	Water Level

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Technical Contributors

Specialised components of the assessment were carried out by expertise in the respective areas:

- Flora and Vegetation: Mr Marika Tuiwawa
- Freshwater fauna: Ms Bhindiya Rashni
- Avifauna: Mr Vilikesa Masibalavu
- Policy and Legal framework: Mr Ulai Baya

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Executive Summary

The Waimanu catchment features the Waimanu River as one of three major and critical river systems draining a surmountable amount of freshwater into the Rewa River. It is a sub-catchment of the greater Rewa catchment, which is the main water source of the broader Viti Levu south-eastern corridor, that contains a population of 244,000 people. The sub-catchment is a recipient of freshwater from the upper Wainibuku, Wainimala and Waibau rivers, that lies within the Nausori-Naitasiri topography. It is an important water source but has never had a stock take of resources assessment, which is required to ensure it is effectively protected and conserved for the purposes of essentially providing safe drinking water to the greater population of south-eastern Viti Levu.

In this report, we discuss a rapid resource assessment (RRA) undertaken by largely a literature review approach to gauge a preliminary understanding of existing resources within the Waimanu catchment. We have documented information under the three main pillars of thematic resources, namely: Ecosystem Vitality, Ecosystem Goods and Services, and assessing the Governance and Stakeholders aspects of the catchment. We also include annotations of existing and projected sources of threats to the catchment.

Under Ecosystem Vitality pillar, we document existing information about the geography, biodiversity and land use changes of the Waimanu catchment. According to several key geological and topographical documents, the geology of the upper Waimanu catchment essentially belongs to the Wainimala group, which shows a low-grade metamorphism that is visible in plutonic intrusions. Along the mid catchment is the Tuvatu Greywacke, Waidina Sandstone and Vago Volcanic formations. On the lower riverbanks of the catchment are recent alluvial deposits as top cover underlined by the volcanic rocks exposed on some of the steep slopes surrounding the river.

In a similar approach of assessment, desktop assessment of available information describing the biodiversity of the Waimanu catchment showed that there has been no dedicated study specifically on the fauna and flora of the catchment. Personal communication with specialists and available information along the peripherals of the catchment indicate that existing natural vegetation comprises mostly of the lowland rainforest with common tree species that have merchantable value as timber. A few of the peaks/mountain top in the Waimanu catchment are over 600 m and classified as upland rain forest where the vegetation type is characterised by dominance of species such as kauvula (*Endospermum macrophyllum*), damanu (*Calophyllum vitiense*) and other important native species. This vegetation type also contains most merchantable timber tree species and a vegetation type greatly impacted by logging in addition to agriculture.

In addition, the faunistic composition of the Waimanu catchment varies across different locations of the catchment. In an assessment of birds by local authorities in 2006, the Waimanu catchment area was identified to be an important part of Viti Levu's Southern Highlands Important Bird Area that is home to Viti Levu's threatened and endemic birds such as the Long-legged Warbler (*Trichocichla rufa rufa*) and Pink-billed Parrotfinches (*Erythrura kleinschmidti*), both of which are on the global species Red List of conservation priority species. Local freshwater experts expand the importance of the Waimanu river system in communicating the observed occurrence of the largest endemic riverine fishes in the South Pacific, *Mesopristes kneri*, in the lower reaches of the Waimanu River at the Waila Water Intake Plant. Other freshwater species of social and economic interest, such as freshwater clam/Kai (*Batissa violacea*); freshwater prawns (*Macrobrachium spp.*); water cress (*Nasturtium officinale*) and Ota (*Diplazium esculentum*), have also been communicated to occur within the Waimanu riverbanks and waterways, emphasising the fact they are an important food source and livelihood sustenance of adjacent communities.

In a qualitative assessment of anthropogenic impact, we find that the impact of physical changes and development varies along the catchment. According to recent local surveys, the upper end of the catchment and forest area appear relatively intact with minimal anthropogenic activity. Along the mid-catchment area, there is similar natural forest appearance, however, it is relatively more prone to landslide/mass movements (as the result of its geological and topographical characteristics). At a significant scale, the amount of landslide will affect the water turbidity and silt deposition that, to a plausible extent, can change the river morphology. In the lower catchment is the most development and densely populated area of the entire catchment with

many land-tenants. There is an estimated total of 665 land tenants with lease types ranging from Agricultural, Residential, Forestry, Educational, Tourism, Commercial, Government Stations, Water Mineral and Others [Religious, Access Way, Way Leave]. In addition, there are an estimated 500 farmers along the Waimanu catchment with lease area ranging from 0.05 ha to 1500 ha. Majority of the farms are subsistence farmers and less than 5% are commercial farms. The distribution of farms along the catchment shows that the most common farming activity is subsistence. Anthropogenic developments along the Waimanu catchment leads to severe soil erosion as is visible along Sawani village, and this is an increasing problem in the nearby villages.

Under the Policy, Law and Regulation (PLR) pillar of assessment, the absence of a customised legislation on water and its management has cascading effects on the protection and management of water catchment areas. Even though relevant legislations such as Environmental Management Act, Public Health Act, Water Authority of Fiji Act, and other related legislations exist, there is no comprehensive law to cover all aspects of water resources and management. Development of an umbrella legislation, which will be specific and purposive to the management and control of water is necessary to supplement the aspiration and policy for integrated water catchment management.

We also assessed the potential threats to the catchment whereby four main sources were identified as likely to have a significantly negative impact on the environment. These were seen to be the presence of invasive species, development, natural disasters, and the lack of appropriate policies, laws and regulation.

In moving forward, the assessment identified the Waimanu catchment as a critical catchment that needs to be managed to sustain water quality and quantity. To fully realise the above, the upper reaches of Waimanu catchment must be protected under conservation lease arrangement while the lower reaches of the catchment will need extensive efforts in awareness and capacity building to ensure sustainable land use practices are adopted and implemented. At the same time, water management policies, laws and regulations need to be reviewed and updated to support integrated water resource management, control, monitoring, surveillance, and enforcement of policy and legislative frameworks, including community rules and by-laws.

1 Introduction

The Waimanu catchment is an important catchment for Viti Levu. Through the Water Authority of Fiji (WAF), the catchment supplies water to the Tamavua and Waila water treatment plants that feeds the greater Suva area (Singh 2017) with a population of 244,000 (UNHSP 2012). It is one of three major rivers that deposits a surmountable quantity of freshwater into the Rewa River.

The Waimanu catchment is a sub-catchment of the greater Rewa catchment and is situated along the south-eastern part of Viti Levu. It is located approximately 20 km from the City of Suva and 10 km from the township of Nausori, accessible via Prince's Road and Sawani/Lomaivuna Road. The sub-catchment is a recipient of freshwater from the upper Wainibuku, Wainimala and Waibau river system, that lies within the Nausori-Naitasiri topography.

Approximately 75% of the upper Waimanu catchment (above Waibau settlement) remains heavily forested (Singh 2017). According to Atherton et al. (2005), the forest covers 148 km^2 of intact forest area, of which Olson et al. (2010) list the entire catchment as a priority forest with a significant amount (75%) of the forest still relatively intact. The Waimanu catchment, according to Olson et al. (2010), is one of 40 priority forests covering 23% of Fiji's total land area and 58% of Fiji's remaining native forest. Although the upper catchment appears to be heavily vegetated, the lower catchment is vulnerable to human induced disturbance. The forest area along Waibau has been drastically converted from forests to farmland and grassland. This section further presents high risk pollution areas affecting the Waimanu River (Atherton et al. 2005).

Agriculture activities in the Waimanu catchment have increased over the years. Most of the agriculture activities are downstream at the lower catchment where lands are leased out for agriculture and other uses. The two most practiced types of agriculture are cash crops and subsistence farming. Cash crops are grown mainly in farming settlements such as Waibau and on various vegetable farms along the Princes Road while subsistence farming is usually done by villagers. Furthermore, regarding the parts of Waimanu catchment that are currently leased for various land use purposes, 10% – 15% of these are agricultural leases with lease periods of 30 years. The cluster of leases along Waibau and along Waila affect the water quality at Waimanu and Waila pumping stations while the land along the Waibau is under agriculture lease. The lower part of the catchment along the Waila has a mix of agriculture and residential lease (Singh 2017).

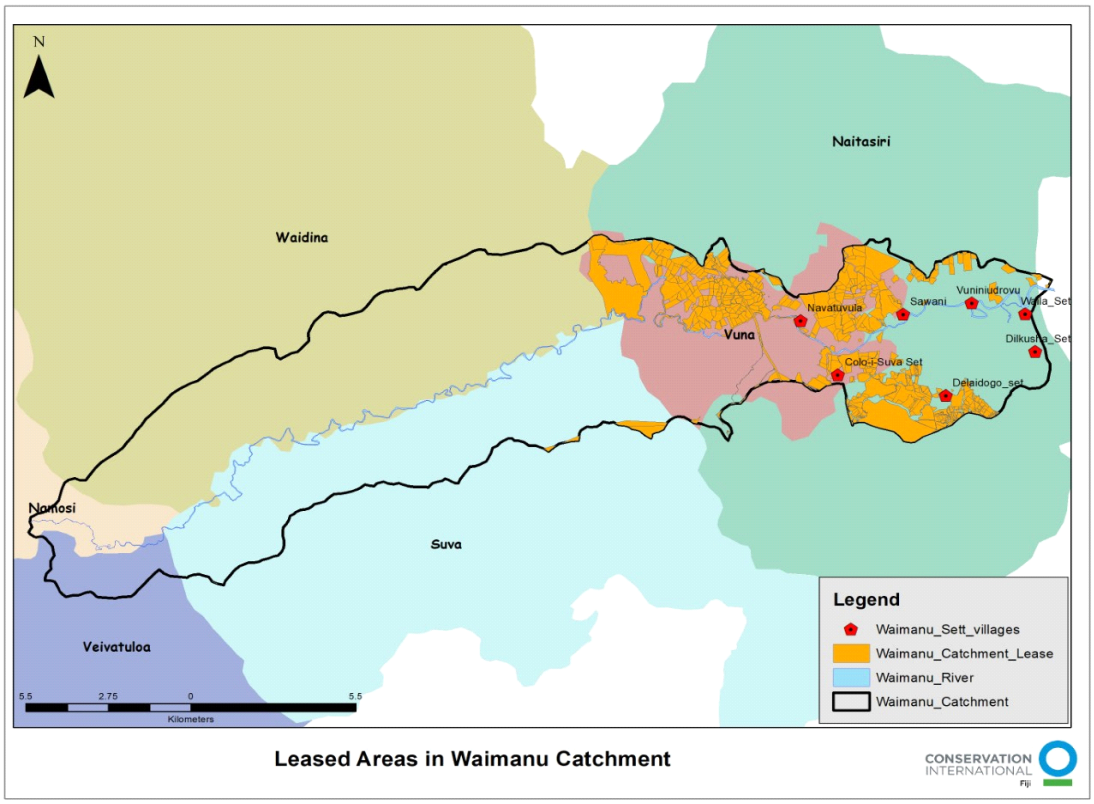


Figure 1: Leased Area in Waimanu catchment (all types of leases)

Occupants living off the catchment area are generally categorised into community stakeholders and lease tenants, each recognised under two different governance systems and infrastructure. Under the traditional governance system, the 122 landowning units in the 6 districts and 3 provinces fall under the iTaukei governance system. Other stakeholder occupants include the government, quasi government and land tenants who are obliged to follow the laws of rural development.

In the context of occupancy, there are altogether seven settlements within the catchment area. These include three customary indigenous villages and four farming community settlements. Customary indigenous settlements are inhabited by iTaukei communities who have traditional rights to the Waimanu catchment, while the farming community settlements hold land lease titles to the land. Additional stakeholders who own land in the upper reaches of Waimanu live in customary indigenous villages outside of the Waimanu catchment area. These villages include Lomai, Nabukaluka, Navurevure and Nasirotu. There are four schools in the area catering local population in the catchment area estimated at 13,000 people (Fiji Bureau of Statistics 2017).

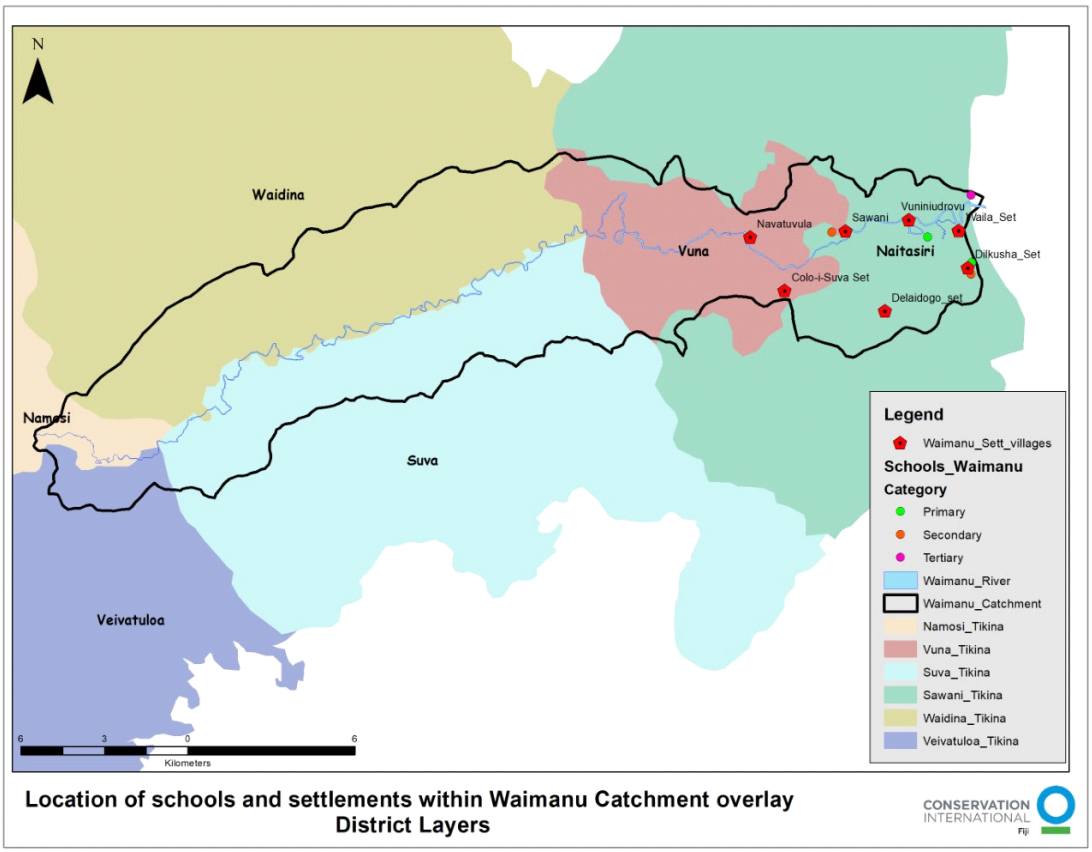


Figure 2: Settlements, Schools and other Social Infrastructure

Set in a peri-urban setting, the water resources and catchment ecosystem services have reportedly been deteriorating as the result of intense land use activities in the area (Figure 3). These are activities such as gravel extraction and dredging; subsistence and commercial farming; quarry; timber harvesting; sawmill, road expansion; business centres (shops) and waste disposal dump sites. Other contributing factors include altered river flow patterns and degraded ecosystem services. These problems are compounded by the effects of climate change through altered rainfall and flow regimes (Singh 2017).

In this Rapid Resource Assessment (RRA), a literature review and qualitative assessment of available information are evaluated for information indicating the status of the environmental resources, governance infrastructure, and legal systems to assess the ecosystem vitality and ecosystem goods and services of the Waimanu catchment in terms of its capacity to continue and sustain water provisions.

