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# National Pilot Project Area Diagnostic Report

## WAIMANU CATCHMENT, Fiji





# National Pilot Project Area Diagnostic Report Waimanu Catchment, Fiji

**Prepared by**  
Conservation International

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# Abbreviations

<b>ACS</b>	Adi Cakobau School
<b>CBD</b>	Central Business District
<b>CI</b>	Conservation International
<b>EIA</b>	Environmental Impact Assessment
<b>EMA</b>	Environmental Management Act
<b>DPSIR</b>	Driver Pressure State Impact Response
<b>FHI</b>	Freshwater Health Index
<b>GEF</b>	Global Environment Facility
<b>iTLTB</b>	iTaukei Land Trust Board
<b>IW R2R</b>	International Waters Ridge to Reef
<b>MoWE</b>	Ministry of Waterways and Environment
<b>PICs</b>	Pacific Island Countries
<b>PLR</b>	Policy Legislation and Regulations
<b>RRA</b>	Rapid Resource Assessment
<b>SPC</b>	Pacific Community
<b>SPREP</b>	Pacific Regional Environment Programme
<b>TC</b>	Tropical Cyclone
<b>UNHSP</b>	United Nations Human Settlement Program
<b>WAF</b>	Water Authority of Fiji
<b>WL</b>	Water Level

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# 1 Executive Summary

The diagnostic analysis of Waimanu catchment was undertaken with an active agenda to collate as much extensive information for the area to provide a sound descriptive analytical narrative of the catchment. Using the Freshwater Health Index under Conservation International's portfolio of assessing freshwater systems, we carried out a qualitative evaluation of the information available by means of reviewing selected literature and where possible, undertook interview surveys where key stakeholder representatives were able to provide some level of on-the-ground data. In the process, we focused on evaluating the catchment by assessing selected literatures that investigated environmental and social variables attributing to the catchment's ecosystem vitality, ecosystem goods and services and the governance infrastructure available, including the legislation framework available that purposefully is meant to protect and conserve the water catchment. It is to be noted that during this period of analysis, Fiji was under COVID-19 restrictions that disabled any form of field assessment, thus we have had to rely on desktop assessment to be able to put this document together.

The assessment deduced the Waimanu catchment to have a critical role in the sustainability of water resources to at least a significant population of people, living in the urban and sub-urban areas, on the southeastern part of Viti Levu. The catchment is classified into the upper, mid, and lower sections where the intensity of development, infrastructure, logging, and agricultural activity are present and have been occurring at different levels of intensity and rigor. The upper catchment, hosts forest that remains relatively intact and pristine and has been noted to potentially harbor a critical hotspot of Fiji's flora, fauna and freshwater biodiversity. Even though, there is yet to be a survey to document the flora and fauna of the area, the supposition of its unique environment is in support of any future survey that will hold to conserving the area as a critical water source. The consensus and approval of existing nexus between the forest and river system stands to be a strong pillar of conservation to protect the function of the catchment in continuing its vital function of providing water. According to several literature sources, the lower catchment is the most heavily compromised in terms of population density, development of building infrastructures for schools, businesses, and farming grounds. Along the entire catchment, runs the main Waimanu River along which are pockets of villages and settlements especially in the middle and lower regions. Communities along the Waimanu River depend on ecosystem services provided by the Waimanu river for sustenance and cater for the daily household activities, although issues of poor hygienic practices and living standards is highlighted as going concern in several documents.

In addition, threats, and key findings of the assessment fall into three main thematic pillars of assessment i.e., Environment, Socioeconomics and Governance. These were as follows:

1. Under the Environment pillar – the catchment is under threat because of (1) increasing incursion of farming and agricultural leases into the mid and upper catchment areas which is the source of freshwater deposits that feeds the lower catchment and the two water in-take pumps for Water Authority of Fiji; (2) increasing development projects in the forms of gravel extractions and quarry sites, road expansion, business, and education centres, as well as shifting cultivation; (3) lack of biodiversity information is likely to implicate the potential loss of biodiversity that can have a significant and direct human health impact should ecosystem services are no longer adequate to meet social and environmental needs.
2. On the socio-economic front, the catchment is under increasing pressure from increasing population and poor waste management in addition to improper sanitation systems. Growth in population has been reflected in the number of communities and settlements across the catchment some of which have been reported to have very poor hygienic standards of effluent discharge. In some instances, the river has been used to as a dumpsite and deposit waste materials that again, will negatively affect the water quality of the river.
3. At the same time, under governance and stakeholders, while there is legal provision that facilitates the distribution and access of freshwater to consumers, there is a lack in the overall legislative provision that deals specifically with protection of water sources. Voluntary commitment agreed through village/settlement consultation may support such protection, but they lack the legal ambit to become effective.

Conclusively, the Waimanu catchment is a vital source of freshwater that has been facilitating and delivering water to about 244,000 people on the south-eastern parts of Viti Levu.

## 2 Introduction

The production of an initial diagnosis of the Waimanu catchment is a key part of the preliminary activities that will be undertaken by the operators at the early stage of project implementation.

The overall goal of such a diagnosis is to allow for a precise characterization of Waimanu catchment in relation to Ridge to Reef objectives and program of activities. As such, the diagnosis also provides a baseline against which the effectiveness and efficiency of the project can be evaluated.

The objectives of the initial diagnosis will determine the subsequent guidance with respect to diagnosis contents. The common framework of Ridge to Reef allows the operator to carry out initial, mid-term and end-of-project diagnoses on the pilot sites in a coherent and consistent manner. As a guiding framework, it leaves room for adjustment to reflect each pilot site's specificities.

The site diagnostic process provides a structured approach to identify, understand, and prioritize key issues impacting on the ecosystem goods and services. A range of risk assessment tools such as problem-tree and causal links analysis are available to the team. The diagnostic analysis will scale the relative importance of source and causes (from the 'immediate' to the 'root') of the problems within the ridge to reef platform and to identify potential preventive and remedial actions.



## 3 Description of Waimanu

### 3.1 Description of Study Site

The Waimanu catchment has been a constant source of water supply to occupants of the greater Suva-Nausori and Rewa corridor. It is recognized as a sub-catchment of the larger Rewa catchment having an area of < 20km<sup>2</sup>. The catchment is located between the Waimanu pump station and the Waila pump station along the Nausori-Naitasiri topographies that are situated alongside the freshwater river corridors, southeast of Viti Levu.

Freshwater supplies are being continuously deposited into the Waimanu River by at least three main adjunct river systems, namely the Wainibuku, Wainimala and Waibau river (Figure 1). The catchment has been long established as the source to one of three major river drainages into the Rewa river (DoE, 2014). As such, the Waimanu river is a major landmark connecting the lower and upper reaches of the catchment, stretching a distance of 1.75km<sup>2</sup> and covering an area of 199 square kilometers (CI 2021). It is also a major source of freshwater fishery and kai, a staple diet and source of subsistence farming for many surrounding communities.

The Waimanu catchment is a critical catchment in Fiji whose location and integrity is critical to conserving and maintaining to ensure a continuous supply of good and clean water to the greater Suva area. Fiji's State of the Environment report in 2013 specified that the Waila water treatment plant, through the Water Authority of Fiji (WAF), treats close to 100 mega liters of raw water from the Waimanu river each day, serving a significant portion of population along the Suva-Nausori and Rewa delta. Accordingly, there is a total of 244,000 (UNHSP, 2012) people living in the greater Suva area that receive water from the Waimanu pump, which according to Raj (2004), draws on average 36,000m<sup>3</sup> per day, while the Waila pump station pumps, 90, 000m<sup>3</sup> per day. The water quality of Waimanu river system is monitored monthly by the National Water Quality Laboratory.

### 3.2 Socioeconomics

The population in the Waimanu area is primarily of the two main ethnic group: iTaukei and Indo-Fijians. The exact population is estimated at less than 28, 981 counts of the entire rural community in the province of Naitasiri with an approximated 13,000 people living along the Waimanu river catchment (Fiji Bureau of Statistics, 2017). There are three main communities in the Waimanu Catchment including Sawani, Navatuvula, Colo-i-Suva and Vuniniudrovu.

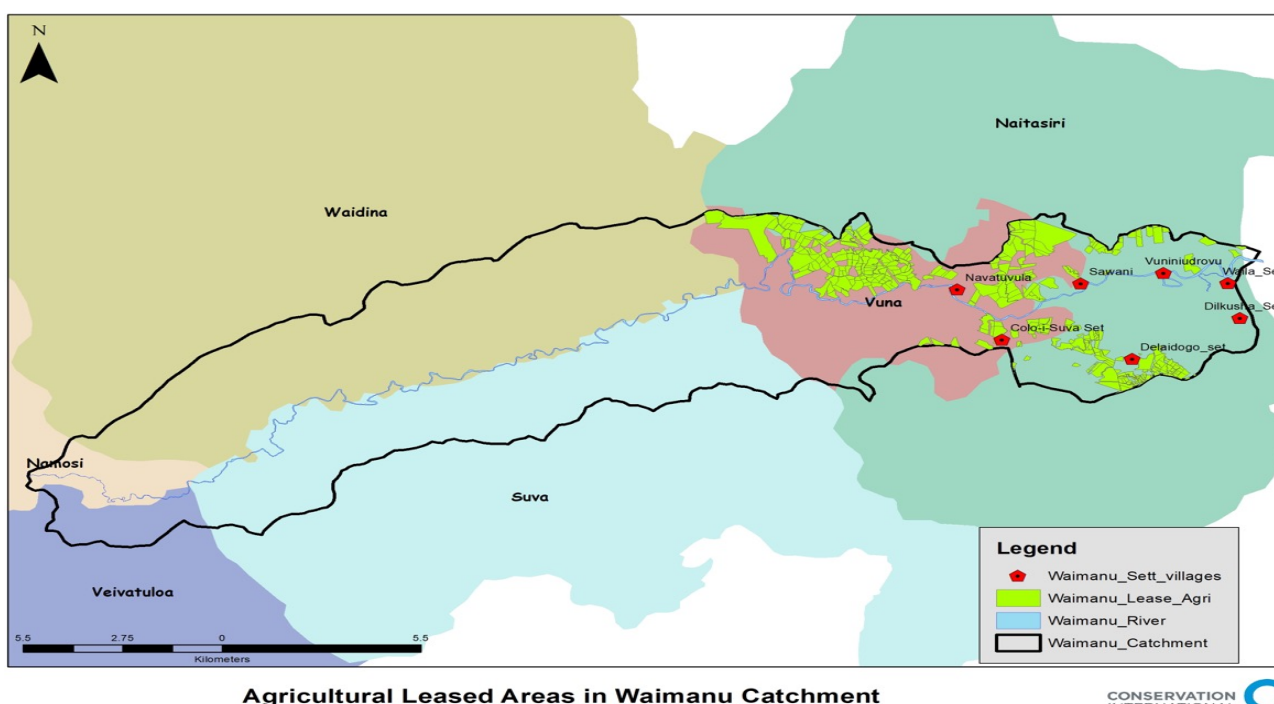
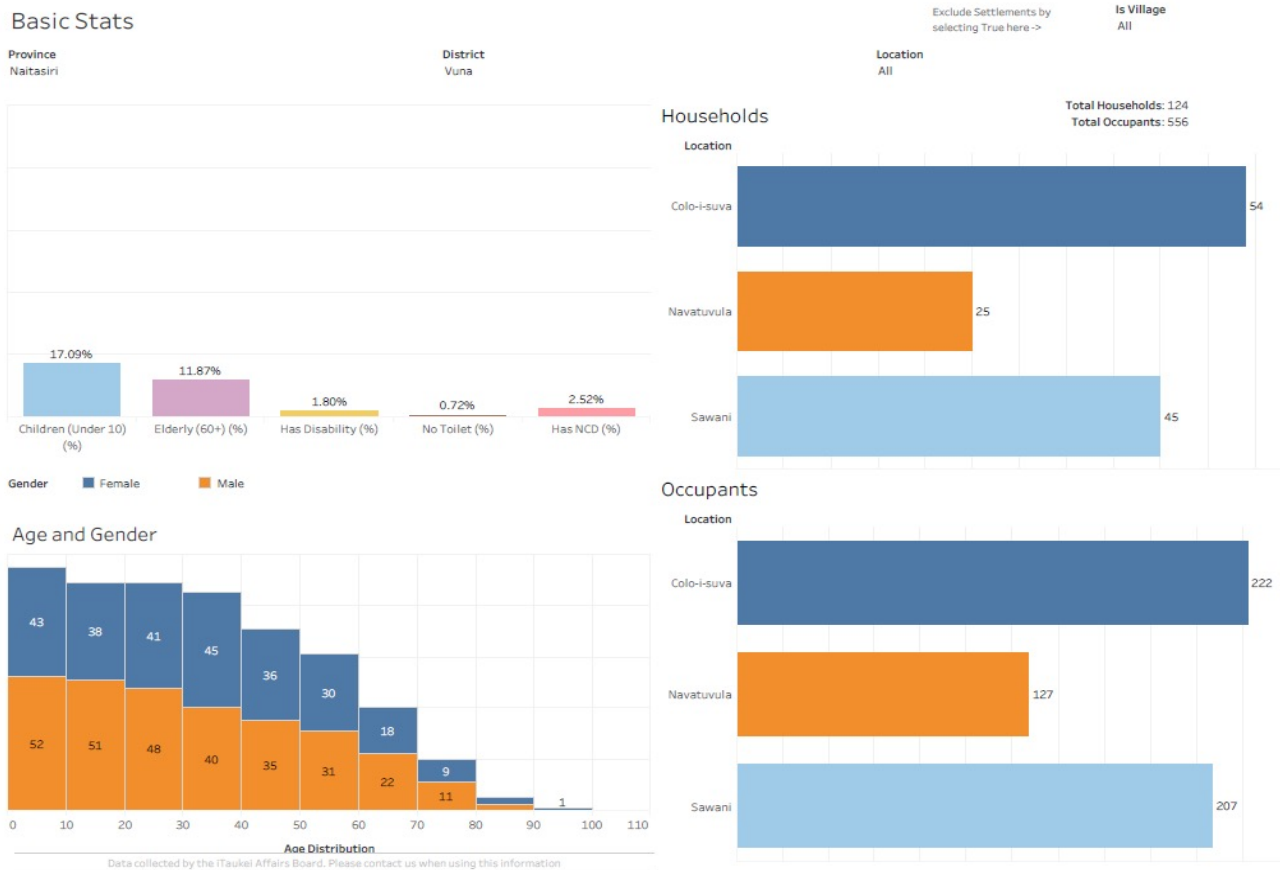


Figure 1: A Map of the Waimanu Catchment showing the Waimanu river from the upper to lower catchment

Demographic information about the above iTaukei communities is outlined in Figure 2. The average number of people in a village is estimated at 185 where age group across all communities is predominately under the age of 50.



**Figure 2:** Demographic information of iTaukei communities in Waimanu Catchment (Source: Ministry of iTaukei Affairs, 2020)

Generically, these communities and others in the area are known to communicate under the three main official languages: Fijian (iTaukei), Fiji Hindi and English. Towards the lower Waimanu are quarry stations, secondary school (ACS - Adi Cakobau School), two service stations, two small shopping centers, villages and poultry abattoir, significant portion of agricultural land area (MoWE, 2019).

The Waimanu catchment covers 19,900ha of land area and is made up primarily of thick, lush lowland vegetation with pockets of developmental sites spread throughout the edges and outskirts of the catchment. As stated in several reports, development activities across the catchment are mostly small, scaled sites of gravel extraction and dredging including quarry, extensive agricultural activities, school establishments, road expansion, business centers and waste disposal dump sites (Chand, 2017; MoWE, 2019). Road expansion is also evident to which the main highway, Princess Road, makes a detour to the Sawani-Serea back road that runs parallel to the Waimanu River (Figure1). The main mode of transportation in the area are buses, private vehicles, trucks, other road vehicles and watercrafts (motorboats).

### 3.3 Cultural Heritage

There are currently no known cultural and archeological sensitive sites of significance that have been reported about the catchment except for the fact that the Waimanu river is part of the traditional fishing grounds for the land-owning unit and Yavusa Solia from the village of Sawani (Dolesau and Rufu, 2011). The assessment by Dolesau and Rufu (2011) was undertaken under an Environmental Impact Assessment (EIA) along the upper Waimanu, 4km to the west of Navatuvula village.

Without having an official record or document of potentially significant cultural and archaeological sites, findings by Nainoca (1998) states *“some sites are semi-sacred or sacred or ‘tabu’; i.e., the people respect them to the extent that they are not disturbed in any way for fear of the consequences that might befall them. Some sites would hold special significance or traditions for the landowners or residents. Traditional sites and tabu sites would include yavutu (sites of tribal origin), koromakawa (old village and town sites) and sautabu (sacred sites, groves, or other features). Certain places names are often all that officially remains of many old stories or tales* (Nainoca, 1998).

## 3.4 Geology and geomorphology

A thorough treatment of the geological and geomorphological study of the Waimanu catchment stating is outlined in the Draft Baseline Report (MoWE 2019) and the final Rapid Resource Analysis (CI 2021), the geology of Waimanu catchment belongs to the Wainimala group that can be 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. These are defined by two types of volcanic rocks present in the Wainimala group: pyroclastic and flow deposits of various chemical composition that includes basalt, andesite, trachyte, and rhyolite (MoWE 2019). More so, the general geology of the Waimanu-Tamavua locality including the Waimanu Catchment can be described from the geology map of Fiji to be largely andesitic rocks of the Medrausucu volcanic merging with Savura volcanic on the upper elevated areas with recent alluvium on the swamps that covers the riverbanks. These rocks are mainly volcanic in the catchment that is composed mainly 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 the Waimanu joins the Waimanu River (Nainoca, 1998).

In further referencing the study by Nainoca (1998), the report continues to describe the Savura Volcanic group having been composed of andesitic to rhyolitic flows, breccias and volcanoclastic sediments with minor basalts flows and intrusions. It also states, that while the lower part of Wainimala Group consists of volcanic breccia and volcanic conglomerate, the upper parts consist of lutite, sandstone, reef limestone and volcanoclastic rocks. And so, the rocks of Wainimala Group have been altered to various extents and covered unconformably by the Medrausucu Group.

Further, report by Singh (2017) states the Waimanu catchment has varying geology. The Tuvatu Greywacke, Namalevu Conglomerate and Veisari Sandstone formations dominate the upper catchment geology. Majority of the formation in the upper catchment belongs to the Wainimala group and the underlying main lithologies are clastic sediments. The mid catchment consists of Tuvatu Greywacke, Waidina Sandstone and Vago Volcanic formations. The Vago volcanic belong to the Savura Volcanic group. The lower Waimanu catchment consists of Tuvatu Greywacke, Waidina Sandstone, Fluvial deposits and Nakasi beds. The unconsolidated quaternary to recent alluvial sediments, found along the lower reaches of the larger rivers, including Waimanu, present favorable locations for potential aquifers.

### 3.4.1 Topography

Adding to the geomorphology of the catchment, the Draft Baseline Report (MoEW 2019) references work by Singh (2017) to describe the upper Waimanu catchment dominated by steep, mountainous topography with deeply incised stream (See Figure 3). Report by Singh (2017) reveals that approximately, 30 - 40 % of the catchment is steep land (slopes > 18°) with much of the remaining catchment area rolling with hilly land (slopes 3- 18°). On the lower part of the catchment especially along the Waila slope, the inclination ranges between 3-4° (Singh, 2017). The upper Waimanu catchments on the other hand is dominated by rugged topography that promotes a high degree of hydrological short-circuiting (Singh, 2017). This means that during a torrential cyclonic downpour, the precipitation is transferred quickly into the river channels, leading to a fast hydrological response (Singh, 2017).

### 3.4.2 Soil

Soil type data is currently available only for Viti Levu that based on major landform categories which are classified into 14 different soil types (Dolesau & Rufu, 2011). Study by Nainoca (1998) shows soil type of the catchment having been made up of humic latosols, highly weathered soils with weakly developed A-horizons, especially the Lobau clay with some Sote clay and Waimaro clay occurring around the Waibau area. Drainage areas such as the Rewa river is made up of the major flood plains that is composed of alluvial soils washed down from hills, mixed with silts, sand and gravels in situ (Nainoca, 1998; Singh 2017). The soil map of the buffer of Waimanu River is outlined in Figure 4.

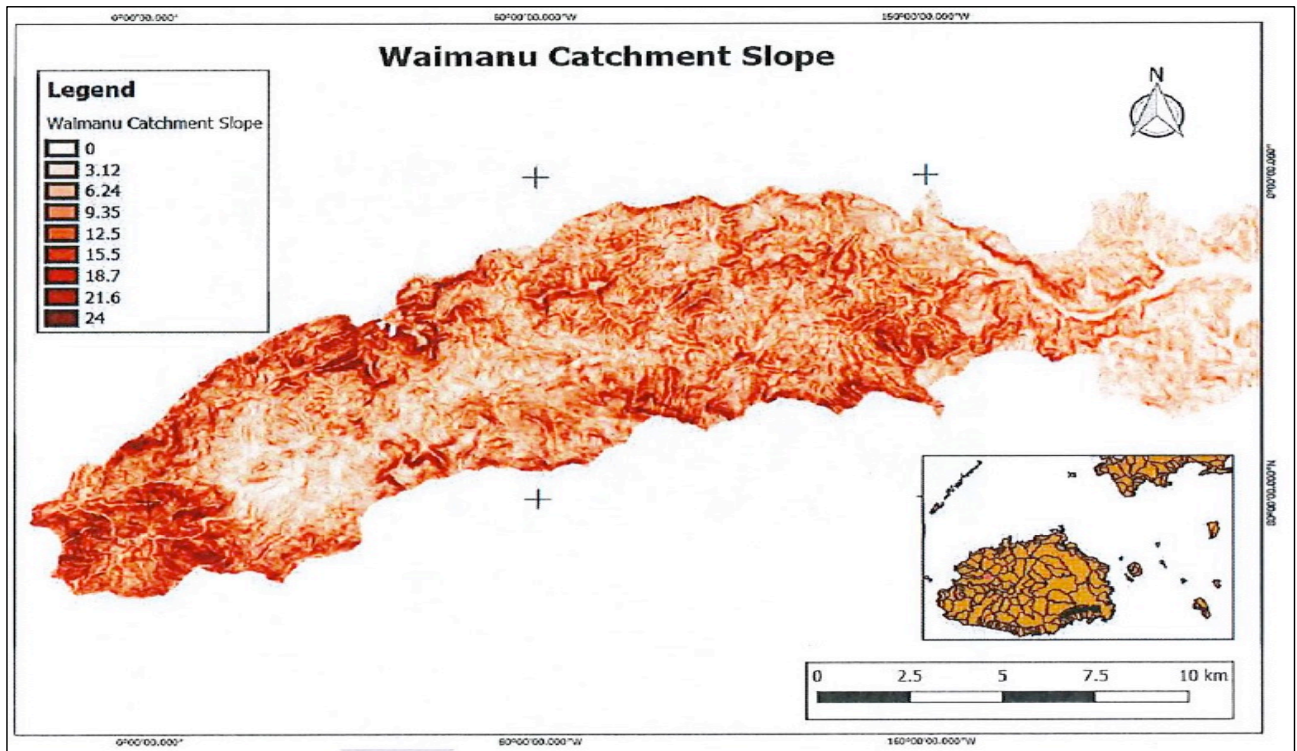


Figure 3: Illustration of the Waimanu Catchment Slope. Adapted from "Problem Analysis and Catchment Characterization" (Singh, 2017).

