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**FRESHWATER ACCESSIBILITY IN RURAL AND REMOTE LOCATIONS OF THE FIJI
ISLANDS: A CASE STUDY OF KALABU AND KOROVISILOU VILLAGES**

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Abstract

Water is a key driver of economic and social development while it also has a basic function in maintaining the integrity of the natural environment. Due to its small sizes and locations of islands that are spread across vast ocean space, many remote and rural communities in the Fiji Islands have barriers in accessing freshwater. The challenges of freshwater accessibility are not only present in small remote islands but in the main islands as well such as Viti Levu and Vanua Levu.

It is important to note that majority of the islands have rivers and streams together with other water source flowing through them. However, some places are still without clean and safe drinking water that is attributed to different reasons. In some areas, the problem is both water quantity and water quality. All too often the magnitude of variability and the timing and duration of periods of high and low supply of freshwater are not predictable; this equates to unreliability of the resource which poses great challenges to water managers in particular and to societies as a whole.

Supply side solutions alone are not adequate to address the ever increasing demands from demographic, economic and climatic pressures that directly affect freshwater accessibility. Nevertheless, water being one of the only vital needs cannot be forgone under any circumstance that means finding solution to remove the barriers associated with it is a must. Hence, it is imperative that freshwater issues accessibility is not considered in isolation if one has to arrive at meaningful solution in addressing the current challenge that will contribute to a sustainable future.

Key Words: Freshwater, Accessibility, Kalabu, Korovisilou, Sustainability

Acronyms

CBD- Central Business District

CSD- Commission on Sustainable Development

EU- European Union

FAO- Food and Agricultural Organization

FIBS- Fiji Islands Bureau of Statistics

FJD- Fiji Dollars

GIS- Geographical Information System

GWP- Global Water Partnership

INBO- International Network of Basin Organizations

ICWE- International Conference on Water and the Environment

IWRM- Integrated Water Resource Management

MDG- Millennium Development Goals

PIC- Pacific Island Countries

SPSS- Statistical Package for Social Sciences

SOPAC- South Pacific Islands Applied Geoscience Commission

TARWR- Total Actual Renewable Water Resources

TLTB- Taukei Land Trust Board

UN- United Nations

UNCED- United Nations Conference on Environment and Development

UNDP- United Nations Development Program

UNDESA- United Nations Department of Economics and Social Affairs

UNED- United Nations Environment and Development

UNEP- United Nations Environment Program

UNESCAP- United Nations Economic and Social Commission for Asia and the Pacific

UNFCCC- United Nations Framework Convention on Climate Change

UNICEF- United Nations International Children Education Fund

UNIDO- United Nations Industrial Development Organization

UNW- United Nations Water

UNPD- United Nations Population Division

US- United States

USD- United States Dollars

WAF- Water Authority of Fiji

WBED- World Bank Environment Department

WCD- World Commission on Dams

WCED- World Commission on Environment and Development

WHO- World Health Organization

WSD- Water and Sewage Department

WSSD- World Summit on Sustainable Development

WWC- World Water Council

WWF- World Water Forum

Glossary for Vernacular (Fijian Terms) Used

Ika- refers to the type of fish which signifies an identity of a tribe

I-taukei – Indigenous Fijian

I-qoliqoli- Customary fishing boundary associated with a particular district and communally owned by those who rightly belong to it. It comprises any area of seabed or soil under water, sand, reef, mangrove swamp, river, stream or wetland.

Liuliu ni Yavusa- a man who leads a tribe (chief)

Lotu- religion

Mataqali- clan

Vanua- Land including life forms, social and cultural systems (traditions, beliefs, values and norms)

Yavu- a piece of land where a house is built in a village

Yavusa- Tribe

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CHAPTER 1
INTRODUCTION

“Only when the last tree has died and the last river been poisoned and the last fish been caught will we realise we cannot eat money”.

Cree Indian Proverb

1. Introduction

Reducing by one half the numbers of people in the world without access to safe drinking water is one of the key *Millennium Development Goals* (MDGs)¹ (Sachs and McArthur, 2005). Although there has been substantial investment in the provision of water, especially in Africa, there is still a long way to go and it is unlikely that this goal will be achieved by 2015 (United Nations, 2007). With an increase in population and a decrease in available freshwater resources, water scarcity has become a more and more pressing issue worldwide (Wang et al., 2010).

Freshwater is a precious resource, it flows throughout all terrestrial life and is used for all aspects of human activity, yet its future is far from secure as humans continue to destroy the ecological base of our water supply. Rapid population growth combined with poverty, industrialization, urbanisation, agricultural intensification is resulting in a global water crisis. While some one billion people, 20 percent of the population, are excluded from their right of access to safe drinking water, almost two and half billion people live without access to sanitation systems. Water is central to the lives of women, yet they are invariably excluded from decisions regarding its management (UNED, 2000). Water resources are essential to human development processes and to achieve the MDGs that seek, inter alia, to eradicate extreme poverty and hunger, attain universal literacy, and ensure environmental sustainability (Hanjra et al., 2009).

There is a growing effort to provide drinking water that has the trust of consumers, but the processes underlying the perception of drinking water quality and risks are still not fully understood (Doria Mde et al., 2009). Nowhere does the link between human health and the environment manifest itself more strongly than our reliance on fresh clean drinking water. It is a critical goal to create a sustainable framework for human utilization of the environment and specifically for the protection of drinking water supplies so as to ensure human and environmental health. Challenges toward achieving sustainable water supplies include a lack of

¹ Are eight international development goals that were established following the Millennium Summit of the United Nations in 2000, following the adoption of the United Nations Millennium Declaration

recognition for the role of strong *watershed*² management and discontinuity between policy makers, policy instrumentation, managers and scientists (Hunter et al., 2009).

Millions of people die every year around the world from diarrheal diseases much of which is caused by contaminated drinking water. By contrast, drinking water safety is largely taken for granted by many citizens of affluent nations. The ability to drink water that is delivered into households without fear of becoming ill may be one of the key defining characteristics of developed nations in relation to the majority of the World. The report from (UNED, 2000) also outlines that:

“the reasons for the water crisis are not technological or financial, but are rooted in mismanagement and the inequitable allocation of resources throughout society. The political nature of some of the proposed ‘solutions’ to the water crisis, such as privatisation of water or biotechnology³ require frank public debate, with full engagement at the local level”. (p.2)

According to the MDG report on Water and Sanitation Targets (UNICEF & WHO 2004); approximately 3 million people in the Oceania region do not have access to safe and adequate drinking water and sanitation services. Providing this access to improved water supplies remains a priority issue in the region. Financial, institutional and structural constraints all contribute to the inability to provide safe drinking water.

Freshwater resources in small islands can be classified in two main categories that are as follows:

- Naturally occurring water resources requiring a relatively low level of technology in order to develop them. This category, which is sometimes referred to as ‘conventional’ water resources, includes surface water, groundwater and rainwater.
- Water resources involving a higher level of technology (sometimes referred to as “non-conventional” water resources). This category includes desalination, importation and wastewater reuse (Carpenter et al, 2003)

² An area or ridge of land that separates waters flowing to different rivers, basins, or seas

³ The exploitation of biological processes for industrial and other purposes. The use of biological processes, organisms, or systems to manufacture products intended to improve the quality of human life.