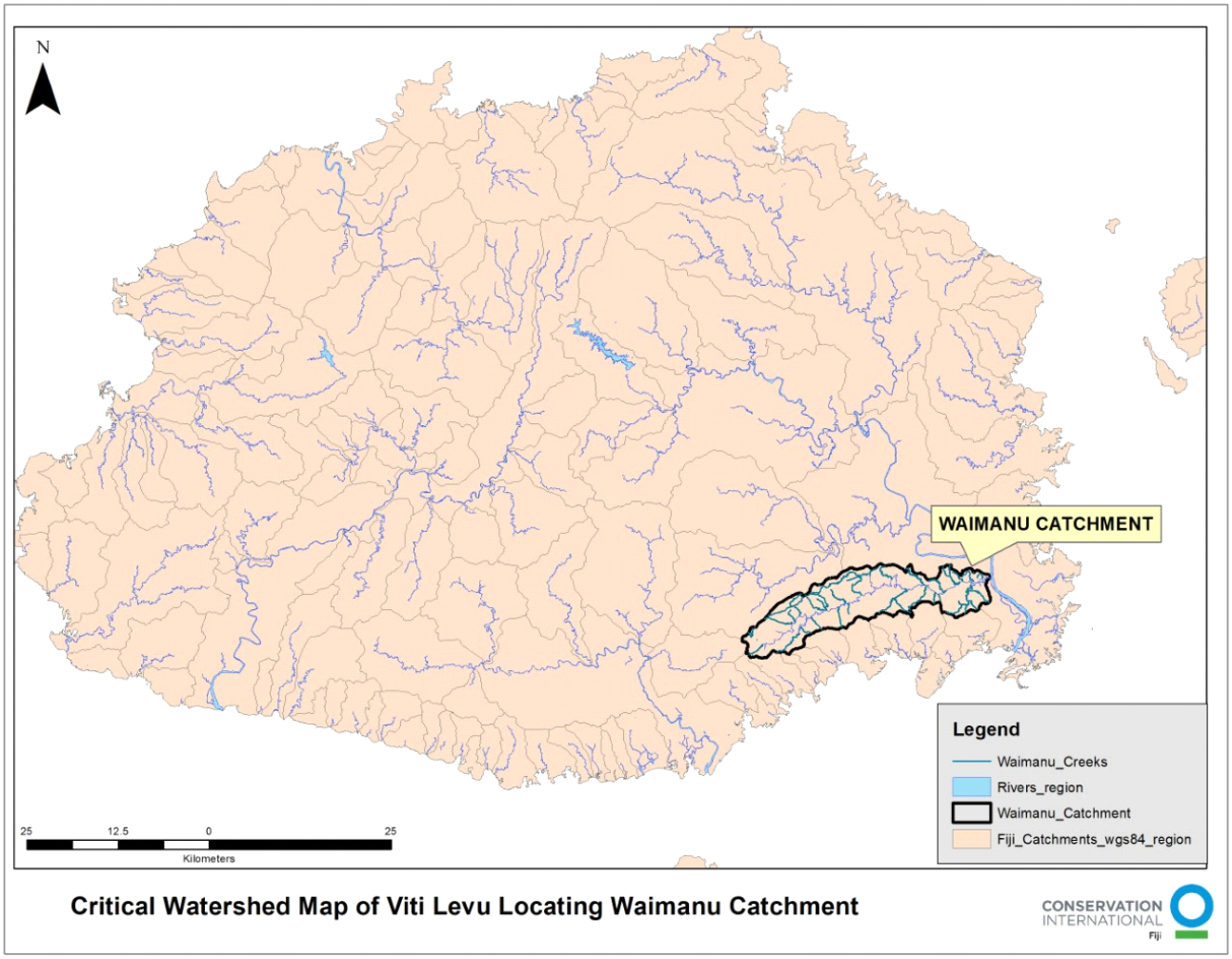


Figure 3: Location of Waimanu catchment on Viti Levu

2 Ecosystem Vitality

Under the Environment pillar of resource assessment, we take a closer evaluation at the geography, biodiversity and land use activities that have been documented in literature to have occurrences within and surrounding peripherals of the Waimanu catchment.

2.1 Geography

2.1.1 Geology

The geology of Waimanu catchment belongs to the Wainimala group, which is traced back to Late Oligocene to Middle Miocene (28.1 – 11.6 Ma). The group shows low grade metamorphism that is visible in plutonic intrusions. There are two types of volcanic rocks present in the Wainimala group; pyroclastic and flow deposits of various chemical compositions that include basalt, andesite, trachyte and rhyolite.

In the upper catchment of the Waimanu, the Tuvatu Greywacke, Namalevu Conglomerate and Veisari Sandstone formations dominate the upper catchment geology (Singh 2017). Majority of the formation in the upper catchment belongs to the Wainimala group and the underlying main lithologies are clastic sediments. Along the mid catchment is the Tuvatu Greywacke, Waidina Sandstone and Vago Volcanic formations – the Vago volcanic belong to the Savura Volcanic group. Rocky outcrops found in the catchment are mainly volcanic composed of the Savura volcanic group (Early and Middle Eocene) and Verata sedimentary group (Pliocene) with Suva Marl. Alluvium is found at the frequently inundated area where Waibau joins the Waimanu River (Nainoca 1998, Kumar 2007). The Savura Volcanic group is composed of andesitic to rhydacitic flows, breccias and volcaniclastic sediments with minor basalts flow and intrusions. The lower part of Wainimala Group consists of volcanic breccia and volcanic conglomerate and the upper part consists of lutite, sandstone, reef limestone and volcaniclastic rocks. The rocks of Wainimala Group are believed to be altered to various extents covering the Medrausucu Group.

The lower riverbanks have recent alluvial deposits as top cover underlined by the volcanic rocks exposed on some of the steep slopes surrounding the river.

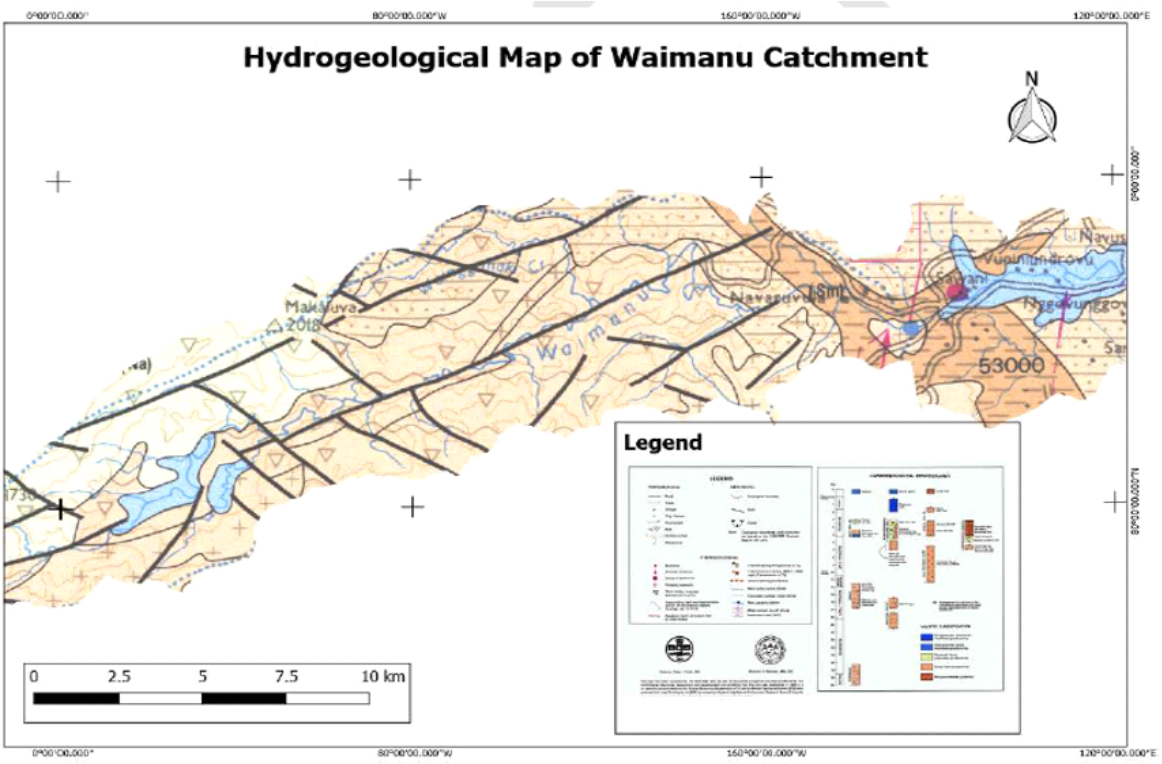


Figure 4: Hydrological Map of Waimanu Catchment (Source: Ministry of Waterways and Environment, 2019)

Figure 4 illustrates the hydrogeology of the Waimanu catchment. The catchment is overlaid with numerous fault lines, with fissured, local moderate productivity aquifers.

The Rewa catchment also has the highest runoff coefficient (0.6–0.9) when compared to Nadi and Ba catchments (0.4–0.6). The Waimanu has a base-flow index of approximately 0.5. Generally, the gradient of the riverbed is very gentle from the point where it joins the main Rewa River to the middle reach; the gradient then becomes very steep while flowing through the rugged hills in the upper reaches. There was an estimate of soil loss of 35 tonnes/ha/year on the eastern side of Viti Levu, which includes the Waibau area and Rewa River.

2.1.2 Topography

The upper Waimanu catchment is dominated by steep, mountainous topography with deeply incised streams (Singh 2017). Approximately 30% – 40% of the catchment is steep land (slopes > 18°) while much of the remaining catchment area is rolling and hilly land (slopes 3- 18°) (Singh 2017).

The lower part of the catchment has a slope in the range of 30 – 4° (Singh 2017). Since the upper Waimanu catchments are dominated by rugged topography, this promotes a high degree of hydrological short-circuiting (Singh 2017). This means that during a torrential cyclonic downpour, precipitation is transferred quickly into the river channels, leading to a fast-hydrological response that results in flash floods (Singh 2017).

The steep terrain contributes to landslide and erosion in the catchment. Sediments and soils are washed during heavy rainfall events, increasing the turbidity of water. Furthermore, agricultural activities on steep areas further aggravates erosion in the catchment (Singh 2017).

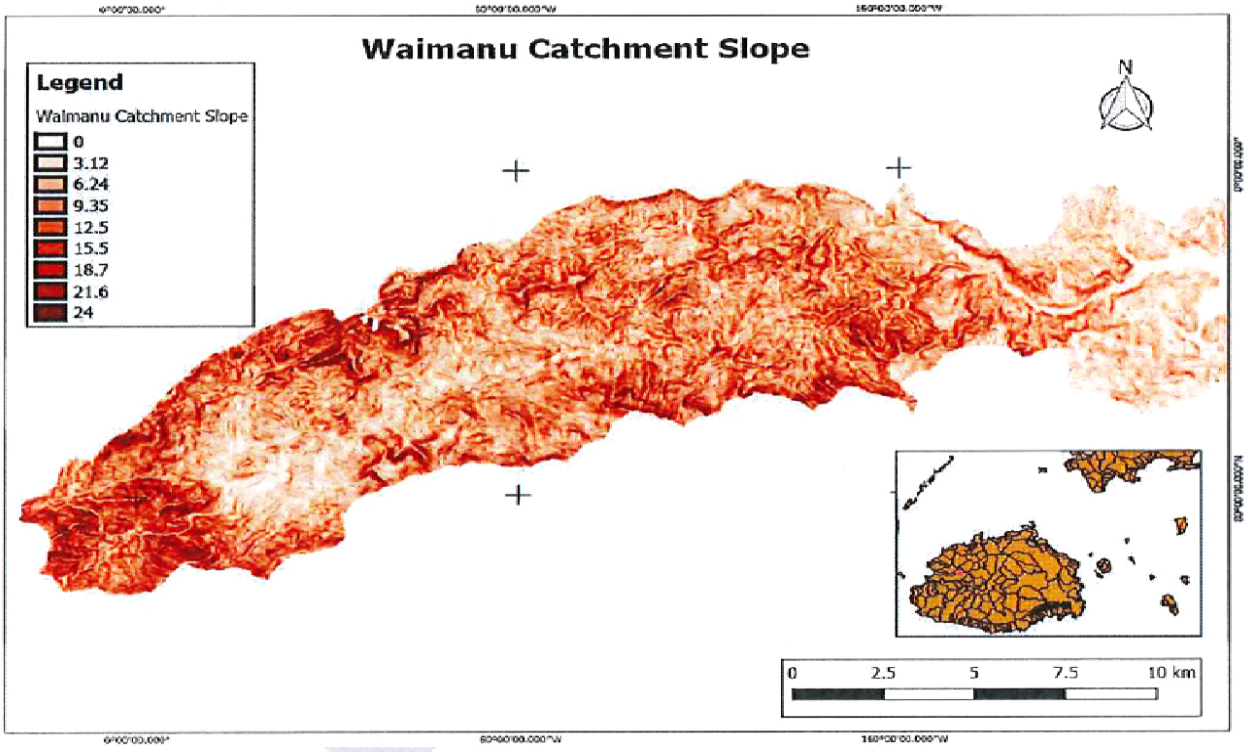


Figure 5: Waimanu catchment Slope. (Source: Singh 2017)

2.1.3 Soils

Using the major landform categories by Dolesau and Rufu (2011), fourteen different soil types found in Fiji were identified in the Waimanu catchment. The soil type humic latosols, highly weathered soils with weakly developed A horizons, dominate in the catchment, especially the Lobau clay with some Sote clay and Waimaro clay occurring around the Waibau area (Nainoca 1998). There is also evidence of alluvial soils (mixed with silts, sand and gravels in situ) in the Rewa delta areas that have been washed from the uphill of surrounding catchment.

2.1.4 Riverbank Stability

Three important parameters influence erosion: rainfall intensity, rainfall seasonality (Watling 1994), and soil type. Rainfall intensity is associated with the erosive factors of surface run-off, and, for rainfall seasonality, water quantity is an important contributing factor for erosion due to heavy rainfall. Repeated cycles of extremely wet conditions followed by dry periods causes the soil surface and vegetation to be highly erosive.

The riverbanks of the Waimanu catchment are mostly degraded with eroded banks. The relative erodibility of the Waimanu catchment is estimated to be medium in comparison to the greater Rewa catchment, which is ranked at higher erodibility (see Figure 6).