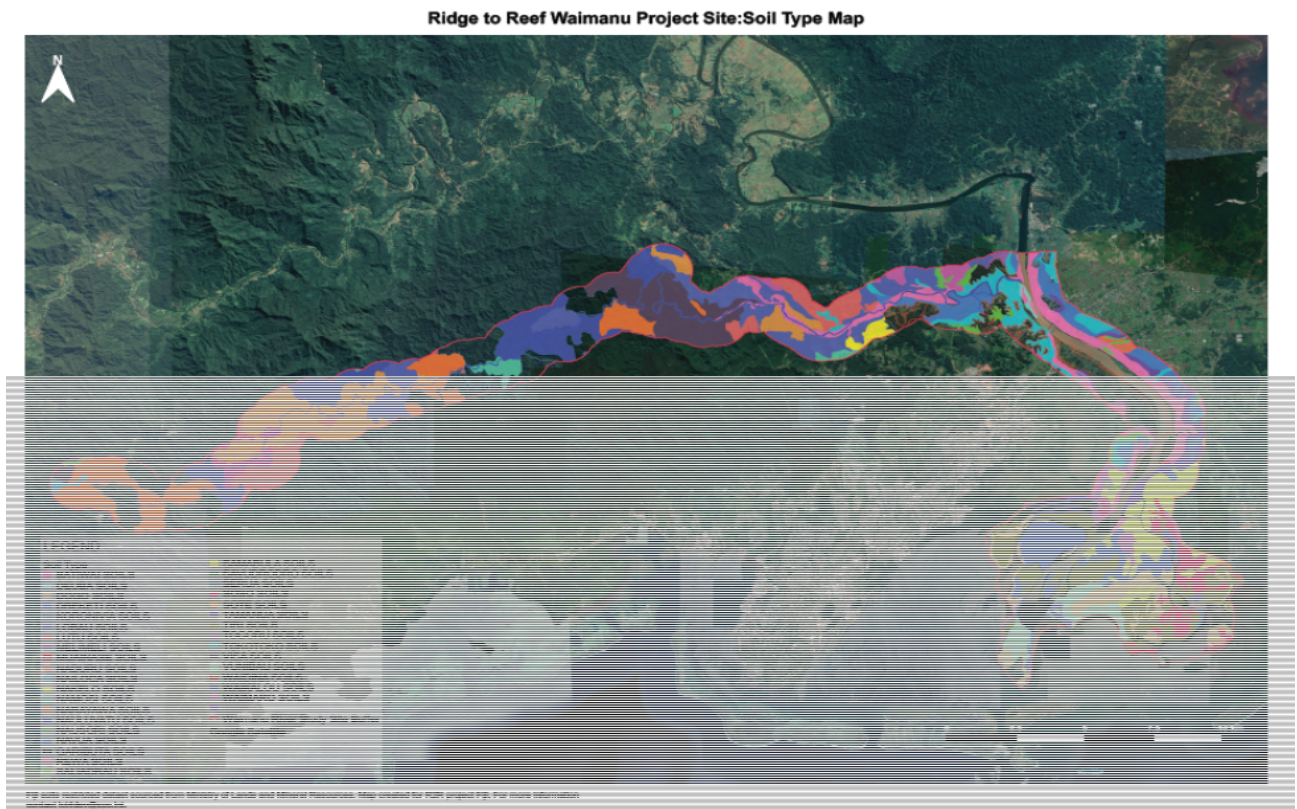


Figure 4: Soil map of the Waimanu river and Rewa river [Source: Ministry of Lands and Mineral Resources]

Throughout the year, Fiji is known to have distinctive dry (May to October) and wet (November to April) season<sup>1</sup>.

1 <https://www.met.gov.fj/>

### 3.4.3 Rainfall and Temperature

According to the annual average rainfall at the Nausori airport (located approximately 5 km from the lower Waimanu catchment), the catchment receives about 3,000 mm. The graph table adapted below showing the temperature and rainfall records for the Central Division including Nausori from December 2016 to December 2017 (Figure 6).

The average rainfall for the Central Divisions including the Waimanu catchment, Rewa River and Delta shows the maximum precipitations recorded during the months of November through March (wet season) and minimum during July and August (dry season) (Ilaitia, 2018). In-addition the catchment received a uniform annual rainfall of 100mm - 400mm from the previous year dating 1971 – 2000 (Figure 7) with a sharp rise in rainfall in the current years. The rainfall peaks in March and is minimal in July. The seasonal nature of rainfall is evident with March being the wettest month and June is the driest month.

There is a large disparity between the wet season maximum monthly rainfall and dry season maximum monthly rainfall. Moreover, rainfall trend analysis studies carried out by (Kumar 2010) further illustrate high inter-annual variability at studied sites. It is evident that the frequency and severity of extreme events has increased in the last decade.

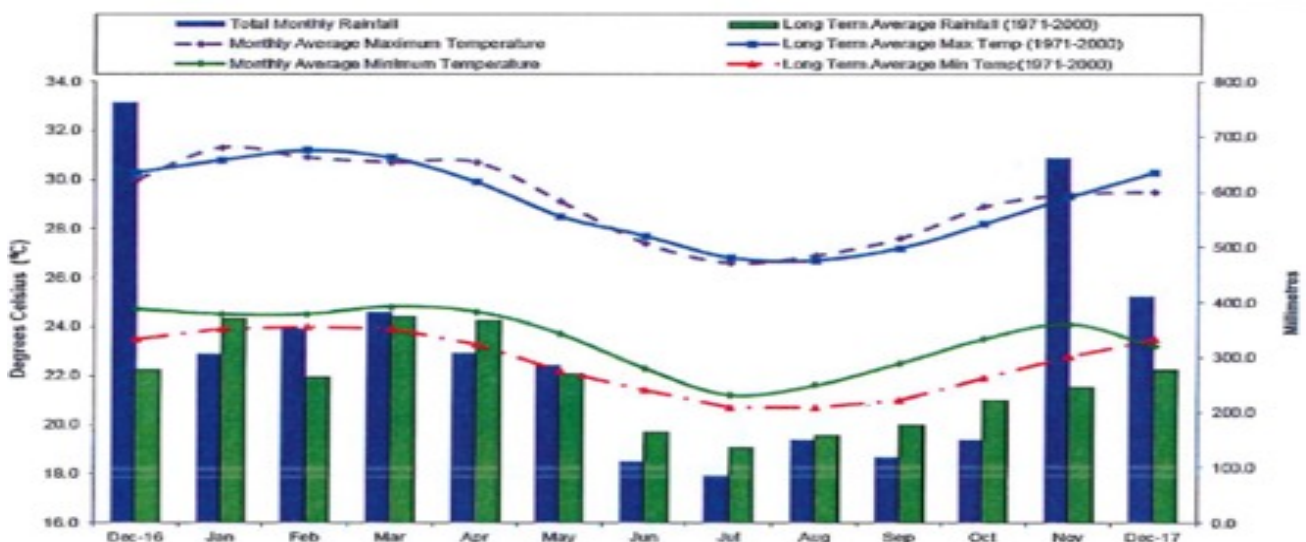


Figure 5: Record of temperature and rainfall records for the Central Divisions, including Nausori, from December 2016 to December 2017 [Source: Singh, 2017]

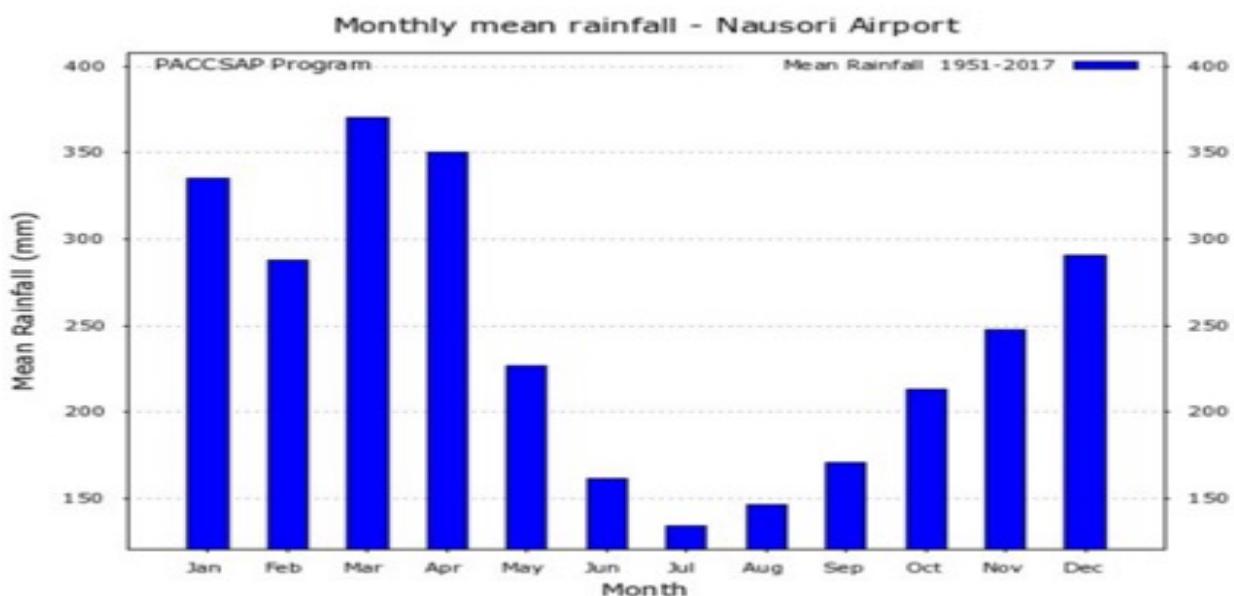


Figure 6: Long term average monthly rainfall at Nausori airport station between 1951-2011. [Source: Singh, 2017]

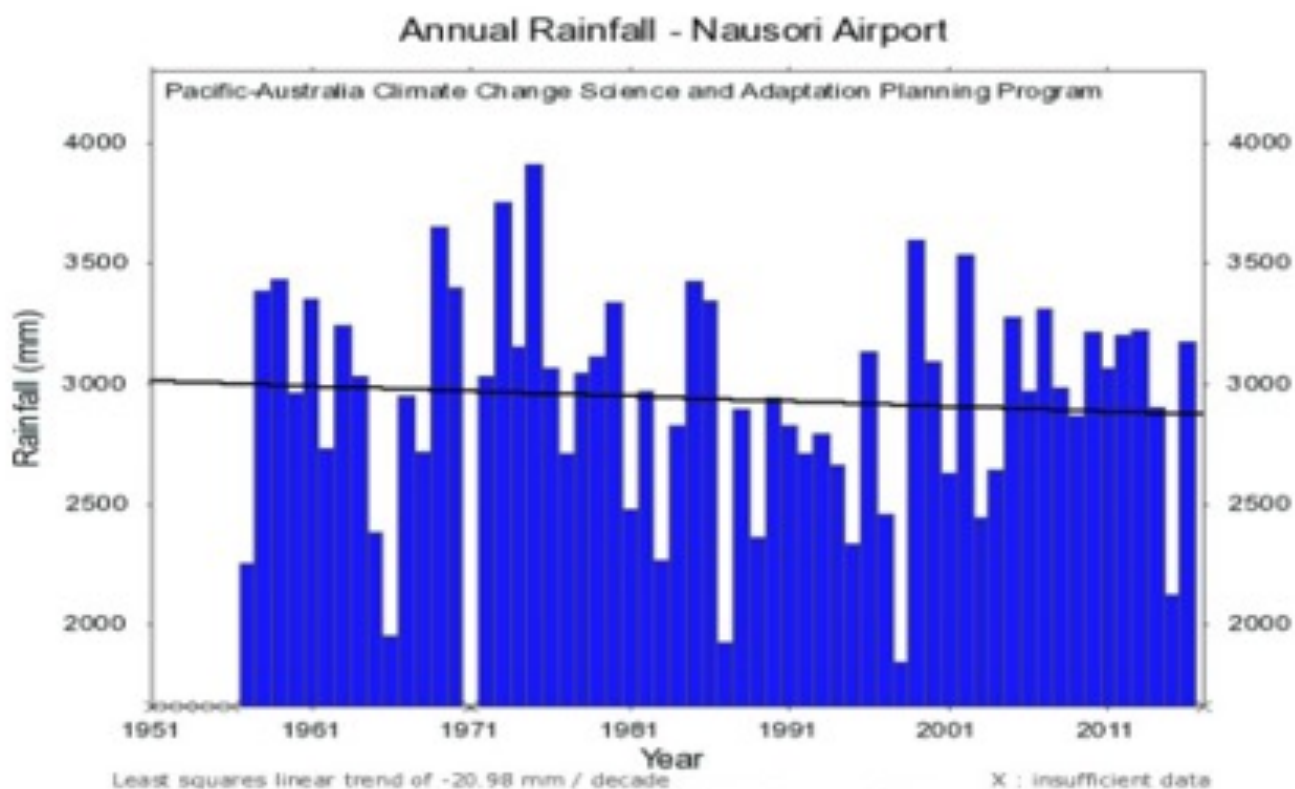


Figure 7: Annual rainfall and associated rainfall trend for the Nausori airport stations for the period (1951-2017) [Source: Singh, 2017]

The last decade (2000-2011) has been wetter than the period 1980-2000. The inter-annual variability highly correlates with the onset of El Niño Southern Oscillation, which influences the rainfall especially on the ‘dry’ side of the larger islands during El-Nino events (Kumar 2010, Singh 2017). While the consequence of such trend on the water availability cannot be ascertain as part of this analysis, further research is required to better understand availability of raw water in such condition.

The whole Rewa catchment receives rainfall in the range of 2,500–4000 mm annually, one of the highest for Fiji. The trend analysis for stations in the Waimanu catchment cannot be ascertained due to non- availability of consistent long-term data with the catchment.

The highest single day rainfall event was recorded as 136 mm on 02/01/2016. The total rainfall during the TC Winston was 122 mm, with the peak water level of 5.47 m, recorded on 20th – 21st, February 2016. Note water levels for telemetry stations including the Waimanu station are measured as heights above fixed benchmarks at the gauging stations and not above mean sea level (a.m.s.l). Gauging stations along Waimanu River are indicated in Figure 8.

The long term (1971-2010) discharge and water level is given in Annex 1. Historical notable events are listed in Table 1. The highest discharge and water level has been recorded during TC Martin in 1986 with 10,982 m<sup>3</sup>/s and 10.48 m a.m.s.l.

Table 1: Peak discharge and WL at Waimanu Pump Station

Date	Peak discharge at Waimanu Pump Station	Water Level at Waimanu Pump Station	Event
1980 04 Apr	6,516	9.13	TC Tia+Vally
1986 19 Apr	10,982	10.48	TC Martin
1993 03 Jan	6,265	9.25	TC Kina





Figure 8: Gauging locations at the Waimanu Catchment

### 3.5 Natural Vulnerabilities

Historical trend analysis of cyclone/hurricane indicates that about 3-9 cyclones hit Fiji per decade with an average of two to four causing severe damage (Ilaitia, 2018; Raj, 2004). The most powerful cyclone to have made landfall in Fiji followed a strong 2014-2016 El Nino event – TC Winston with a restoration bill of \$2.9 billion FDJ. 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 9. 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).

Adaptation measures are restricted to identification of flooded areas and escape routes, identifying new evacuation centers, strengthening infrastructure, and improving techniques of forecasting. Identification of flood prone danger zones for future restrictions (Raj, 2004). Although major climate-related events such as cyclones have led to many injuries and death it is indirect and diffuse effects of climate-sensitive health risks which are seen as of highest priority in Fiji (McIver, et al. 2016). Four climate-sensitive diseases common in Fiji include dengue fever, typhoid fever, leptospirosis, and diarrhea (McIver et al., 2012). Fiji tends to experience diseases outbreaks following floods and or cyclones (GoF, 2017).

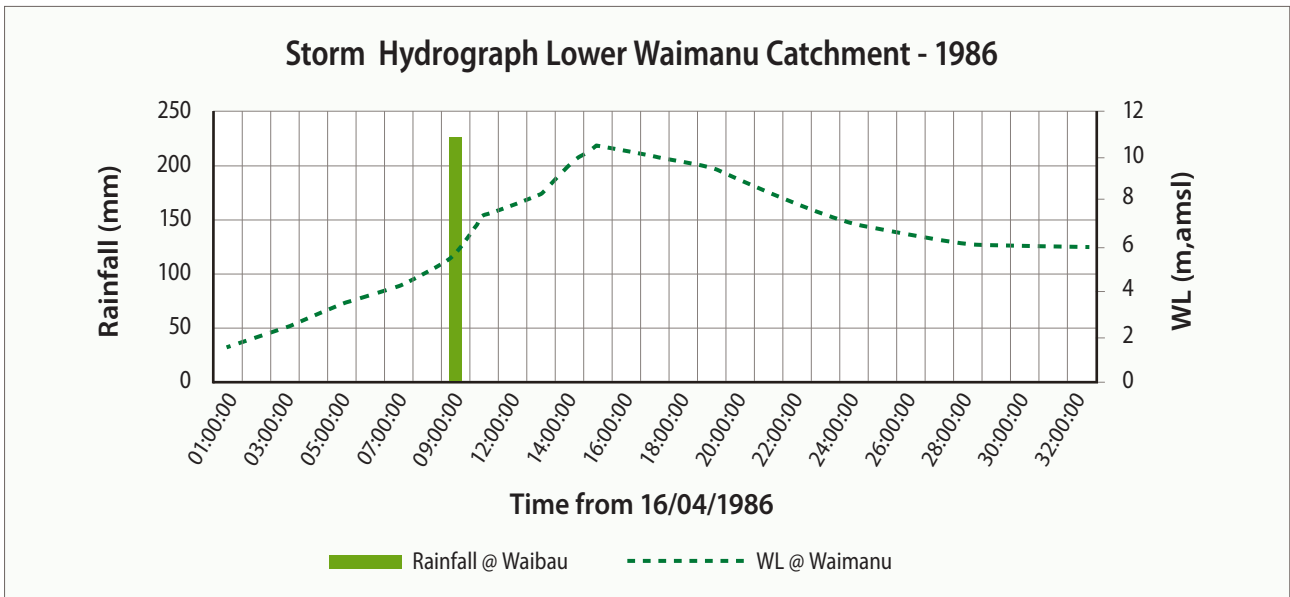


Figure 9: Trend in water level during Tropical Cyclone Martin - 1986



Planting vetiver grass at Waimanu River as a solution for riverbank stabilisation and erosion control.

## 4 Methodology

### 4.1 Data Collection

#### 4.1.1 Literature review

Undertakings of a literature survey and review to capture existing knowledge and gaps of a specific subject area. The private and public domains have been the sources of these activities with a range of literature that will require selective actions of the surveyor to itemize relevant information to the subject area. During this phase, two key criteria guided the process: 1). relevance of the literatures 2). Reliability of the sources of literatures.

At inception, a literature review was undertaken by the project team to scope and access as many documents about the Waimanu catchment, as possible. Technical contributors, who were part of the project team, were relied on with confidence to provide their selected references on the subject area of specialty as per their respective terms of reference.

In addition, the project team reached out to several Fiji government ministries for key national documents concerning the Waimanu catchment. The survey included reaching out to the Ministry of Waterways and Environment (MoWE), Water Authority of Fiji (WAF), Fiji' provincial offices, private and public stakeholders including a few private consultants that have had working exposure in Waimanu catchment through arrangement with either government or private sector. In most instances, the availability of past and recent documents was the main literature available to evaluate information required for the analysis.

#### 4.1.2 Terrestrial habitat assessment

Rapid Biodiversity Assessment (RAP) is the tool used to carry out terrestrial assessment in priority areas to gather information on the current biodiversity of any given area. In the past, Conservation International's Rapid Assessment Program (Bio Raps) has been instrumental in collecting baseline assessments in critically important sites across Fiji's main islands, particularly Viti Levu. The expeditions involve core scientists and technical support teams to lead respective surveys and synthesize assessments of the areas concerned.

According to Fiji's Biodiversity RAP lead, Mr. Tuiwawa, the terrestrial habitat assessment of the Waimanu catchment is comparable to the geographical and physical attributes of adjacent catchments, particularly the upper Waimanu. Documented assessments within these parts have been recorded by scientists that describe similarities that is likely to occur within the Waimanu, where creek elevations begin at about 40m a.s.l. and progresses to about 200m a.s.l., with isolated peak area at 700m a.s.l. Typical physical attributes coupled with high rainfall and mean annual temperature are likely to have these areas share similar habitual traits.

An example of adjunct catchment areas, similar to the Waimanu catchment, is part of the Sovi Basin conservation area. The Sovi Basin encompasses several catchment creeks that drains off into the conservation area namely: the upper and mid portions of the **Wainavadu catchment creek** with elevation from 95m a.s.l. to 500m a.s.l.; the lower section of the **Waisoi catchment creek** – that now has roads and drilling activities, associated with mining explorations at altitudes higher than 600m a.s.l. that extends into the steeper slopes of the Korobasabasaga range into the large forest blocks of intact primary forest; the **Wainasavu creek catchment**, located near Waivaka village, that is now also heavily disturbed from human habitation and farming. Along the southern slope of Mt. Delaimatauca is the only intact forest system and the main headwater of the Wainasavu creek; the Sovi basin creek, **Wainavalau creek**, is found at 95m a.s.l. up to 800m a.s.l. being made up of the lowland and upland vegetation.

Further, the rock cliffs of the Korobasabasaga range have been known to be a habitat of unique significance. The summit (1107m) together with some of the lower (679m) peaks and ridges support small areas of cloud forest (normally found in elevations above 800m, although some have been reported from mountain top from much lower elevations like Mt. Korobaba (25km southeast of Waisoi Base camp) at 400m elevations (Kirkpatrick and Hassal 1985). For the Wainakatama creek and the Waivaka/Wainamanumanu creek their creek elevation begins at around 250m to around 500m and 70m up to 450m with surrounding mountains attaining heights of up to 600m. The forest system surveyed that were nearer the coast is what is referred to as the Naikorokoro Catchment (comprised of the Wainaburu creek near the Naval base at Kalokolevu) and a creek system near Monfort Boys

with creek elevation starting at around 15m to 90m with surrounding peaks (Mt. Kaname, Joske's thumb, Mt. Korobaba) at around 400m. It should be noted that all these forest systems are Lowland water catchment and that some are most likely to have Upland and Cloud Forest systems.

### 4.1.3 Water quality assessment

In recognizing the importance of water quantity and quality while noting the importance of land use for local farming communities against the larger national interest in water security (drinking water), we resorted to using a Freshwater Health Index (FHI) to trigger conversations about the appropriate indicators to measure, management effectiveness overtime based on current adverse situations in the Waimanu Catchment.

Despite decades of research and interest in assessing sustainability of freshwater systems, no clear approach is available to transparently assess trade-offs in a rigorous manner. The FHI aims to address this gap and provides a tool that can diagnose how social, hydrological, and ecological systems interact to provide critical ecosystem services. The framework for FHI aims to identify priorities that will ensure balance in the social, economic and political with biophysical context while recognizing the importance of water dependent factors that influence the above parameters. The framework assumes that the stakeholders set and respond to agreed rules that will govern ecosystem modification (for development) and the distribution of benefits to the beneficiaries who are part of the stakeholders. There are three main components to the freshwater health index including (1) ecosystem vitality; (2) ecosystem services and (3) governance and stakeholder. Each of these components is assessed with a suite of measurable indicators that are aggregated into an index. 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). See Figure 10. Developed by Conservation International, the Freshwater Health Index synthesizes a range of indicators to provide simplified and better understanding of the interface between habitat protection, ecosystem services and human development.

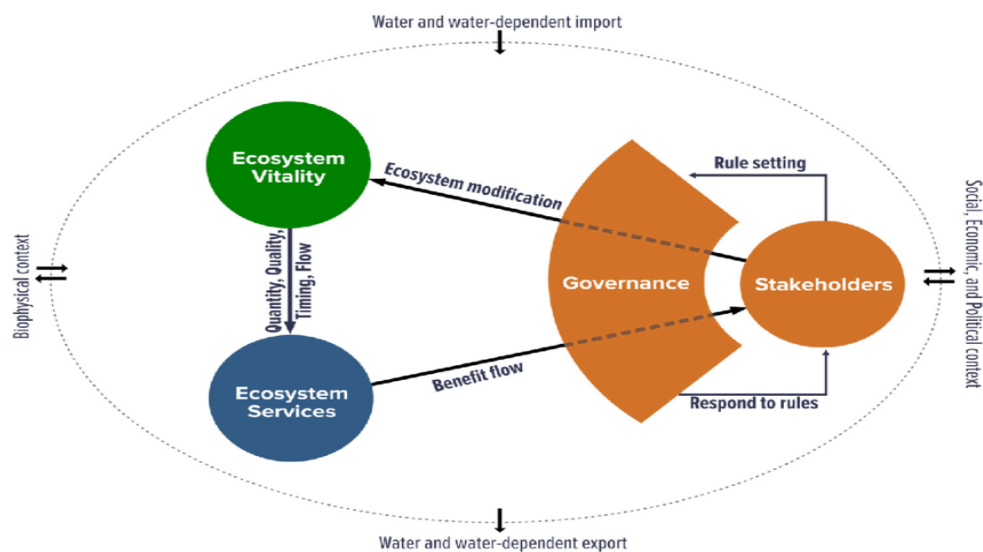


Figure 10: Conceptual Framework of the Freshwater Health Index [Source: Vollmer et al. 2018]

The web-based tool was used in this analysis to assess stakeholder responses to priority issues in Waimanu Catchment. A rapid survey was undertaken through a virtual workshop to introduce the FHI Conceptual Framework and invite respondents to undertake the survey online. Four out of eight expected respondents were recorded. Expected respondents included representatives of four Government agencies, two statutory bodies and two local community representatives. Each of these components is assessed with a suite of measurable indicators that are aggregated into an index. The Freshwater Health Index (FHI) synthesizes a range of indicators to provide simplified and better understanding of the interface between habitat protection, ecosystem services and human development (Vollmer et.al. 2018). For, the purpose of this work, FHI is discussed in the same lens as the Regional Guideline for Implementing the (modified) R2R Science to Policy Strategic Framework (SPC, 2021). Comparison of the index used under each model is listed in Table 2.