Hence, it is important to note that most of the Pacific Island communities rely mostly on the first category “conventional water resources” for their daily livelihoods. The Pacific Island Countries (PICs) differ significantly in size, population and resources endowment, but nevertheless share many common development constraints and challenges. PICs are constantly faced with drinking water supply problems (Mirti and Davies, 2005). Drinking water quality challenges are prevalent across the Pacific; however the degree of constraints varies from country to country. Variations in water resource availability, supply conditions, increasing pollution and water contaminants and lack of proper institutional frameworks for water quality monitoring, are all issues that affect water quality and consequently the health and well-being of Pacific Islanders.

Though in total Fiji has a large water resource, in fact these water resources are not evenly distributed- they are not equally plentiful in all places, nor is water equally available at all times. The variability is very dependent on geographical location, variability in climate conditions, and socio-economic and environmental developments ((Kumar, 2010).

1.1 Motivation, Aims and Objective of Research

Over the past years and now in the present, there had always been issues that are associated with freshwater. One of the major issues that is affecting freshwater is its accessibility to individuals and household. Though, Fiji has many rivers and countless streams, there are still household and individual that have little or no access at all to freshwater.

International, regional and local organizations divert resources and time on the issues associated with freshwater accessibility. This is also the case in most villages and islands in Fiji where organizations steps in with measures and strategies of trying to help the people cope with the problem that they are confronted with in respect to freshwater.

History has it that my grandmother and later on my mother had to walk some distance in order to get freshwater. With water as a need, I recall my mother telling me and my other siblings that a large portion of her time had to be used fetching water for the family. In the same manner, access to freshwater also became a challenge for me when growing up in Kalabu village even though there was tap water. From time to time, there would be no water coming out of the tap and one would think that it was even useless to have a tap in the first place. There was injustice in the

supply of water as household continue to pay for water bills but hardly water coming out of the tap when it is needed. Vividly, in my Primary School days, our parents would wake us up early in the morning so that we could make our way to the nearby river (Figure 1) and have our bath. On our way to the river, we have to carry empty containers that we have to fill from an aquifer (Figure 2) that will be used for drinking, washing utensils and cooking meals. The same had to be done in the evening when we go for bathing.



(Source: Ilaisa Naca)

Figure 1 Villagers enjoying themselves in the river at Kalabu Village.



(Source: Ilaisa Naca)

Figure 2 Aquifer near Kalabu Village.

The rivers and streams in Kalabu bring back those memories that this freshwater does not only provide our family with drinking water but is a major provider of food and income as well. These rivers as my mother said, provide a spawning ground for prawns and freshwater fish that the women enjoy to swim in with their fishing nets trying to capture it so that most families would have their share of protein while the excess catch is sold at a price in the market. Children would gather in groups and laughter would fill the air as the waterfall attracts people of different ages with its charm. Along the river banks and streams, there would be evergreen trees and abundant coconut and fruit trees of different varieties that truly make the place spectacular.

As a Christian believer, water signifies life and their present signifies a harmony between nature. There were many cases in the holy bible where water is being mentioned. Infact, the first miracle that was performed by Jesus Christ was associated with water whereby he turned water into wine during a wedding celebration. Hence, this research looks not only into my academic life but it also provide a glimpse into my spiritual life. There are people out there who have no access at all

into freshwater, so as a believer in Christ, it says that we have a duty as Christian to those that are not so fortunate. People have to share things that they have in order for others to live a life that they have a right too.

Power and greed had blinded so many people from giving what they have to their neighbors. There is almost a price to everything nowadays. Water which was supposedly to be free resources and can be accessed by anyone without a price is now something that can only be accessed if one has money. Private institutions and large corporations had now put a price tag in most fresh water source areas that restricts people's accessibility to it. Due to restriction and barriers to freshwater accessibility, a lot of people face difficulty in life and a deprived of one of the basic need which all individuals should have.

Village life as I recall had its own share of ups and downs. In the present, water problem is still experienced and this is the time where individual household turn to the river to meet their needs. A small portion of the villagers still do not have tap water and they rely on natural water sources to carry on with their daily livelihood. Thus, this issue of freshwater accessibility can be look at from different dimensions but at the end of the day, water will always be a need and there a people out there who are in one way or the other facing problem about it which means that researchers, policy makers and other stakeholders have to keep on working on solutions to meet this problems.

The aim of this research is to study the nature and characteristics of freshwater accessibility among the rural population and isolated areas in Fiji. It will be centred on the following objectives.

- To investigate the nature and characteristics of freshwater accessibility in Kalabu and Korovisilou villages.
- To explore the strength and weakness of freshwater accessibility in the two case study areas.
- To compose mitigation approaches that institutions can use to solve freshwater accessibility barriers.

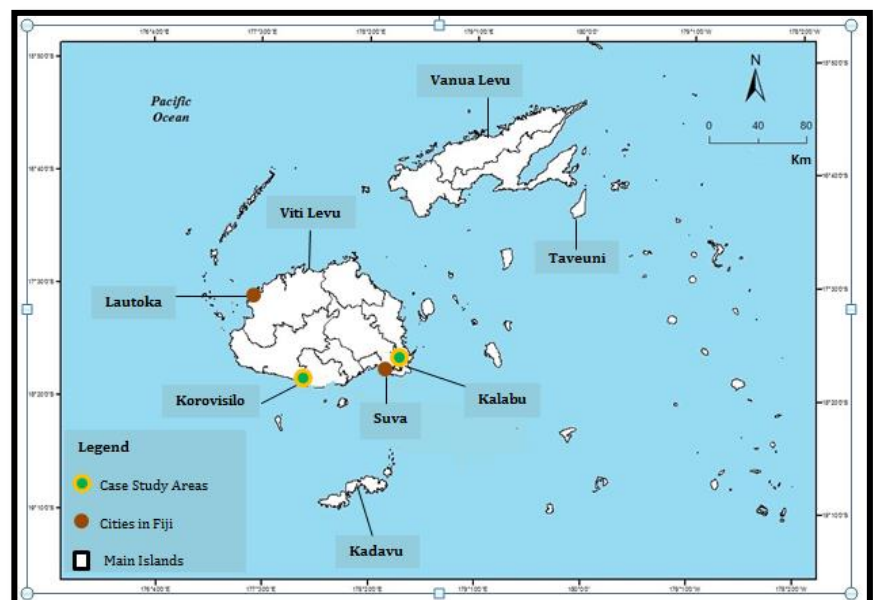
With that in mind, this work will also aim to contribute to the growing research that is being carried out in relation to freshwater. This will be done in close relation to freshwater accessibility that is confronting people in remote locations and those in rural areas. The study of freshwater accessibility is of utmost importance as it will highlight the gap between urban dwellers and rural dwellers in regards to the supply and their accessibility to freshwater resources. Such being the case; it will encourage the invention of workable strategies that will allow decision makers and stakeholders to bridge the gap between urban dwellers and rural dwellers to access freshwater at their own ease with no possible discrimination and meeting the need of every individual when it comes to water.

1.2 Research Methodology

The method that was used to carry out the research was mainly qualitative in nature. Due to the distance of the study area and how data was stored by the informants, qualitative method would ensure that information required to do the research can be gathered to the researchers' best ability. Thus, detail method of this discussion can be found in Chapter 4 of this thesis.

The selected case study area in Figure 3 shows an illustration of the geographical location of Kalabu and Korovisilou village. Together with that, the map also shows the four large islands and the only two cities in the Fiji Islands. The capital city, Suva, host almost all main administrative and government headquarters where planning and decisions are being made for the well-being of the nation.