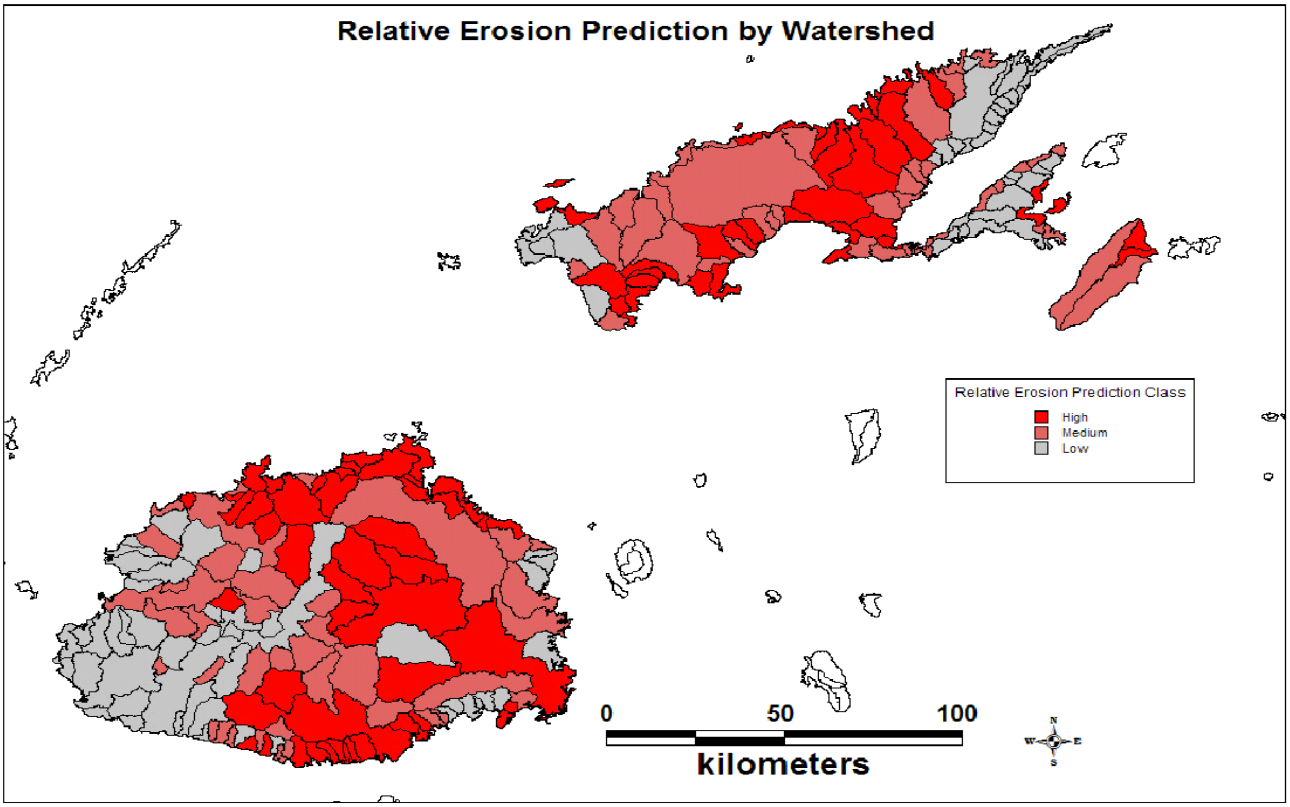


Figure 6: Relative Erosion Prediction for Water catchments in Fiji (Source: Atherton et.al. 2005)

2.2 Biodiversity: Fauna and Flora

2.2.1 Flora and Vegetation

There has been no dedicated study on the flora and vegetation of Waimanu catchment but deductions can be made based on information from key botanical surveys in adjacent catchments, conducted as part of a separate scientific assessment of major developments. According to Tuiwawa (2021), the physical attributes of the Korobasabasaga range, Naikorokoro catchment and Mt. Korobaba area share similar attributes of the Waimanu River catchment (especially the upper catchment) where the creek elevation begins at around 40 m above sea level and progresses to around 210 m with some high peaks of up to 700 m. These physical attributes together with similar high rainfall and mean annual temperature would, in all likelihood, make these areas share similar floral composition (Tuiwawa 2021).

From the surveys in the locations mentioned, we can postulate that the plant diversity of the Waimanu catchment will be around 300 species (333 actual average) (Tuiwawa 2021). This is relatively high for Fiji, but it is not surprising as this is expected from an area that potentially has 3 out of the 9 vegetation types found in Fiji, and the Waimanu catchment is on southeast Viti Levu, an area known for its high plant diversity (Tuiwawa 2021).

Already, a total of 344 taxa have been reported, predominantly native species (IAS 2009), of which there are 261 angiosperms, 75 ferns and fern allies, and eight gymnosperms. The highest number of plant taxa recorded has been at Wainavadu with 291 taxa made up of 232 angiosperms, 51 ferns and eight gymnosperms. Waisoi recorded the second highest with 263 taxa made up of 209 angiosperms, 46 ferns and 8 gymnosperms. Tuiwawa (1999) recorded 467 taxa in Waisoi over a three-year study. Kirkpatrick and Hassel (1985) documented 310 vascular plant species on Mt Korobaba (Tuiwawa 2021).

Focus species

From these previous surveys, a total of 23 "focus" taxa have been identified as species of conservation concern used as indicators that tells us the status of the area. Of these, 18 species are listed as being protected under the Convention on International Trade in Endangered Species (CITES), and the amended Fiji Endangered and Protected Species Act. For CITES the Orchids are collectively treated and as noted from Table 3 this includes twelve species. The other species are mostly IUCN red listed and those recorded in Tuiwawa (1999) as rare and threatened species based on the review of Smith's (1979–1991) work.

The focus taxa recorded were:

- The palm, *Balaka macrocarpa*, that was observed in 2009 was thought to be the same species observed in the upper Wainavadu area. This palm happens to be now like the newly described *B. diffusa*, thus, from now will be referred to as *Balaka cf. diffusa*.
- *Podocarpus affinis* was observed in Waisoi and the upper Wainavadu catchment and elsewhere outside of the Namosi province where similar habitats in the upland vegetation were found. *P. affinis* is also found in the cloud forest and is locally common and widespread.
- *Schefflera euthytricha* and *Elaeocarpus chionanthus* appear to be also present in the intact headwaters and slope forests of the upper Wainavadu survey site. Both were sterile, thus, their identification was not conclusive. Their presence in the lowland forest elsewhere is well established.
- *Lycopodium serratum* was recorded in the upland vegetation of upper Wainavadu and Waisoi. This epiphytic herb is locally common and favours areas that are very wet.
- *Freycinetia vitiensis* is a creeping Pandanus species and is restricted to high altitude habitats in the Upper Wainavadu and Waisoi areas. It is uncommon.
- Aglaia archboldiana is a subcanopy tree and is relatively common in the upper Wainavadu catchment.
- *Physokentia rosea* is a subcanopy palm recorded along creekflats and slopes in lowland vegetation in the upper Wainavadu catchment. It is uncommon.

Five species of the tree ferns in the genus *Cyathea* were observed:

- *Cyathea lunulata* is the largest of all the tree ferns in Fiji. It is the most common and widespread tree fern in secondary forest and open forested areas where it can be the dominant tree species. It can be found in lowland to upland vegetation types.
- *Cyathea propinqua* is another very common and widespread subcanopy tree fern. It can be found in both lowland and upland vegetation especially in secondary forest. It was the most common tree fern in some plots at Wainavadu.
- *Cyathea hornei* is another very common subcanopy tree fern that is found in all forest types in lowland and upland vegetation types. It is the most common tree fern in some plots at Waisoi.
- *Cyathea alta* is another subcanopy tree fern species recorded from the upland forest of Wainavadu and Waisoi. It is not as common and widespread in the surveyed area compared to the above three *Cyathea* species.
- *Cyathea decurrens* is a subcanopy tree fern common along forest margins and is relatively widespread in the low and upland vegetation.

Clinostigma exorrhizum was noted on the south slope of Mt. Naitaradamu and is the largest stand of this palm observed anywhere in Fiji. The species also occurs in Waisoi in its natural higher elevation habitat and surprisingly, at lower elevation of around 300 m.

A summary of the annotated list of plants that are "**Highly Likely**" to be found in the intact Waimanu Catchment is provided in Annex 1.

The discovery of populations of several endemic palms – *Balaka cf. diffusa, Clinostigma exorrhizum, Physoketia rosea, Balaka microcarpa* and *Gulubia macrocarpa*, in the surveyed catchments is important; more so as they are all IUCN Red Listed (1998). *Veitchia vitiense* and *Balaka longirostris* are not documented as an endangered species in the survey report because they are the most common and widespread species of native palm on Viti Levu. The study area could potentially be a biodiversity hotspot for native palms for Fiji.

Although not positively identified due to the absence of diagnostic flowers, it is assumed that *Schefflera euthytricha* and *Elaeocaprus chionanthus* are most likely to be present in the study area given the availability of habitats preferred by these species.

The Wainavadu area, together with the Sovi Basin, is of considerable botanical and vegetation interest being amongst the last remaining areas of lowland primary forest for Fiji. It is a rare system, and this survey has added considerably to our previous state of knowledge. Some of the largest trees ever encountered in Fiji's forest were seen by the author during the survey (Tuiwawa 2021). An endemic tree, white wood, *Endospermum macrophyllum* (kauvula), with a diameter at breast height (dbh) of 180 cm and height of more than 30 m was seen on this survey (upper Wainavadu Creek). Such tree size is a rare find in Fiji's forest. Stands of very large loggable trees were observed in flat areas between slopes and ridges and this included *Calophyllum* spp., *Myristica* spp. and *Agathis* spp. trees with average dbh of around 80 cm.

Areas at the base of the Korobasabasaga Range (which are headwaters of the Waisoi and Wainavadu rivers) are areas of high endemism and hot spots for some focus species and rare plants (Tuiwawa 1999). A botanical field survey in the area (Tuiwawa 1999) recorded four focus species and a cloud forest at an elevation of 750 m. These four species were *Tmesipteris truncata, Lycopodium serratum, Acmopyle sahniana* and *Podocarpus affinis*. Other species of botanical interest (rarity and restrictiveness to cloud forest) found in the cloud forest, include the ferns *Cyathea affinis* and *Dennstaedtia flaccida*; and the palms *Clinostigma exorrhizum* and *Calophyllum amblyphyllum*. With the exception of *Tmesipteris truncata*, all the other plant species are endemic. An interesting feature about this cloud forest system is its very rich cryptogam flora, the vegetation is always "wet" and there is a very thick layer of partially decayed organic matter on the ground.

2.2.2 Avifauna

Fiji has a total of 57 breeding land bird species, 27 of which are endemic and 11 are introduced species. Viti Levu has a total of 43 land birds of which 17 are endemic to Fiji (Watling 2001). Of the 43 Viti Levu species, 34 are forest birds, three are non-forest and six are introduced species. On Viti Levu, the globally threatened birds of Fiji include the red-throated lorikeet (Critically Endangered), long-legged warbler (Endangered), pink-billed parrotfinch (Vulnerable), friendly ground dove (Vulnerable) and black-faced shrikebill (Vulnerable) (Masibalavu and Dutson 2006).

The Waimanu catchment is part of the Viti Levu's Southern Highlands Important Bird Area (IBA). The Viti Levu Southern Highlands supports all of Viti Levu's threatened and endemic birds, including long-legged warbler (EN) and pink-billed parrotfinches (VU) (Masibalavu and Dutson 2006). The bird survey within and around the Waimanu catchment recorded a total of 41 bird species, missing only two species – the critically endangered red throated lorikeet and the introduced Java sparrow.

Initial bird surveys in 2003 recorded a total of 34 species of which 16 were endemic species and no sightings of any introduced bird species were recorded (Masibalavu pers.com. Annex 2). The absence of introduced bird species indicated the pristine nature of the upper Waimanu catchment. Upon observation, logging activities only covered the Waidina side of the ridge while the Waimanu catchment area is still intact and pristine. The area surveyed was the forest between Waiqanake creek and the Waimanu River (Masibalavu 2021).

Figure 7: Viti Levu pink-billed parrotfinch (vulnerable on IUCN Red List)

Prior to 2003, another bird survey was conducted in 2002 within the Waivaka catchment area. The total number of species recorded was also 34, but there were no sightings of the long-legged warbler, which was thought to be replaced by two introduced species, the red-vented bulbul and the mynah. At the time of the 2002 survey, a mining company was noted to be prospecting at the survey site with significant environmental damages in most parts. It is believed that alien invasive species such as the red-vented bulbul and mynah may have followed the access road into the Waivaka catchment prospecting site (Masibalavu 2021 Annex 2).

Additional avifauna survey sites in the Waimanu catchment include Wainikatama, Korobaba and Savura. These sites are accessed frequently due to proximity and accessibility to road transport. Records show the number of introduced species increased slightly in these easily accessible sites with notable presence of mongoose and rats. Nevertheless, the overall status of birds within these areas is currently in good condition (Masibalavu 2021).

2.2.3 Freshwater Fish

The turn of the twenty first century resulted in an increased knowledge on the riverine ichthyofauna of Fiji (Boseto 2006, Boseto and Jenkins 2006, Copeland 2013, Jenkins et al. 2010, Jenkins and Jupiter 2011, Lin et al. 2017). About 98% of the documented riverine fishes are diadromous species that migrate between freshwater and marine environments (Jenkins et al. 2010). Close to 170 species were recorded by Boseto and Jenkins (2006) in their riverine checklist of the Fiji archipelago. The bulk of freshwater fish studies in the early 2000s was conducted under the Pacific-Asia Biodiversity Transect (PABITRA) on Viti Levu. Fish surveys were carried out on three focal sites along this longitudinal transect (Savura catchment, Sovi Basin and Wabu reserve). A total of 21 fish species was documented across these three sites and only two goby species considered endemic to the Fiji Islands (*Shistmatogobius vitiensis* and *Redigobius leveri*) were recorded (Copeland et al. 2016). Work by the Institute of Applied Sciences as part of proposed infrastructure assessments has also documented additional species compared to the early PABITRA research. The bullshark *Carcharhinus leucas* and mangrove jack *Lutjanus argentimaculatus* are known to penetrate the Waimanu catchment. An undescribed pipefish from the family Syngnathidae has also been documented in the northern neighbouring Waidina and Sovi River catchment. Preliminary morphology work by Copeland (2013) cannot place it into a known genus due to the absence of ridges that characterise the different genera in the family Syngnathidae (Copeland 2013). The largest endemic riverine fishes in the South Pacific *Mesopristes kneri* (Figure 8) has also been observed in the lower reaches of the Waimanu River at the Waila Water Intake Plant. This endemic diadromous species has been caught in the Waidina River near Navurevure village (Copeland pers. com.).

Figure 8: Endemic *Mesopristes kneri (Photo courtesy Kinikoto Mailautoka)*

Work done in Colo-i-Suva Forest Park by Tuiwawa et al. (2018) documented a goby (*Awaous guamensis*) and eel (*Anguilla marmorata*). The *Anguillidae* family is ubiquitous throughout catchments on Viti Levu (Copeland 2013). There are three species of eels found in Fiji (Copeland 2016) and a longitudinal pattern of distribution has been observed within this family. It is most likely that *Anguilla obscura* (Figure 9) will be found in the lower-reaches of the Waimanu catchment, while *A. marmorata* (Figure 9) will be found in the mid-reaches and the more cryptic and rarer of the three, *A. megastoma*, found in the headwaters of Waimanu catchment.

Figure 9: Species of *Anguilla obscura* and *Anguilla marmorata*

Introduced freshwater fish species are also present in the Waimanu catchment. According to Jenkins et al. (2010) about 10 species have become established in several riverine networks in Fiji. The introduced tilapia *Oreochromis niloticus* and *O. mossambicus* and grass carp (*Ctenopharyngodon idella* and *Barbonymus gonionotus*) are important protein sources for remote communities in the interior of Viti Levu and Vanua Levu. The Nile tilapia *O. niloticus* has been able to establish feral populations in the mid to upper reaches of the Sovi catchment. It is likely that this species is also present in mid to upper reaches of the Waimanu catchment.

2.2.4 Freshwater Benthic Macroinvertebrates (BMI)

Fijian freshwater benthic macroinvertebrates (BMI) comprise 61 families with over 200 species predicted, many of which have not been described (Haynes 2009, Haynes and Rashni 2016, Mangubhai et al. 2019, Zielske and Haase 2014). Taxa endemic to Fiji include the naiads of damselflies of the endemic genus Nesobasis; the aquatic gastropods *Acochlidium fijiense*, *Fijidoma maculata* and all 28 species of spring snails of the genus *Fluviopupa*; a leaf-case caddis *Anisocentropus fijianus*; net-building caddis *Abacaria fijiana* and *A. ruficeps*; loose case caddis *Goera fijiana*; the purse-case micro-caddis *Oxyethira vitiensis*; and the polychaete worm *Namalycastis vuwaensis* (Choy 1984, Choy 1991, Donnelly 1990, Haase et al. 2006, Haynes 2009, Haynes and Kenchington 1991, Ryan 1980). Of these, it is highly certain that *Nesobasis* spp., *Fluviopupa* spp., *Abacaria ruficeps*, *Goera fijiana* are present in the intact forested upper catchment of Waimanu River. These taxa are known to be associated with primary rainforest systems in the PABITRA transect of Fiji and have been recorded from Savura Creek, Waiqanake Creek, Waivaka Creek, Waidina River and Sovi river systems (Rashni 2021b). Given the connected systems of all sub-catchments in Waimanu Catchment, it is estimated that over 56 distinct BMI taxa within 45 families are represented. This represents 74% of freshwater BMI families recorded for Fiji to date, which is quite high for a total catchment area of 191 km^2.