Table 2: Comparison of Indicators under R2R and FHI

Freshwater Health Index		SPC R2R Indicators
Governance & Stakeholder	Enabling Environment	Legislation
	Stakeholder Engagement	Traditional Governance Coordinating Mechanism Stakeholder participation NGO & CBO Activity Knowledge & training
	Vision & Adaptive Governance	Management Plan
	Effectiveness	Risk Management
Ecosystem Services	Provisioning	Demographics Human Pressures on habitat Exploitation of living resources
	Regulation & Support	Pollutants & Introduction
	Cultural	Coastal Protection
Ecosystem vitality	Water Quantity	Habitat Quality
	Water Quality	Water Quality Habitat Quality
	Basin conditions	Abundance Shoreline stabilisation
	Biodiversity	Diversity Biodiversity Hotspots (Coastal and catchment) Species Health



Planting vetiver grass Waimanu River for riverbank stabilisation and erosion control

# 5 Diagnostic Analyses

## 5.1 Scope and objectives

The scope, objectives and responsibilities pertaining to the focus area under investigation include:

1. identify and prioritize the challenges and problems associated with the Waimanu catchment;
2. gather and interpret information on the environmental impacts and socio-economic consequences for each problem;
3. analyse the immediate, underlying and root cause for each problem, and identify specific practices, sources, locations, and human activity sectors from which environmental degradation arises or threatens to arise. Identify and evaluation of options for reform and arise.

## 5.2 Issues, problems, and impacts using problem-tree and causal-link analyses

### 5.2.1 Ecosystem Vitality

It is important to understand the effect of surrounding environment on the catchment area as water has an impact on its quality. According to literature, there have been three main sources of threat to the water quality of the catchment, namely the agricultural areas, agricultural chemicals and quarry effluents, and the low standards of septic tanks and livestock management. While farming and agricultural fields are a common occurrence, especially in the lower catchment, it still poses a great risk of contaminating the river by stirring up sediments and animal feces thus contaminating the water quality of the catchment (see Section 5.2.1.2). Agricultural chemicals and quarry effluents too are equally common contaminant sources that have been known to pollute river systems and so lowering the quality of water received from the catchment into treatment plants. Additionally, the low standards of septic tanks and livestock management in communities and settlement as well as other aggregate group is another concerning threat affecting quality of river water. The water quality index is an indicator of the water quality of the catchment that measures suspended solids, total nitrogen, total phosphorous and other quality parameters. The measure and monitoring of water quality are administered by WAF.

Similarly, there are two water intakes from the Waimanu river that is facilitated by two water treatment plants i.e., the Tamavua and Waila plants. The Tamavua treatment plant holds a capacity of 60ML per day with an intake of 55ML per day while the Waila treatment plant holds a capacity of 100ML per day with an intake of 96ML per day. With reference to the Freshwater Health Index (FHI), the indicator to monitor water intakes assesses any deviation from natural flow regime and groundwater storage depletion.

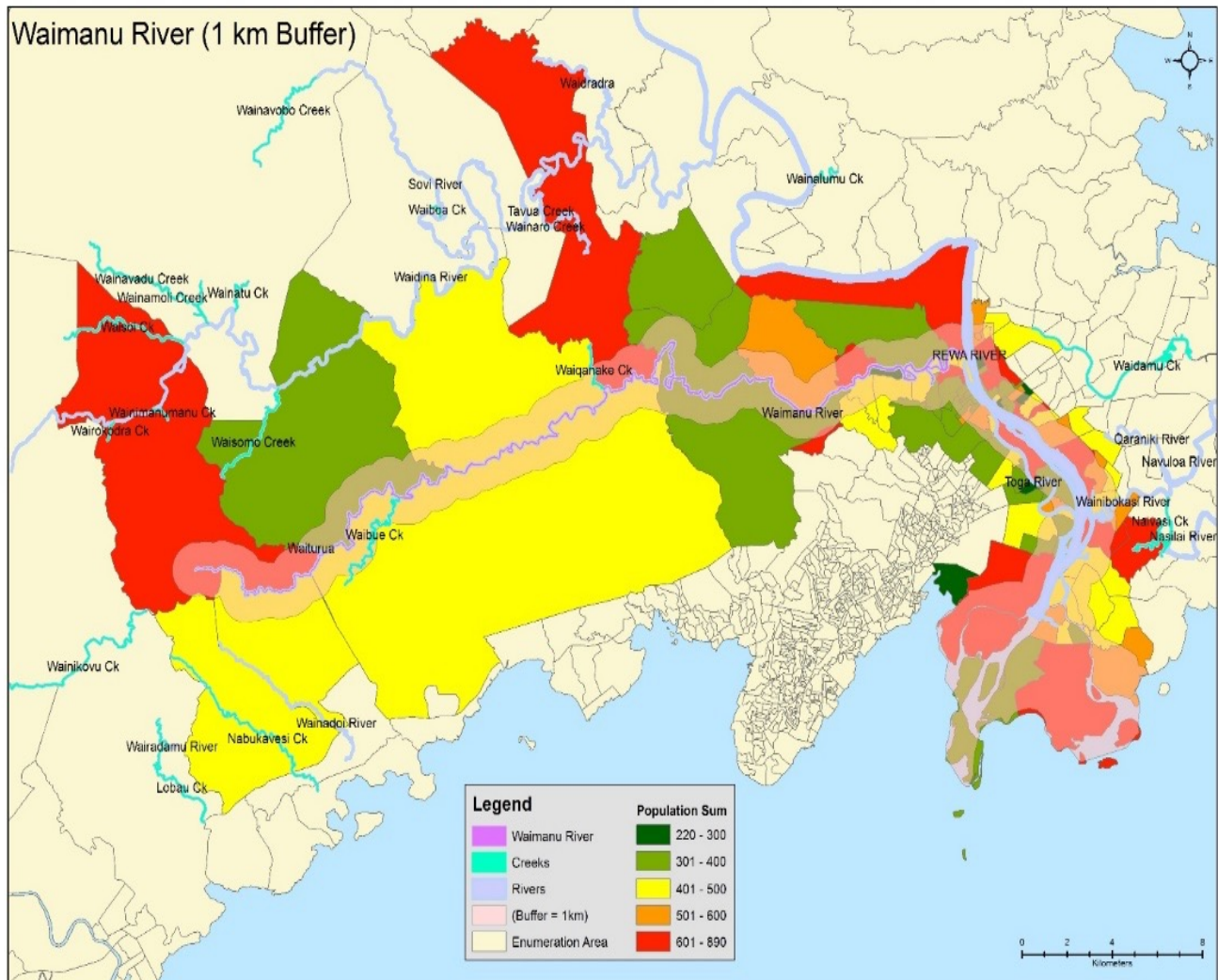
Drainage of basin condition is also an important factor that is responsible for the movement of water and sediments from the upper to lower reaches of the catchment. Erosion becomes a concerning factor considering the steep terrains that are prone to landslides throughout the catchment. Currently, there is minimal anthropogenic influence on re-shaping riverbanks although conditions can rapidly change should development continue to grow unmonitored. The FHI recommends the use of these indicators to monitor basin conditions: bank modification, flow connectivity and landcover naturalness.

Biodiversity is another thematic area of assessing ecosystem vitality of the Waimanu catchment. According to the Rapid Resource Assessment (RRA) survey, there are three main key threats that jeopardizes the vitality of biodiversity i.e., land use change that involves incursion of farming and agricultural land units into natural forest areas; rate of infrastructure development and the lack of policy, regulations and laws that advocates water conservation. With reference to the FHI, the indicators to monitor biodiversity are species of conservation concerns and occurrence of invasive species.

In accordance with the problem analysis trees derived from the literature survey, we identified the environmental and socio-economic problems associated with the Waimanu catchment. On the socio-economic aspects, we looked at two concerning factors: 1) the population and demography and 2) Waste management and improper sanitation systems. Problems associated with 1) Biodiversity and 2) Development in the agriculture, farming and forestry sectors is discussed from environmental aspects.

### 5.2.1.1 Population and Demography

In a recent review of Fiji's national census in 2017, the population and demography of the Waimanu catchment area have shown an increasing trend in occupants at an estimated 13,000 people. Population have been reported as heavily been concentrated along the upper catchment of the Namosi area, the source of the Waimanu river, yet there also has been a well-balanced spread along the Waimanu river over the years.



**Figure 11:** Population distribution around the Waimanu river, Rewa river and Rewa delta [Source: Census of Population and Housing, 2017]

In addition, occupancy have been reported to comprise predominantly of villages and settlements. Indigenous villages host clans that own land areas in Waimanu Catchment while settlements consist of lease holders who rent land and issued land titles through consensus of the indigenous landowners through the iTaukei Lands Trust Board. Gravel extraction and other business licenses is issued by the Ministry of Lands and Mineral Resources. Community stakeholders that own land in the upper Waimanu live in customary villages of Lomai, Nabukaluka, Navurevure and Nasirotu which are located outside the boundary of the Waimanu Catchment. There are also four registered schools within the Waimanu Catchment area. The total population within the catchment area is estimated at 13,000 people (Fiji Bureau of Statistics, 2017). See Figure 11 for distribution patter of population in the Waimanu catchment area. Accordingly, the catchment has been facilitating and delivering water to 244,000 (UNHSP, 2012) people living in the greater Suva area that receive water from the Waimanu pump administered by Fiji's WAF. Raj (2004) reported the Waimanu pump draws an average of 36 000m<sup>3</sup> per day while the pumping station located at Waila pumps 90 000 m<sup>3</sup> per day. The catchment's critical function of water supply to key central business district (CBD) areas on Viti Levu has been a widely accepted reason to support efforts of preserving the water source.

### 5.2.1.2 Waste Management and Improper Sanitation Infrastructure

Waste management has been reported to be at a level of poor practice, management by rural communities and other occupants of the Waimanu catchment. Concerns are raised in a proposed baseline report by the MoWE (2019) noting that villages in the lower section of the Waimanu catchment have low standard of living entailing poor hygiene standard practices and inadequate community management of waste materials and disposals. According to the report:

1. Vuniniudrovu village in the district Naitasiri has a total of 138 individuals (77 women, 61 men) whose main water source for drinking, cooking, bathing, and toilet is through the grid Public Works Department pipeline – sourced from the Waimanu river. Despite the village having rubbish pits and individual household dumping rubbish area, there is record of only a few households managing its waste with rubbish trucks not visiting the village simply due to the fact that the village lies in the rural sector where organized rubbish collection is not practiced. Also, food wastes are not separated from other waste materials and were instead collectively placed into the village dumping area by some villagers while the majority use it for manure, food for pets and other breeding animals such as pigs. Cans and plastic waste are either buried, burnt, or found as litter the village compound. Grey water from households or wastewater is noted to flow through the village and collectively ends up at the edge of the village and into the main Waimanu river. The village water ditches are channeled out either to the river or the drain outlet at the center of the village. Sanitary waste outlets such as septic tanks are placed close to the river. Main livestock in the village is free-range chicken that are not fenced.
2. Similarly, the second village of Navatuvula village in the district Vuna has a total of 222 individuals with a total of 47 households. While the village has rubbish pits and individual household rubbish dumping area, the village currently does not have a collective village dumping site nor rubbish trucks accessing the village due to remote rural setting. In terms of the wastewater flow through village, there is more or less good flow of water and proper drainage of water to flow through the village which all collectively ends up at the edge of the village and the main Waimanu river.
3. **Table 3:** Summary of Stakeholders in Waimanu Catchment

Name of District	Total Area in District (Ha)	Total Area in Waimanu Catchment (Ha)	No. Mataqali in Waimanu Catchment (LOU)	Total Area under lease in Waimanu Catchment (Ha)	No. Leases in Waimanu Catchment
Naitasiri	21,472.82	3,348.69	56.00	1,105.01	363 leases mainly Agricultural, Residential, Forestry, Educational, Tourism, Commercial, Government Stations, Water Mineral, Others [Religious, Access Way, Way Leave]
Vuna	4,702.85	3,998.44	23.00	1,812.75	299 Leases mainly Agricultural, Residential, Forestry, Educational, Tourism, Commercial, Industrial, Government Stations, Water Mineral, Others [Religious, Access Way, Way Leave]
Waidina	46,408.93	6,360.76	50.00	none	none
Veivatuoa	16,274.91	653.15	7.00	none	none
Suva	18,008.30	4,786.95	46.00	83.94	3 leases; 1 from Government and 2 are to be confirmed by TLTB
<b>TOTAL</b>		<b>19,148</b>	<b>182</b>	<b>3,002</b>	<b>665</b>



In the event these poor hygienic practices continue and escalates to concerning warning level, the repercussions are likely to target health risks and associated social issues and insecurities of communities.

Similarly, Fiji's State of the Environment in SPREP (2013) and DoE (2014) explain health issues and associated risks due to increasing population, unsafe septic systems and leaking sewage into receiving waters of residing communities within proximity of the catchment. According to the country report (DOE 2014), in spite of the Waimanu river being well oxygenated with low in nutrients and heavy metals there is concern of the occasional fecal coliforms exceeding the guideline requirements (Figure 12) for drinking and bathing that indirectly lowers dissolved oxygen levels and so poses risks to human health (see Figure 13).

Such scenario has been known as the result of increasing population not having the proper management and community infrastructure to monitor effluent discharges into receiving waters. As such, communal outbreaks and pandemics are likely outcome should current waste practices continue to a significant level and poor sewage infrastructures are left with no maintenance and monitoring protocols.

### Problem Analysis Tree

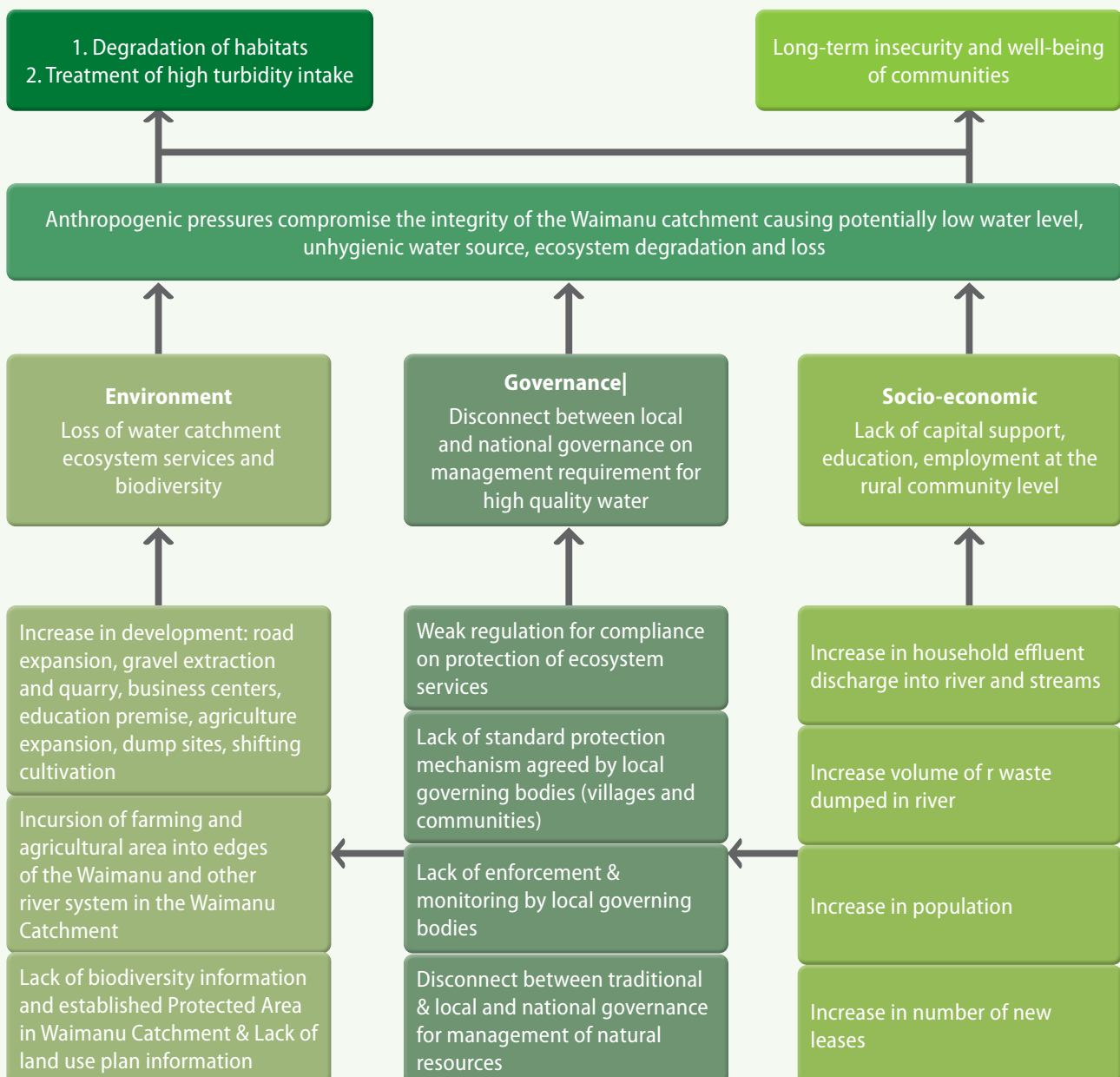


Figure 12: Problem Analysis Tree

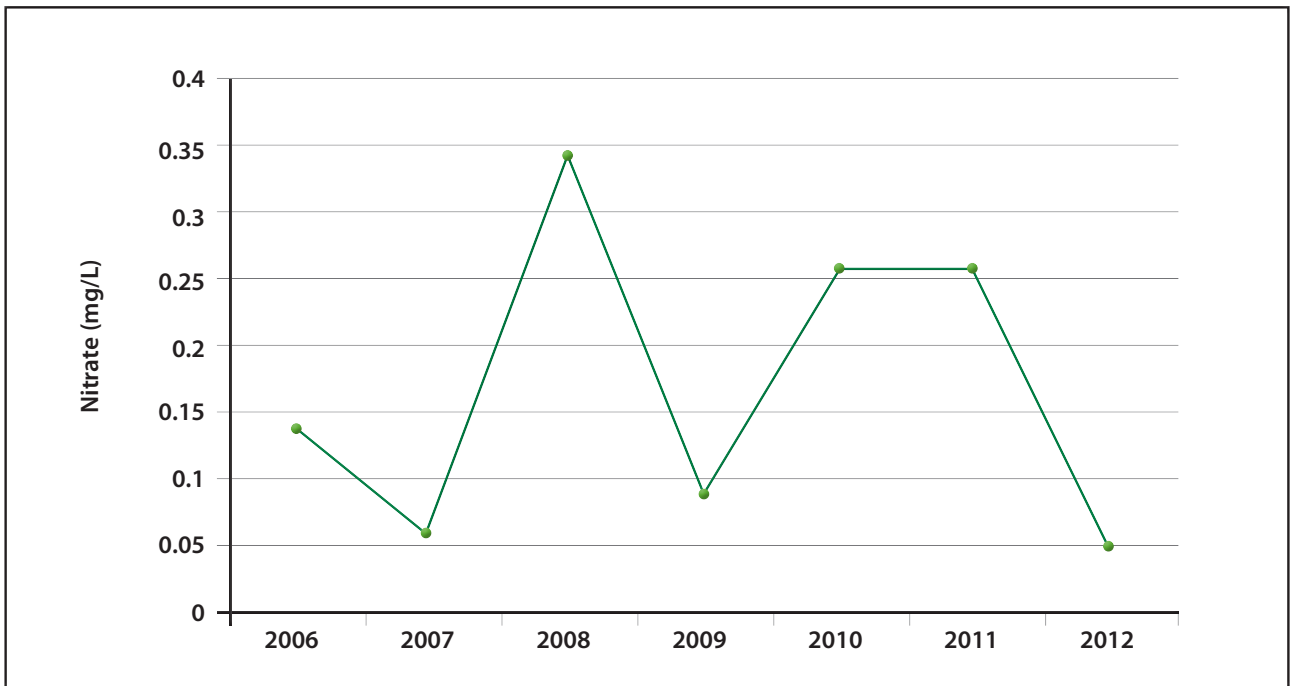


Figure 13: Dissolved oxygen levels in the Waimanu river [Source: WAF]

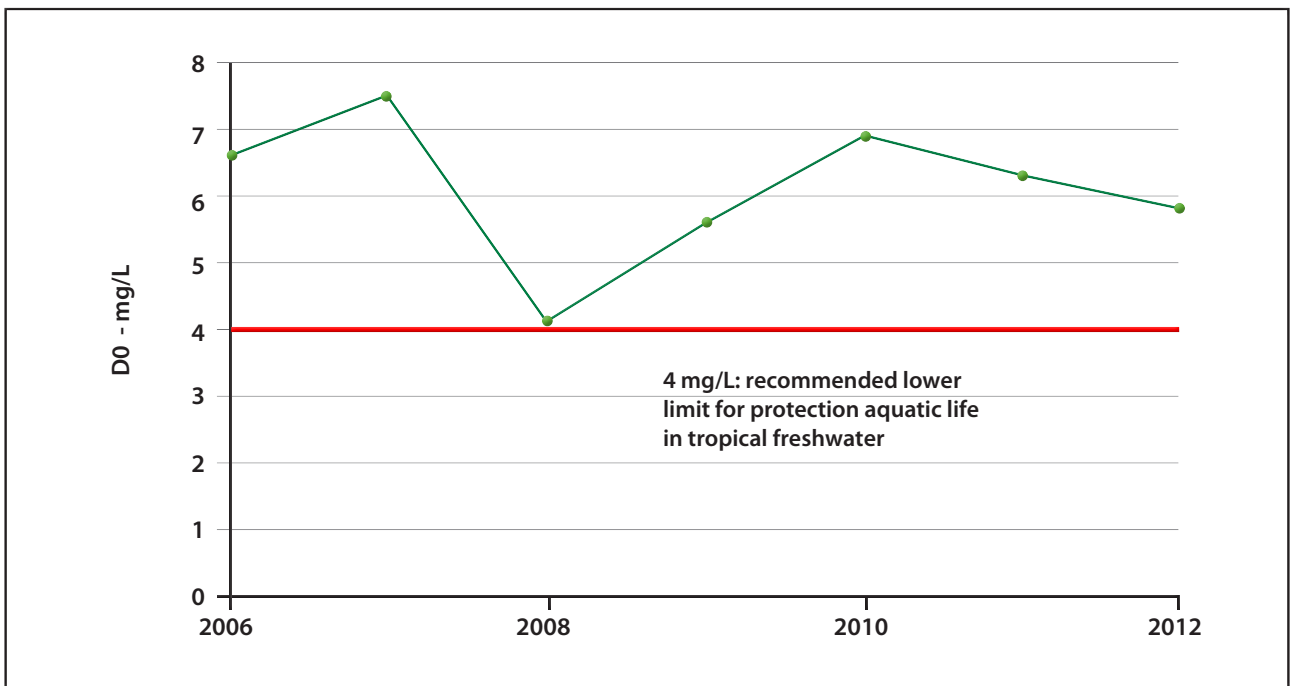


Figure 14: Nitrate levels in the Waimanu river [Source: WAF]

Concerns of build-up of low nutrients and heavy metals along the Waimanu river including the exceeding level of faecalis coliforms that could have human health risks and concerns (see Figure 15). This is likely to come about as the result of increasing population and poor waste management practices within rural communities.