Figure 3 Geographical location of the Study Areas in relation to the Fiji Islands



1.3 Conceptual Framework of Thesis

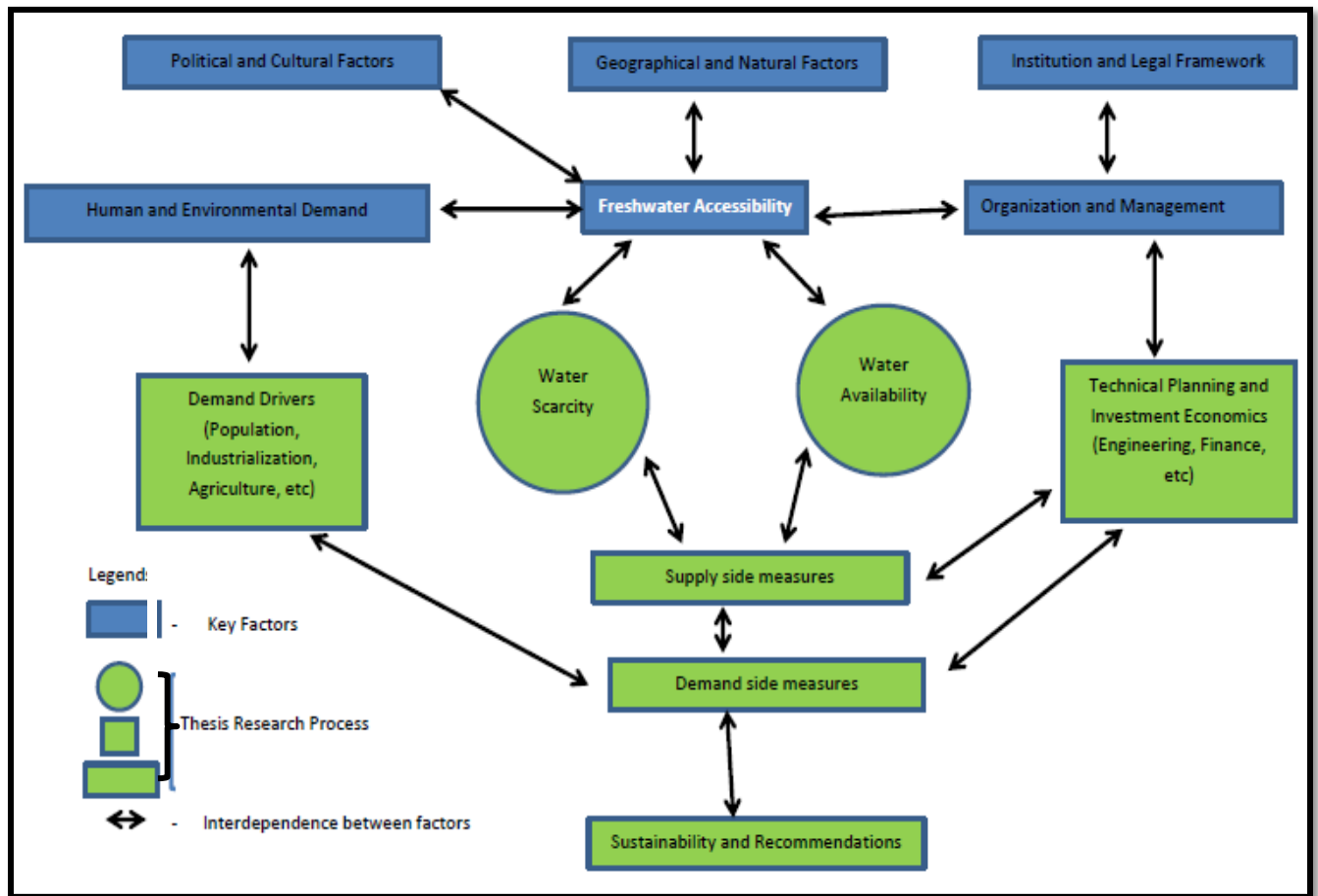


Figure 4 Conceptual Framework

The *Conceptual framework*⁴ (Figure 4) exhibit the idea that depending on the resource (water) present on a certain location, it will determine the situation whether there is water scarcity or water availability. It is important to keep in mind that water is one of the only vital resources that are needed for all life forms. Hence, it is crucial that all issues affecting it should not be kept or approached in isolation. It demands that all key factors are accounted for in the decision making processes to ensure that freshwater accessibility barriers are eliminated. Indeed for a developing country like Fiji, the supply side cannot meet all the demand side factors mainly due to the limited capital and human resources. Together with that, there is demographic, development and climatic factors that drive demand and will determine supply. However, given time, this should

⁴ Is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas.

change as a result of technical planning, investment economics and other factors that can advance as the country grows. This will improve accessibility to freshwater for the current generation and improve sustainability for the future generations.

1.4 Work structure

In order to make the discussion clear and allow the readers to easily understand this research, chapters are being allocated. There are six chapters altogether that can be found in this thesis. Chapter one gives the introduction of the five chapters that follows it and gives a glimpse of the research aim and objectives. In chapter two, one will find the state of the art that explores various literatures from several different sources to allow an understanding of the theme.

Furthermore in chapter three, detail discussions are being made about the study area. In the same chapter, there are also facts and a bit of backgrounds given about the Fiji Islands where the case study area is located simply to give readers some knowledge of the country and be able to relate it to the case study areas.

Chapter four accommodates the method used to carry out the research together with the materials and tools that were used to input, process, produce and store data for the whole research. On the other hand, Chapter five contains the discussions of the field results that are gathered from the case study area. The chapter six of this thesis gives the recommendations and conclusion for the research. Finally, all reference used in this research are being provided followed by the appendix.

CHAPTER 2

The Nature and Characteristics of Freshwater Accessibility

“Water is the driving force of all nature”.

Leonardo da Vinci

2. The Nature and Characteristics of Freshwater Accessibility

Water is an extraordinary and a very precious substance. It is an essential part of any living organism and without it life would cease to exist. There had been many discussion and debates that happens globally on issues relating to freshwater. Numerous institutions, governments' organization, researchers and scientist focused their work on finding solutions to freshwater problem that is present in almost all parts of the world.

Studies had revealed that water is affected by natural processes, ecosystem characteristics and anthropogenic activities. This chapter will discuss various literatures review that were carried out regarding freshwater accessibility and issues that are associated with it. It attempts to bring the readers into light on factors relating to the objective of the study before later moving into chapter three of this work. It is important to note that this literature review does not only account for a single case study but it combines various case studies from different researchers that had been peer reviewed and will give a clear picture on the issue of freshwater accessibility.

2.1 Defining Water and Accessibility

Water is a colorless, transparent, odorless, liquid which forms the seas, lakes, rivers, and rain and is the basis of the fluids of living organisms (Oxford Dictionaries, 2013). It is a chemical substance, with chemical formula H_2O liquid but may also occur in various forms such as gas (water vapor) and solid (ice) (Biology Online, 2013). Water is one of the most unique molecules known to man and also one of the most important to the biological systems. Not only does water exist in nature's three states of matter (solid, liquid and gas), it also covers 75% of the earth and composes roughly 78% of the human body (Moulton, 2004).