BMI taxa such as neritid gastropods, prawn and shrimps are diadromous and have swimming larvae that are washed out to sea and may be carried from island to island before settling at the mouths of rivers and streams. Continuous connectivity of the target catchment to Rewa River system will be important to ensure long term survival of these diadromous species. The euryhaline crab *Varuna litterata* (herring bow crab) has been recorded in the lower reaches of the Sovi River and lower reaches of Rewa River. *Varuna litterata* is a diadromous species that develops in the marine environment and migrates upstream into freshwater ecosystems to mature to the adult life stage. Five species of Palaemonid prawns (*Macrobrachium spp.*) recorded from upper Waidina, Wainioka Creek and Sovi River include *Macrobrachium lar, M. placidulum, M. australe, M. latidactylus,* and *M. sophroneium* (Golder Associates 2011).

Figure 10: *Melanoides tuberculata* assemblage on a quiet stream channel

The Malaysian trumpet snail (*Melanoides tuberculata*) (Figure 10) is the only known introduced BMI species possibly present in the waterways of interest as it has been recorded in the connected systems, especially in the systems adjacent to the inhabited areas of a catchment in south-east Viti Levu.

Freshwater BMI species (Figure 11: a-e) are important sources of protein and contribute to food security of the local riverine communities. These BMI species include: (i) freshwater clam (*Batissa violacea*)/Kai with a local market value of (price as per year 2020) FJD5/heap; (ii) freshwater prawns (*Macrobrachium spp.*) with a local market value of (price as per year 2020) FJFD20–FJD25/heap; and (iii) freshwater gastropods harvested for household consumption (Figure 11: f-g). Water affinity plants such as water cress (*Nasturtium officinale*) with a local market value of FJD2–FJD3/bundle and Ota (*Diplazium esculentum*) (FJD2–FJD3/bundle are regarded as one of the Fijian common delicacies and are grown alongside rivers and waterways in parts of Fiji, including Waimanu, as they require moist soil (Rashni pers. comms.).

Figure 11: Freshwater BMI species – provisioning services

Freshwater BMI taxa of highest conservation concern are the endemic (*Nesobasis*) and near endemic genus (*Melanesobasis*) of damselflies and the spring snail micro-gastropods, Fluviopupa, all of which are highly likely to be present in the upper intact forest systems of the Waimanu catchment with high degree of possibility to host new species to science and new records for Fiji. Freshwater spring snails or Rissoodean snails belong to the family Tateidae (former family Hydrobiidae) with a single genus, Fluviopupa, present in the Melanesian archipelago (Haase et al. 2010, Haase et al. 2006). Fiji holds a record of 28 endemic Fluviopupa species, the majority of these are endemics (Zielske and Haase 2014, Zielske et al. 2017). There is no known record of the spring snails in the Waimanu catchment boundary, but they are highly likely to be present in the upper reaches of intact forest systems. The Fluviopupa spring snails are known to evolve in the headwaters of catchments and are usually catchment endemic and area endemics. Coenagrionidae is a family of damselflies widely distributed in Melanesia, and Fiji has its endemic genus, *Nesobasis*, with 21 aerial adult species and near endemic *Melanesobasis* with seven aerial adult species. The juvenile stages (aquatic nymphs) prefer excellent water quality and stable sequences of aquatic micro-habitats in swift, partially shady streams draining undisturbed forest systems (Marinov and Waqa-Sakiti 2013).

2.2.5 Aquatic Flora

Periphyton (assemblage of algae including diatoms): Periphyton provides an important source of food for invertebrate grazers. A total of 17 taxa has been recorded from Wainikoroiluva, Waivaka, Wainioka and Wainikovu systems. The periphyton communities recorded from stony streambed sites were dominated by thin algal films, namely, single-celled Chlorophyta and Bacillariophyta (diatoms), and it is these thin algal film taxa that are likely to provide a significant food resource and shape macroinvertebrate community composition in Waimanu catchment (i.e. high proportion of scraper/grazers) (Rashni 2021b). Examination of the stomach and digestive gland of the grazing gastropod *Fijidoma maculata* living in the Wainibuka River showed they contained diatoms, *Chlorella, Characium* and unicellular and filamentous Cyanobacteria (Haynes 1988).

Periphyton communities growing on stable cobble substrates in running water and riffle habitats were made up by uni-celled Bacillariophyta (e.g., *Synedra, Navicula, Gyrosigma, Pinnularia* and *Meridian*), unbranched filamentous Bacillariophyta (e.g. *Diatoma, Tabellaria* and *Melosira*), Chlorophyta (e.g., *Chlorella, Characium, Microspora Hyalotheca, Mougeotia* and *Spirogyra*) and Cyanobacteria (e.g., *Rivularia, Anabaena* and *Oscillatoria*). Uni-celled Chlorophyta including *Chlorella, Characium* and Microspora, and single-celled diatoms *Navicula* and *Synedra* were the most widely distributed and abundant periphyton taxa recorded across stony streambed sites. These uni-celled taxa were most likely to represent the main component of thin periphyton films recorded as being most abundant at stony streambed sites. The highest abundance of filamentous *Spirogyra* and *Rivularia* represented the filamentous green algae coverage (Figure 12: a, b & e) in these systems (Rashni 2021b).

Macrophytes: A few aquatic macrophytes have been recorded within the connected catchments due to habitat constraints (i.e., turbulent and stony streambeds). The exotic submerged species *Potamogeton crispus* (curly pond weed) (Figure 12:c) was recorded in the lower Waidina River where lowland river characteristics at this site (i.e., sluggish flow and gravel/sand streambed), and good water clarity, provide conditions which are more conducive to plant establishment and survival. Frequent beds of the ribbon weed (*Hydrilla verticillata* (Figure 12:g) and the introduced water hyacinth (*Eichhornia crassipes*) (Figure 12: d) were recorded across the waterways of Wainikoroiluva, lower Wainikovu Creek and Rewa River. The channel margins (edge) supported small Hydrilla beds where habitat is characterised by sluggish flow. Bank support coupled with gravel/sand/silt streambed substrates, allows the roots to establish. *Eichhornia crassipes* and a species of charophyte green algae/stonewort (*Chara sp.*) (Figure 12:f) have been recorded from Waivaka Creek (Figure 12:h). Water hyacinths (*Eichhornia crassipes*) rooted firmly (bulbous structure fallen off) were observed along channel margins at Waidina and Waivaka systems (Figure 12:h). None of the discussed macrophyte species are yet known to be a pest in these systems (Rashni 2021b).

Plankton: A total of 37 planktonic taxa was recorded; 10 zooplankton and 27 phytoplankton have been recorded from Wainikoroiluva, Waivaka and Wainikovu systems. Freshwater zooplankton is typically rare in well-shaded fast flowing waterways as planktonic organisms are washed downstream before they have a chance to complete their life cycles and, if the catchment is subjected to regular naturally occurring flash floods, it prevents planktonic fauna from establishing populations in the water column. The most frequently recorded zooplankton taxa across these creeks were baetid mayfly (Pseudocloeon) and chironomids (non-biting midge) of sub-family chironominae. Zooplankton taxa that were rare (single site) included ostracoda, empididae (dance

fly), *Hydropedecticus vitiensis* (hydrophilous cricket) and pyralidae (aquatic moth). Amphipod and ostracod taxa were only recorded from Wainikovu Creek probably due to it being a tributary to Navua River, which provides tidal influence that may support upstream migration of these taxa (Rashni 2021b).

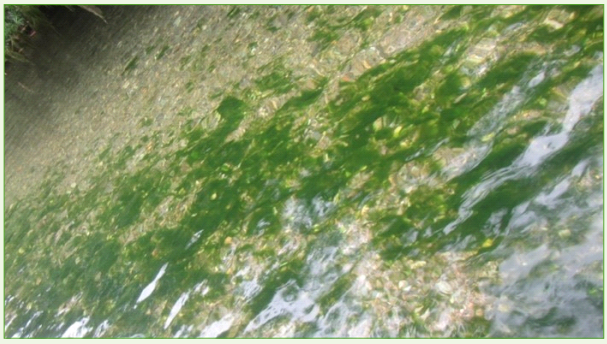
Freshwater Flora

a) Filamentous green algae in the Wainioka creek

b) Filamentous green algae in the Waivaka Creek

c) Curly pond weed (Potamogeton crispus) bed in lower Waidina River

d) Water hyacinth in the lower Rewa River



e) Filamentous green algae in Wainikovu creek

f) Chara in Waivaka Creek

g) Hydrilla in Wainikoroiluva Creek

h) Water hyacinth in Waivaka Creek

Figure 12: Aquatic Flora

2.3 Land Use Changes

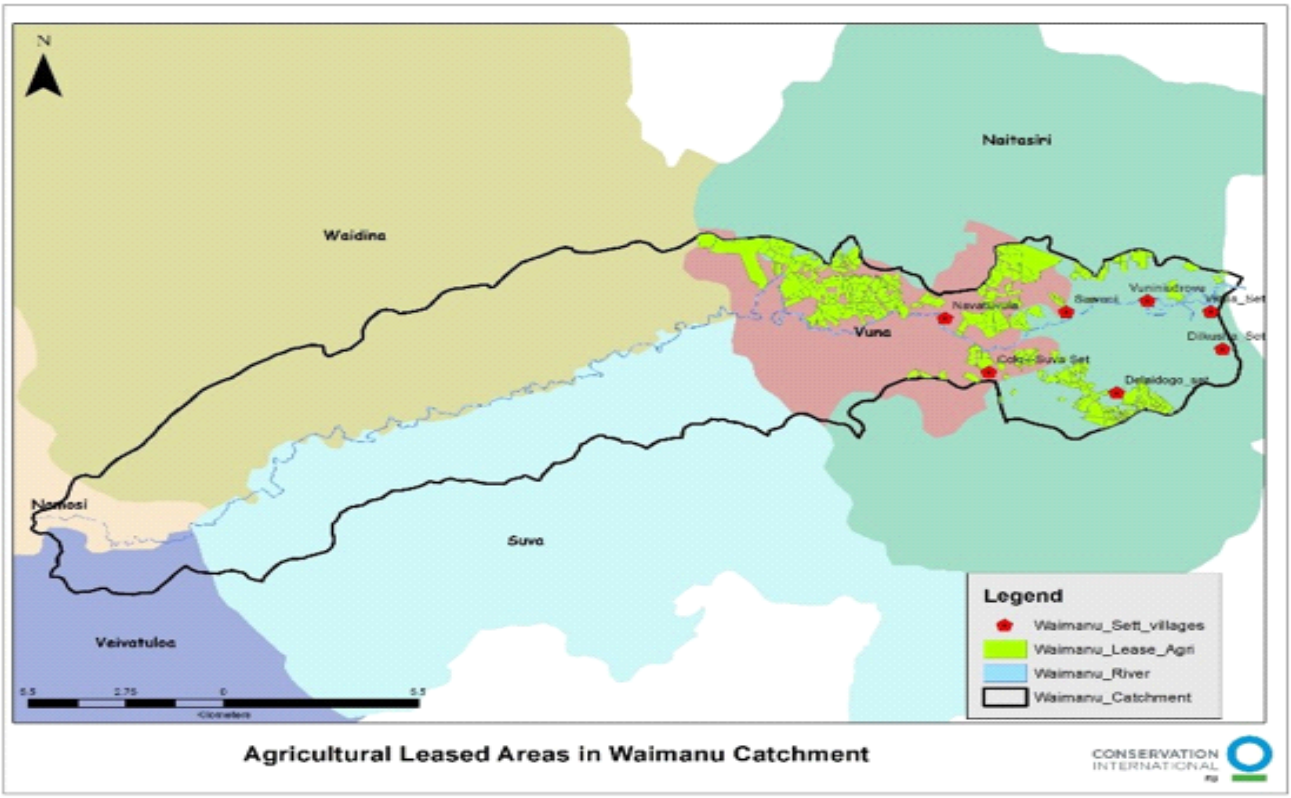


Figure 13: Extent of Agriculture Lease in Waimanu catchment

The lower reaches of the Waimanu catchment are populated with many land-tenants. There is an estimated total of 665 land tenants with lease types ranging from Agricultural, Residential, Forestry, Educational, Tourism, Commercial, Government Stations, Water Mineral and Others [Religious, Access Way, Way Leave]. Significant surrounding vegetation has been removed for agricultural purposes, while scattered pockets of African tulip, guava, coconut and rain trees are found along the riverbank (E-Care Environment Consultants 2010). The alluvium soils on the floodplains and valley adjoining the Waimanu River support all kinds of subsistence agriculture, including vegetables (cabbage, tomato, lettuce), cash crops (cabbage, tomato, lettuce, ginger, yaqona), root crops (cassava, dalo), and cattle breeding.

One major farming activity in the catchment is ginger cultivation, which requires the clearing of all vegetation during land preparation and harvesting (Nainoca 1998). The agricultural expansion in catchments has led to forest cover reductions in Fiji. For instance, at lower altitude, land is easily converted for agriculture or forestry (Rashni 2014). Forest cover loss may lead to increase in sediment load and alteration in nutrient cycling due to excess nutrient input, which may result in alteration in channel hydrology of the riverine network, and in turn, may alter streambed conditions that influence the macroinvertebrate community structure (Rashni 2021).

3 Ecosystem Goods and Services

3.1 Ecosystem Services

Ecosystem goods and services concepts can offer a valuable approach for linking humans and nature, supporting arguments for the conservation and restoration of natural ecosystems. Ecosystem goods and services is often considered through the lens of provisioning, regulating and cultural aspects.

Using the lens of goods and services to assess what ecosystems can provide to maximise benefits for human wellbeing enables better appreciation of the intrinsic relationships of ecosystem services – nutrient cycling, soil formation and primary production, and of the processes of ecosystem services through provision, regulating and cultural aspects. Assessment commonly considers key ecosystem services and identifies the drivers, pressure, state, impact as well as response (DPSIR) mechanism that will reduce the pressure while improving management (Haines-Young and Potschin 2010).

Considering DPSIR alone simplifies the complex interaction of negative interaction and responses that exists between different activities, economic and social mechanisms (refer Figure 14) (Rounsevell et al. 2010). Valuation of potential positive impacts on the above would thus provide opportunities to assess trade-off and select the most suitable response strategy (Figure 14). Integrating ecosystem services and impact on human wellbeing with DPSIR ensures a more holistic approach (Haines-Young and Potschin 2010, Kelble et al. 2013).

Various assessments for ecosystem services are recognised, including the Millennium Ecosystem Assessment (MEA 2005) and the Economics of Ecosystem and Biodiversity (TEEB 2010), which are carried out at national level. Other assessments analyse ecosystem services by typology of ecosystems (Maes et al. 2016). Braumann et al. (2007) used the concept of "hydrologic ecosystem services" where each hydrological service is characterised by attributes of quantity, quality, location and timing to define the benefits people accrue from terrestrial ecosystems. Guswa et al. (2014) linked hydrological modelling and ecosystem services relevant to river basin management. Delegates at the 2014 World Parks Congress identified key issues that can maximise contribution of forest protected areas to water services including: (1) knowledge and capacity building; (2) valuation; (3) policy framework; (4) pricing policy; (5) water security; (6) partnership; and (7) learning lessons learnt from successful catchment management (Dudley et al. 2016).