The impact of these activities is that they can lead to the lack of capital investment to support better hygienic practices, employment, and education among rural communities. Health security and the wellbeing of communities are likely to be gravely affected as has been with similar cases in other parts of the country.

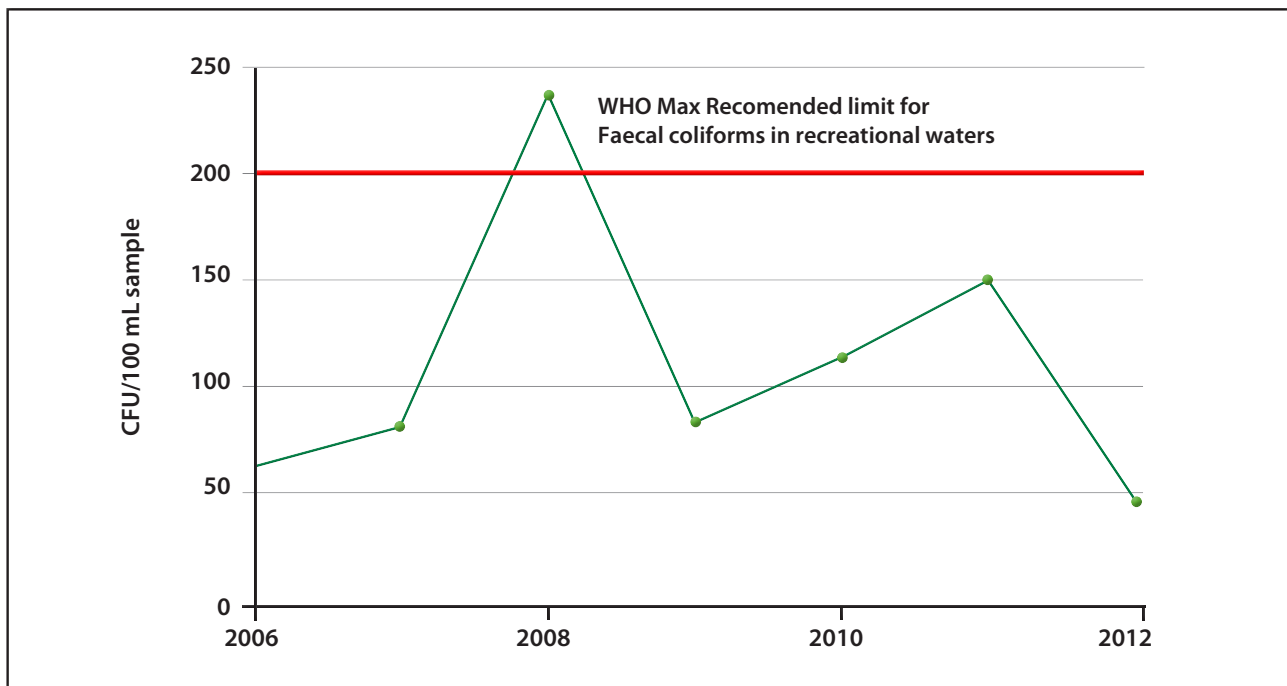


Figure 15: Faecal coliforms in Waimanu river [Source: DoE, 2014]

Having a national socio-economic survey for the catchment is necessary in order to fully appreciate and understand the drivers for ecosystem degradation and to avoid typical health mishaps in the future. As there are currently no specific comprehensive and representative assessments for the Waimanu sites, socio-economic surveys that have been held in other similar sites can be referenced as models to develop comparative community perceptions. For instance, socio-economic survey undertaken for the Rewa catchment under the Ministry of Forestry project 'Community Based Restoration and Sustainable Management of Vulnerable Forest of the Rewa Delta, Viti Levu Fiji funded by the ITTO'. The survey would be most useful in the heavily populated parts of the Waimanu catchment which according to several light demographic surveys lie within the lower parts of the catchment.

### 5.2.1.3 Biodiversity: Fauna and Flora

In the environment front, there has not been any biodiversity study dedicated solely to assessing the Waimanu catchment which has become problematic in efforts to understand the ecosystem vitality of the catchment. Available surveys and studies have been selective and confined to the outskirts of the catchment with only postulations made by experts to determine likelihood of occurrences in the catchment. For the most part, site studies have been mostly in accessible areas such as the Mt. Korobaba, Savura area and Colo-i-Suva, that visually are furthest from Waimanu river and catchment area. The closest topographical and habitual characteristics of the catchment are the anecdote description of adjunct catchment such as the Sovi Basin, detailed by Fiji's biodiversity lead and expertise (refer to section 3.2.3). In addition, faunistic surveys have been undertaken by Birdlife International who have reported conservation species occurrences in selected site of the catchment. A summary of selected relevant findings is listed as follows:

1. With reference to the Rapid Resource Assessment (RRA), the team leader for Fiji's biodiversity rapid assessments describes the use of an assessment criteria to determine the likelihood of species of conservation interest occurring in the study area (Annex 1) of terrestrial protected areas as part of a network of Key Biodiversity Area (KBA) – these includes the forest block of the Sovi Basin, Wainavadu, Savura-Vago (Savura) and Colo-i-Suva Forest Park (Kalabu) (Tuiwawa pers. comm). A tabulation of key references is outlined in Annex 2. These references are important in determining high value plant species for conservation in surveyed forest systems "near or adjacent "to the Waimanu river catchment, as well as list of terrestrial flora species likely to be found within the Waimanu catchment (Annex 1).

2. The Ministry of Environment's (2019) draft report describes a tentative list of birds using various local studies. In the accounts of Important Bird Area in the Savura and Waimanu area by Birdlife International, presence of globally threatened birds having a restricted range namely near Waimanu Catchment include the long-legged warbler, Friendly Ground-dove, Black-faced Shrike bill, Pink-billed Parrotfinch and Masked Shining parrot. These important bird species are found in areas where there has hardly been any development. The more common birds such as the mynahs (*Acridotheres tristis*), bulbul (*Pycnonotus cafer*) and the white breasted wood swallows are also noted with the more common poultry animals such as mongoose, cane toads, cows and common pests can be expected in the lower clear areas.
3. The draft report also mention the occurrence of many freshwater species of eels, prawns and freshwater fish including tilapia in the upper river habitats of the catchment.
4. Olson et al. (2010) lists the Waimanu catchment as a priority forest with a significant amount (75%) of the forest still relatively intact. The catchment, according to the paper, is one of forty priority forest sites that covers 23% of Fiji's total land area and 58% of Fiji's remaining native forest. It has been also identified and recognized to support the Fiji government policy goal in protecting at least 40% of the remaining forest area to achieving its goals under Fiji's NBSAP and action plans towards sustaining ecosystems and ecosystem services for Fijian communities.

However, for the purposes of having a broader appreciation of the biodiversity of surrounding areas to the catchment, a list of selected studies outside the catchment are as follows:

1. The Fiji's Ministry of Environment (2019), cites findings by Ilaitia (2018) in the Verata area of the Rewa corridor where there is mention of: the potential occurrence of the 49 land and freshwater bird species found throughout Viti Levu to which 13 were recorded (generalist species and not of conservation significance) in this particular survey; three species of herpetofauna, although which exact ones are not specified; the widespread and common green tree sink; two mammals, without being specific as to which ones; the mongoose, *Herpestes auropunctatus*; the Pacific Flying Fox *Pteropus tonganus*; the rich kai (*Batista violacea*).
2. Tuiwawa et al. (2018) biodiversity assessment of the Colo-i-Suva Forest Park by Fiji's Bio RAP team of the University of the South Pacific (USP) noted the location of Colo-i-Suva which is adjacent to Vago and Savura catchment; on the peripherals of the southernmost end of the Waimanu catchment. In the assessment, team assessed the plants, birds, insects, and freshwater fauna of the park as part of the "Queens Commonwealth Canopy" project.
3. Kirkpatrick and Hassal (1985) collected samples from Mt. Korobaba and collectively describe 15% of Fiji's local plants. The site is located in the southern most parts of Waimanu.

It can be confidently argued that biodiversity assessment of the Waimanu catchment has yet to take a baseline approach of assessment as there are currently no site-specific study of the catchment to date. Seeing the conservation and economic importance likely presented by the catchment, a biodiversity assessment is needed to provide an in-depth biodiversity overview of the catchment area.

#### **5.2.1.4 Development**

Development is evident throughout the catchment area. It is a contributing factor that is known to be responsible for the high level of soil erosion along the riverbanks. This has been observed as an increasing problem in nearby villages, such as Sawani village, where according to Brown et. al. (1998), Carpenter & Lewadrau (2002); significant levels of sedimentation and nutrient loading are likely to have some level of impact on the water quality of the river system resulting in abundant occurrence of water hyacinths along the river ways – an indication of eutrophication process in the waterways of the catchment.

Chand (2017) and Watling (2017) describe the most recent citing and progressive reconnaissance details of development in the Waimanu Catchment area as follows;

- (1) Farm and Gravel Extraction
- (2) Agricultural practices
- (3) Establishing sanitation system
- (4) Waimanu quarry

- (5) Deforestation
- (6) Establishment of education centers
- (7) Business operations (petrol stations, garage)
- (8) Arterial Road expansion
- (9) Resident households
- (10) Shopping centers
- (11) Waste disposal sites.

The assessment by Chand (2017) was carried out in the upper Waimanu catchment from the Fushun Farm gravel extraction site at the western end of Waibau to downstream of the Waila Pumping Station.

Chand (2017) also cites, the lower Waimanu catchment having been more developed than the upper Waimanu area and so, would require a separate assessment, potential water quality hazards, threats, and actions that WAF could then review to address realistically. In alignment to the sources of environmental problems listed, Watling's draft report (2017), features a preliminary hazard analysis of the Waimanu catchment that assesses a list of activities occurring at the catchment area against potential consequence category.

In total, there are at least seven extraction development sites comprising of two river gravel extraction and five similar operation of extractions/dredging gravel and sand along the Waimanu and connecting Rewa river. The activity entails logging and dredging activities where large stands of forest areas often are completely removed with embankments of dredge spoils and embankment erosion observed further downstream (Tuiwawa, Pene & Tuiwawa, 2013).



Transporting vetiver grass for planting along Waimanu Riverbank

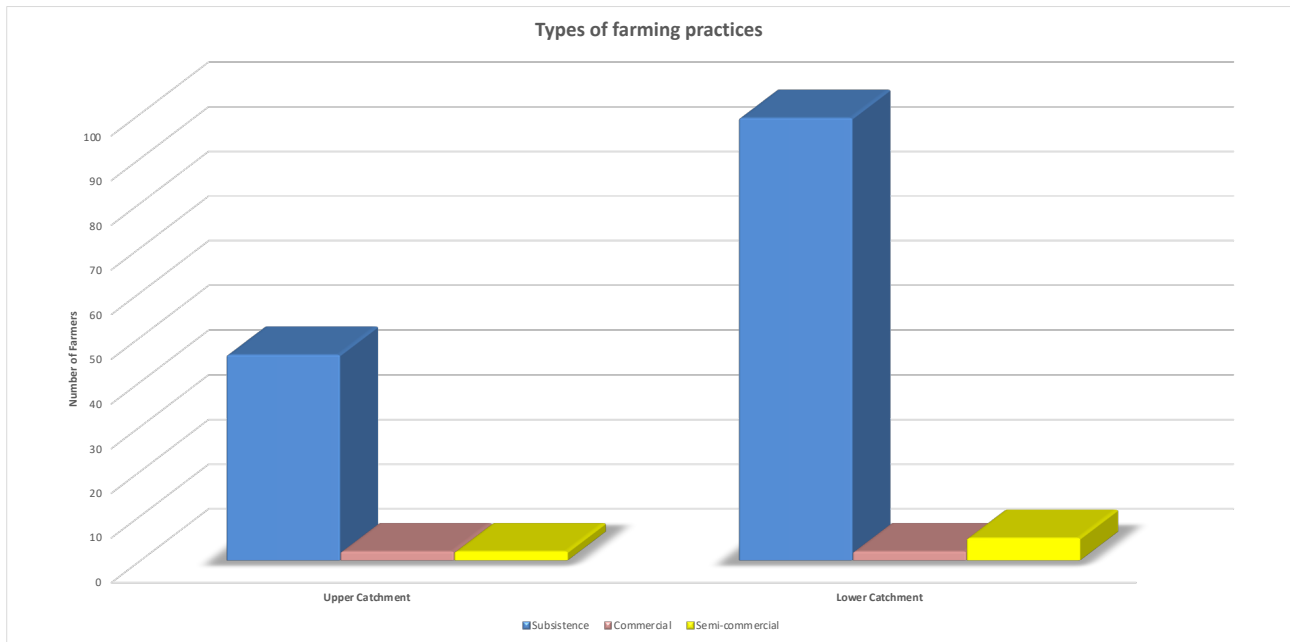


Figure 16: Type of farmers along the Waimanu river. [Source: MoWE, 2019]

#### 5.2.1.4.1 Agriculture and Farming

Agriculture activities in the Waimanu catchment has been growing over the years. Waibau is located at the northern portion of the mid catchment area and is one of the main farming areas for ginger cultivation. Land tenants in the Waibau area practice semi-commercial agriculture. According to Nainoca (1998), the intensity of farming in Waibau has led to major soil erosion of slopes as significant blocks of forest have been removed and cleared for land preparation and harvesting activities. Improper management of forest removal for agricultural and farming purposes is likely to result in: 1) the increase in sediment loads; 2) Alteration in nutrient cycling due to excess nutrient input; and 3) reduction in cover. Additionally, Nainoca (1998) describes two main forms of agriculture: 1) cash crop and 2) subsistence farming. Cash crops is reported have been grown mainly in farming settlements such as Waibau area while subsistence farming is usually carried out by villagers. The mixing of subsistence and cash crop activities among local farmers is also a common practice where those at the roadside of the lower catchment have road-side vegetable stalls as an outlet to local produce hence the use of both subsistence farming and cash crop mix of farming.

There are an estimated total of 500 farmers along the Waimanu catchment with lease area ranging from 0.05ha to 1500ha. MoEW (2019) reports a total of 156 farmers of which there are 50 located in the upper catchment and 106 located in the lower catchment. Discrepancies in number is likely due to potential growth in population. Nonetheless, 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 (see Table 4, Figure 16). The majority semi-commercial are conducted in the lower catchment. The downstream impacts on marine fisheries and coral reef systems are not considered during environmental impact assessment, however evidence from google earth imagery suggests extraction is linked to increased deposition of fine sediments on coral reefs in some locations. Figure 13 shows most of the farmers are subsistence farmers and few are commercial farming.

Table 4: Tabulated data about the types of farming practices along the Waimanu river

Waimanu			
Types of Farming	Subsistence	Commercial	Semi-commercial
Upper Catchment	46	2	2
Lower Catchment	99	2	5

Agriculture leases are predominately at the lower catchment (see Figure 17). Incursion of leased land into the mid and upper catchment could threaten the integrity of water quality of the Waimanu river especially when consent is unmonitored and poorly managed. While there currently has been no logging in the catchment for the past 20 years, anthropogenic development via agricultural leases is most likely to result in severe soil erosion - this even now has been visible along Sawani village and is an increasing problem in nearby villages (MoWE, 2019).

The loss of soil into the river system is another problematic issue that negatively affects the water quality of the Waimanu river. Before now, there have been two separate assessments of soil loss that indicated soil loss at a rate ranging from 53-79 tons per hectare pre year. Hasan (1986) calculated soil loss in the catchment to be 79 t/ha/year giving an erosion rate of 7.8 mm/year. Glatthaar (1988) calculated a value of 53.2 t/ha for the annual mean erosion in the catchment which means an erosion loss of 2.0 or 2.5 mm. Nainoca (1998) study reported soil erosion an intensive activity within the catchment whether by natural and or associated causes (Nainoca, 1998). Together with nutrient-loading, they threaten the quality of water in a river system (Brown et. al, 1998).

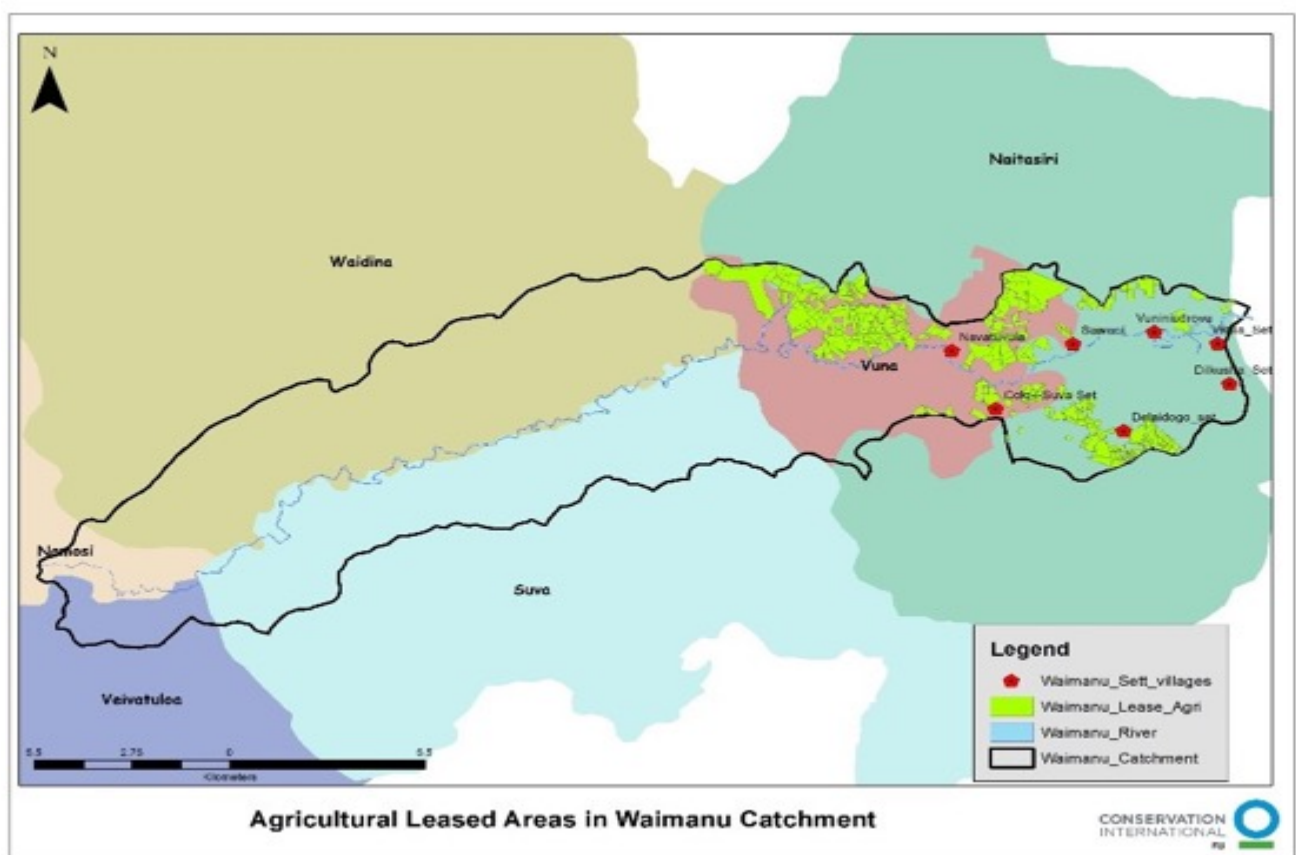
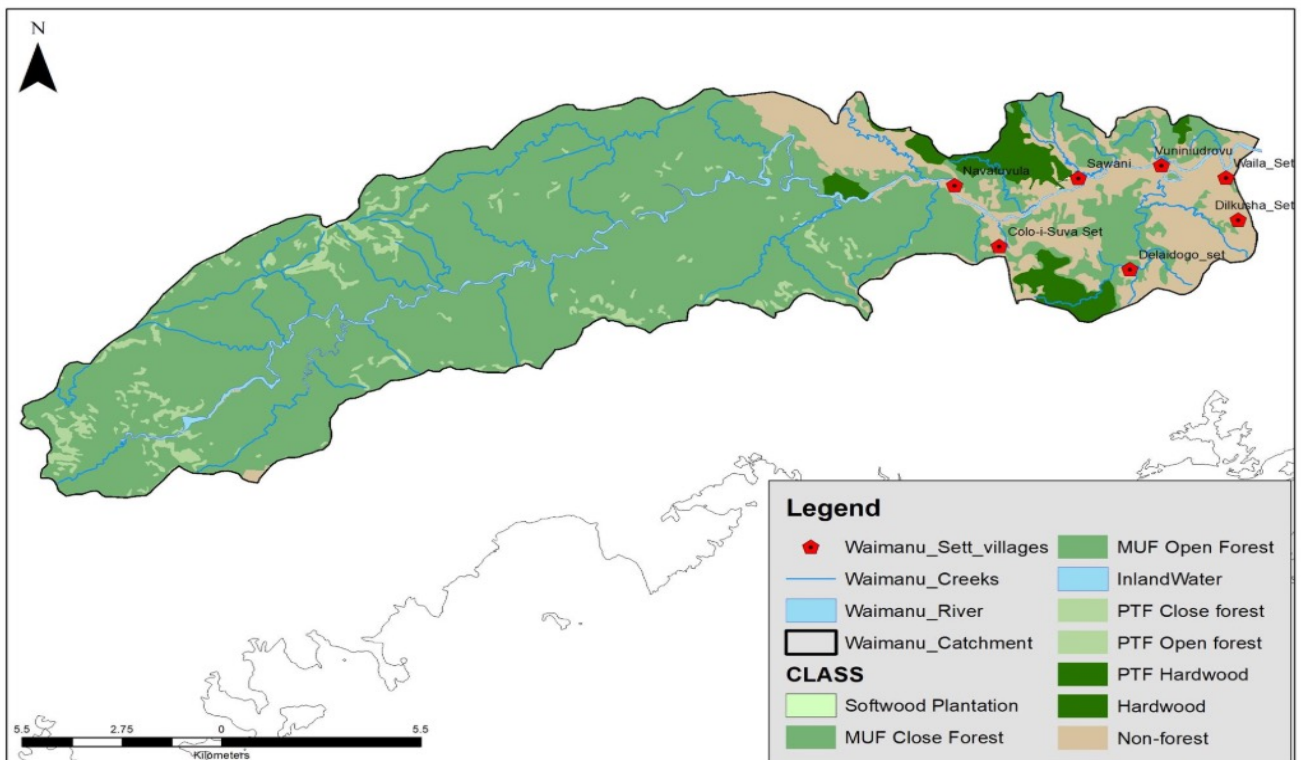


Figure 17: Agriculture Leases in the Waimanu catchment

#### 5.2.1.4.2 Forestry

In the draft report by MoWE in 2019, logging activities was seen to be kept at a controlled level when viewing the vegetation cover map of the catchment (Figure 15, 16). According to Ministry of Forestry timber production or logging has not taken place in the Waimanu catchment for the last 20 years (Rinamalo, 2019).

Concurrently, 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<sup>2</sup> of intact forest area to which Olson et al. (2010) lists the entire catchment 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 forty priority forests covering 23% of Fiji's total land area and 58% of Fiji's remaining native forest (see Figure 18).