The total volume of water on Earth is about 1 400 million Km^3 of which only 2.5%, or about 35 million Km^3 , is freshwater (Table 1). Most freshwater occurs in the form of permanent ice or snow, locked up in Antarctica and Greenland, or in deep groundwater *aquifers*⁵. The principal sources of water for human use are lakes, rivers, soil moisture and relatively shallow

⁵ A body of permeable rock which can contain or transmit groundwater.

groundwater basins. The usable portion of these sources is only about 200 000 Km³ of water, less than 1% of all freshwater and only 0.01% of all water on Earth. Much of this available water is located far from human populations, further complicating issues of water use. Water demand is defined here as the volume of water required by users to satisfy their needs. *Surface freshwater*⁶ is the most readily available resource to meet the water demand of agriculture (i.e., irrigation and livestock), industry, households and municipalities. We take surface freshwater as indicative of blue water availability and thus depart from its common definition (e.g., Falkenmark et al., 1997) that includes groundwater resources as well.

Table 1 Major Stocks of Water

	Volume (1 000 km ³)	% of total water	% of total freshwater
Saltwater			
Oceans	1 338 000	96.54	
Saline/brackish groundwater	12870	0.93	
Salt water lakes	85	0.006	
Inland Waters			
Glaciers, permanent snow cover	24 064	1.74	68.7
Fresh groundwater	10 530	0.76	30.06
Ground ice, permafrost	300	0.022	0.86
Freshwater lakes	91	0.007	0.26
Soil moisture	16.5	0.001	0.05
Atmospheric water vapor	12.9	0.001	0.04
Marshes, wetlands*	11.5	0.001	0.03
Rivers	2.12	0.0002	0.006
Incorporated in biota*	1.12	0.0001	0.003
Total Water	1 386 000	100	
Total Freshwater	35 029		100
Source: Shiklomanov 1993			
<i>Notes: totals may not add exactly due to rounding</i>			
<i>* Marshes, wetlands and water incorporated in biota are often mixed salt and freshwater</i>			

According to the Oxford Dictionary, *accessible* is a term that describes a place that can be reached or entered. It is the extent to which a consumer or user can obtain a good or service at the time it is needed (Business Dictionary, 2013). The ease of approach to one location from other locations. This may be measured in terms of the distance travelled, the cost of travel, or the time taken (Oxford Dictionary of Geography, 2013). In the case of both resources and services, it is possible to distinguish between *physical accessibility* where a resource is within reach, and

⁶ Includes the streams (of all sizes, from large rivers to small creeks), ponds, lakes, reservoirs and canals (man-made lakes and streams), and freshwater wetlands.

social accessibility whereby the individual actually has the means to reach the resource or location; for example, it is argued that class structures, income, age, educational background, gender, or race can limit people's access to services. Hence, freshwater accessibility in this study will attempt to discuss both physical and social accessibility.

2.1.1 Freshwater for Nature

The relationship between humanity and *natural systems*⁷ is discussed in the Bible, in the book of Genesis. However, different views are expressed within Genesis (Cohen, 1985). In the first chapter, Man is viewed as supreme, and thereby allowed to subdue the earth, and to dominate the fauna and flora for his benefit (particularly, Genesis 1:28). In the second chapter, a different normative approach is advanced, whereby Man is a steward of nature, who should take care of it (Genesis 2:15). This second normative position is the basis for the evolving ethic whereby humans have a moral obligation to sustain natural ecosystems and hence to retain water in streams, rivers, aquifers and lakes for this purpose (an obligation recognized in Chapter 18, Part C of Agenda 21).

This ethic may be couched in the language of stewardship, such as Postel's (1997) water ethic, or Falkenmark and Folke's (2010) ecohydrosolidarity; in a bio-centric ethic, whereby humans are only the first among equals (Merchant, 1997; Breckenbridge, 2005); or in a view of sustainability and inter-generational ethics, whereby the environmental rights are part of a human right for a green future (Hiskes, 2009). Earth's water is always in movement, and the natural water cycle, also known as the hydrologic cycle describes the continuous movement of water on, above, and below the surface of the Earth. Water is always changing states between liquid, vapor, and ice, with these processes happening in the blink of an eye and over millions of years.

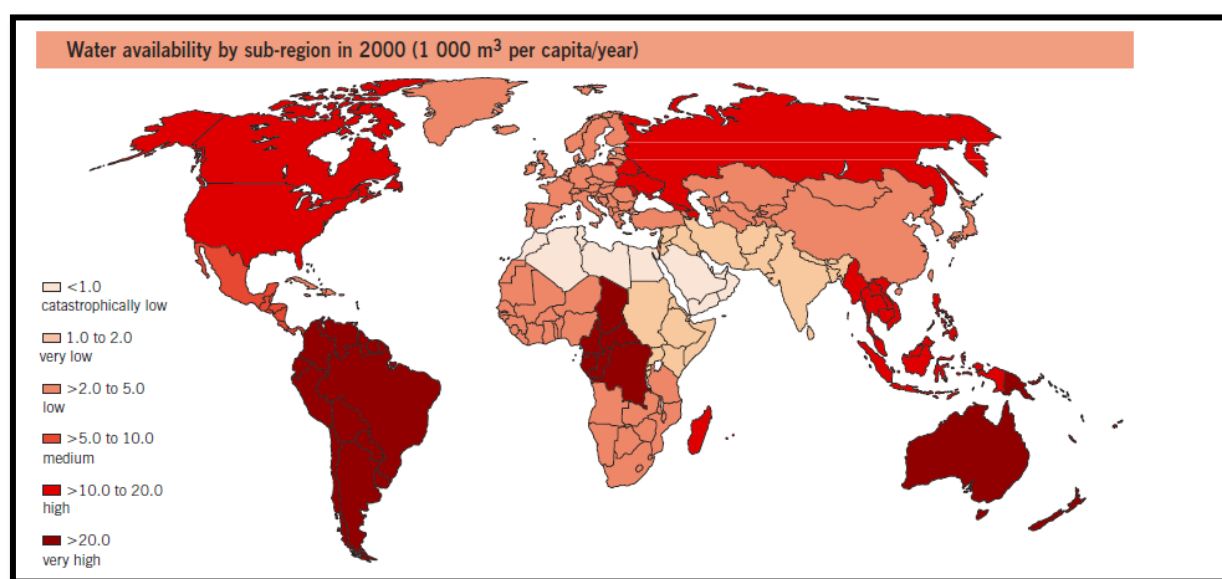
Water is necessary for human survival. This well-recognized fact is the basis for the emerging view of basic human water needs as a human right to water (Glieck, 1998; Cunha, 2009). But human rights are about more than survival. They include dignity for, as Hiskes (2009, p. 27) states: 'Human dignity ... is both producer and product of moral rights, in the sense that morality is impossible without them'. Human dignity also underlies the Millennium Development Goals

⁷ *Natural systems* are those systems that exist in nature and consist of all the materials that are physical and biological and the interrelated processes occurring in it.

(MDG) premise that extreme poverty is unacceptable because it does not allow for dignified living. But the water-related goals stated in the MDG pertain only to access to clean water and sanitation, without specifying what is meant by access (Marin et al., 2009), or the amounts to which humans are entitled. Clearly, any use of water by humans that is based on the abstraction of water from natural courses or aquifers affects the environment (Sophocleous, 2003). Hence, the amount of water that should be retained in nature is not the same as the amount that was there in a pristine state.

2.2 Demands for Water and Scarcity

In the modernist era, water is discussed as a single substance which has multiple uses (Ward, 2013). Research had shown that, over 97% of all water on Earth is found in the oceans. Of the remaining 3%, most is locked up in glaciers and icecaps in Greenland and Antarctica, in saline inland seas or in the atmosphere, and is not readily available for consumptive use. Less than 1% of available water is usable by humans and other members of the biosphere. Water is continually being shifted (recycled) from one of these reservoirs to another in the water cycle. The total amount of water in the different reservoirs remains nearly constant with time on a short time scale, but it can change for various reasons. These changes have profound effects on the biosphere (Global Hydrology and Climate Centre, 2013).