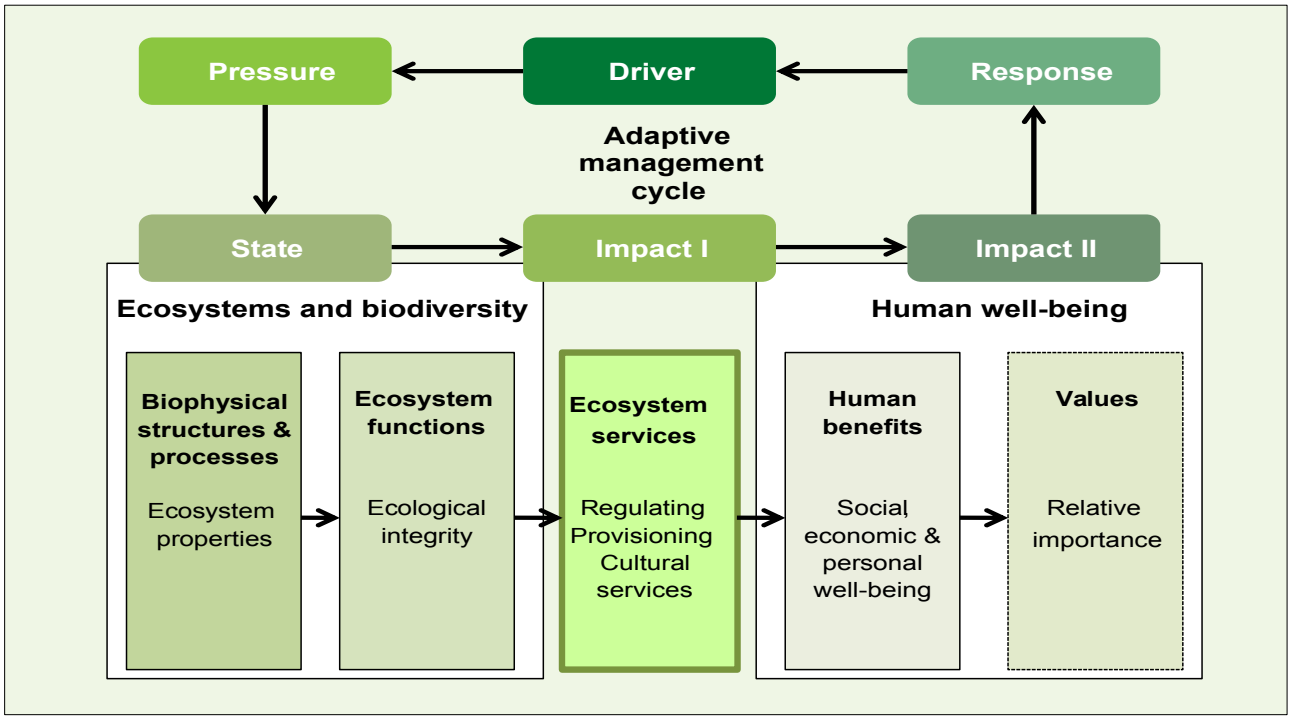


Figure 14: Integrated Framework for Ecosystem Service Provision (Haines-Young and Potschin 2010)

3.2 Freshwater Health Index

Assessment of the Ecosystem Goods and Services is approached from an analysis of the level of threats using the Freshwater Health Index (FHI). The FHI aims to transparently assess trade-offs in the driver, response state and impact (Figure 13) in a rigorous manner. It provides a tool that can diagnose how social, hydrological and ecological systems interact to provide critical ecosystem services. The FHI is a web-based tool that measures system health by making clear connections between freshwater ecosystems, the benefits they provide to people, and the governance system in place (Vollmer et al. 2018). There are three main components to the freshwater health index: (1) ecosystem vitality; (2) ecosystem services; and (3) governance and stakeholder. Each of these components is assessed and synthesised with a suite of measurable indicators that are aggregated into an index developed by Conservation International to provide simplified and better understanding of the interface between habitat protection, ecosystem services and human development.

The FHI is based on a framework that accounts for the interactions between the ecosystem, the services it provides to people, and the water governance and management systems in place in a basin. It allows resource managers, engineers, policymakers, and other interested stakeholders to transform data into commonly scaled indicators (on a 0–100 scale), providing a baseline diagnosis of a basin's health, as well as a platform for analysing changes over time. Users can evaluate scenarios, understand trade-offs, prioritise interventions, and communicate about basin health with a broad audience. **The FHI does not estimate the value of ecosystem services but provides decision-support through a set of indicators that transparently assesses the health of freshwater systems in their ecological and social dimensions.** Built on the best available science, the indicators and measurement protocols quantify and map the multiple benefits that freshwater naturally provides. The FHI identifies 11 key indicators of a healthy freshwater ecosystem. Their relative importance may vary from basin to basin, but together these indicators enable people and communities to survive and thrive.

In the Waimanu catchment, a rapid survey was undertaken virtually, where we captured perceptions on ecosystem services and governance and stakeholders. Seven indicators of the health of the Waimanu catchment were assessed. We were not able to undertake detailed analysis of ecosystem vitality and its four indicators due to insufficient data on water quality, water quantity, basin condition and biodiversity. Information on water quality and quantity was requested from WAF and the Ministry of Waterways, with no response. Basin condition and biodiversity indicators needed field assessments, which were not possible during COVID-19 restrictions. The assessment of the seven indicators indicates the relative importance of each issue to ensure health of the catchment. By way of priority, the results of the FHI indicate ecosystem services to be most important, while priority for sub-indicators (highest to lowest) include Provisioning, Regulation & Support, Cultural, Enabling environment, Stakeholder engagement, Vision & Adaptive governance, and Effectiveness.

4 Governance and Stakeholders

4.1 Governance

There are two governance systems in place, formal and informal.

The formal governance structure can be considered in two layers: the various government ministries that regulate policies and laws, and the statutory agencies operating in the Waimanu catchment, which are quasi-government organisations mandated by specific laws such as WAF and iTaukei Lands Trust Board. In the Waimanu catchment area (as in surrounding areas) the two layers are governed by the Head Administrator of the Central Division, which is the Commissioner Central at the Ministry of Rural and Maritime Development and Disaster.

Informal governance includes the application of traditional, cultural and religious norms observed by communities living in the Waimanu catchment. Given the predominant rural setting of the Waimanu catchment, focus of the assessment is on traditional governance. Nevertheless, with a large community of land tenants at the lower reaches of the catchment, cultural and religious leadership are equally important. To the indigenous communities within the Waimanu catchment, the Vanua is the cumulative association of a group of people with similar identity.

The iTaukei governance structure consists of several layers of hierarchy. At the broadest level, are the Confederacy, Provinces and Districts. Each District has a chiefly village. Within each village, there are clans or mataqali where each clan plays a specific role as outlined in Figure 15. A large village may have all seven mataqali while a small village may only have the critical clans.

In the context of the traditional organisational structure of the Fijian society, the Waimanu catchment falls under the Kubuna Confederacy consisting of the Province of Naitasiri and Namosi, while a small portion in the northern reaches of the catchment belongs to the people of Rewa Province under the Burebasaga Confederacy.

Figure 15: Structure of the iTaukei Governance at Community Level

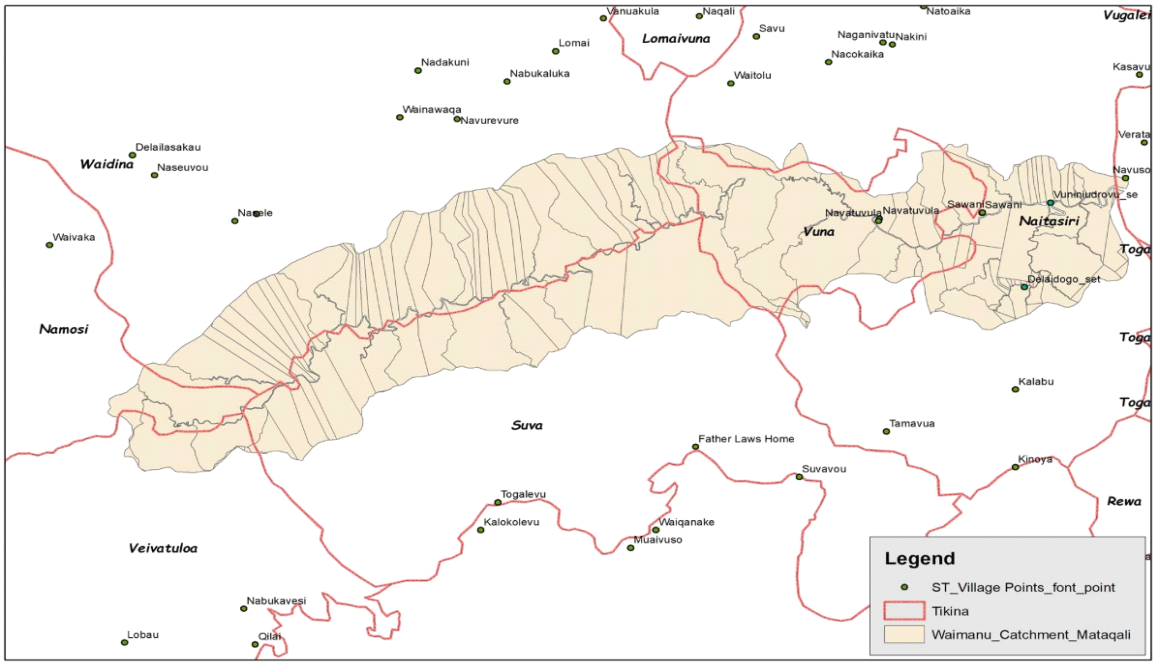
At the provincial level, the district of Naitasiri are the traditional chiefs of Naitasiri Province. The chiefly village is the village of Navuso (outside the Waimanu catchment) with the chiefly title of Matanikutu na Turaga na Qaranivalu. Vuniniudrovu, which is part of Naitasiri district and the Waimanu catchment, is listed as the fourth out of twelve villages in the leadership hierarchy. Waitolu village, also part of the Naitasiri district, does not fall within the catchment area but hosts landowners who are direct stakeholders of the Waimanu catchment. Vuna district is the second chiefly district under the title of Roko Tui Vuna na Vunivalu. The village of Sawani is the chiefly village of Vuna district. Other villages in Vuna district include ColoiSuva and Navatuvula.

Each district, village and clan has a place in society, which dictates their contribution to the decision making process (see Figure 15).

4.2 Stakeholders

Data from a number of sources provided the opportunity to collate information about stakeholders in the Waimanu catchment as outlined in Table 1. These data sources include lease information with the iTaukei Lands Trust Board, village profile from the Ministry of iTaukei Affairs, and the Native Lands Commission mataqali/clan boundary.

There are many stakeholders in the Waimanu catchment including Government and quasi government bodies, traditional communities, and land tenants. There is an estimated total of 122 landowning units within the Waimanu catchment distributed over six Districts under three Provinces. Districts in the Waimanu Catchment include Vuna, Waidina, Naitasiri (in Naitasiri Province), Suva (Rewa Province), Namosi and Veivatuloa (Namosi Province).



WAIMANU CATCHMENT OVERLAY WITH MATAQALI LAYER AND DISTRICT LAYER

Figure 16: Map showing boundaries of clan (mataqali) land in Waimanu catchment (*Source: Conservation International, Fiji*)

Table 1: Stakeholders in Waimanu Catchment

District Name	Total Area in District (Ha)	Total Area in Waimanu catchment (Ha)	Numberof Mataqali in Waimanu catchment (LOU)	Number of Leases in Waimanu catchment-	Total Area under lease in Waimanu catchment (Ha)
Naitasiri	21,472.82	3,348.69	56.00	363 leases mainly Agricultural, Residential, Forestry, Educational, Tourism, Commercial, Government Stations, Water Mineral, Others [Religious, Access Way, Way Leave]	1,105.01
Vuna	4,702.85	3,998.44	23.00	299 Leases mainly Agricultural, Residential, Forestry, Educational, Tourism, Commercial, Industrial, Government Stations, Water Mineral, Others [Religious, Access Way, Way Leave]	1,812.75
Waidina	46,408.93	6,360.76	50.00	None	None
Veivatuloa	16,274.91	653.15	7.00	None	None
Suva	18,008.30	4,786.95	46.00	3 leases;1 from Government and 2 are to be confirmed by TLTB	83.94
TOTAL		**19,148**	**182**	**665**	**3,002**

Lease tenants also constitute critical stakeholders in the Waimanu Catchment. An estimated 700 lease holders are concentrated at the lower reaches of the Waimanu catchment. The majority of the area is leased for Agriculture, Residential, Forestry, Educational, Tourism, Commercial, Government Stations, Water Mineral, Other [Religious, Access Way, Way Leave].

There is an estimated total of 500 farmers along the Waimanu catchment with lease area ranging from 0.05 ha to 1500 ha. Most of the farms are subsistence farmers, with less than 5% being commercial farms. The distribution of farms along the catchment shows that the most common farming activity is subsistence.

There are at least seven extraction developments conducted along the Waimanu and Rewa rivers, including two river gravel extractions, while five similar operations of extraction/dredging for gravel and sand are located along the Rewa River.

4.3 Policy, Law and Regulation

Fiji's legislation regarding water is fragmented and, in most parts, outdated. Whilst Fiji has associated parts of legislation, there is none that is specific to treatment of water as a proprietary resource other than regulating the management and control for public use and access. Ownership, therefore, can be traced through implications of early common law developments under the British colony – (Fiji being a British colony with common law origin) to water rights. Given the transcendent nature of water, rights to water have been widely defined as a right to use or to enjoy the flowing water in a stream, and it may emerge from a person's ownership of land on the banks of the stream (riparian ownership) or from a person's actual use of the stream. Furthermore, it is common that water may be administered and controlled through a government agency for access and use by the general commons (Scott and Coustan 1995). However, ownership of land under rivers and streams is clearly defined and vests to the State as per Fiji's Rivers and Streams Act [Chap 136], sections 2 and 5.

In the context of water ownership, considerations may be needed to whether there are marked inconsistencies between the common law principles and the customary laws. Both customary and common riparian water rights in Fiji have striking similarities in that; (i) the ownership of riparian land is the basis of acquiring water rights in both instances; (ii) the lower riparian equally entitled as the upper riparian to the natural flow of water in its natural state and quality; and (iii) in a navigable water course, the right of navigation of all people, including non-riparian is acknowledged and guaranteed. A closer examination of Fiji's Rivers and Streams Act [Chap 136], indicates the presence of the above considerations. It is therefore safe to assume that this consistency may help in reviewing proper application considerations of any water rights regime with socio-economic implications for sustainable use and management of water as a resource within the greater Waimanu catchment systems.

Overall, rights to adequate water are guaranteed under section 36, Part 2, of Fiji's 2013 Constitution, towards progressive realisation of the right of every person to have clean and safe water in adequate quantities. In other pieces of legislation, water and management of water is mentioned under several guiding policies (Kumar 2010), laws and regulations discussed herein. These are better understood through linked interrogations under the categories of Water Resources, Environment and Land. Major policies, laws and regulations that have an impact on water catchment are highlighted in Annex 3.

As evidenced by the enumerated summary of laws and regulations (Annex 3), the absence of clear and specific protection of water catchment areas and its management results from lack of clear legislative arrangements (environmental policies), hence resulting in the absence of statutes with an express or implied environmental mandate. An identifiable pattern is that most of Fiji's existing laws associated with effective water management and environment protection are from an era where environment protection was of less emphasis. Overall, there is limited public engagement in the decision-making processes of the Rivers and Streams Act, a crucial element that is vital in the success and support of any environment related regime.

Fiji's commitment through latest policies and strategic outlooks provides direction and a framework for collaborative and integrated approach to catchment management (see Annex 3). The policies are also forward looking to support national development plans aided to some extent by Fiji's obligations to international Instruments with respect to conservation and sustainable development goals (Ministry of Waterways and Environment 2020). This, in turn, informs Fiji's national strategies and plans that will support effective management of natural resources, including water catchments.

5 Threats

5.1 Invasive Species

There have been no invasive species surveys conducted in the Waimanu catchment. Available information has been gleaned from surveys on the periphery of the catchment. Daigneault et al. (2013) conducted a study through household surveys on the impact of selected invasive species within 30 communities near the Waimanu catchment, and found the prevalence of African tulip (*Spathodea campanulata*). Other invasive species noted from the study include the presence of small Indian mongoose (*Herpestus javanicus*) and red-vented bulbul (*Pycnonotus cafer*). Several other invasive plant species noted by Watling (pers comm.) during several of his visits to the lower and mid catchment as part of WAF/ADB work includes the presence of broad-leaved mahogany (*Swietenia macrophylla*) and in the lower catchment, the presence of water hyacinth (*Eichhornia crassipes*) especially around the Waimanu pump area.