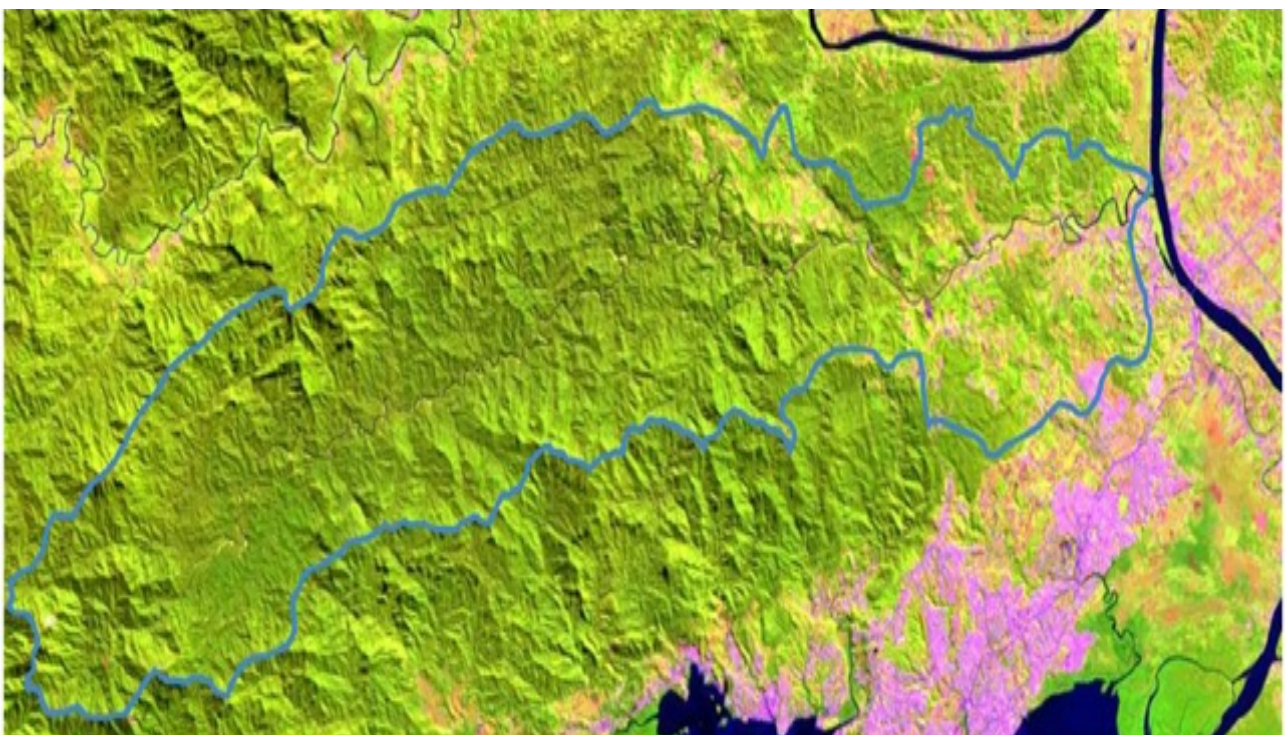


**Map of Waimanu Forest Cover**



**Figure 18:** Forest Types in the Waimanu Catchment

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 which poses a high-risk pollution area affecting the Waimanu River (Atherton et. al, 2005). Furthermore, Singh (2017) shows the forest cover analysis between the year 2000 - 2015 (Figure 19) indicating the forest cover loss of 100 ha (trees with height greater than 5m) in the catchment (Singh, 2017). Further analyses are required to ascertain the changes in vegetation of height less than 5m, and its impact on the hydrology of the catchment (Singh, 2017).



**Figure 19:** Vegetation Cover Analysis for Waimanu Catchment. [Source: Singh, 2017]



## 5.2.2 Ecosystem Goods and Services

We use the Driver-Pressure State Impact Response (DPSIR) Framework to analyse the causal link analysis whereby the Driving Forces, Pressures, State, Impact and Responses are itemized and discussed with reference to the technical problems identified and highlighted in the problem analysis tree. The DPSIR framework (Figure 20) is a valuable tool that has been used quite commonly to organize, evaluate, and communicate rather complicated environmental issues. It assumes cause and effect relationship between interacting components of the social, economic, and environmental systems.

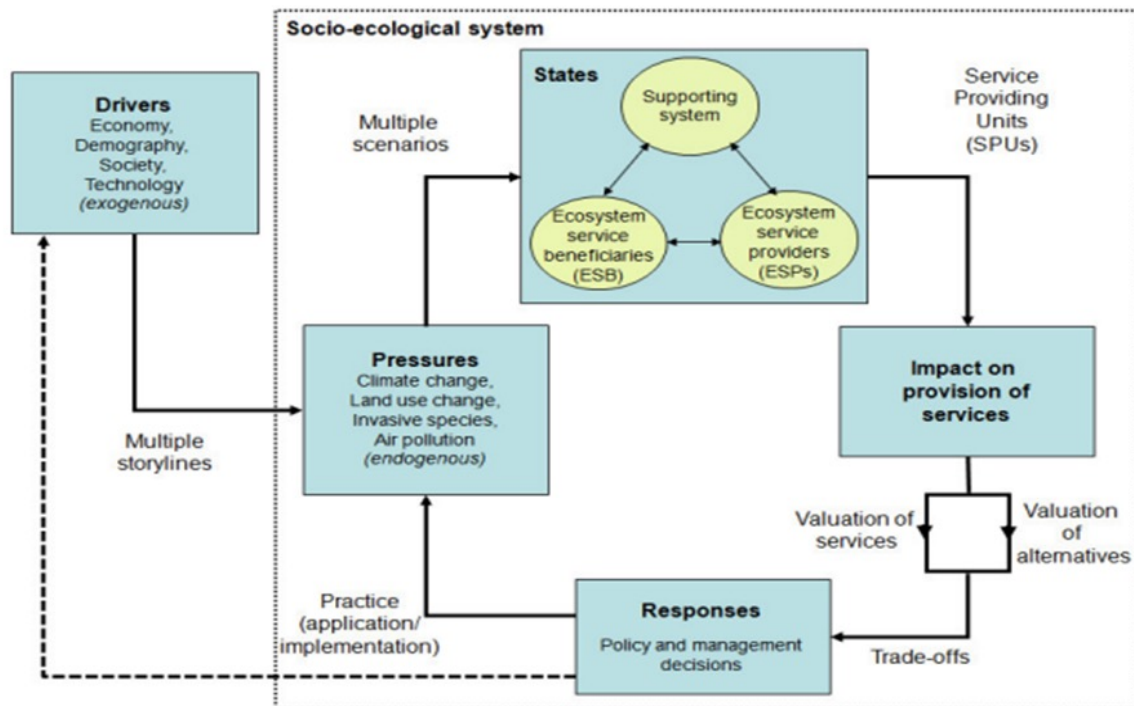


Figure 20: Driver-Pressure State Impact Responses (DPSIR) Framework

What is seen as driving the socio-ecological system of the catchment is a composition of external drivers triggering pressure on different aspects of the catchment. Increasing population, settlements and housing infrastructures has grown over the last years resulting in an estimated 13, 000 people residing throughout the catchment's terrains. Reliance of staple food sources on the Waimanu river itself is an important economic driver that potentially could see to the overharvest and exploitation of freshwater resources if left poorly managed. There also lies the means of sustenance that communities and other aggregates of people living in the area adopt as a source of livelihood. The effect of these drivers affects the environment through visible changes evident at the lower part of the Waimanu catchment landscape. Indicators of drivers for effective policy decisions would focus on the rate and impact of population growth on infrastructure development as well as the impact of subsistence harvest of freshwater food sources.

Pressure on the environment has been observed in the form of land use changes and the occurrence of invasive species across the Waimanu catchment. Land use change is one of the most common form of development by communities in that most land areas have been converted into agricultural production. Local entrepreneurs have seen to the expansion of semi-urban space for businesses and shopping centers, farming and gravel extraction sites and quarry sites. Local government investments have also seen to the expansion of Sawani-Serea back road and the establishment of four schools in the lower Waimanu catchment. The development of these facilities and infrastructures inevitably means the removal and clearance of forest blocks and derailing of local physical environment to facilitate the changes. As a result, the occurrence of invasive species, such as the African Tulip, water hyacinth, merremia climbing vine, to list a few, are appearing significantly in mass to occupy cleared and open land areas. The occurrence of invasive species on the local ecosystem has yet to be evaluated although similar scenario in other places have indicated the ultimate loss in biodiversity and demise in the value of ecosystem services and provisions. Indicators of pressures for effective policy decisions would prioritize on the rate of development and land use change, occurrence of invasive species.

Mutually, these drivers create **pressures** in the forms of land use change, which opens opportunities for invasive species to expand beyond current habitats thus affecting the biodiversity and ecosystem services. The impact of these pressures affects the level of provision of services rendered by the catchment which calls for the valuation of services and alternative influences that would guide policy priorities and management **responses** to address the pressures and drivers identified.

In response to the above, there is a need to evaluate the policy and management framework of catchments in Fiji while highlight those most relevant to the Waimanu catchment. Review of watershed legislations and other related conventions identified the need to enforce environmental regulations and even land use planning procedures and mechanisms. Clear procedures and processes need to be developed, regulated and socialized to ensure best practices are put in place to improve the standard of living while protecting ecosystem services in the Waimanu Catchment. This is most important when considering business ventures and land excavation for agriculture and common practice of shifting cultivation that would require the clearance of land area to rid trees, shrubs and weed. Also, in response to the state of the environment and human well-being, improving the current community and household infrastructure is one way to curb potential unhygienic waterways. Again, stronger policies, laws and regulations possibly with reliable monitoring, control, surveillance and enforcement by relevant institutions such as the Provincial Office and others in Government in collaboration with community wardens. These factors are inter-related with one inevitably affecting the other, and vice versa. Finally, in response to the impact caused, finding out mitigation tools and compensation initiatives for opportunity foregone is a significant step to avoid ecosystem and biodiversity loss.

Using the causal link analyses, we assess impacts by identifying the root cause, underlying causes and immediate causes based on available literature. Application of the DPSIR model and root cause analysis on Waimanu Catchment is outlined in Figure 21.

## Causal link-analyses

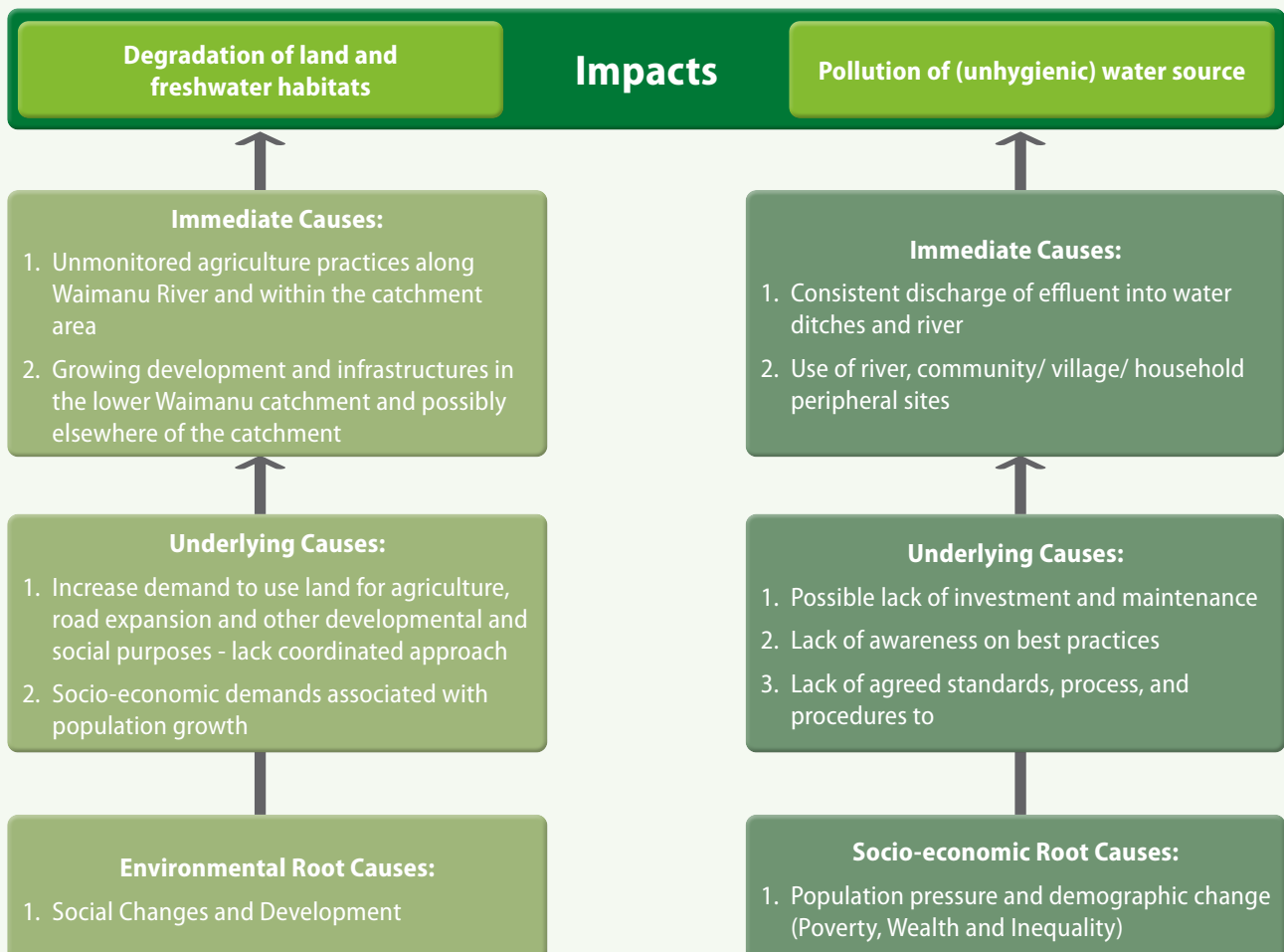


Figure 21: Causal link-analyses

Further we identified the root cause of environmental problems aligned to challenges associated with ‘Social Change and Development’. The underlying causes of these categories concerns the people and their demand to use land for various reasons – subsistence and commercial agriculture, road expansion, gravel extractions and others. Coupled with weak policies, laws and regulations, day-to-day unsustainable use of resources and development is noted as the immediate cause for this demand.

Accordingly, we identified the root cause of socio-economic problems aligned to challenges associated with ‘Population pressure and Demographic change’ and ‘Poverty, Wealth and Inequality’ category. The underlying causes are due to the possible lack of re-investment and pressure to adopt sustainable practices resulting in mediocre maintenance of current infrastructures and resources as evident in the early socio-economic surveys that have been carried out. The immediate cause that is clearly articulated in reports cited indicated consistent discharge of effluent into water ditches and river and the use of river and village sites as dumping sites for domestic waste materials. Together with the lack of information and awareness, non-best practices of basic hygiene and health is seen as the main immediate cause of threat towards polluting the main water source..

### 5.2.3 Governance and Stakeholders

There are two governance systems in place, formal and informal. The formal governance structure can be considered in two layers, the regulator of policies and laws through Government Agencies operating in Waimanu Catchment. Quasi government interests through the statutory bodies such as the Water Authority of Fiji and iTaukei Lands Trust Board and others are also important and are established and governed by relevant laws.

Informal governance includes the application of traditional, cultural, and religious norms observed by communities living in Waimanu Catchment. Traditional communities include the indigenous communities while cultural and religious groups include Hindu and Muslim communities as well as the Chinese tenant farmers that live in the Waimanu Catchment. Given the predominant rural setting of the Waimanu Catchment, focus is on traditional iTaukei governance is described. With a large community of land tenants at the lower reaches of Waimanu 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 is the order scaling down from Confederacy, Province and District. 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 22. The chiefly village may have seven to eight mataqali while a small village may only have the critical clans such as the traditional chief, warriors, and craftsmen. Typical clans and roles of each clan in a large Chiefly village is outlined in Figure 23. Each village is headed by a village headman, selected by the community but may not come from the Chiefly clan or be the Chief of the village. Village Headmen are registered with the Ministry of iTaukei Affairs and receive a small monthly allowance.

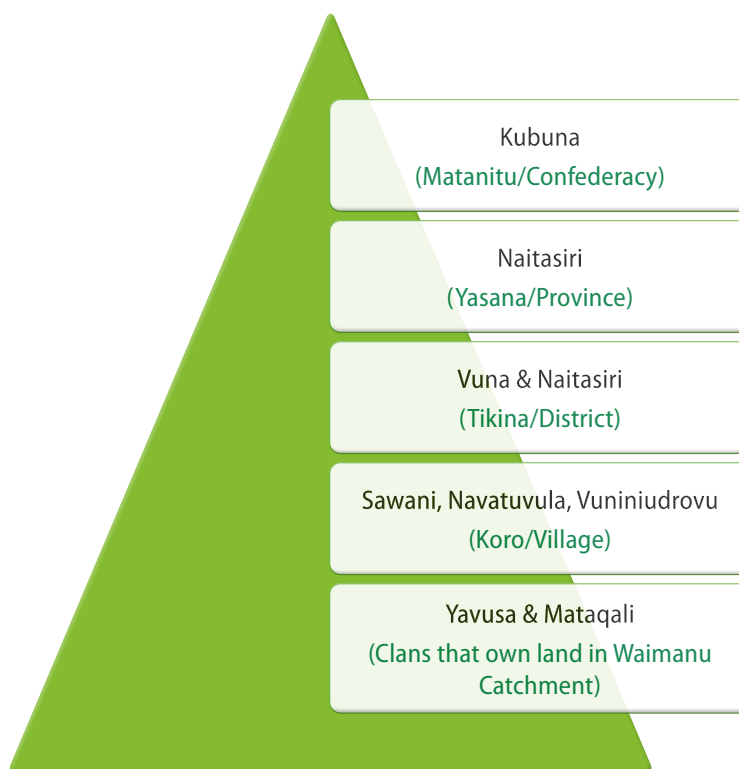


Figure 22: Hierarchy of iTaukei governance structure

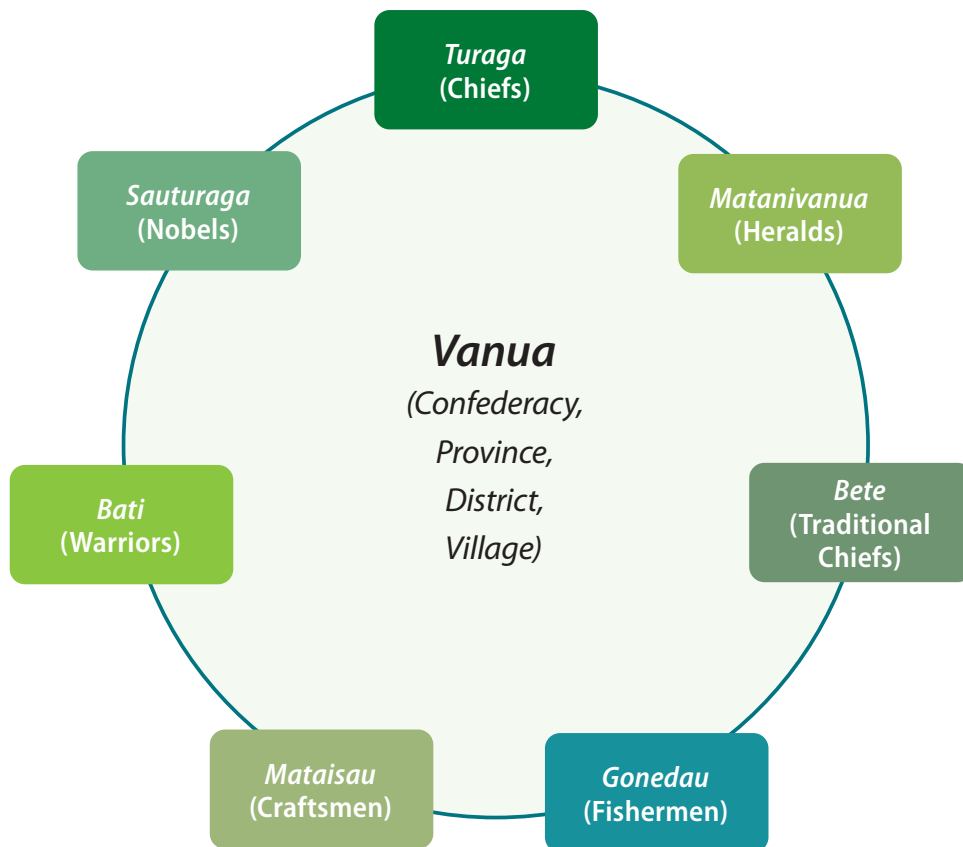


Figure 23: Structure of the iTaukei Governance at Community Level

In the context of the traditional organizational structure of the iTaukei society, 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.

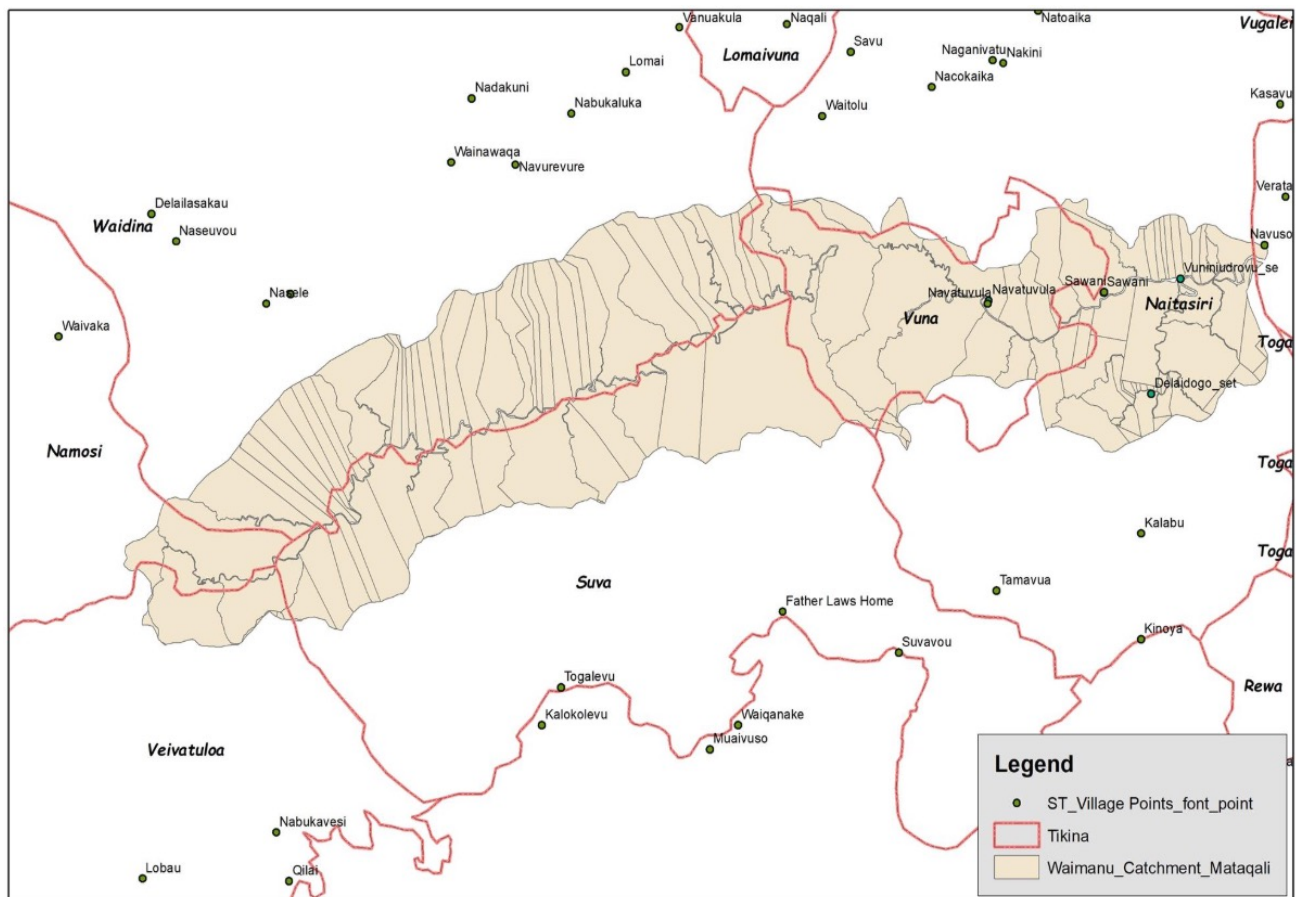
At the Provincial level, the District of Naitasiri is the Chiefly traditional leader of Naitasiri Province. The Chiefly village is the village of Navuso (outside the Waimanu Catchment) with the Chiefly title of Matanikutu na Turaga na Qaranivalu. Vuniniudrovu being part of Naitasiri District and Waimanu Catchment is listed as the fourth out of twelve village in the leadership hierarchy. Waitolu village, also part of the Naitasiri Village does not fall within the catchment area but host landowners who are direct stakeholders of 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 Colo-i-Suva and Navatuvula. Each district, village, and clan have a place in society which dictates their contribution to decision making process.

iTaukei governance structure is linked to the national governance through the Provincial Council and the District Administrator. Provincial Councils and District Administrators are under the Commissioner Central Office in the Ministry of Rural and Maritime Development. Similarly, religious and other governance structures in Waimanu Catchment would fall under the Provincial Administrator who reports to the Commissioner Central.