(Source: FAO 2001, Shiklomanov 1999)

Figure 5 Water availability measured in terms of 1 000 m³ per capita/ year

The three major factors causing increasing water demand over the past century are population growth, industrial development and the expansion of irrigated agriculture (Figure 5). Agriculture accounted for most freshwater withdrawal in developing economies in the past two decades. Planners have always assumed that growing demand would be met by taming more of the hydrological cycle through building more infrastructures. The damming of rivers has traditionally been one of the main ways to ensure adequate water resources for irrigation, hydropower generation and domestic use. About 60% of the world's largest 227 rivers have been strongly or moderately fragmented by dams, diversions or canals, with effects on freshwater ecosystems (WCD 2000).

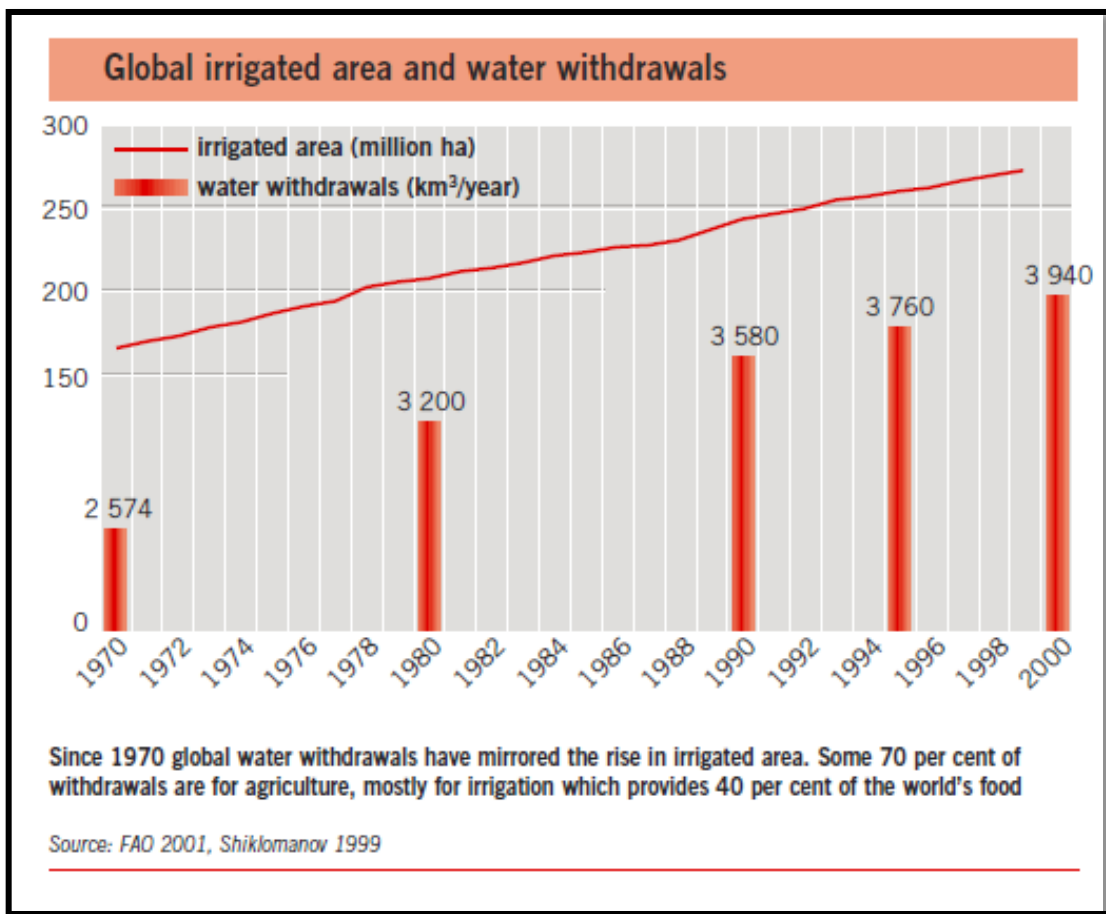


Figure 6 Water withdrawals from global irrigated areas

In most countries, water withdrawal and consumption have increased (Figure 6) over the last decades because of demographic and economic growth, changes in lifestyle, and expanded water supply systems (Kundzewicz et al., 2007). The existing imbalance of water availability and water

demand causes water scarcity to be one of the most pressing environmental issues in the world today.

Scholars across academic disciplines, sciences and social sciences, are studying *Water scarcity*⁸ and developing new ways of analyzing water issues. One of the emerging conceptual frameworks is virtual water and the hidden global water trade. *Virtual water* is the amount of embedded water or hidden water used to produce agricultural and industrial goods. For example, it takes approximately 500 liters of virtual water to produce one cup of rice (Hoekstra and Chapagain 2007). The quantification of virtual water exposes water-intensive products and processes. This new type of measurement provides a more comprehensive understanding of water-use and supports the development of innovative policies for water savings and water conservation. Virtual water is exported through trade. It is contained in water-intensive products that are sold in the global market. One of the most consequential dynamics of the virtual water trade is that water-scarce countries often produce and export water-intensive crops (Kehl, 2011). Water scarce countries would benefit from altering their agricultural policies and trade practices to minimize the amount of virtual water they export, and importing water-intensive food products from the international market.

About one-third of the world's population lives in countries suffering from moderate to high water stress where water consumption is more than 10% of renewable freshwater resources. Some 80 countries, constituting 40% of the world's population, were suffering from serious water shortages by the mid-1990s (CSD,1997a) and it is estimated that in less than 25 years two-thirds of the world's people will be living in water-stressed countries (CSD,1997b). By 2020, water use is expected to increase by 40%, and 17% more water will be required for food production to meet the needs of the growing population (WWC, 2000a).

2.3 Ownership of Water

Numerous people view water as a natural resource (Falkenmark & Lindh, 1974; Clarke, 1993; Gliick, 1993; Postel, 1997, for example). Others (mostly economists) argue that it should be viewed as a commodity or a factor of production (Winpenny, 1994; Rogers et al, 2002).

⁸ A condition in which people lack sufficient water or else do not have access to safe water supplies.

However, water is first and foremost a source of life. Hence, it has been argued that water should be considered as a basic need, and therefore it constitutes a right to which people are entitled (Gleick, 1998).

Water is widely shared among nations, regions, ethnic groups and communities. A total of 261 rivers (Figure 7), covering 45.3% of the total land area (excluding Antarctica), are shared by two or more countries (Wolf and others 1999), making transboundary water resources management one of the most important water issues today.