Environment impact assessment for the Namosi Hydro project in the Waivaka Creek (headwaters of the Waimanu catchment), found invasive weed species such as *Mimosa pudica, Clidemia hirta, Mikania micrantha, Piper aduncum* and *Spathodea campanulata* (GHD 2019). These species are notoriously known to proliferate rapidly, thus displacing local ecosystem species through invasion of forest gaps, preventing regeneration by tree seedlings and other plants.

5.2 Development

The Waimanu catchment is threatened by logging and, in places, by mining. Although the Ministry of Forestry has no records of issuing logging licenses to landowners in the Catchment, small-scale localised logging activities occur across the catchment, particularly to thin the low catchment area in association with development of leased lands. Associated threat from localised logging is the intrusion of invasive species in the clearing created. Opportunistic invasive alien species such as mongoose, black rats and introduced birds as well as African tulip trees are evident from the survey results.

Logging from the Waidina Tikina happened around 30–40 years ago. Some villages involved with logging include Nasirotu, Navurevure and Nabukaluka. Although these villages are located outside the Waimanu catchment, members of the village own land within the catchment boundary. Some of the logging roads associated with previous activities are still used by the community to access the Waimanu River for hunting and fishing. The potential for re-logging is a real possibility and it may pose a threat to the proposed Waimanu Catchment (Masibalavu pers. comms).

A consequence of this aquatic migration is that natural and man-made barriers can greatly affect these species. Deleterious activities such as over-hanging culverts, weirs and dams (Algera et al. 2020, Kocovsky et al. 2009) are known to greatly impact diadromous species. The impact of gravel extraction on Fijian fishes is poorly understood, but increased sedimentation and poor water quality due to these activities are known to affect aquatic fauna and flora (Brown et al., 1998).

The extent to which introduced aquatic species have travelled up the Waimanu catchment is unknown. Introduced tilapia species have been linked to species reductions in mid-reaches of the catchment (Jenkins et al., 2010). However, more detailed ecological studies need to be undertaken to better determine the interactive effects of native and introduced aquatic assemblages in our rivers. Due to the low productivity in our native riverine fish stock, introduced tilapia has been a significant important dietary protein supplement to rural inland communities (pers. obs.).

Dams and weirs impact the life cycles of amphidromous species that migrate between and saltwater habitats (Jenkins and Jupiter, 2011). Degradation in these habitats will impact local communities who are highly dependent on healthy water and ecosystems for food, livelihoods, and other ecosystem services (Jenkins et al. 2010). Considering the existing rural water supply schemes in the Waimanu catchment, Community Based River Monitoring (CBRM) (Rashni 2021a) is recommended to support livelihood dependence on clean water, food security, Climate Smart Agriculture (CSA) and continued harnessing of essential ecosystem services and, eventually, informed decision making for catchment management planning by the resource owners and relevant stakeholders.

5.3 Natural Disasters

Historical trend analysis indicates that between three and nine cyclones hit Fiji per decade with an average of two to four causing severe damage (Ilaitia 2018, Raj 2004). TC Winston was most powerful cyclone to have made landfall in Fiji following a strong 2014–2016 El Nino event. The restoration bill was FJD2.9 billion. The cost of damages and the loss of human lives indicate the magnitude of flood disasters encountered. Agricultural crops are damaged or lost completely; livestock are swept away by floodwaters. Damage to roads and bridges make access difficult if not inaccessible. Transport, not only to the markets, but also to schools for children and medical facilities for the injured and ill are affected (Raj 2004).

Records indicate the lower Waimanu catchment at high risk of flash floods. The hydrograph for the lower Waimanu taken over 32 hours during TC Martin in April 1986 is illustrated in Figure 17. The peak rainfall recorded is 225 mm with a peak water level 10.48 m above the mean sea level. Lag time between the catchment rainfall and increasing dam water level is approximately 6 – 8 hours. The shape of the rising limb of the hydrograph indicates catchment characteristics, shape and geology. The gradual falling limb indicates the catchment has medium drainage density while the presence of alluvium and unconsolidated soils allow water to infiltrate, acting as a store in a drainage basin. This indicates the tendency of the system to flash floods after heavy rain events (Singh 2017).

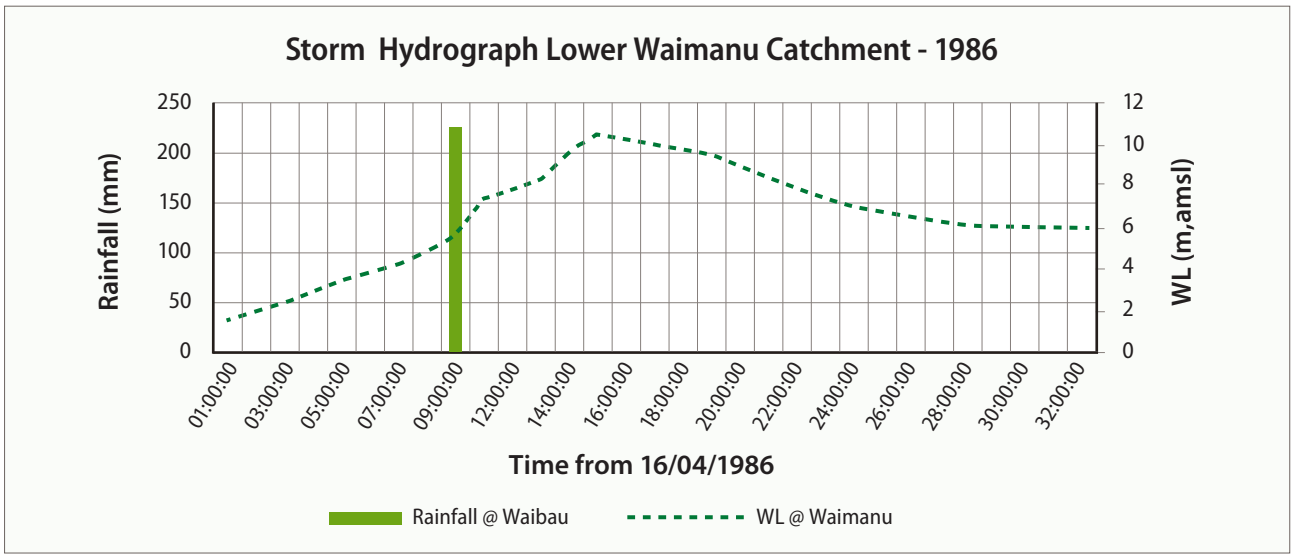


Figure 17: Trend in Water Level during Tropical Cyclone Martin 1986. (Source: Ministry of Waterways and Environment, 2019)

Flood management measures are restricted to identification of flooded areas and escape routes, identifying new evacuation centres, strengthening infrastructure, and improving techniques of forecasting. Cautious planning and improvement in land and water use, including the imposition of restrictions is necessary for integrated flood management. (Raj 2004). Although major climate-related events such as cyclones have led to many injuries and deaths, it is the indirect and diffuse effects of climate-sensitive health risks that are seen as of the highest priority in Fiji (Mclver et al. 2016). Four climate-sensitive diseases common in Fiji are dengue fever, typhoid fever, leptospirosis and diarrhoea (Mclver et al. 2012). Fiji tends to experience disease outbreaks following floods and/or cyclones (GoF 2017).

5.4 Policies

At the national level, there is no policy to protect freshwater wetlands in general, or those of national significance. Threats to rivers and catchments include alteration in flows for water supply or hydropower generation, gravel extraction, reduction in forest cover and water quality from poor land use practices, loss of riparian vegetation, invasive and introduced species (e.g., water hyacinth Eichhornia crassipes, tilapia *Oreochromis mossambica* and the freshwater malaysian trumpet snail *Melanoides tuberculata*), pollution and overexploitation (Haynes 1994, Haynes 1999).

Targeted policies will need to address key thematic threats for watershed, wetlands and freshwater systems and respond to drivers causing environmental, socio-economic as well as governance constraints. This report identifies key threats for the Waimanu catchment, which include invasive species, unregulated development, and natural disaster. Policy would thus focus on drivers causing infiltration of invasive species, measures to control and ensure compliance with acceptable standards for all socio-economic development in the catchment area as well as mitigation and adaptation hierarchy for natural disasters.

Infiltration of invasive species is driven by development such as logging, agriculture expansion, road construction and others. Policy analysis indicates existence of supporting instruments such as the Rural Land Use Policy (2005), Green Growth Framework (2014), National Development Plan 2020–2030 (2019). Two key outcomes that potential water catchment policies must capture include the protection of the forest system at the head waters of major catchments as well as the adoption of transparent methods in appropriation of resources through wide stakeholder consultation on development opportunities in the catchment area compliant to the management zonation of critical habitats and aligned to land capability (Rural Land Use Policy 2005).

5.5 Problems and Gaps

The gaps identified are as follows:

- Freshwater bodies are affected by logging, deforestation, reforestation, poor agricultural practices, and poor land management practices. Water catchments need to be managed actively based on sustainable land use.
- Lack of conservation practices in freshwater management.
- Poor agricultural practices such as planting on slopes and close to streams, are causing soil erosion, siltation and eutrophication.
- Environmental management and controls are weak. There is a major need to strengthen supervision and law enforcement to protect fisheries resources and habitats.
- Flood management requires an integrated approach to address all issues in a holistic manner. Issues related to land and water resource use need to be planned and executed in a manner that will reduce or eliminate risks (Raj 2004).

Problems such as lack of coordinated land use, rapid and unplanned land cover changes, geology, catchment slope, weak legal and policy framework, all lead to unsustainable practices within the catchment and exacerbate low water quality. The organisational arrangements for catchment management and the impact of scale on bioregional water regulation regimes also have enormous impact on management of water resources in Fiji.

The upper Waimanu catchment has limited anthropogenic changes. The middle Waimanu catchment appears natural, however, these areas are prone to landslide/mass movement. This affects the turbidity of the water and deposition of silt, which changes the river morphology. According to Singh (2017) the major problems identified in the lower Waimanu catchment area include:

- Semi-urban area where villages and settlements situated along the riverbanks, upstream of Waimanu and Waila pump stations often dump household waste and effluent in the waterways, which eventually end up in the river. Water quality analysis indicates higher than normal levels of faecal coliform in the raw water at Waila water treatment station 2.
- Moreover, the river is also seen as a convenient site for rubbish and waste disposal for farmers and industries upstream, such as Goodman Fielder. This problem worsens especially during adverse weather conditions with high rainfall and sewage waste is washed into the river.
- Extensive farming carried out along Waibau, often on steep slopes, results in runoff of pesticides, fertilisers and other chemicals, which seep into the river and pose potential health risk.
- Runoff from piggery, poultry and cattle farms established along the riverbank upstream of the pumping stations contribute to nutrient overloading and compromises the water quality of the river.
- Given the catchment slope and occurrence of landslides, heavy sedimentation during high rainfall events affects turbidity of the water and increases treatment costs for WAF.
- Gravel extraction carried out along Waibau and Navatuvula affects river morphology, destabilises the riverbank, and increases turbidity of water during operations and rainy conditions. Furthermore, oil and fuel leakage from the machinery further compromise the water quality.

6 Conclusion

The Waimanu catchment is a subset of the Rewa catchment. It is an important catchment as it supplies drinking water to the greater Suva population. Despite the modern context and emphasis on environmental management, Fiji's natural resource laws are not as effective and present an opportunity to upgrade and align to Fiji's growing engagements with international instruments. Fiji is party to several international conventions and treaties that relate to environmental issues, acceding to or ratifying many that place increased responsibilities to improve environment and social considerations in development initiatives. Indeed, some reprieve in protection (though not specific), may be found in national engagement programmes such as in the reduction of carbon emissions under REDD+ projects. A specific legislative proposal towards clear definition and ownership of water as a resource, its management and regulations are crucial. Time is of the essence, since persisting issues on water and the need for better management and control have been identified since the late 1990s.

There also have been some advances in measures to prevent the pollution of water sources, through government initiatives where mechanisms are in place for example, under WAF to protect the integrity of water sources and a penalty applies for anyone found polluting the environment as indicated in the Act.. The efficacy and success of such measures, even when sanctioned by law, will depend on implementation and monitoring by the responsible authority.

The National Water Resources Management and Sanitation Policy (in draft) promises to cover all water resources of Fiji and their inter-relationship such as surface water, groundwater and rainwater. It states goals and principles to guide water resources and sanitation management in Fiji and identifies the most important elements of water reform to be considered in the future. The policy recognises the cross-cutting and multidisciplinary nature of water resources management and the specific needs of all sectors and their roles in successful implementation of the policy.

Water is largely a free resource in Fiji. Given multiple stakeholders' demands on water, coupled with increasing commercial nature of its uses, the Government will need to reassess its current stance on the management and control of water. To this end, commercial users of shared water resources must recognise the role played by the public and its obligations to maintaining water quantity and quality. It is recommended that the Ministry of Environment and WAF undertake awareness and stakeholder consultations to better understand their willingness to engage in the development of payment for ecosystem services (PES). PES unpacks Hardin's assumptions to understand the range of stakeholders, what roles they play and how they benefit or are impacted. Perhaps a levy by way of an environmental bond on all commercial users, is a financial initiative that could introduce the concept of PES to the greater Suva consumers. In such a case, it is recommended that wide stakeholder consultation be undertaken to determine the level of willingness the Government, Water Authority of Fiji, iTaukei landowners, water consumers and other stakeholders want to engage to ensure provision of consistent quality and quantity of water in perpetuity. This leads to the creation of water markets, which can be based on water catchments, where water is provisioned through an appropriate agency as a tradeable asset. Prices are determined by the market and are influenced by supply and demand drivers, such as water availability, climate conditions and demand for different agricultural commodities where water can be traded on a permanent or temporary basis. This of course, will require extensive studies given the marked different climate conditions within the major islands of Fiji.

Recommendations

Considering the above discussion and analysis, it can be concluded that the Waimanu catchment is a critical catchment that needs to be managed to sustain water quality and quantity (Atherton, Olson and Qauqau 2005). To fully realise the above, it is imperative to protect ecosystem services in the upper reaches of the Waimanu catchment to ensure provisioning of clean and abundant water supply to the greater Suva area. Protection under the Forest Decree 1992 – Nature Reserve will require consensus from at least 60% of all mataqali members to facilitate the issue of conservation lease. At the same time, it is imperative to improve hygienic standards of all communities in the catchment area to ensure high quality of water uptake at the two water pumps administered by the Water Authority of Fiji at the lower catchment of Waimanu River.

In view of the fact that water is largely a free resource in Fiji, it is considered a common goods where Hardin's' tragedy of the commons may prevail causing depletion and reduction in quantity and quality of water. Hardin's solution was to cede our freedoms to the state, to be bound by "mutual coercion mutually agreed upon", however, given the nature of landownership in Fiji, this will need clear and transparent consultation. Three key steps are recommended when considering the development of PES system related to water, including the recognition that (1) common resource is our collective responsibility; (2) the role of habitat protection in the provisioning function of ecosystem services; (3) full engagement of landowners in any discourse of privatisation/ private ownership to ensure creation of ownership/rights to resources; and (4) the need for relevant government regulations that will support the above. Once the willingness of stakeholders to engage in PEF is confirmed, it is further recommended that economic valuation of ecosystem services be undertaken, specifically the conservation cost method, market value method and the payment ability method (Sun et Al. 2017) be undertaken to determine the payment standards for the Waimanu catchment. Perhaps a levy by way of an environmental bond on all commercial users, is a financial initiative that can set up the PES mechanism related to integrated water management in Fiji.

In the absence of any interest to pursue PES in integrated water management, it is strongly recommended to secure protection of the upper Waimanu catchment under conservation lease arrangement while the lower reaches of the Waimanu Catchment will need extensive efforts in awareness and capacity building to ensure sustainable land use practices are adopted and implemented. At the same time, water management policies, laws and regulations need to be reviewed and upgraded to support integrated water resource management, linking the provision of water quantity and quality to multiple sectors including agriculture, health, forestry, extraction (gravel) industry and others. It also recommended that routine monitoring, control, surveillance and enforcement is carried out to ensure compliance.