### 5.2.3.1 Stakeholders

There are many stakeholders in the Waimanu Catchment including Government and quasi government bodies, traditional communities, and land tenants. Government stakeholders consist of all Government Ministries that have offices and operation in the Provinces of Naitasiri, Namosi and Rewa, under the leadership of the Commissioner Central at the Ministry of Rural and Maritime Development. Traditional indigenous stakeholders consist of all communities that own indigenous land in the Waimanu Catchment. As outlined in Table 3 there are 182 landowning units within the Waimanu Catchment distributed over six Districts under three Provinces (see Figure 24). Districts in the Waimanu Catchment include Vuna, Waidina, Naitasiri (Naitasiri Province), Suva (Rewa Province), Namosi and Veivatuloa (Namosi Province).

Lease tenants also constitute critical stakeholders in the Waimanu Catchment. There are an estimated 700 lease holders concentrated at the lower reaches of the Waimanu Catchment. Majority of the area are leased for agriculture, residential, educational, tourism, commercial, government stations, water mineral, others.



**WAIMANU CATCHMENT OVERLAY WITH MATAQALI LAYER AND DISTRICT LAYER**

Figure 24: Map showing boundaries of clan (mataqali) land in Waimanu Catchment

## 5.3 Prioritize the issues using risk assessment and problem-tree analysis

Risk analysis of environmental issues identified key problems as well as critical goals that can then be developed to address the issues. We use the 'Criteria for prioritizing environmental problems' to highlight environmental issues identified within the Waimanu catchment as those concerns that need immediate attention, keeping in mind, the detrimental effects each issue poses to the catchment and the broader environment at large.

In a descending list of priority (Table 5), the main environmental concerns with variable extent of their impacts on ecosystem goods and services for the Waimanu catchment are: (1) incursion of agricultural practices into the catchment area & the use of river and village sites as dump sites for waste materials and effluent discharge; (2) increasing number of infrastructure development in the lower Waimanu catchment; (3) growing population; (4) growing number of infrastructure development in the lower Waimanu catchment and the; (5) lack of biodiversity information

**Table 5:** Criteria and Prioritizing environmental problems

Weighting: 1.no importance 2. low importance 3. moderate importance 4. high importance					
	Environmental issues				
Criteria	Incursion of agricultural practices into the catchment area	Growing number of infrastructure development in the lower Waimanu catchment	Lack of biodiversity information	Growing population	Use of river and village sites as dump sites for waste materials and effluent discharge
Whole-of-island nature of a problem – geographical and temporal scale	4	4	4	4	4
Future risk of the problem – (in 10 years)	4	4	3	3	4
Relationship with other environmental problems	4	4	4	4	4
Expected multiple benefits that might be achieved by addressing a problem	4	3	3	4	4
Progress in addressing this problem at the national level	4	3	2	4	4
Urgency of addressing this problem	4	3	2	4	4

## 5.4 Develop priority systems and plans for actions and interventions

The assessment adopted the Freshwater Health Index as a decision hierarchy to quantify priorities between ecosystem services and governance. The result of the Freshwater Health Index survey indicates consensus that ecosystem services are of top priority followed by governance and stakeholders. Within the context of ecosystem services, provisioning is considered of higher priority than regulating and cultural aspect. In terms of the governance and stakeholders, enabling environment is of most importance. The overall weighting of the results is listed in Table 6.

The Ecosystem Services focuses on the benefits delivered to stakeholders across a range of sectors with indicators measuring provisioning, regulation, and support as well as cultural values of freshwater system. The responses indicate an emphasis on provisioning which measures outputs from freshwater ecosystems that provide human benefits in particular, water supply reliability ranked higher than biomass for consumption. The result of the survey is outlined in Figure 25.

Although the two indicators are often considered as stand-alone factors, they are combined based on their heavy reliance on each other. Assessment of governance system directly relates to freshwater ecosystem rather than the broader social, economic, and political context. Four key indicators that are assessed include enabling environment, vision and adaptive government, stakeholder engagement and effectiveness.

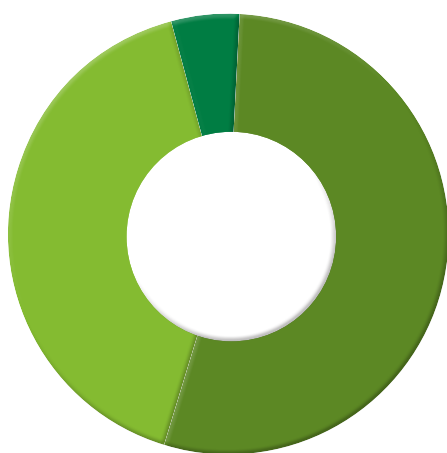
Enabling environment considers constraints and opportunities of policies, laws, regulations, market mechanisms as well as social norms in governing and managing water resources. Stakeholder engagement considers access to information that supports decision making. It also measures whether stakeholders have a voice within the

cycle of policy, planning and decision making. Vision and adaptive governance assess the level of engagement stakeholders engage with in the planning and monitoring of progress towards social and environmental objectives while the last indicator measures the degree to which laws are upheld. As evident in Figure 25, local stakeholders place more emphasis on enabling environment followed by stakeholder engagement, vision and adaptive governance.

**Table 6:** Decision Hierarchy under the Freshwater Health Index Framework

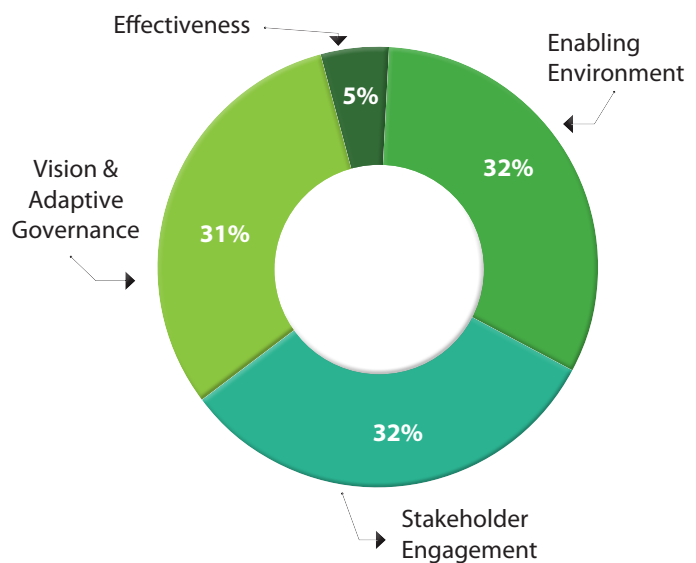
Level 1	Level 2	Level 3		
<b>Ecosystem Services</b> 0.375	Provisioning	0.538	Water Supply Reliability 0.700 Biomass for consumption 0.300	
		Regulation	0.408	Sediment Regulation 0.356 Water Quality Regulation 0.319 Flood Mitigation 0.277 Disease Regulation 0.047
	Culture		0.054	Conservation Area 0.807 Water related recreation 0.193
			Enabling Env.	0.323
	Stakeholder Engagement			0.317
		Vision & Adaptive Governance		0.311
	Effectiveness			0.050

**Ecosystem Services**



■ Provisioning ■ Regulation ■ Culture

**GOVERNANCE AND STAKEHOLDER**



**Figure 25:** Response of the survey for Ecosystem Service, Governance and Stakeholder using Freshwater Health Index Tool.



Waimanu Riverbank erosion along Sawani Road



# 6 Legislation and Policy Framework

## 6.1 National and Local Legislation and Policy

Approximately 82% of land in Fiji is customary land or native land. Out of this 2/3 has been leased out and 1/3 is only to be used and leased by Fijians (Singh, 2017). The land policy in relation to native lands in Fiji is carried into effect in three pieces of legislation; namely, the Native Lands Act Cap. 133, the Native Land Trust Act Cap. 134 and the Agricultural Landlord and Tenants Act Cap. 270 (Singh, 2017).

Land tenure is one the major factors that affect the effective management of catchments in Fiji. It is a volatile issue, one which can be an impediment and great strength for resource management in Fiji if cooperation and partnerships are sought between the resource owners and management authorities (Singh, 2017).

The main legislation in Fiji dealing with the management of natural resources are as follows:

1. Forest Decree 1992 specifically protects the exercise of iTaukei customary rights regarding sustainable management and protection of forest areas. The legislation, however, does not provide for reforestation or compensation for disturbance/damage to land. Under Section 17 of the Forest Decree, royalties of timber harvested from native lands can be paid to the Conservator of Forests r which is then paid to the iTLTB or paid directly to iTLTB for distribution to the beneficial owners. The iTLTB under the Native Land Trust Act deduct 25% and forward the balance to the "mataqali" for distribution.
2. Mining Act Cap. 146: Under Section 3 all minerals including crude oil under all land is to be the property of the Crown, this means that minerals and crude oil is not part of the Fijian culture and tradition.
3. Fisheries Act Cap. 158: The Act does not provide for procedures regulating commercial fishing, the payment of royalties and so on.
4. There is no legislation pertaining to licensing of freshwater abstraction in Fiji. Fair compensation for use of the resources has been an issue and has resulted in numerous high profile legal case. To avoid such issues in water provision it is worthwhile to start looking into policies that govern the use of water and specifically address the protection of water sources (Singh, 2017).

Whilst Fiji has associated pieces of legislations that pertains to water as a resource, there is no overall legislative provision that deals specifically with water nor one that offers water catchment protection and/or its ownership. Fiji's legislation with regards to water is fragmented and outdated. This especially, when water exists within the relativity of the natural ecosystems such as in watersheds, and subjected to various stakeholder considerations in policies, laws and regulations. Ownership, therefore, can be traced through implications of early common law developments, Fiji being a British colony with common law origin, to water rights. To this end, given the wandering and transcendent nature of water, rights to water has 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 traditional that water may be administered and controlled through a government agency for general access and use by the general commons, (Scott and Goustan 1995). However, ownership of land under rivers and streams is clearly defined and vests on the State as per Fiji's Rivers and Streams Act, [Chap 136], sections 2 and 5.

In assessing whether the common law principles relating to water is consistent to recognized customary laws regarding water ownership, observations must be paid to whether there are marked inconsistencies. Both customary and common riparian water rights in Fiji, have striking similarities in that; (i) in both instances the ownership of riparian land is the basis of acquiring water rights (ii) the lower riparian are 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 close examination of Fiji's Rivers and Streams Act [Chap 136], shows the presence of the above considerations. It is therefore safe to assume that this consistency may help in interrogating considerations to render smooth application of any water rights regime and its socio-economic implications with regards to 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 realization 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 laws and regulations discussed herein. These are better understood through the interlinked lens and interrogations under the categories of policies, laws and regulations in Water Resources, Environment and Land. A list of the major policies, laws and regulations are highlighted in Annex 3.

As evidenced from the enumerated summary of laws and regulations, the absence of clear and specific protection of water catchment areas and its management results from lack of clear legislative (environmental policies) hence resulting in the absence of statutes with an express or implied environmental mandate (Evans 2006). Perhaps an identifiable pattern is that most of Fiji's existing laws associated to effective water management and environment protection are from an era where environment protection was of less emphasis.

Fiji's next generation of policies and strategic outlooks as itemized below is key in providing direction given its contemporaneity to national development plans aided to some extent by Fiji's obligations to international instruments with respect to conservation and sustainable developments. This in turn informs Fiji national strategies and plans. Some of the instructive policies and plans are outlined in Annex 4. The Rural Land Use Policy (2005) provides guidelines for the allocation and management of resources in the rural sector by encouraging prudent and sustainable land use. Furthermore, a Rural Land Use Plan has been developed but legislative instruments for monitoring and execution is required (Raj R. , 2004) citing the crucial need for proper allocation and sustainable use of land and water resources.

The Land and Water Resources Management Act 2016 makes provision for the management, conservation and improvement of land and water resources (Gazette, 2016). The challenge now is finding the balance between anthropogenic demands on the catchment, biodiversity conservation while supporting sustainable development of the catchment.

Currently catchment management initiatives have been implemented with the purpose of providing water supply or to reduce the risk of floods, without adequate inter-sectorial engagement or legislative frameworks. There is a need now to expand this with a holistic approach and move onto good governance, biodiversity conservation, economic and livelihood security (Singh, 2017).

Singh (2017) further states that the biggest barrier to implementation of integrated water resources lies in the lack of detailed policy and inadequate legislation, coupled with no coordination and serious deficit of technical and scientifically qualified staff. According to Singh (2017) the commitment of management of water resources and raw water in Fiji is minimal and needs strong political will to get the draft water regulations through parliament and enforce these laws. This can be depicted in the timeline of legislations pertaining to land and water conservation and management in Fiji (Annex 5).

## 6.2 Policy, Legislation and Regulations in the context of Waimanu

As evident in the enumerated summary of the laws and regulations, the absence of a customized legislation on water and its management has cascading effects onto protection of water catchment areas and its management. Even though relevant legislations such as the Environmental Management Act, Forest Decree, Public Health, Water Supply, and other related areas legislatively exist, there is no comprehensive legislation to cover all aspects of water resources and management. It is crucial to advocate for an umbrella legislation which will be specific and purposive to the management and control of water that can supplement the existing legislation as applicable.

This deficiency is deductible from lack of clear legislative (environmental policies) hence resulting in the absence of statutes with an express or implied environmental mandate (Nathan 2006). Perhaps an identifiable pattern is that most of Fiji's existing laws associated to water management and environment protection are from an era where environment protection was of less emphasis. Overall, it is apparent that there is limited public engagement in the decision-making processes of the Acts, a crucial element desirable in any environment related regime, but severely lacking in this instance.

The policy, legislation and regulation identified and itemized are broadly assigned to five major categories including (i) tenure jurisdiction; ii) infrastructure and land use planning; (iii) laws for environment protection; (iv) laws for resource development, and (v) laws relating to biodiversity conservation. In the context of water and watershed management, these can be difficult to harmonize given the multitude of agencies that deal with water. Nevertheless, opportunity to consider integration of traditional leadership and environmental management could be presented through the alignment of the Village By-Law and the Environment Management Act 2005. The Village By-Law is proposed as a regulation under the iTaukei Affairs Act (Chapter 120) Regulation 25 and aims to ensure strong traditional leadership, maintenance of law, order and peaceful living in traditional communities, ensure the regulation and maintenance of hygiene, sanitation and environmental standards that will encourage community accountability and responsibility.

Cumulatively, the above analysis provides a snapshot of current policy, legislation and regulation on environment and natural resource relating to water as a resource, its quality and quantity and its overall impact on watershed management schemes. With demands for commercial use of water and resource extraction from rivers and streams, adverse impacts of upstream industries on catchment areas and increasing demands and concerns from landowners, the various competing stakeholder interests warrant a clear legislative framework in terms of policies, laws and regulations, and the creation of a properly constituted body to administer and control all matters relating to water. This ideal must be considered with all the political and socio-economic sensitivities one would expect when dealing with multiple and powerful stakeholders as it is customary when dealing with all matters relating to natural resources.

## 6.3 Problems and Issues of current coverage by Policy, Legislation and Regulations (PLR)

The main problem encountered in the above is, again, the lack of an overall legislation to govern water. In addition to the multi-agency approach from the PLRs is the piece meal management of the various sectors. From the discussion there is very little ownership of freshwater resources by any single government department. The main challenge therefore is to ensure that resource is owned by a single government agency that will ensure its sustainable development. Any such development would mean existing water stakeholders to surrender their powers to enable successful management of the resource.

Furthermore, chronological connection to environmental management and sustainable use together with its thinking are largely limited to the recent years of legislative coverage in Fiji. The early period legislations before the mid-1980s, understandably, given the lesser exertion and demands on resource use, offered routine thinking to this effect. In notable cases there is some degree of confusion in the intent of the Acts and implementable effect. For example, Agriculture Dept. and multilateral partners 'preach' sustainable agricultural practices; but the priority of the Ministry and the Government is to encourage greater agricultural production at any 'cost' without apparent regard for sustainable land use. Forestry seeks to implement the Permanent Forest Estates provisions of its Policy (MoF 2007) while Agriculture seeks to clear forest. This becomes problematic in situation where one agency relies on other agencies to implement conservation practices as per their regulatory powers and mandate. (Singh, 2017)

From the PLR analysis, water management in Fiji continues to be divided, notably between surface water under the various control of the Water Authority of Fiji, the Ministry of Waterways, the Ministry of Agriculture and the Ministry of Environment and groundwater administered and controlled by the Mineral Resource Department of the Ministry of Lands. With the recent formulation of the Land and Water Resources Management Act (2016), the management and conservation of water and land now rests with the Land and Resources Planning Division of the Ministry of Agriculture.

Furthermore, there is the challenge in finding the balance between anthropogenic demands on the catchment and biodiversity conservation and developing and implementing catchment management plan using the Land and Water Resources Management Act 2016. Currently catchment management initiatives have been implemented with the purpose of providing water supply or to reduce the risk of floods, without adequate inter-sectorial engagement or legislative frameworks. There is a need to expand this by integrating good governance, biodiversity conservation, economic and livelihood security (Singh, 2017).

Government has over the years been able to improve service delivery for the water and sanitation sectors by undertaking both policy and institutional reforms. However, practical implementation of the current legislation lacks water specific policy framework, which then renders a lack of overall coordination. Furthermore, there is a serious deficit of technical and scientifically qualified staff, which cumulatively presents efficacy challenges which presents a barrier for the implementation of integrated water resources management (Singh, 2017).

Over the years, limited application of the PLRs may be found in the complex arrangements of subjecting a particular resource and its management to a multitude of controlling agencies. For example, gravel extraction is subject to four permitting organizations – Ministry of Environment through Environmental Impact Assessment (EIA); Mineral Resources Department, Department of Lands and iTaukei Land Trust Board. One of the two purposes of the Environmental Management Act stipulates that such exploitation of natural resources should be sustainable – this is ignored in current EIAs undertaken and so there is no monitoring to determine sustainable extraction levels, there is limited literature to determine sustainable gravel yield in Fiji's river systems. Efforts are underway to review the River and Streams Act, the State Lands Act and align with the EIA of the Environment Management Act (EMA 2005) to empower relevant authorities to penalize illegal gravel extractions (FBC, 2020).

It is also noted that the PLRs are sector specific and offer no cross sectoral arrangements to ensure the development and use of water resources by sectors and agencies in a coordinated manner. At the same time, no lead agency is designated the responsibility to ensure consistency. Whilst the EIA procedures under EMA 2005 identifies environmental impacts, there is no ongoing mechanism except for the studies involved in EIA, to guarantee that such activities as water abstractions are consistent not only with environmental objectives but that one water user does not adversely affect availability of water to other users.

From the PLRs, it is evident that attention given to water resources, their sustainability and protection over the years has been far less than resources given to the development of water infra-structure to ensure portable supply. Considered in the general context of the protection of water catchment areas and its integrated management, there is a need for a new paradigm in water management towards principles of integrated water resource management (IWRM), integrated river basin management (IRBM) or integrated catchment management (ICM). Such integrated management initiative involves a shift towards governance within natural boundaries to manage water more holistically, equitably, efficiently, and sustainably (Singh, 2017). While the catchment remains an interconnected system with greater degree of interdependence between users, the collective governance of catchments to meet the needs and aspirations of multiple users, multiple stakeholder and multiple value systems needs to be developed (Singh, 2017).

Perhaps related and underlying all the above is the fact that while Fiji has strong Rural Land Use Policy (2005), it is yet to develop a national land use plan. Lack of implementation of the above policy can be attributed to the absences related legal framework to support its full implementation. Nonexistence of national land use plan and related legislation will continue to cause major constraints to wise allocation and management of resources in the rural sector and is of critical importance as it covers all land-based resources such as forest, agriculture, minerals, rivers, and streams.

The legal administrative government body that looks after and manages the native reserve land is the iTaukei Land Trust Board. However, the Department of Lands administers the traditional fishing (qoliqoli) areas (river).

Water resources in Fiji have traditionally been managed within administrative rather than natural boundaries, in a fragmented rather than holistic manner, and in a technocratic rather than participatory way (Singh, 2017).

While the catchment remains an interconnected system with greater degree of interdependence between users, the collective governance of catchments as multiple users, multiple stakeholder and multiple value systems needs to be developed (Singh, 2017).

There is an urgent need to review existing water laws to streamline various stakeholder functions and powers for effective water, sanitation and land management in Fiji to provide the required legal framework for drinking water supply management in Fiji (Singh, 2017).

Water policy or legislation is not new and has been mooted back as far as 1974. For Fiji, the National Water Resources and Sanitation policy was developed to mitigate the raising concerns of water threats and competing demands for the resource (National Water Resources Management and Sanitation Policy, 2014). A coordinated effort between major stakeholders and community participation is necessary to ensure development and management of watersheds, water quality in streams and rivers are controlled and maintained effectively.

To prevent the pollution of water sources, government has mechanisms in place to protect the integrity of water sources and have applied a penalty for anyone found polluting the environment. The government has responded to challenges within the water sector through the water management reform program to Strengthen the existing water management capabilities; introduce new water management and institutional measures where necessary through setting guiding principles by which water resources should be managed and through an identifying series of key steps necessary for creating an effective regime for managing water resources.

Government will also appoint a National Water and Sanitation Committee which include line ministries, non-government organizations, and a technical secretariat tasked to assist the committee to the develop comprehensive water legislation, relevant sub-policies and regulations as well as serve as a national forum to discuss water resource issues and management.

The National Water Resources Management and Sanitation Policy will cover all water resources of Fiji and their inter-relationship such as surface water, ground water 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 recognizes cross-cutting and multi-disciplinary nature of water resources management and the specific needs of all sectors and their roles in successful implementation of the policy.

There is no certain policy that deals with extraction activities but instead there are several general policies related to the environmental effect resulted from developments such as the Integrated Management Policy, the Sustainable Coastal Management Policy, the National Biodiversity Strategy and Action Plan and many more. Partly due to the lack of policies available for the extraction of Development Minerals, extractors work unmonitored and unregulated which takes its toll on the environment, particularly on rivers and streams ecosystems as this is where the bulk of extractions takes place (Smith, et al., 2013).

General weakness in the current policies contributing to ineffective implementation of existing legislation include (Singh, 2017):

- i. Paradox of sustainable land use approaches – The Agriculture Dept. and multilateral partners ‘preach’ sustainable agricultural practices; but the priority of the Ministry and the Government is to encourage greater agricultural production at any ‘cost’ without apparent regard for sustainable land use. Forestry seeks to implement the Permanent Forest Estates provisions of its Policy while Agriculture seeks to clear forest. This becomes problematic in situation where one agency relies on other agencies to implement conservation practices as per their regulatory powers and mandate.
- ii. Ill-defined regulatory responsibilities – Gravel extraction is subject to four controlling or permitting organizations – Ministry of Environment (Environmental Impact Assessment); Mineral Resources Department, Department of Lands, and iTaukei Land Trust Board. One of the two purposes of the Environmental Management Act stipulates that such exploitation of natural resources should be sustainable. However, this is ignored in current EIAs undertaken and so there is no monitoring to determine sustainable extraction levels and there hasn’t been any studies conducted which determines the sustainable gravel yield in Fiji Rivers and often gravel extraction is under-reported.
- iii. Lack of incentive to compensate loss of land use rights by resource owners. For effective management of catchments, it becomes imperative to involve the resource owners and ensure tangible benefits for conservation of their resources (Singh, 2017) to maximize ecosystem benefits such as water quality and quantity.

For the Waimanu catchment, where majority of the land is native land and owned communally catchment management process needs to be accommodative and participatory (Singh, 2017). A community led management options are best in such situation, where parts of the catchments are owned by different land-owning entities (Singh, 2017).

## 6.4 Indicators, Considerations and Way Forward

Governance and stakeholder indicators considered under the lens of current legal environment are viewed through the lens of water resource management, rights and resource use, incentives and regulations/financial capacity, technical capacity, strategic planning and adaptive governance, monitoring, enforcement compliance, distribution of benefits, and water related conflicts. Analysis of these indicators is outlined in Annex 6 and discussed herein.

From the analysis informed at indicators level, it is evident that Fiji's legal environment relating to watershed protection and control have not progressively developed with time, especially reflecting the demands of socio- economic paradigms, its impact on resource use and sustainable development. A clear pattern persists in this regard given most of Fiji's legislation, its administration structure and penalty provisions are a relic of the colonial era and are therefore not effective in a modern conservation management context. Furthermore, latest legislative proposals seem to stem from Fiji's obligations under international instruments such as UNFCCC REDD+ Program.