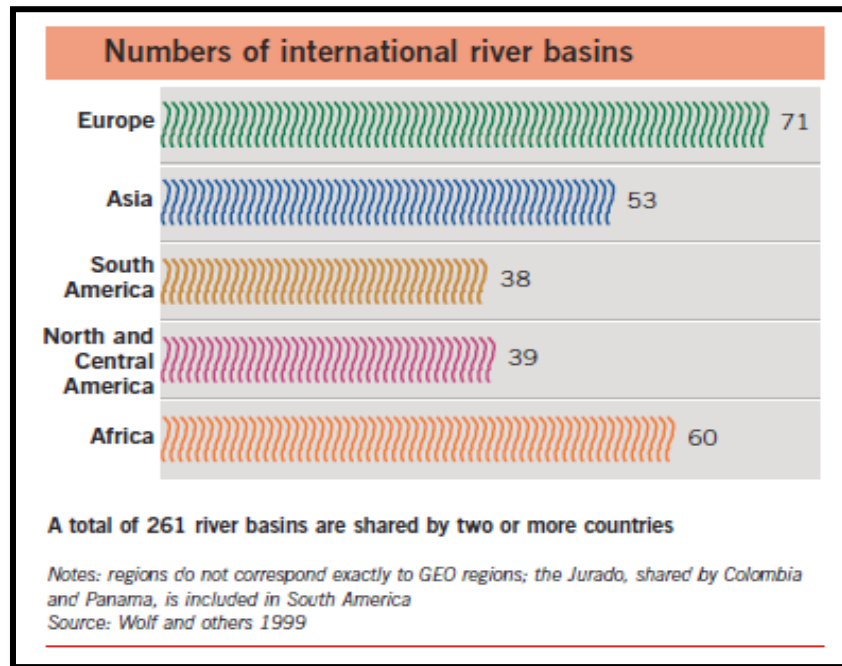


Figure 7 International River Basins

Disputes over shared water resources have a long history. Water has been used as a tool and weapon of conflict, access to water has been a source of dispute and contention, and major water development projects (for example dam construction) have led to violence and civil strife (Gleick 1998). But shared waters can also be a source of cooperation. This is particularly evident today with the increase in the number of initiatives related to river basin management regimes and institutions committed to bilateral and/or multilateral management of transboundary water resources. This can be traced back to the 1966 Helsinki Rules which laid the foundation for international principles for shared watercourses and influenced many specific river treaties. The Rules were subsequently followed up by various international efforts, including particularly the

work of the UN International Law Commission, which led in 1997 to the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses.

The recognition of *river basin*⁹ organization over the past 30 years has also resulted in the establishment of the International Network of Basin Organizations (INBO) in 1996. Other initiatives include the 1998 International Conference on Water and Sustainable Development, which declared that ‘a common vision of riverine countries is needed for the efficient management and effective protection of trans-border water resources’. The conference’s priority action programme (Bernard 1999) emphasized the need to:

- facilitate the exchange of accurate and harmonized information among riverine countries;
- promote consultation at all levels, especially within pertinent international institutions and mechanisms; and
- define medium-range priority action programmes of common interest to improve water management and decrease pollution.

Similarly, in the 6th World Water Forum held in Marseille, France on March 2012, the key messages discussed about transboundary waters include:

- The involvement of all stakeholders is vital.
- It is necessary to think beyond the river to the entire basket of benefits.
- It is important to create strong, transparent, predictable, and flexible institutions.
- There should be a focus on sustainability and achieving results.
- Financial support for process can increase political will and facilitate dialogue.
- Support to international agreements regarding transboundary watercourses is useful.
- 2013, the International Year of Water Cooperation must be meaningful.

2.4 Pollution and Untreated Water

The rapid industrialization in developing countries, though contributed to economic development, has resulted in heavy losses to economic welfare in terms of effects on agricultural activities, human health and ecosystem at large through air and water pollution. Basically water

⁹ The land area that is drained by a river and its tributaries (boundaries)

pollution poses a serious challenge due to its impact on a large number of economic activities (Reddy and Behera, 2006).

For many of the world's poorer populations, one of the greatest environmental threats to health remains the continued use of untreated water. While the percentage of people served with improved water supplies increased from 79% (4.1 billion) in 1990 to 82% (4.9 billion) in 2000, 1.1 billion people still lack access to safe drinking water and 2.4 billion lack access to improved sanitation (WHO and UNICEF 2000). Lack of access to safe water supply and sanitation results in hundreds of millions of cases of water-related diseases, and more than 5 million deaths, every year (Figure 8).

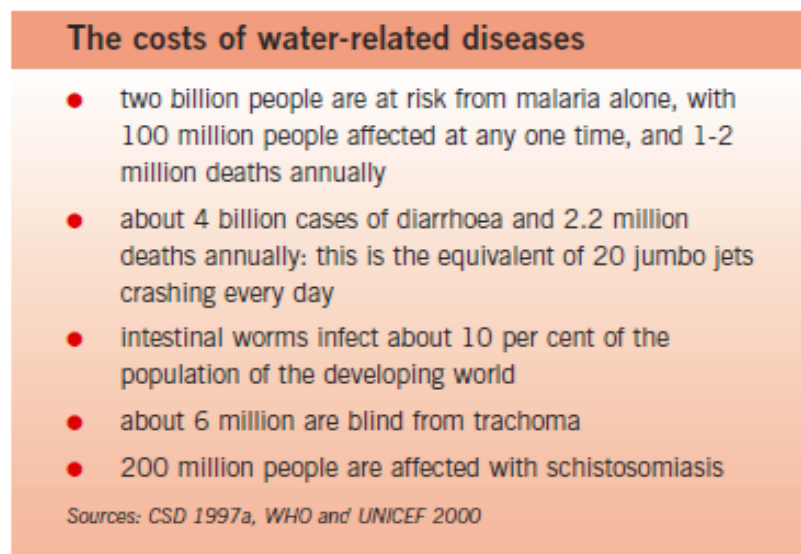


Figure 8 Impacts of Water related diseases

Water plays an important role in the transmission of many infectious diseases, which pose a great burden on global public health. However, the global distribution of these water associated infectious diseases and underlying factors remain largely unexplored (Yang et al., 2012). Water is essential for maintaining life on Earth but can also serve as a media for many pathogenic organisms, causing a high disease burden globally.

2.5 Influence of Climate Change on Water Accessibility

Water is the primary medium through which climate change impacts, it will be felt by humans and the environment. These impacts will affect all countries, but primarily the least developed –

and most vulnerable – areas of the world (World Water Forum, 2012). Given water’s strategic importance to national development processes, climate change constitutes a serious threat to the progress of developing nations. Furthermore, investment in adaptation measures is highly cost-effective as compared to the cost of reacting to extreme events.

*Anthropogenic*¹⁰ climate change is only one of many pressures on freshwater systems. Climate and freshwater systems are interconnected in complex ways. Any change in one of these systems induces a change in the other (Kundzewicz et al, 2007). As shown in the schematic (Figure 9), human activities affect freshwater resources (both quantity and quality) and their management.

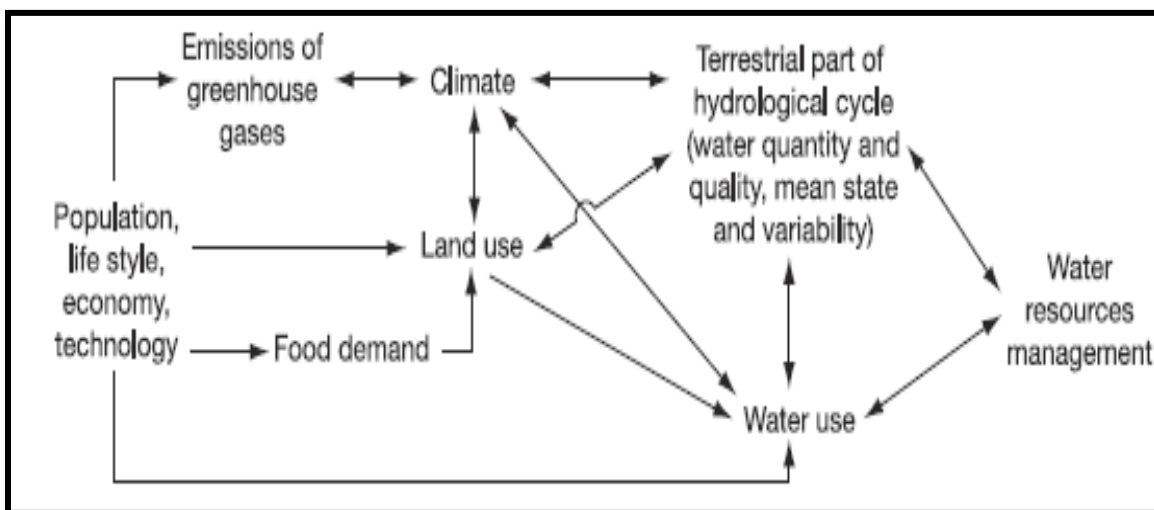


Figure 9 Impact of human activities on freshwater resources and their management, with climate change being only one of multiple pressures (modified after Oki, 2005).