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Annexes

Annex 1: Plants that are "Highly Likely" to be present in the Waimanu catchment (Tuiwawa, 2021)

Botanical Name	Observations on surveys especially more recent (2009, 2011) surveys	Probable Occurrence in Study Area as per reviewed document
Aglaia archiboldiana	Observed on slopes especially on upper Wainavadu in intact forests on Waisoi west and outside of the surveyed areas.	Widespread and common on Lowland slopes and ridges of all areas surveyed.
Aglaia gracillis	Slopes collected from remained intact and observed elsewhere of the surveyed areas	Uncommon in dense forest on lowland slopes of Korobasabasaga range, Wainavadu and Naikorokoro.
Alpinia vitiensis	Observed on the slopes of lowland forests in the upper Wainavadu, Waisoi, Waivaka and Naikorokoro Catchment and elsewhere outside these surveyed areas.	Widespread and uncommon but highly likely to occur in the study area. Easily confused with juveniles of other Alpinia spp.
Astronidium saulae	Observed at Naikorokoro and upper Waivaka creek catchment. It also found on the upper slopes of Mt Korobaba. Also observed in upland systems outside surveyed areas.	It is uncommon and restricted in distribution but given the rugged nature of the head waters of the study area, it is highly likely to be present there.
Balaka diffusa	Observed in dense forest on river flats and along slopes of the upper Wainavadu and Waivaka catchments, and Nabukavesi creek.	The under-storey palm is common and widespread and is highly likely to occur in the study area.
Balaka macrocarpa	Good viable population (300) at Savura and Colo I Suva Protected Forest observed in dense forest	Common and restricted in distribution. The topography is similar and close proximity to the study area, so is highly likely to occur in the study area.
Clinostigma exorrhizum	Observed along high and lower altitude ridges at the upper Wainavadu, Waisoi, and Waivaka catchments.	Common and widespread in distribution. Topography is similar the study area especially towards the headwaters.
Cyathea alta	Mostly observed in lowland and upland forest	Common but widespread and highly likely to occur there
Cyathea decurrens	Mostly observed in forest margins of lowland and upland forest	Uncommon but widespread and highly likely to occur there
Cyathea hornei	Mostly observed in most forest type in lowland and upland forests in all catchments surveyed and elsewhere in Fiji.	Common in similar areas elsewhere in Fiji so highly likely to occur there
Cyathea lunulata	The most common tree fern species observed in all the catchments surveyed except for the cloud forest. Found elsewhere outside the surveyed area.	Very common and widespread in similar areas elsewhere in Fiji and especially the study area
Cyathea propinqua	Mostly in dense low and upland forests	Common in similar areas elsewhere on Viti Levu and highly likely to occur in the study area
Elaeocarpus chionanthus	Few look alike trees observed on slopes in the Wainavadu Catchment but observed along the Waivaka creek at Wainavuga.	Uncommon and widespread on the slopes of dense forest and is highly like to occur in the study area.
Freycinetia vitiensis	Observed in the upper Wainavadu catchment, Waisoi and Naikorokoro catchments	Uncommon and widespread and occurs outside of the surveyed areas

Botanical Name	Observations on surveys especially more recent (2009, 2011) surveys	Probable Occurrence in Study Area as per reviewed document
Gulubia macrocarpa	Known distribution on Viti Levu is the coastal mountainous ridge from Naboutini to Mt Korobaba. The same chain of mountains continues into the mid Waimanu catchment.	Locally common with restricted distribution. Known range is adjacent to the study area so highly likely to occur there
Lycopodium serratum	Observed in the lowland and upland wet and dense forest of the areas surveyed.	Uncommon and widespread epiphyte and highly likely to occur in the study area due to similar topography
Orchidaceae spp.	Observed in all forest types surveyed in densely forested area. No less than 5 species observed at any study area – a common trend in all intact forest in Fiji	Common and widespread. 48 native species at Waisoi so occurrence is very highly likely.
Pandanus joskei	Observed at in and or near creeks in the lowland forest at Naikorokoro, Colo I suva, and Savura	Locally common but restricted to creeks and their embankments. Range is adjacent and similar topography, its highly likely to occur there
Physokentia rosea	Observed on slopes and creek flats of intact Upland Forest and upper lowland systems in Sovi Basin, Waivaka and Waikatama and Naikorokoro catchments	Uncommon but widespread and with similar habitat and topography, it will be highly likely to occur there.
Podocarpus affinis	Observed on higher ridges of upland and cloud forest of Waisoi, Waikatama and upper Wainavuga / Waivaka catchments	Locally common and restricted to wet, densely forested areas. Highly likely to occur in the upland vegetation of the study area
Psychotria scitula	Observed on the slopes and ridges with dense forest areas surveyed. Observed elsewhere of the surveyed areas	Uncommon and widespread. Highly likely to occur in the study area
Schefflera euthytricha	Few look alike plants observed headwaters of the Waisoi and upper Wainavadu creeks, and the Naikorokoro catchments. Also occurs elsewhere on Viti Levu	Uncommon and maybe widespread and given the close proximity, its highly likely to occur there.
Syzygium amplifolium	Observed at Colo I Suva Forest Park and Savura	Uncommon and widespread and highly likely to occur in study area due to similar forest type and topography.

Annex 2: Summary of recorded bird species at each site

Bird species recorded within Waimanu Catchment										
	English Name	**Fijian Name**	**Scientific Name**	**Endemicity / Status**	**Iucn Listing**	**Bird Survey Sites**				
						Waivaka	**Navurevure**	**Wainikatama**	**Korobaba**	**Savura**
Forest birds										
Raptor	Fiji Goshawk	Reba	*Accipiter rufitorques*	1. Endemic		Y	Y	Y	Y	Y
	Pacific Harrier	Manu levu	*Circus approximans*			Y	Y	Y	Y	
Doves & Pigeon	White-throated Pigeon	Soqeloa	*Columba vitiensis*			Y	Y	Y	Y	Y
	Friendly Ground Dove	Qilu	*Gallicolumba stairi*		Vulnerable.	Y	Y	Y		Y
	Barking Pigeon	Soqe	*Ducula latrans*	2. Endemic		Y	Y	Y	Y	Y
	Many-coloured Fruit-dove	Kulavotu	*Ptilinopus perousii*	3. Endemic		Y	Y	Y	Y	Y
	Golden Dove	Bunako	*Ptilinopus luteovirens*	4. VTL Endemic		Y	Y	Y	Y	Y
Parrots	Collared Lory	Kula	*Phigys solitarius*	5. Endemic		Y	Y	Y	Y	Y
	Red-throated Lorikeet	Kulawai	*Charmosyna amabilis*	6. Endemic	Critically Endangered					
	Masked Shining Parrot	Kaka	*Prosopeia personata*	7. VTL Endemic		Y	Y	Y	Y	Y
Cuckoo	Fan-tailed Cuckoo	Todi	*Cacomantis flabelliformis*			Y	Y	Y		
	White-rumped Swiftlet	Kakabace	*Collocalia spodiopygius*			Y	Y	Y	Y	Y
	Collared Kingfisher	Lesi	*Todiramphus chloris*			Y	Y	Y	Y	Y
Woodswallow	Fiji Wood swallow	Vukase	*Artamus mentalis*	8. Endemic		Y	Y	Y	Y	Y
	Polynesian Starling	Vocea	*Aplonis tabuensis*			Y	Y	Y	Y	Y
	Island Thrush	Tola	*Turdus poliocephalus*			Y	Y	Y	Y	Y
Old World Warbler	Fiji Bush-warbler	Manu	*Cettia ruficapilla*	9. Endemic		Y	Y	Y	Y	Y
	Long-legged warbler		*Trichocichla rufa*	10. Endemic	Endangered		Y			
Robin	Scarlet Robin	Diriqwala	*Petroica multicolor*			Y	Y	Y		Y
Monarch & Flycatcher	Streaked Fantail	Sasaira	*Rhipidura spilodera*			Y	Y	Y	Y	Y
	Slaty Monarch	Sasaira	*Mayrornis lessoni*	11. Endemic		Y	Y	Y	Y	Y

Bird species recorded within Waimanu Catchment

	English Name	Fijian Name	Scientific Name	Endemicity / Status	Iucn Listing	Bird Survey Sites				
						Waivaka	Navurevure	Wainikatama	Korobaba	Savura
	Lesser Shrikebill	Digisau	*Clytorhynchus vitiensis*			Y	Y	Y	Y	Y
	Black-faced Shrikebill	Kiro	*Clytorhynchus nigrogularis*	12. Endemic	Vulnerable	Y	Y	Y	Y	Y
	Vanikoro Broadbill	Matayalo	*Myiagra vanikorensis*			Y	Y	Y	Y	Y
	Blue-crested Broadbill	Batidamu	*Myiagra azureocapilla*	13. Endemic		Y	Y	Y	Y	Y
	Golden Whistler	Ketedromo	*Pachycephala pectoralis*			Y	Y	Y	Y	Y
	Polynesian Triller	Manusa	*Lalage maculosa*			Y	Y	Y	Y	Y
White Eyes	Fiji White-eye	Qiqi	*Zosterops explorator*	14. Endemic		Y	Y	Y	Y	Y
	Silvereye	Qiqi	*Zosterops lateralis*			Y	Y			
	Fiji Parrotfinch	Qiqikula	*Erythrura pealii*	15. Endemic		Y	Y	Y	Y	Y
	Pink-billed Parrotfinch	Sitibatitabua	*Erythrura kleinschmidti*	16. VTL Endemic	Vulnerable	Y	Y	Y		
	Orange-breasted Myzomela	Delakula	*Myzomela jugularis*	17. Endemic		Y	Y	Y	Y	Y
Honeyeaters	Wattled Honeyeater	Kikau	*Foulehaio carunculata*			Y	Y	Y	Y	Y
	Giant Forest Honeyeater	Sovau	*Gymnomyza viridis*	18. Endemic		Y	Y	Y	Y	Y
Non-forest birds										
	Pacific Black Duck	Ganiviti	*Anas superciliosa*					Y		Y
	Eastern Reef Heron	Belo	*Egretta scara*					Y		Y
Raptor	Peregrine Falcon	Gãnivatu	*Falco peregrinus*	R/Endemic race			Y			
Introduced birds										
Dove	Spotted Dove							Y		Y
	Common Mynah	Maina	*Acridotheres tristis*					Y	Y	
	Jungle Myna	Maina ni veikau	*Acridotheres fuscus*			Y		Y	Y	Y
	Red-vented Bulbul	Bulbul	*Pycnonotus cafer*			Y		Y	Y	Y
	Red Avadavat	Siti	*Amandava amandava*					Y	Y	Y
	Java Sparrow	Manumanu ni raisi	*Pada Oryzivora*							

Annex 3: Analysis of Existing Laws related to Waterways/Water Catchment

Policies, Laws and Regulations	Application	Comments
Constitution of the Republic of Fiji (2013)	Section 36 of Part 2-Bill of Rights. Guarantees the right to adequate Food and Water.	The State must take reasonable measures within its available resources to achieve the progressive realisation of the right of every person to adequate food and water.ie to have clean and safe water in adequate quantities.
5YR &20YR National Development Plan (Nov 2017)	Goals, Policies and Strategies to strengthen policy planning and sustainable resource management. To also expand access and work towards ensuring equity in the provision of water sanitation services. See pp 18-24	Formulate and implement a National Water Resources Management and Sanitation Policy to govern the planning and development of water sources. Plan to review existing policies and standards, incentives, legislations, and processes governing the provision of water and sanitation services to improve quality of services and action. Amend Public Health Act (Cap 111) and National Building Code to cater for water storage and rainwater harvesting systems.
Agricultural Land and Tenant Act [Cap 270]	Governs relationship between the two parties in an agricultural lease between Landlord (TLTB Trustee] and Tenant	Pressures on land indicate an urgency to increase sustainable production per unit area. However, there is inadequate understanding throughout the agricultural/land use sector about the closer relationship between land use, crop type and capacity. Section.13 defines the notion of good husbandry and is defined in terms of traditional farming practices e.g. construction of hedges, terraces, drains and maintaining soil fertility and control of pests. Act does not address issues of preserving ground water quality, soil compaction and enrichment of surface water.
Drainage Act [Cap 143]	Works by establishing drainage areas under the jurisdiction of a local drainage Board, which carry out particular works with respect to that drainage area. Much of the Act is devoted to levying rates for drainage. Board may sue for the sale of land to recover defaulted payments.	The Act provides considerable capacities for the Government to intervene in the use of private lands. But has a lack of attention to defining a drainage area. With no other guidance supplied, there is vast potential for application and abuse under this tool.
Endangered and Protected Species Act [No 29 of 2002]	This Act materially enhances the Government's ability to conserve threatened species. The Act operates primarily to adopt Fiji's International controls per its obligations under CITES.	The protection of wildlife exists only in trade context, however definitional drafting gaps exist between CITES and Fiji's context that warrant correction.
Environment Management Act (2005)	For the protection of the natural resources and for the control and management of developments, waste management and pollution control and for the establishment of a National Environment Council and for related matters.	Deals with any activity or undertaking likely to alter physical nature of land in any way and includes construction of buildings, or works, the deposit of waste or other material from outfalls, vessels or by other means, the removal of sand, coral, shells, natural vegetation, seagrass, or other substances, dredging filling, land reclamation, mining or drilling for minerals, but does not include fishing. Introduces power to manage water quality in both freshwater and marine.