From the discussion on PLRs, it is clear that to improve water resource management it may need to be protected under a single legislation. Currently, water is handled under the auspices of the Water Authority of Fiji, the Mineral Resources Department, and the Ministry of Agriculture, who administers watershed management issues, while the Ministry of Forestry, Ministry of Environment and iTaukei Land Trust Board administers forest, biodiversity and ecosystem services on native lands. The intent and ideals of the various Acts is prove to the fact that IWRM is not a new idea in Fiji but a difficult one to implement given the multitude of agencies that deals with water and the lack of a specific legislation. Key constraints therefore point to the absence of National Land Use Plan to map and allocate appropriate land use in alignment with land capability and resource capacity. Wise allocation and management of resources is crucial as it covers all land-based resources that have direct correlation to quality and quantity of water such as forest, agriculture, minerals, rivers and streams. Current institutional management framework as discussed, is highly sectorial.



Fiji Government Minister of Environment Dr. Mahendra Reddy (left) and Permanent Secretary Joshua Wycliffe (Right) launching Fiji International Waters Ridge to Reef Project community awareness campaign and compost bin handover in Sawani village to commemorate World Environment Day.

Village By-Law was proposed in 2016 which provides opportunity to strengthen existing traditional governance. The by-laws aim to uphold traditional leadership, maintain law and order, ensure hygiene, sanitation and environmental standards are maintained as well as to preserve, safeguard and strengthen leadership, culture, tradition and the vanua thus increasing community ownership and accountability to managing natural resources. It clearly stipulates processes for self-governance by indigenous local communities providing clear guidelines on the roles of existing governing bodies within the traditional system. Implementation of the by-law will ensure the opportunity for local communities to effectively participate in the governance of natural resources, attract community buy-in and compliance of existing laws and regulations. The village by-law is under further review for debate and endorsement by Parliament.

The By-Law notes its alignment with several existing laws but fails to recognise the synergy with the Environment Management Act Section 16 which calls for the establishment of environment management committee. Alignment of the Village By-Law to the EMA 2005 would provide the opportunity to enable and facilitate inclusion of environmental issues in local governance.

With reference to governance and stakeholder assessment, an analysis of the current enabling legal environment and its effectiveness is provided. The stakeholder engagement and adaptive vision of governance regarding watershed management and control, demands interrogation against the respective indicators identified. Especially, the collective approach to watershed management and control in the context of a social ecological system providing the overall understanding of a functioning ecosystem, leading onto the supply of ecosystem services to the dependent population at large, with its support and able maintenance.

Given the dominant utility provided by customarily held iTaukei lands in the Waimanu catchment area, stakeholder assessment of landowning units, and lease tenants to such lands is a crucial element if watershed management and control are to be visible through community support. Available avenues in the existing PLRs do provide the necessary water resource management coverage through mandated procedures, however this must have the emphasis of unified outcomes rather than disjointed tasks that demands the oversight that are driven by plans of integrated watershed management.

As it is, the overall WAF water supply catchments are not included in the GIS/LIS mapping systems of major planning and regulatory authorities (see Watling, D, 2017 p 18). These include major data planning systems for TLTB, Min of Agriculture, Department of Forest, Department of Mineral Resources and Fiji Land Information System to name a few. As per the provisions of water legislations, the current WAF possess no mention or substantive coverage of catchment provisions towards watershed management and control, nor towards the formal protection of water sources. The Rivers and Streams Act defines land boundary delineation of waterways to the midway point of adjoining river and covers public rights of access along water boundaries together with the right to draw water under Department of Lands. The Act vests ownership of non-tidal water resources to the Crown.

# 7 Key findings

The diagnostic analysis revealed some key findings about the Waimanu catchment as follows:

1. Waimanu catchment is a sub-catchment of the larger Rewa catchment.
2. The catchment features the Waimanu river that is one of three main river systems, connecting the upper and lower reaches of the catchment, that deposits a surmountable amount of freshwater into the great Rewa river. Waimanu river is a major source of freshwater, freshwater fishery for local sustenance and economic gains such as kai harvesting that is a constant source of staple diet.
3. Maintaining the integrity of the Waimanu catchment is critical because of the long-term expectation of water supply to the greater south-eastern parts of Viti Levu that according to the recent census, has a population of 244,000 people.
4. Waimanu catchment is a priority conservation site, noting opportunity for nature-based solutions to support eco-tourism generating alternative benefits to landowners and communities. These efforts warrant the use of a Rapid Biodiversity Assessment to carry out a habitat assessment including, the faunistic and floristic survey of the area. In displaying similar physical attributes with adjacent catchments and topographies, it is likely the catchment will share similar habitual characteristics as well. Although the Forest Decree 1992 provides the legal framework to establish protected areas, sustainable financing of the same disincentivises ease of establishment.
5. Developmental activities are amongst the highest sources of threat on forest continuity and biodiversity and is most evident in the lower parts of the catchment. These activities have been reported in the forms of (1) Farm establishment and expansion; (2) Agricultural practices; (3) Establishing sanitation system; (4) Waimanu quarry; (5) Gravel Extraction; (6) Establishment of education canter; (7) Business operations (petrol stations, garage); (8) Arterial Road expansion; (9) Resident households; (10) Shopping center and (11) Waste disposal sites.
6. Despite decades of research and interest in assessing sustainability of freshwater systems, no clear approach is available to transparently assess trade-offs in a rigorous manner. The Freshwater Health Index (FHI) aims to address this gap and provides a tool that can diagnose how social, hydrological, and ecological systems interact to provide critical ecosystem services. Further research and modelling work can investigate the interactions of these important contributing variables that sustain ecosystem goods and services.
7. Rural community population and demography assessment of the catchment show concerning reporting of poor hygiene standard practice and lack of proper community management of waste materials and disposals. This is evident in the lower Waimanu catchment area where two main village communities share waste management concerns and poor hygiene practices that when left unmonitored and unmanaged may lead to serious short- and long-term health risks, issues, and insecurity of surrounding communities.
8. Concerns of build-up of low nutrients and heavy metals along the Waimanu river including the exceeding level of faecal coliforms that could have human health risks and concerns. This is likely to come about as the result of increasing population and poor waste management practices within rural communities.
9. There is no clear policy and legislative frameworks that provide for the protection and management of watersheds. Whilst there are ancillary pronouncements in related legislations to forest management (Forest Decree 1992) or environment conservation but there is no specific watershed management legislation.
10. Diversified institutional responsibilities hinder capacity to enforce legislations capacity effectively.
11. Roles and responsibilities of agencies involved are unclear. For instance, there may be lack of clear distinction between the lead agency in the provision of water supply and the regulated and protection of water resources. From the PLRs there may be more examples of fragmentation and lack of co-ordination
12. Possibility that lacks funding and competition may also result in the inertia in the lack of contemporaneous legal development.



13. There is no legislation pertaining to licensing of water abstraction in Fiji. Related to this is the issue of fair compensation for use of the resources that has resulted in numerous high profile legal cases. To avoid such issues in water provisioning it worthwhile to start looking into policies that govern use of water and specifically address the protection of water sources and supporting natural habitats that produce healthy ecosystem services.
14. Insufficient community education, awareness, and participation especially on water rights issues and implications on customary land ownership results in the insufficient attention to the human activity system or social dimension of catchments. This would entail the recognition of the traditional systems and values including land tenure and social structures.
15. Recognise the opportunity to align the Village By-Law (Section 6 - iTaukei Affairs (Provincial Council) Regulations 25) to Section 16 of the Environment Management Act 2005 which calls for the establishment of environmental management committees. The Village By-Law would provide grassroots reach of the Natural Resources Council (NRC) appointed under the National Environment Council.



Vuniniudrovu village along Waimanu River.

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# Annex 1: Likelihood of Occurrence of plants in Waimanu

Rating #	Comment (These rating is to be used in the table of species occurrence below)
3	Very or highly likely to occur in the study area
2	Unlikely to occur in the study area
1	Known to occur in forest blocks near or immediately adjacent to or containing portions of the Waimanu catchment area defined as- the Sovi Basin; Waisoi, Wainavadu-Naitaradamu catchments; Waivaka and Wainikatama catchments; Savura and Kalabu catchments; Nabukavesi, Wainadoi, Naboro creeks catchment, and creeks catchment along the Naval Base at Kalokolevu, Monfort boy's town and the Veisari area. A species rated with this score is therefore considered likely to occur in the study area of interest- Waimanu catchment.

Family name	Scientific Name	Status IUCN, CITES, Fiji EPS Act, Tuiwawa 1999.	Habitat requirements	Rating # Likelihood of presence on site?	Occurrence in other protected area	Comments/ notes
<b>ANGIOSPERMS</b>						
Araliaceae	<i>Schefflera costata</i>	IUCN Red List (Vu), Fiji EPS: Tuiwawa (pers. com.)	Lowland – ridges and slopes	1		Ref. 1, 3, 5, 6, 16, 21
Araliaceae	<i>Schefflera euthytricha</i>	IUCN Red List, Tuiwawa (pers. Comm.)	Lowland - headwaters	3	Sovi Basin	Ref. 1, 3, 5, 6, 8, 11, 21
Caesalpiniaceae	<i>Storckiella vitiensis</i>	IUCN Red List (Vu), Fiji EPS	Lowland – slopes and ridges	1	Colo i Suva, Savura	Ref. 1, 3, 5, 8, 16, 17, 20, 21
Chrysobalanaceae	<i>Atuna elliptica</i>	IUCN Red List (Vu), Fiji EPS	Lowland	2		Ref. 1, 2, 3, 5, 6, 21
Convolvulaceae	<i>Carruthersia micrantha</i>	IUCN Red List, Tuiwawa (1999) known from type locality	Lowland, creek flat and forest edge	2		Ref. 3, 5, 6, 7, 21
Cunoniaceae	<i>Acsmithia vitiense</i>	IUCN Red List	Primary Upland and Cloud Forest	2	Mt Victoria	Ref.1, 3, 5, 6, 13, 16, 18, 21
Cunoniaceae	<i>Geissois imthurnii</i>	IUCN Red List (En), Fiji EPS	Upland - slopes	1	Mt Victoria, Nadarivatu	Ref. 1, 3, 5, 18
Cunoniaceae	<i>Geissois superba</i>	IUCN Red List (Vu), Fiji EPS	Lowland, Upland	1	Mt Victoria, Sovi Basin	Ref. 1, 3, 5, 8, 18, 21
Cunoniaceae	<i>Spiraeanthemum graeffei</i>	IUCN Red List (En), Fiji EPS	Lowland to cloud forest	1	Mt Victoria	Ref. 1, 3, 5, 6, 8, 11, 18, 21
Cyperaceae	<i>Schoenus achaetus</i>	IUCN Red List, Tuiwawa (1999) , known from two collection with one locality	Cloud Forest	2	Sovi Basin	Ref. 3, 5, 6, 7, 8, 11, 21

Family name	Scientific Name	Status IUCN, CITES, Fiji EPS Act, Tuiwawa 1999.	Habitat requirements	Rating # Likelihood of presence on site?	Occurrence in other protected area	Comments/ notes
Ebenaceae	<i>Diospyros elliptica</i> var. <i>opaca</i>	IUCN Red List, Fiji EPS, Tuiwawa (1999), known from type collection	Lowland	1		Ref. 3, 5, 6, 7, 21
Elaeocarpaceae	<i>Elaeocarpus</i> <i>chionanthus</i>	IUCN Red List, Fiji EPS, Tuiwawa (1999), known from type collection	Lowland – ridges and slopes	3	Sovi Basin	Ref. 3, 5, 7, 10, 21
Elaeocarpaceae	<i>Elaeocarpus</i> <i>pittosporoides</i>	IUCN Red List, Fiji EPS, Tuiwawa (1999), known from type collection	Lowland	1		Ref. 3, 5, 6, 7, 21
Gesneriaceae	<i>Cyrtandra</i> <i>chlorantha</i>	IUCN Red List, Tuiwawa (1999), known from type locality	Upland	1	Mt Victoria, Nadarivatu	Ref. 3, 5, 6, 7, 18, 21
Gesneriaceae	<i>Cyrtandra</i> <i>cyathibracteata</i>	IUCN Red List, Tuiwawa (1999), known from type locality	Cloud forest	2	Mt Victoria	Ref. 3, 5, 6, 7, 18, 21
Gesneriaceae	<i>Cyrtandra</i> <i>prattii</i>	IUCN Red List, Tuiwawa (1999), known from type locality only	Cloud forest	2	Mt Victoria	Ref. 3, 5, 6, 7, 18, 21
Gesneriaceae	<i>Cyrtandra</i> <i>spathacea</i>	IUCN Red List (Vu)	lowland, upland (Dry)	2	Mt Evans	Ref. 1, 3, 5, 8, 21
Melastomataceae	<i>Astronidium</i> <i>degeneri</i>	IUCN Red List (Vu), Fiji EPS	Lowland, Upland	1	Mt Evans	Ref. 1, 3, 5, 8, 16
Melastomataceae	<i>Astronidium</i> <i>floribundum</i>	IUCN Red List (Cr), Fiji EPS	Lowland	1	Nadarivatu	Ref. 1, 2, 3, 5, 8
Melastomataceae	<i>Astronidium</i> <i>inflatum</i>	IUCN Red List (Cr), CITES, Tuiwawa (1999)	Upland	1	Nadarivatu	Ref. 1, 3, 5, 6, 7, 8, 18
Melastomataceae	<i>Astronidium</i> <i>kasiense</i>	IUCN Red List (Cr), Fiji EPS	Lowland	2		Ref. 1, 3, 5, 6, 16
Melastomataceae	<i>Astronidium</i> <i>lepidotum</i>	IUCN Red List (Cr), Fiji EPS, Tuiwawa (1999)	Lowland	1		Ref. 1, 3, 5, 6, 7, 21
Melastomataceae	<i>Astronidium</i> <i>pallidiflorum</i>	IUCN Red List (Cr), Fiji EPS, Tuiwawa (1999)	Lowland	1		Ref. 1, 3, 5, 6, 7, 16, 21
Melastomataceae	<i>Astronidium</i> <i>saulae</i>	IUCN Red List (Cr), Fiji EPS, Tuiwawa (1999)	Lowland – closed forest slopes	3		Ref. 1, 3, 5, 6, 7, 16, 19, 21
Meliaceae	<i>Aglaia</i> <i>archiboldiana</i>	IUCN Red List, Fiji EPS	Lowland, Upland	3	Sovi Basin, Mt Victoria, Savura	Ref.1, 3, 5, 6, 10, 14, 16, 18, 20, 21
Meliaceae	<i>Aglaia</i> <i>basiphylla</i>	IUCN Red List,	Lowland	1	Sovi Basin	Ref.1, 3, 5, 7, 11,13, 21

Family name	Scientific Name	Status IUCN, CITES, Fiji EPS Act, Tuiwawa 1999.	Habitat requirements	Rating # Likelihood of presence on site?	Occurrence in other protected area	Comments/ notes
Meliaceae	<i>Aglaia fragilis</i>	IUCN Red List	Cloud forest	2	Mt Victoria	Ref.1, 3, 6, 21
Meliaceae	<i>Aglaia gracilis</i>	IUCN Red List	Lowland, Upland, Cloud forest	3	Mt Victoria	Ref.1, 3, 5, 6, 11, 13, 18, 21
Meliaceae	<i>Aglaia parksii</i>	IUCN Red List	Lowland	1		Ref.1, 3, 5, 6
Moraceae	<i>Ficus smithii</i> var. <i>smithii</i>	IUCN Red List, Fiji EPS, Tuiwawa (1999),	Upland	1	Mt. Victoria, Sovi Basin	Ref. 3, 5, 6, 7, 13, 18, 21
Myrtaceae	<i>Syzygium amplifolium</i>	IUCN Red List (Vu), Fiji EPS	Lowland	3	Colo I Suva	Ref. 1, 3, 5, 6, 7, 8, 14, 17, 20, 21
Myrtaceae	<i>Syzygium minus</i>	IUCN Red List (En), Tuiwawa (1999), Fiji EPS	Upland	1	Mt Evans Range	Ref. 1, 3, 5, 7, 8, 21
Orchidaceae	<i>Agrostophyllum megalurum</i>	IUCN Red List, CITES, Tuiwawa (1999)	Lowland	1		Ref. 1, 3, 5, 6, 7, 21 Vicinity of Namosi village
Orchidaceae	<i>Appendicula bracteosa</i>	IUCN Red List, CITES, Tuiwawa (1999)	Lowland	1		Ref. 1, 3, 5, 6, 7 Vicinity of Namosi village
Orchidaceae	<i>Bulbophyllum amplistigmaticum</i>	IUCN Red List, CITES, Tuiwawa (1999)	Upland	2	Nadarivatu	Ref. 3, 5, 6, 7, 18, 21
Orchidaceae	<i>Bulbophyllum polypodioides</i>	IUCN Red List, CITES, Tuiwawa (1999)	Unknown	2		Ref. 3, 5, 6, 7, 21
Orchidaceae	<i>Bulbophyllum samoanum</i>	IUCN Red List, CITES, Tuiwawa (1999), known from type locality	Upland	1	Mt Victoria	Ref. Ref. 3, 5, 6, 7, 8, 18, 21
Orchidaceae	<i>Bulbophyllum sessile</i>	IUCN Red List, CITES, Tuiwawa (1999), Known from type locality	Lowland	1		Ref. 3, 5, 6, 7, 21
Orchidaceae	<i>Calanthe imthurnii</i>	IUCN Red List, CITES, Tuiwawa (1999))	Upland	1	Sovi Basin, Nadarivatu	Ref. 3, 5, 6, 7, 18, 21
Orchidaceae	<i>Dendrobium carnicarinum</i>	IUCN Red List, CITES, Tuiwawa (1999), known from type locality	Upland	1	Mt Victoria	Ref. 1, 3, 5, 7, 8, 18, 21
Orchidaceae	<i>Dendrobium unicarinatum</i>	IUCN Red List, CITES, Tuiwawa (1999), known from type locality	Upland	1	Mt Victoria	Ref. 3, 5, 6, 7, 18, 21
Orchidaceae	<i>Malaxis platychila</i>	IUCN Red List, CITES,	Lowland	1	Mt Victoria	Ref. 3, 5, 6, 7, 8

Family name	Scientific Name	Status IUCN, CITES, Fiji EPS Act, Tuiwawa 1999.	Habitat requirements	Rating # Likelihood of presence on site?	Occurrence in other protected area	Comments/ notes
Orchidaceae	Orchidaceae spp	CITES listed on Appendix 2	All Vegetation types	3	Mt Vic, Sovi Basin, savura	Ref. 2, 3, 5, 6, 7, 8, 10, 13, 18, 20
Orchidaceae	Zeuxine vieillardii	IUCN Red List, CITES, Tuiwawa (1999)	Lowland forest	2	Sovi Basin	Ref. 3, 5, 6, 7, 21
Palmae	Balaka diffusa	IUCN Red List (Cr), Fiji EPS, Tuiwawa (1999)	Lowland	3	Sovi Basin	Ref. 1, 5, 6, 7, 15, 21. Criteria need changing
Palmae	Balaka microcarpa	IUCN Red List (En), Fiji EPS, Tuiwawa (1999)	Lowland	3	Savura, Vago and Colo I suva	Ref. 1, 3, 5, 6, 7, 8, 14, 15, 16, 17, 20
Palmae	Gulubia microcarpa	IUCN Red List (Vu), Tuiwawa (1999)	Lowland - ridgetop	3		Ref. 1, 5, 6, 7, 15, 21
Palmae	Physokentia rosea	IUCN Red List (En), Fiji EPS	Lowland, upland	3	Savura, Sovi basin	Ref. 1, 3, 5, 15
Palmae	Clinostigma exhorhiza	IUCN Red List (En), Fiji EPS	Lowland, upland	3	Sovi Basin, Monasavu, Mt Victoria	Ref. 1, 3, 5, 15
Pandanaceae	Freycinetia vitiensis	IUCN Red List, Tuiwawa (1999)	Upland	3	Sovi Basin	Ref. 3, 5, 6, 7, 11, 18, 21
Pandanaceae	Pandanus joskei	IUCN Red List (Vu): Fiji EPS	Lowland, upland	3	Savura, Colo I suva, Monasavu	Ref 1, 3, 5, 14, 18, 20, 21
Peperomiaceae	Peperomia namosiana	IUCN Red List, Tuiwawa (1999) known from type collection only	Upland	1		Ref. 3, 5, 6, 7, 21
Poaceae	Garnoti villosa	IUCN Red List, Tuiwawa (1999), known from type collection	Upland	1	Sovi Basin	Ref. 3, 5, 6, 7, 11, 21
Poaceae	Mapania parvibractea	IUCN Red List, Tuiwawa (1999), known from one collection only	Lowland	1		Ref. 3, 5, 6, 7, 21
Rubiaceae	Alyxia erythrosperma	IUCN Red List, Tuiwawa (1999)	Lowland	1		Ref. 1, 3, 5, 6, 7, 21 Vicinity of Wainikoroluva
Rubiaceae	Psychotria scitula	IUCN Red List (vu), Tuiwawa (1999) known from two collection only	Lowland, upland forest	3		Ref. 3, 5, 6, 7, 18, 21
Rubiaceae	Psychotria vomensis	IUCN Red List, Tuiwawa (1999) ,known from two collection with one locality	Lowland, upland forest	3		Ref. 3, 5, 6, 7, 21

Family name	Scientific Name	Status IUCN, CITES, Fiji EPS Act, Tuiwawa 1999.	Habitat requirements	Rating # Likelihood of presence on site?	Occurrence in other protected area	Comments/ notes
Zingiberaceae	<i>Alpinia vitiensis</i>	IUCN Red List, Tuiwawa (1999)	Lowland	3	Ravilevu, Taveuni, Sovi Basin	Ref. 1, 3, 5, 6, 7, 16, 21
<b>GYMNOSPERMS</b>						
Cycadaceae	<i>Cycas rumphii</i> (Syn. of <i>C. Seemannii</i> )	IUCN Red List (vu), CITES, Tuiwawa (1999)	Dry forest, Small Island veg.	2	Nakauvadra	Ref. 1, 3, 5, 6, 7, 21
Podocarpaceae	<i>Acropyle sahniana</i>	IUCN Red List (cr), Tuiwawa (1999), Fiji EPS	Primary Upland and Cloud Forest – ridges, closed forest	1	Mt Victoria, Sovi, Wabu	Ref. 1, 3, 5, 6, 7, 8, 13, 16, 21. IUCN status needs revising
Podocarpaceae	<i>Podocarpus affinis</i>	IUCN Red List (vu), Tuiwawa (1999), Fiji EPS	Upland, cloud forest - ridges	3	Mt Victoria, Monasavu, Nadarivatu	Ref. 1, 3, 5, 6, 7, 8, 11, 16, 18, 21. Sovi Basin
<b>FERN &amp; FERN ALLIES</b>						
Adiantaceae	<i>Pteris vittata</i>	IUCN Red List, known from two collection with one locality	Lowland, upland forest	1	Sovi Basin, Nadarivatu	Ref. 3, 4, 5, 6, 21
Aspidiaceae	<i>Pleocnemia elagans</i>	IUCN Red List, Tuiwawa (1999), known from two collection only.	Lowland	1		Ref. 3, 4, 5, 6, 7, 21
Aspleniaceae	<i>Asplenium induratum</i>	IUCN Red List, Tuiwawa (1999)	Lowland	2		Ref. 3, 4, 5, 6, 7, 21 Vicinity of Mt Voma
Cyatheaceae	<i>Cyathea</i> spp	CITES, Tuiwawa (1999)	All habitats	3	All Protected Areas	Ref. 1, 2, 3, 4, 5, 6, 7, 8, 10, 13, 14, 17, 18, 20, 21
Dennstaedtiaceae	<i>Dennstaedtia inermis</i>	IUCN Red List, Tuiwawa (1999))	Upland	1	Mt Victoria, Nadarivatu	Ref. 3, 4, 5, 6, 7, 8, 21
Grammitadaceae	<i>Grammitis vitiensis</i>	IUCN Red List, Tuiwawa (1999), known from type collection only.	Upland	1	Nadarivatu	Ref. 3, 4, 5, 6, 7, 21
Grammitidaceae	<i>Ctenopteris vomaensis</i>	IUCN Red List, Tuiwawa (1999)	Upland, ridge	2		Ref. 3, 4, 5, 6, 7, 21
Lomariopsidaceae	<i>Elaphoglossum basitruncatum</i>	IUCN Red List, Tuiwawa (1999), known from type collection only.	Upland – ridges closed forest	1		Ref. 3, 4, 5, 6, 7, 21