In developed countries, flood-related water-borne diseases are usually contained by well-maintained water and sanitation services (McMichael et al., 2003) but this does not apply in developing countries (Wisner and Adams, 2002). Regretfully, with the exception of cholera and salmonella, studies of the relationship between climate change and micro-organism content in water and wastewater do not focus on *pathogens*¹¹ of interest in developing countries, such as specific protozoa or parasitic worms (Yarze and Chase, 2000; Rose et al., 2000; Fayer et al., 2002; Cox et al., 2003; Scott et al., 2004).

¹⁰ Something that originate due to human activity

¹¹ A bacterium, virus, or other microorganism that can cause disease.

With higher temperatures, the water-holding capacity of the atmosphere and evaporation into the atmosphere increase, and this favors increased climate variability, with more intense precipitation and more droughts (Trenberth et al., 2003). The hydrological cycle accelerates (Huntington, 2006). Higher water temperature and variations in runoff are likely to produce adverse changes in water quality affecting human health, ecosystems, and water use (Patz, 2001; Lehman, 2002; O'Reilly et al., 2003; Hurd et al., 2004). Lowering of the water levels in rivers and lakes will lead to the re-suspension of bottom sediments and liberating compounds, with negative effects on water supplies (Atkinson et al., 1999).

More intense rainfall will lead to an increase in suspended solids (turbidity) in lakes and reservoirs due to soil fluvial erosion (Leemans and Kleidon, 2002), and pollutants will be introduced (Mimikou et al., 2000; Neff et al., 2000; Bouraoui et al., 2004). Higher surface water temperatures will promote algal blooms (Hall et al., 2002; Kumagai et al., 2003) and increase the bacteria and fungi content (Environment Canada, 2001). This may lead to a bad odour and taste in chlorinated drinking water and the occurrence of toxins (Moulton and Cuthbert, 2000; Robarts et al., 2005).

2.6 Integrated Water Resource Management

Integrated Water Resource Management is a risk based approach advocating the co-ordinated development and management of land and water resources in order to ensure sustainable development. Water is central in the production of most forms of energy, and, as finite freshwater supplies become scarcer as a result of population growth and climate change, energy is becoming increasingly pivotal in the provision of water (Cammerman, 2009). However, the energy, climate and water sectors remain largely disconnected in terms of policy and decision making. This poses a problem for the holistic and sustainable management of water resources.

Water is central in the production of most forms of energy and its provision is pivotal since it is becoming limited. In the United States (US), many energy facilities have been *curtailed*¹² as a result of water scarcity and the US Congress, viewing this as a security issue, has responded by

¹² Reduce in extent or quantity; impose a restriction on it.

enacting legislation to assess potential threats associated with water and energy related issues across the nation (US Department of Energy, 2006; EWIA, 2009).

A more thoughtful, comprehensive approach is needed to develop policies that will truly improve the management of water and other natural resources, while also enhancing livelihoods (Wichelns, 2011). Millions of people die every year around the world from diarrheal diseases much of which is caused by contaminated drinking water. By contrast, drinking water safety is largely taken for granted by many citizens of *affluent*¹³ nations. The ability to drink water that is delivered into households without fear of becoming ill may be one of the key defining characteristics of developed nations in relation to the majority of the world. Yet there is well-documented evidence that disease outbreaks remain a risk that could be better managed and prevented even in affluent nations (Hrudey et al., 2006). The Walkerton Inquiry described some essential characteristics of risk management as:

- “being preventive rather than reactive;
- distinguishing greater risks from lesser ones and dealing first with the former;
- taking time to learn from experience; and
- investing resources in risk management that are proportional to the danger posed” (O'Connor, 2002b).

2.7 Water Resource Management and Governance

The former Secretary General of the United Nations, Kofi Anan, reflects a growing consensus when he states that ‘good governance’ is perhaps the single most important factor in eradicating poverty and promoting development (Sanday, 2003). Governance is a “complex mechanisms, processes, relationships and institutions through which institutions and groups articulate their interests, exercise their rights and obligations and mediate their differences” (UNDP, 2005).

The effect of good governance has also been echoed to have a positive correlation with institution effectiveness (Kaufmann, et al., 2009); and (Lockwood, 2010) echoes that establishing and maintaining good governance across the diversity of ownership and responsibility arrangements is critical for future effectiveness and acceptability of natural

¹³ Flowing freely or in great quantity

resources. Pressure on our natural resources has mounted and (Chhotray & Stoker, 2009) noted that this has been triggered by forces of globalization and democratization; and the implications have increased the pressure on established systems on collective decision making and thus have brought forth new forms of governance.

The Pacific Islands have little prominence in the good governance and resource management literature or, when they have appeared, have been seen as small environments and communities inevitably caught up in the wider impacts of global environment change (Pernetta & Hughes, 1990). Decision making institutions than needs a system of governance devised to consolidate institutions that make important decisions for the well-being of the people. Governance is a very critical process to strengthen institutional arrangements and structures and how best people manage their resources. In the case of water accessibility governance, Graham, et al., (2003) states that it concerns “the structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken and how stakeholders have their say”. Good governance is a subset of governance, where in public resources; problems are managed effectively, efficiently and in response to critical needs of society (Graham, et al., 2003). It constitutes principles that are participatory, transparent, accountable, equitable, and promotes the rule of law fairly (UNESCAP, 2007).

Good governance ensures that the voices of the poorest and the most vulnerable are heard in decision-making over the allocation of development resources, and that political, social and economic priorities are based on broad consensus among the three Stakeholders: the state, private sectors and civil society (UNDP, 2005). The European Commission (2001) defines principles of good governance by stating that the following elements are crucial to a complete understanding of governance: openness, participation, accountability, effectiveness and coherence. In terms of development the United Nations (2008) states that good governance is probably perhaps the single most important factor in eradicating poverty and promoting development. The problem of poor governance has been linked to institutional weaknesses. This has been confirmed by Grindle (2004) who stated that:

“Almost by definition poor countries of the world have institutions that are weak, vulnerable, and very imperfect; their public organizations are bereft of resources and are usually badly managed; and human resources are generally poorly trained and motivated” (p.2)

Emphasis on water supply, coupled with weak enforcement of regulations, has limited the effectiveness of water resource management, particularly in developing regions. Policy-makers have now shifted from entirely supply solutions to demand management, highlighting the importance of using a combination of measures to ensure adequate supplies of water for different sectors. Measures include improving water use efficiency, pricing policies and privatization. There is also a new emphasis on integrated water resources management (IWRM), which takes into account all the different stakeholders in water resource planning, development and management (CSD 1997b).