Policies, Laws and Regulations	Application	Comments
Forest Decree Bill [No 31/1992]	Replaces the Cap 150 through promulgation. General scheme remains similar to its predecessor, but with attempts to broaden the forest agenda. More elaborate framework for forestry undertaking than in Forest Cap 150. Has a very useful inclusion in a national Forestry Plan but with little elaboration other than it is the task of the Forestry Board.	Forest and nature reserve provisions are saved under the new law. Unalienated State land, Unalienated native land already reserved for public purpose and land leased by the State may be declared by the Minister as a forest reserve or nature reserve. The Minister, upon advice of the Forestry Board, may compulsorily acquire alienated land for reservation, per sec 6. Forestry can only occur within forest or nature reserve, so reservation of land is precursory to any activity –see s.28. Provisions of Forest Reserve and Nature Reserve can offer protections for water catchment BUT compensation for such ventures is poorly known/understood by landowners.
Forest Bill [No 13 of 2016]	An Act to provide for the management of Fiji's forests and other related matters	Defines development activity on land like the definition under EMA. Refers to forest biomass and forest management inventories to meaning measurement and assessment of the current forest resource, for the purposes of sustainable resource management. It also defines forest management standards with expected levels of performance in the execution of a range of management functions and operational activities compromising ethical, social, ecological, and economic dimensions of sustainable forest management.
Gravel Extraction	Major requirement for Government's infrastructure development plans. Existing under application of four different controlling laws; Environment Management Act (EIA), TLTB Trust Act- Leases and Licenses Regulation, Department of Lands and Mineral Resources Department.	Multiple controlling agencies may result in gravel extraction not being managed sustainably. Possible cross purposes of intent and function may arise where stipulations for the applications of principles of sustainable use and development of natural resources under EMA are overlooked in cases of boulder and gravel extraction from rivers.
Health Act Cap [111]	Of slight relevance to environmental protection through the concept of public nuisance which is a common law principle and has been codified and given statutory basis to protect public health. The Act governs the collection and disposal of waste and sewage. It does not, however, cover sanitary landfills.	The Act may provide, to some extent, remedies for compelling the abatement of nuisance events that may affect public health such as pollution of internal water bodies (rivers, foreshores, ponds) under ss 57-59. Authority can compel an owner or occupier to abate the nuisance and seek Court order for non-compliance.
Irrigation Act [Cap 144A]	Concerned with improving Agricultural productivity through the optimal use of impounded water. Within gazette irrigated areas, broad powers vested on to the Commissioner to promote irrigated agriculture accrue to the Commissioner. These include constructing bridges, canals, pumps, sluices and other irrigation works at any time-see s.7	Under this Act, there is heavy emphasis on agricultural production, but surprisingly environmental needs are non-existent. Indeed, farmers can be compelled under this legislation to remove vegetation from their land. Little to no support for environmental protection is found under this legislation.
iTaukei Land Trust Act [Cap 134]	Facilitates all dealings through control and administration of customarily owned lands in Fiji. This applies to approximately 90 percent of all lands in Fiji. All procedural policies pertaining to lease types and treatment of resources such as forests and gravel are covered under TLTB Leases and Licenses Regulations.	In practice, TLTB does not readily recognize the practical provisions of Forest Reserve or Nature Reserve under Forest Decree [1992] as appropriate for rights and aspirations of LoUs so will not arrange for such leases. Instead TLTB has opted for Conservation Leases which is predominantly used for biodiversity protected areas and suitable for use in water catchment areas
Land Conservation Act [Cap 141)	The Act provides statutory basis for the government to act in anticipation of farming related impact activities such as erosion, eutrophication, soil compaction, localised pollution caused through livestock husbandry or cultivation of crops.	One of the pivotal laws relevant to protecting the environment of Fiji. It ensures integrity of land and water resources that sustains agricultural productivity. The Act makes provisions for the Conservation and improvement of the land and water resource of Fiji. see ss 6, -9

Policies, Laws and Regulations	Application	Comments
Land and Water Resource Management [Bill No.7 2016]	This is an Act to make provisions for the management, conservation and improvement of Land and Water Resources and for other related matters. If passed as law, it promises to streamline various stakeholder functions and powers for effective water sanitation and management.	There is little or no coverage of compensation to loss of land use rights by landowners under the Bill, but it directly addresses land degradation issues while water supply issues are marginally and effectively integrated into it.
Mining [Cap 46]	The mining Act is typical in any legislation of Commonwealth heritage. It aims to expedite the prospecting of minerals. The Act ensures that land is available for mining but affords protection to some of the parties that can be affected by mining related activities. Tenement holders are entitled to compensation for surficial damages and will be determined by the Director if parties do not agree. –s.40. Rights to prospects give primacy to the tenement holder; prospector can revegetate land, extract water and dig shafts with less restraints-see s. 24.	All land in Fiji is essentially open for mining under the Mining Act. One exception is REDD+ project areas
Natural Disaster Management Act [1998]	Instrument of institutionalizing disaster management in Fiji related to disaster response and management, It also provides foundation for Fiji national Disaster Management Plan	The National Disaster Management Office shall in consultation with other government departments and agencies coordinate and implement formulated disaster prevention policies under s.39(1). These include Drainage and Irrigation Department for the assessment of coastal riverine flooding AND the Ministry of Agriculture in liaison with Public Works Department re flood controls and watershed management programmes.
Petroleum (Exploration and Exploitation Act) [Cap 148]	The legislation governs petroleum development and borrows heavily from comparable Federal Australian legislation. The structure of the regime of works presented under the Act is comparatively clear with mature structure and drafting precision. Its application is to designated areas and the State is empowered to explore for or recover petroleum with full liberty under s.4.	Environmental issues are treated clearly and under other provisions of the Act. Licensees are compelled to employ good oilfield practices which are designed to protect the environment from pollution by oil-see s.62. Regulations require all applications and renewals for production and pipeline licenses to be accompanied by an environmental impact assessment under Regs.7-11.
Quarries [Cap 147]	This Act compliments the Mining Act and applies to the extraction of minerals not covered under the latter. The Act is more on Safety in the workplace n=and is very brief.	Whilst addressing some aspects of health and sanitation, major environmental impacts directly attributed to quarrying have not been foreseen and therefore not addressed.
Rivers and Streams Act[Cap 146]	Enshrines the rights of the public to have access to riparian water bodies. An easement exists along riverbanks for public access, except where under control of the Town Planning Act to have altered the status of another use per section 3. Similarly, these classes of people may seek to build on riverbanks and encroach upon or impede public access under section 10. Residents living close to the river may apply for additional rights to extract water for consumptive purposes- per section 7.	Noteworthy for the advocating of public interest in relation to rivers and streams. Could probably be expanded to capture other aspects of riverine management, water quality preservation and control of material extraction. Also allows for traditional activities to be conducted by customary owners in small streams.

Policies, Laws and Regulations	Application	Comments
Roads Act [Cap 175]	Enables the construction of public roads and provides the government with fairly broad powers to this end. The rights of adjoining land users therefore yield to the State on a compensable basis under section 4. Materials may be similarly extracted from adjoining properties for the purposes of road works-per sections 7and 8. Excavated material may be dumped on lands adjacent to roadworks under section 10.	In both governance and environmental issues, the Act may be repugnant to the fundamentals of private property rights and ethics of sustainable developments
Sewerage Act [Chap 128]	Provides for the construction and the maintenance of infrastructure for the treatment of sewage. Powers to this end is shared between Councils and the Government	Coverage of the Act applies to all towns. The Act does not evidence any awareness of environmental considerations. Neither the construction nor the operation of sewage facilities is subjected to any constraints or controls to protect the environment or the attainment of environmental goals.
State Lands Act [Chap132]	This governs tenure typology of lands belonging to the State, which can be disposed of permanently by Government or transfer through leasing agreements. The sale of any State lands does not automatically vest ownership of minerals under it to the new owner. The State retains all mineral rights exploitation rights on any land it has sold. The Regulations to the Act creates different types of leases including agricultural, residential, grazing, quarry, and special purposes amongst others.	Farming leases and quarries may be up to 30 years while other categories can extend to 99 years. Notably farming leases impose minimum conditions designed to conserve soil and vegetation per Regs 14 and 17. There are opportunities for the grant of annual licenses to graze livestock, extract building materials and cultivate crops with attached conditions that recognize erosion and vegetation, but this is not reflected in other types of licenses, refer Regs. 35-39. Little provisioning is given to environmental issues State lands see providing access to public lands for production [i.e., agriculture] as it's a main purpose
Town Planning Act [Cap139]	An Act defining physical development of land in built up areas of Fiji that represent an early approach to development on an environmental basis. Town planning schemes are the preferred instruments for controlling land use within Town Planning Areas as opposed to development permission. A scheme consists of plans and provisions to regulate land development in terms of the objects –see s.17.	The Act is afflicted with problems related to both its policy intent and actual construction. Uses expediency as a consideration for decision making but lacks substantial basis of decision making. Broad public input into planning is excluded and planning schemes are not prepared through public consultation. Section 17(4) seems to elevate a town planning above the operation of any inconsistent Act, Regulation, or by-laws.
Water Supply Act [Cap 144] **REPEALED** **Water Authority Promulgation [No 25 of 2007]**	Legislation governing the supply of water-with much emphasis on infrastructure delivery. Charges for supplying water are covered substantially by the Act.	Little coverage in relation to environmental aspects of supplying water. Catchment areas can be declared by the Minister. Catchment areas are by nature intended to protect water quality from pollution per section 24. Hence, it is an offence to pollute water in the water works. The WAF Promulgation (2007) makes no mention of catchment or provisions for water catchment management
Policies relating to Water, Environment and Land		
Policy	**Policy Focus**	**Comments**
National Biodiversity Strategy and Action Plan 2020-2025 (2018)	Emphasizes the conservation and sustainable management of Fiji natural forest as the single most important means of conserving the vast majority of Fiji endemic flora and fauna while meeting local needs	It identifies the strategic concern of reducing major threats to forest and freshwater ecosystems from unsustainable logging, agriculture, fisheries, mining, and human settlements. The correlative objective to this is to improve coordination of Government policies, legislations, and management guidelines to ensure protection of Fiji forest and water catchment ecosystems.

Policies, Laws and Regulations	Application	Comments
Fiji National Adaption Plan (2018)	To spearhead efforts to comprehensively address climate change, in response to Fiji's international commitments and national needs; To bring adaptation efforts across multiple government sectors under one document; To influence and accelerates the national development pathway towards climate resilient development and to improve resilience against changes in climate but also climate variability which will also increase under future scenarios. Created as a continuous, progressive, and iterative process to support a systematic and strategic approach to adaptation by all government decision making, which will facilitate institutional coordination, resource mobilisation and ultimately effective adaptation actions	Action for hazard management activities include flood management activities for priority river systems including Rewa river, landslide protection measures and the development of a national waterways Policy to establish institutional arrangement to comprehensively manage waterway resources and address related issues. There is the inclusion of biodiversity and the natural environment predicated on large social and economic climate resilience benefits derived from intact and healthy ecosystems. There is also the need to protect biodiversity and the natural environment from climate and non-climate threats.
Fiji Environment Strategy [1992]	Aimed to provide a framework which will enable Government to assume management of the various emerging environment issues from a policy and legal base and administration structure that provides a firm foundation for immediate and future action.	Amongst the sectorial emphasis to be assisted through external financing was land and resource management legislation. Strategy requires effective legislation to enable sustainable land and water resources. It recognizes then that the freshwater resource was under no effective legislation or management, yet development and exploitation of the resources was proceeding rapidly. See Fiji Environment Strategy Report, section 10.4 at p45.
National Climate Change Policy	Integrate climate change issues in all national and sector policy and planning process by incorporating climate change into national plans and budgets with Climate Change Policy framework and to ensure all national and sectoral policies align with NCCP. To collect manage and use accurate and scientifically sound climate change related data and information through a clearing house mechanism for climate change. The policy also increases awareness and understanding of climate change related issues across all sectors and at all levels in Fiji; Integrate climate change in school curricula, tertiary courses, vocational, non-formal education and training programmes through development of appropriate materials and learning tools;	Integrate climate change issues in all sector policy and planning processes by incorporating climate change in national plans and budgets with the Climate change Policy framework and to ensure all national and sectoral policies align with NCCP.
Fiji REDD+ Policy [2011]	It has the overall intention of enhancing the national forest-based carbon balance by supporting and strengthening initiatives that address the drivers of forest-based carbon emissions and encouraging the drivers of forest-based carbon sinks. The policy will regularly review policy and technical issues to maintain alignment with ongoing international policy and technical developments. Furthermore, the implementation policy will ensure REDD+ plus program will involve the participation of all relevant stakeholders coming from the various sectors and agencies.	Policy is aligned to the objectives of Fiji's sustainable economic and empowerment development strategies that include amongst others energy and environment strategies.

Policies, Laws and Regulations	Application	Comments
Forest Policy (2007)	Ensures ecosystem stability through conservation of forest biodiversity, water-catchments and soil fertility; Ensures sustainable supply of forest products and services by maintaining a sufficiently large permanent forest area under efficient and effective management. Increased engagement by landowners and communities in sustainable forest management and ensure an equitable distribution of benefits from forest products and processes including ensured protection of intellectual properties;	Forest Department has no powers to create water catchments although it can and does prohibit logging in areas important as water catchments and selected as such, based on topographical considerations.
Green Growth Framework for Fiji [2014]	A tool to accelerate integrated and inclusive sustainable development, the GGF inspires action at all levels, to strengthen environmental resilience, build social improvement and reduce poverty. It supports economic growth and strengthen capacity to withstand and manage adverse effects of climate change To be innovative in finding new transformative solutions to long standing problems through bold and adaptive leadership and fair and transparent consultative processes, in advancing the transition to a people centred green economy. Integrated through a holistic approach to support development that is sustainable and climate change resilient;	Inspires action at all levels to strengthen environment resilience, build social environment and reduce poverty. Also, to inspire through creation empowerment of all members of the community to make decisions and o take and build green economy and to inspire in transformative change to better align the economy and society with the environment to sustain livelihoods now and future generations.
National Disaster Risk Management Policy [2018-2030]	Promotes good disaster risk governance through good risk assessment. It also promotes active participation and engagement of all groups in society, recognizing their different priorities, skills and knowledge and knowledge in addressing climate change and disaster risk reduction	Consolidating legal systems and instruments. It seeks to strengthen risk governance and identify priorities for future action by learning from the past. The plan is to mainstream sustainable development and risk reduction into all policies, plans and practice, even at community level.
Rural Land Use Policy (2005)	Includes provision for the protection of soil and water values such as promoting effective integrated watershed land and water management to improve water quality and quantity in degraded catchments.it also seeks the establishment of guidelines that maintain biophysical minimum needs for water quality and quantity.	Policy has led to the adoption of Land Use capability classification guidelines which is a systematic approach to land use to determine capacity for sustained production.
Ministry of Waterways and Environment Strategic Plan [2020-2024]	The Strategic Plan provides the blueprint for identification and better management of environment and waterways risks in Fiji. The government is committed to this through the vision of safeguarding environment and keeping communities safe. The Strategy is linked to 20YR development Plan, the Green Growth Framework, and the SDGs 2030 Agenda.	Facilitated in its process stakeholder participation/ mapping to ensure that the expectations and needs of clients and partners including CSOs, Academic Institutions, and the private sectors are all integrated into the strategy. The process of developing strategy included detailed analysis of existing conditions and foreseeing the future while keeping a direct connection to national environmental and development goals. One of its strategic objectives is the sustainable management of waterways and watersheds.

Policies, Laws and Regulations	Application	Comments
National Plan for Disaster Management [1998]	To develop a way forward to overcome the overlapping roles in administrative boundaries and to create a stronger sense of shared responsibility for disaster risk reduction.	To ensure that learnings from TC Winston were incorporated into the legislative frameworks and disaster governance, documents have been updated according to selected priority areas, including the role of climate change in disasters and with an enhanced focus on the needs of vulnerable groups.
Review of Policy and Legislation Relating to the Use and management of Mangroves in Fiji [undated]	To take stock and assess/analyse existing mangrove policies and legislations in Fiji and to propose to Government recommendations that it may wish to consider to better address the issues relating to use and management of mangroves	Sustainable use and management of mangrove ecosystems is hindered by the absence of clear policy direction and effective regulatory control. Fiji's land use planning legislation does not provide the tools required for coherent planning and zoning which could support mangrove's sustainable management at national and sub-national levels
National Resource Inventory Report of Rep of Fiji [2010]	The consistent development of water resources and supply strategies in Fiji has been thwarted by lack of clear and comprehensive legislation compounded by several government agencies that are mandated to deal with water at one level or another.	The commercial use of water catchment from groundwater supplies, as well as resource management issues in catchments including logging, underlies the need for a comprehensive review of national policies followed by legislation. Many of these issues are politically and socially sensitive in Fiji.
National Water Resources Policy for the Fiji Islands **[DRAFT]**	Developed in recognition of increasing threats and competing demands for water resources in Fiji. The draft policy covers all freshwater resources in both groundwater and surface water and acknowledge that freshwater can affect the quality of coastal and marine water. The policy states goals and principles to guide water management in Fiji	Aims for institutional strengthening by establishing a coordinating body to provide consistent advice on water reform and water management problems and national significance. Also, to strengthen coordination arrangements between water use sectors.
Watershed Management Master Plan [1998] ***Yachio Eng Group JICA**	To formulate a Master Plan for the watershed management and flood control of Viti Levu's four major rivers.	Erosion resulting from inappropriate land use and poor land management practices in the watersheds had led to progressive siltation of rivers resulting in deterioration in drainage and floodplains, frequent inundation and formation of shallow bars across river mouths. Dredging has become a costly necessity. General lack of attention by loggers to erosion, stream follows and ecological considerations, similarly, to established reserved forest area.
Mangrove Management Programme [1985]	This contains a formulated Mangrove Management Program for Fiji. It contains characterisation, policies and maps of the mangrove location, types and use zones for the Main islands of Viti Levu, Vanua Levu, Ovalau, Gau and Kadavu.	In the absence of a specific legislation, this document is used for decision making purpose on foreshore reclamation of mangrove areas by the Department of Lands and Surveys. An ongoing mangrove management programme is in place to monitor the use and extent of mangrove areas.