Family name	Scientific Name	Status IUCN, CITES, Fiji EPS Act, Tuiwawa 1999.	Habitat requirements	Rating # Likelihood of presence on site?	Occurrence in other protected area	Comments/ notes
Lycopodiaceae	<i>Lycopodium serratum</i>	IUCN Red List, CITES, Tuiwawa (1999), known from one collection only.	Lowland – closed forest	3	Sovi basin	Ref. 3, 4, 5, 6, 7, 8, 21
Marattiaceae	<i>Angiopteris opaca</i>	IUCN Red List, CITES, Tuiwawa (1999)	Lowland – slopes headwaters	1	Savura Forest Reserve	Ref. 3, 4, 5, 6, 7, 8, 16, 21
Psilotaceae	<i>Tmesipteris truncata</i>	IUCN Red List, Tuiwawa (1999), known from two localities.	Cloud forest – ridges terrestrial	1	Mt Evans	Ref. 3, 4, 5, 6, 7, 8, 21
Schizaeaceae	<i>Schizaea fistulosa</i>	IUCN Red List, Tuiwawa (1999)	Cloud Forest	2	Sovi Basin	Ref. 3, 4, 5, 6, 7, 8, 11, 21

## Annex 2: Information consulted for terrestrial flora review

Ref. Code	Information Source	Relevance
1	IUCN Red List of Threatened Species 2008	Global assessment of threatened species. Palms: Comprehensively revised in 1997 and reviewed in 2006. Listing is accepted locally as accurate. Gymnosperms: Revised in 1998 and 2000 without much local input and generally regarded as adequate but requiring review. Cycas reviewed in 2003 and considered accurate. Pteridophytes and other Angiosperms: Revised in 1998 without much local consultation and was restricted to only a few families. Generally considered inaccurate and seriously requiring a review.
2	Fiji Islands- 2019. Amendments to the Endangered and Protected Species Act of 2002.	Schedule 1 to the act comprises a comprehensive list of threatened species not listed in Convention on International Trade in Endangered Species (CITES) Appendices (I, II, III). This has legislative relevance in respect to the local names where in some cases there are none. Schedule 2 is a list of native species (especially endemic) and has little relevance to threat status or use.
3	Smith A. C. 1979, 1981, 1985, 1988, 1991. Flora Vitiensis Nova – A new Flora of Fiji (Spermatophytes Only). Vol 1- 5. National Tropical Gardens, Lawai, Kauai, Hawaii.	Documents Fiji's terrestrial plants (that are exotics and native) since the mid 1800's to the 1980. Some 1800 native species with ca. 800 endemic are recorded. About 200 native species (majority are endemic) are considered rare and these are mostly known from a single collection and/or its type locality.
4	Brownlie, G. (1977). The Pteridophyte flora of Fiji. Vaduz [Liechtenstein]: J. Cramer. 397pp	Lists the Pteridophyte (fern) flora of Fiji – an authoritative fern plants resource for Fiji in terms of its rarity, distribution, and density.
5	South Pacific Regional Herbarium (SUVA) databased records. University of the South Pacific, Suva, Fiji 2009	The database is a record of ca. 100,000 plant specimen collected over the past 100yrs to the present from all over Fiji and other Pacific Island countries. A.C.Smith's flora is based on this vast reference. Specimens are regularly added to this collection. Thus, it holds the most reliable and up to date record of plants distribution for Fiji.
6	Tuiwawa, M. and W. Liebregts. 1998. Technical Group 3 - Botanical Biodiversity Report. Fiji Biodiversity Strategic and Action Plan, Fiji Department of Environment, Suva, Fiji.	Full list and most detailed analysis of conservation status of Fiji's plants at the time. Threat status derived using rarity based on A.C. Smith 5 volumes- flora Vitiensis Nova and known IUCN Red Listing outcomes at that time e.g. native palms and gymnosperms of Fiji.
7	Tuiwawa M. V. 1999. MSc. Thesis. The Flora, Ecology and Conservation of the Botanical Biodiversity of Waisoi and the Southeastern Slopes of the Korobasabasaga Range in Namosi Province, Fiji. Biology Department. University of the South Pacific, Suva, Fiji.	The report recorded a total of 426 plant species. Listed 15 plants from Waisoi with unpublished IUCN categorized conservation status. It includes an appendix containing a reviewed summary of plants of Fiji deemed "rare and threatened". Review was based on Smith's (1979-1991) 5 vol. Flora Vitiensis Nova and Brownlie's (1977) Pteridophyte Flora of Fiji and Specimens held at the SUVA herbarium
8	Tuiwawa, M. 1998. Technical Group 7 – Priority Locations for Biodiversity Conservation – Fiji Biodiversity Strategic and Action Plan, Fiji Department of Environment, Suva, Fiji.	Provides review data for plants within the priority sites (mostly Protected Areas) for conservation throughout Fiji. The locations and justification of priority sites for the conservation of Fiji's botanical biodiversity.

Ref. Code	Information Source	Relevance
9	Mueller-Dombois, D. & Fosberg, F. R. (1998). <i>Vegetation of the tropical Pacific Islands</i> . New York: Springer.	Most comprehensive description, distribution, and definition of the principal vegetation types for Fiji. Has some focus species list of plants.
10	Tuiwawa M. and A. Naikatini. 2003. Report of the Preliminary Baseline Survey of the Flora and Vegetation of Waivaka South, Namosi Province, Fiji. IAS Technical Report No. 2003/04. Institute of Applied Sciences, USP, Suva, Fiji. pp31.	Baseline flora survey of the Waivaka south catchment. The adjacent catchment of the Waivaka creek is the headwaters and catchment of the Waimanu river. The report list high value conservation plant species
11	Morrison, C. (Ed.) 2006. Consolidated Biodiversity Report for the Sovi Basin. Institute of Applied Sciences Environmental Report No: 182. Suva	Provides survey data for plants within the Sovi Basin because of a series of surveys from 2002 to 2006
12	Tuiwawa, M., & Pene, S. (Eds.). 2015. Reassessment of the biodiversity and archaeology of the Sovi Basin Protected Area. Suva: Institute of Applied Science, University of the South Pacific. 132pp	Provides most recent flora data for a huge intact lowland forest system (Sovi) that would be like the upper Waimanu river catchment. Species of high conservation value are also listed.
13	Tuiwawa M. and A. Naikatini. 2004. Flora Report. In Morrison C. (ed.) Baseline Flora and fauna survey of Wabu Forest Reserve, Naitasiri, Fiji Islands, 16 <sup>th</sup> – 22 <sup>nd</sup> November 2003. SPRH Biodiversity and Ethnobiology Report 4/2004. South Pacific Regional Herbarium, Institute of Applied Science, University of the South Pacific, pp 4-9 of a 38-page report.	Provides survey data for plants within the Wabu Forest Reserve. This would mostly be for plants in the upland forest systems. It also lists high value species for conservation.
14	Keppel G. et. al. 2005. Botanical diversity at Savura, a lowland rainforest site along the PABITRA gateway transect, Viti Levu, Fiji. <i>Pacific Science</i> 59:175– 191.	Records important plant species for conservation in an area adjacent to the Waimanu catchment. The area is a Protected Forest for water conservation
15	Watling, D. (2005). <i>Palms of the Fiji Islands</i> . Suva, Fiji: Environmental Consultants Ltd.	The most up to date comprehensive analysis and assessed, distribution and conservation status of the palms of Fiji.
16	David Olson, et. al. 2009. Priority Forests for Conservation in Fiji: landscapes, hotspots, and ecological processes. <i>Fauna &amp; Flora International, Oryx</i> , 44(1), 57–70	A comprehensive analysis of remaining forest areas in Fiji that are to be targeted for protection. The review was carried out in 2005 and involves a very exhaustive collation of data that includes both the biological and physical parameters e.g. rainfall data, temperature, flora, fauna, roads, etc. This formed the basis for the identification of “Key Biodiversity Areas” for Fiji.
17	Marika Tuiwawa, et.al. 2018. <i>Colo-i-Suva Forest Park Wildlife</i> . Suva, Fiji: The University of the South Pacific Press.	The status of several threatened species is documented in the book and these species are not restricted to Colo i Suva but spill out into the adjacent Vago and Savura Protected areas. These two PAs are part of the Savura creek catchment which is adjacent to the Upper Waimanu river catchment.
18	Tuiwawa, M., & Pene, S. (Eds.). 2018. An assessment of the biological diversity & sites of archaeological significance within the Greater Tomaniivi Protected Area. IAS Technical Report No. C36. Institute of Applied Science, University of the South Pacific. pp158.	The survey documented close to 600 species of higher vascular plants with almost 50% endemic plant species. Most of these were high conservation value species based on their rarity. Note that these are mostly high altitude or upland plant species.

Ref. Code	Information Source	Relevance
19	Kirkpatrick, J.B. and Hassal, D.C. 1985. The vegetation and flora along and altitudinal transect through tropical forest at Mt. Korobaba, Fiji. <i>New Zealand Journal of Botany</i> 23, 33-46	Contains a checklist of plants, most of which are high value species for conservation, that are unusually found at lower altitudes. Mount Korobaba has a cloud forest despite its highest peak is just at 400m asl. Mt Korobaba is part of a systems of mountains near the Waimanu catchment
20	Senilolia H. Tuiwawa and Gunnar Keppel. 2012. Species diversity, composition, and the regeneration potential of native plants at the Wainiveiota Mahogany Plantation, Viti Levu, Fiji Islands. <i>The South Pacific Journal of Natural and Applied Sciences</i> .	Records important plant species for conservation in an area close to the Waimanu catchment. The area is a protected areas a Forest Park and is an old growth mahogany plantation.
21	Institute of Applied Sciences, USP. 2009. Pre-Feasibility Stage, Waisoi Project – Terrestrial Ecology Assessment. IAS Environment Report Number C226. pp121. Plates and Annex included.	The most recent comprehensive and exhaustive documentation of floristic information of the rainforest of south Viti Levu based on actual field and literature surveys. It covers most of Fiji's principal vegetation types found on the windward side or the wet/moist forest of Viti Levu. It documents known species of plants for conservation and where they can be found in Fiji's terrestrial Protected areas.

# Annex 3: Major Policies, Laws and Regulations

Policies, Laws and Regulations	Application	Comments
<b>Constitution of the Republic of Fiji (2013)</b>	<u>Section 36</u> 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 realization of the right of every person to adequate food and water. ie to have clean and safe water in adequate quantities.
<b>5YR &amp; 20yr National Development Plan (Nov 2017)</b>	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 in order 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 system.
<b>Agricultural Land and Tenant Act [Cap 270]</b>	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 how closer relationship between land use, crop type and capacity. Section.13 defines 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
<b>Drainage Act [Cap 143]</b>	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 Government to intervene in the use of private lands. But has lack of attention to defining a drainage area. With no other guidance supplied, there is vast potential for application and abuse under this tool
<b>Endangered and Protected Species Act [No 29 of 2002]</b>	This Act materially enhance 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 exists between CITES and Fiji’s context that warrant correction.
<b>Environment Management Act (2005)</b>	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, sea grass 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
<b>Forest Decree Bill [No 31/1992]</b>	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. Minister may, upon advisement of 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.
<b>Forest Bill [No 13 of 2016]</b>	An Act to provide for the management of Fiji's forests and other related matters.	Defines development activity on land similar to 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.
<b>Gravel Extraction</b>	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 Licences Regulation, Department of Lands and Mineral Resources Department.	Multiple controlling agencies may result in gravel extraction not being managed sustainably. Possible cross purpose of intent and function may arise where stipulations for the applications of principles of sustainable use and development of natural resource under EMA is overlooked in cases of boulder and gravel extraction from rivers.
<b>Health Act Cap [111]</b>	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 waterbodies (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.
<b>Irrigation Act [Cap 144A]</b>	Concerned with improving Agricultural productivity through the optimal use of impounded water. Within gazette irrigated areas, broad powers vest 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.
<b>iTaukei Land Trust Act [Cap 134]</b>	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 is covered under TLTB Leases and Licences 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

Policies, Laws and Regulations	Application	Comments
<b>Land Conservation Act [Cap 141]</b>	The Act provides statutory basis for the government to act in anticipation of farming related impact activities such as erosion, eutrophication, soil compaction, localized 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.
<b>Land and Water Resource Management [Bill No.7 2016]</b>	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.
<b>Mining [Cap 46]</b>	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 devegetate 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,
<b>Natural Disaster Management Act [1998]</b>	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 co-ordinate 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.
<b>Petroleum (Exploration and Exploitation Act) [Cap 148]</b>	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 practice which are designed to protect 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.
<b>Quarries [Cap 147]</b>	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 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.
<b>Rivers and Streams Act [Cap 146]</b>	Enshrines the rights of public to have access to riparian waterbodies. An easement exists along riverbanks for public access, except where under controls of 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
<b>Roads Act [Cap 175]</b>	Enables the construction of public roads and provides government with fairly broad powers to this end. The rights of adjoining land users therefore yield to the State on compensable basis under section 4. Materials may be similarly extracted from adjoining properties for the purposes of road works-per sections 7 and 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
<b>Sewerage Act [Chap 128]</b>	Provides for the construction and the maintenance of infrastructure for the treatment of sewerage. 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 environment goal.
<b>State Lands Act [Chap132]</b>	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 quarry 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 type 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
<b>Town Planning Act [Cap139]</b>	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 lack 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.
<b><u>Water Supply Act [Cap 144]</u></b> <b><u>REPEALED</u></b> <b>Water Authority Promulgation [No 25 of 2007]</b>	Legislation governing the supply of water-with much emphasis on the infrastructure delivery. Charges for supplying of water is covered substantially by the Act.	Little coverage in relation to environment 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.



## Annex 4: Environment, National Strategies and Reports

	Coverage	Comments
<b>National Biodiversity Strategy and Action Plan 2020-2025 (2018)</b>	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.
<b>Fiji National Adaption Plan (2018)</b>	<p>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.</p> <p>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 co-ordination, resource mobilization and ultimately effective adaptation actions</p>	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.
<b>Fiji Environment Strategy [1992]</b>	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 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.

	Coverage	Comments
<b>National Climate Change Policy</b>	<p>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 sectorial policies align with NCCP.</p> <p>To collect manage and use accurate and scientifically sound climate change related data and information through a clearing house mechanism for climate change.</p> <p>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;</p>	<p>Integrate climate change issues in all sector policy and planning process by incorporating climate change in national plans and budgets with Climate change Policy framework and to ensure all national and sectorial policies align with NCCP.</p>
<b>Fiji REDD+ Policy [2011]</b>	<p>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.</p> <p>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.</p>	<p>Policy is aligned to the objectives of Fiji's sustainable economic and empowerment development strategies that include amongst others energy and environment strategies.</p>
<b>Forest Policy (2007)</b>	<p>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.</p> <p>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;</p>	<p>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.</p>

	Coverage	Comments
<b>Green Growth Framework for Fiji [204]</b>	<p>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.</p> <p>It supports economic growth and strengthen capacity to withstand and manage adverse effects of climate change</p> <p>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.</p> <p>Integrated through a holistic approach to support development that is sustainable and climate change resilient;</p>	<p>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.</p>
<b>Ministry of Waterways and Environment Strategic Plan [2020-2024]</b>	<p>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</p>	<p>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</p>
<b>National Disaster Risk Management Policy [2018-2030]</b>	<p>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</p>	<p>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.</p>
<b>National Plan for Disaster Management [1998]</b>	<p>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.</p>	<p>To ensure that learning from 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.</p>
<b>Review of Policy and Legislation Relating to the Use and management of Mangroves in Fiji [undated]</b>	<p>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.</p>	<p>Sustainable use and management of mangrove ecosystems is hindered by the absence of clear policy direction and effective regulatory control.</p> <p>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</p>

	Coverage	Comments
<b>National Resource Inventory Report of Rep of Fiji [2010]</b>	The consistent development of water resources and supply strategies in Fiji has been thwarted by lack of clear and comprehensive legislation compounded by a number of 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.
<b>National Water Resources Policy for the Fiji Islands [DRAFT]</b>	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.
<b>Rural Land Use Policy (2002)</b>	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.
<b>Watershed Management Master Plan [1998]</b>  <b>*Yachio Eng Group JICA</b>	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.
<b>Mangrove Management Program [1985]</b>	This contains a formulated Mangrove Management Program for Fiji. It contains characterization, 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, his document is used for decision making purpose of foreshore reclamation of mangrove areas by the Department of lands and Surveys. An on- going mangrove management program is in place to monitor the use and extent of mangrove areas.

## Annex 5: Timeline -related legislation to land and water in Fiji

Year	Legislation	Land/Water	Conservation and Management
1953	Land Conservation and Improvement Ordinance	Land	Conservation orders relating to soil conservation practices in agriculture, to prevention of overgrazing, to protection of vegetation cover, and to the prohibition of the land use of land damaging sledges
1985	Rivers & Streams Act, 1985	Rivers and Streams	Regulation of water rights and use. Landowner, town, village and inhabitants neighboring the river have right for using river and have indemnified water rights to river water.
1985	Drainage Act	Drainage	Mandates the Controlling Authority to establish Drainage Area
1985	Irrigation Act	Drainage	Mandates the jurisdiction minister to assign a Commissioner for Irrigation, who designates Irrigation Area and has responsibility for maintenance of irrigated institution and irrigated agriculture
1973	Town Planning Act (Cap.139) and Subdivision of Land Act (Cap.140)	Land	Regulates all lands and building developments, land subdivision, on-site operations and activities defined as development under the Act. It extends to all town planning areas, both urban and rural as well as islands where developments have taken plan, excluding proclaimed villages, village reserves and native reserves.
1998	Town Planning General Provisions	Land	Outlines the requirements for building developments in flood areas. According to the Act, no building shall have the floor level of any habitable room lower than 6.0meters relative to Mean Sea Level
2005	Environmental Management Act	Environment	Provides legal framework for Environmental Impact Assessment, EIA and comprehensive management practice for natural resources, waste management and anti-pollution measures. Competent authority of this law is the Department of Environment, DOE  For regulation of this law, Environment Management (EIA Process) Regulations 2007 and Environment Management (Waste Disposal & Recycling) Regulations 2007 were established in January. 2008 and many sorts of procedures about environmental management were prescribed. DOE had prepared Environmental Impact Assessment Guidelines in 2008 and revised second edition in 2012.
2007	Fiji Forest Policy	Forests and catchments	Conservation of biodiversity, water catchments and soil fertility
2002	Fiji Rural Land Use Policy	Soil and water	Protection of soil and water
2007	WAF Promulgation	Water supply	Managing water and sewerage systems
2016	Land and Water Resource Management Bill	Land and Water Resources	Land resources management. Drinking water catchments covered indirectly by some of its provision/

# Annex 6: Governance and Stakeholders indicators assessed

Indicators	Bearing on Water Catchment Management	Gaps/Comments	Way Forward
<b>Water Resource Management</b>	<p>Main tools are Natural Resource Inventory database and management plan.</p> <p>WAF bears no specific mention of catchment.</p> <p>EMA introduces powers to protect water quality through EIA</p>	<p>Protected Area systems implemented by DoE, does not address catchment issues.</p> <p>Natural Resource Inventory must be prepared with wide input and maintained in publicly accessed manner</p>	<p>Move towards introduction of Protected Areas Legislation could include water catchment, and accordingly its protection control and management</p> <p>Government announced in 2014 that it was going to review existing water laws</p>
<b>Rights and Resource Use</b>	<p>TLTB does not recognize the provisions of Forest Reserves or Nature Reserves under Forest Decree</p>	<p>Current measurement offered under Forest and Nature Reserves deemed inappropriate for rights and aspirations of landowners therefore not favoured as policy direction under leasing regimes on offer</p>	<p>Introduction of Conservation leases which is used for Biodiversity protected areas and may provide an alternative, but this is subject to the terms and conditions of the Lease under TLTL Lease and Licenses Regulations (2010) as amended</p>
<b>Incentives and Regulations/ Financial Capacity</b>	<p>Fiji Forest Policy (2007) ensured ecosystem stability through conservation of forest biodiversity water catchments and soil fertility</p>	<p>Department of Forest has no powers to create water catchment</p> <p>Under Forestry Decree (2002) compensation procedure for existing Forest reserve is poorly understood by landowners</p>	<p>Department of Forest under the policy can however prohibit logging under areas marked as important water catchments and selected as such.</p> <p>Review and clarify compensation procedures of existing Forest Reserves improve cost recovery as a strategy for water under national Development Plan 2017-2021.</p>
<b>Technical Capacity</b>	<p>Land Resource Management Bill (2016) has capacity of incorporating provisions of improving technical capacity through its provisions of effective water and sanitation management</p>	<p>There is no discussion for compensation of loss of land use rights by landowning units in the proposed Bill.</p>	<p>Proposal by Government in 2014 to review [existing water law] s promises to streamline various stakeholder functions and effective water and sanitation management in Fiji</p>
<b>Strategic Planning and Adaptive Governance</b>	<p>5yr&amp;20Yr Development Plan to formulate and implement a National Water Resource Management and Sanitation Policy to govern the planning and development of water resources</p> <p>An integrated approach by WAF and Department of Water and Sewerage to develop mechanism for detail water resource monitoring in collaboration with other relevant agencies</p>	<p>Previous Reports had identified the need to overhaul legislations regarding land and water resource management. (See Watling, D, 2017)</p>	<p>Review existing policies, regulations and standards, incentives, legislations, and processes governing the provisioning of water and sanitation services to improve quality service and access.</p> <p>Support community awareness of water conservation practices, civic responsibility on use of water resources, protection, of traditional water sources as well as promotion of a blend of traditional and modern water conservation practices</p> <p>Providing incentives to encourage water saving and management of freshwater resources</p>

Indicators	Bearing on Water Catchment Management	Gaps/Comments	Way Forward
<b>Monitoring and Learning Mechanisms</b>	Gravel extraction is a major requirement for government infrastructure development plans but is also a major environmental issue as it is not managed sustainably	To apply principles of sustainable use and development of natural resource is one of the two main purposes of EMA, but this is overlooked in cases of gravel and boulder extraction undertaken from rivers	The National Environment Council established under EMA is in place to ensure that the provisions of EMA are administered correctly throughout government.  Issues of sustainable development such as drinking water catchment are core issues for NEC deliberation
<b>Enforcement Compliance</b>	Fiji Rural Land Use Policy (2002) includes provisions for the protection of soil and water values including establishing guidelines and standards that maintain biophysical minimum needs of water quality and quantity.	Provisions under the guidelines does not have legislative basis and therefore cast a long shadow over proper enforcement and compliance when it comes to established guidelines.  EIA efficacy and effluent discharge monitoring is under resourced and widely regarded as weak.  DoF supervision and control of logging practices is under resourced and ineffectual	Land Use capability classification guidelines is included as part of the implementation of the policy for fit and proper use, which is a systematic arrangement of different kinds of land according to properties that determine its capacity for sustained production.
<b>Distribution of Benefits from Ecosystem Services</b>	There is no discussion of compensation issues for loss of land use rights by landowners on the proposed Land and Water Resource Management Bill.	Valuation of ecosystem services within the water catchment area is not properly ascertained to inform and highlight the crucial elements played by the different constituent parts.	Landowner/Community Management Initiatives to seriously consider proposing paying of water to provide landowners/communities with a commercial incentive to maintain good land management practices
<b>Water Related Conflicts</b>	Agriculture Department advertise sustainable agricultural practices but in practice, focus is in greater production  Forestry seeks to implement permanent Forest Estate under its policy while Agriculture seeks clearing of vegetation to make way for farms to boost production.	Enforcement of the regulations under EMA must improve greatly if there is a real desire to improve water quality and minimize deterioration of riverine ecosystem.	Provide formal survey of water catchment areas such that they are entered into local and regional maps and plans, marking them as sensitive areas.  Ensure that water catchment areas are integrated in the consideration by other agencies relating to all development proposals such that there are referrals to WAF for comments