2.8 Water and Sustainable Development

Prior to the 1960s the majority of industrialized nations viewed progress as boundless economic growth and prosperity (Colby, 1989). It was assumed that nature was an infinite supply of stock resources, raw materials, energy, water, soil and air, and that nature could act as a sink by absorbing or neutralizing the by-products of the development and consumption of these benefits (Colby, 1989). Feats of gigantic and prestigious hydraulic engineering occurred; natural resources were viewed as an essential driver of economic development and were therefore to be exploited as such (Molle, 2008). Governments and engineers strove to ‘command and control’ water resources in order to establish highly predictable supply and yield outcomes for the betterment of industry profits and for national economies (Meffe, 1996). Policy making gave primacy to economic decisions, assuming that environmental problems could be solved if the economy was sound (Newton, 2008).

However, between 1950 and 1986, the world’s population doubled from 2.5 to 5.0 billion and gross product and world fossil fuel consumption quadrupled. Such pressures on resources led to continued environmental degradation and in the late 1960s and early 1970s a rapid emergence in environmental awareness and action indicated a turning point in conceptual thinking (Hooper, 2005). Hardin (1968) in his influential article the *Tragedy of the Commons* suggested that individuals autonomously act in their own self-interest to eventually destroy shared and finite resources even though it is environmentally, socially and economically counter-intuitive to do so.

Holling (1973) advocated that in order to effectively sustain our natural resources we need to recognise the complex interdependent linkages and non-linear, emergent and unpredictable

behaviour that forms part of our socio-ecological systems; a theory which would later develop in to the concept of Adaptive Management. For the first time, the 1972 United Nations (UN) Conference on the Human Environment in Stockholm emphasised conservation which included protection and the rational use of natural resources and advocated a balance of environmental, social and economic development in order to ensure a future for civilisation (UNEP, 2007). Similarly, the 1977 UN Conference on Water, held in Mar del Plata, considered holistic and comprehensive approaches to the management of water resources, signaling a shift away from the preceding hydraulic paradigm (Rahaman, 2005).

Ideas presented at Stockholm did not gain real currency until the Bruntland Commission delivered the World Commission on Environment and Development (WCED) report to the UN in 1987. The report, whilst reiterating the major points put forward at Stockholm, is widely attributed with popularizing the concept of 'sustainable development' internationally (UNEP, 2007), which is universally understood to mean "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987 p.54). In its report the Commission also called for countries to initiate institutional reform in terms of incorporating environmental concerns and investments into issues of national security and advocated for institutions and laws to reflect the interconnectedness of environmental and economic problems (WCED, 1987). Nevertheless, the WCED report, whilst extensively discussing energy and making the linkage between energy and climate change, barely addressed the issue of water which, according to Rahaman (2005), had fallen off the international agenda.

Water was to return to the international agenda in 1992 when the International Conference on Water and the Environment (ICWE) was held in Dublin, as a preparatory event to the 1992 Rio de Janeiro 'Earth Summit' which, amongst other things, reaffirmed the need to manage water in an integrated and holistic manner. The Conference also recognised that water should be treated as an economic good (ICWE, 1992: cited in Calder, 1999), a declaration which acted as a catalyst for a number of water reform programs globally. The 'Earth Summit' subscribed to Dublin's outcomes and they were subsequently incorporated into Chapter Eighteen of Agenda 21. Chapter Eighteen of Agenda 21 also introduced the term 'integrated water resource management' as:

The *holistic management*¹⁴ of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social policy, are of paramount importance for action in the 1990s and beyond. The fragmentation of responsibilities for water resources development among sectoral agencies is proving, however, to be an even greater impediment to promoting integrated water management than had been anticipated. Effective implementation and coordination mechanisms are required (Chapter Eighteen, Agenda 21, UNCED, 1992)

Chapter Eighteen also affirmed water as an economic good and since this time, and as water resources have become more scarce, more attention has been paid to assessing the value of water and to establishing the means for its valuation in economic or monetary terms (Mfodwo, 2008a). The valuation of water is now often treated as a separate issue to its governance and, drawing on the 2006 World Water Development Report, Moran states “there is still no adequate system of water allocation to support equitable, ethical and progressive allocation of water to meet the various needs” (2006, p. 116).

2.9 Water Accessibility in the Pacific Island Countries

The Pacific region (Table 2) is characterized by widely scattered countries composed of numerous islands that varies considerably in their size, physical and hydrologic characteristics (Carpenter and Jones, 2004). The region contains a wide variety of island types, ranging from the large, high volcanic islands of Papua New Guinea (PNG) to the tiny low coral *atolls*¹⁵ of Kiribati and Marshall Islands in Micronesia; from states with relatively few inhabited islands to those inhabited and highly populated islands; from those states such as Papua New Guinea, with mighty river systems that run through many linguistic and sociocultural systems, to those that have no natural surface water systems such as Niue, and are completely dependent upon rainwater catchments and groundwater (Carpenter and Jones, 2004).

¹⁴ Good planning system and better management of resources

¹⁵ Is an island formed by a ring-shaped coral reef encircling a lagoon.

Table 2 Summary of Water Resources and Water supplies in selected SOPAC PIC's.

Pacific Island Country (PIC)	Main water resources	Access to safe water (% of population)	Water supply coverage (% of population)
Cook Islands	SW, GW, RW	95	100
FSM	SW, GW, RW	44	–
Fiji	SW, GW, RW, D (tourist resort only)	77	47
Kiribati	GW, RW, D (limited)	76	47
Marshall Islands	RW (from airport catchment and buildings), GW, D (emergency)	82	–
Nauru	D (regular use), RW, GW (limited)	100	–
Niue	GW, RW	100	100
Palau	SW, GW, RW	86	79
Papua New Guinea	SW, GW, RW	24	42
Samoa	SW, GW, RW	100	99
Solomon Islands	SW, GW, RW	64	71
Tonga	GW, RW	95	100
Tuvalu	RW (primary), GW (limited), D (emergency)	85	100
Vanuatu	SW, GW, RW	87	88

Notes:

1. **SW** = Surface water, **GW** = groundwater, **RW** = rainwater; **D** = desalination.
2. Estimates from UNDP (1999).
3. Estimates for 2000 from WHO/UNICEF (2000) based on UNDESA (1999).

When considering water resources management, PIC's may be grouped into those countries with:

- low-lying islands in which surface water is limited or virtually absent apart from rainfall runoff, and
- those islands with significant surface water resources, namely the 'high' volcanic islands and territories, such as Papua New Guinea (PNG), the Solomon Islands, Vanuatu and Fiji. PNG, for example, has some of the wettest territory in the world, but also experiences prolonged dry spells in other low-lying and island areas, which are subject to El Niño¹⁶ climatic fluctuations.

¹⁶ El Niño events are large climate disturbances which are rooted in the tropical Pacific Ocean, and occur every 2 to 7 years usually in late December. It is characterized by warming of surface waters and reduced upwelling of cold, nutrient-rich water off the western coast of South America, causing die-offs of plankton and fish and influencing jet stream winds, altering storm tracks and affecting the climate over much of the world.

On small islands, where the only usable resource apart from rainwater is in the form of fresh groundwater lenses no more than several meters deep, the resource is highly vulnerable to damage through over-use or inappropriate use or pollution and degradation. Examples of atoll countries of this nature are Tuvalu, Marshal Islands and Kiribati (Carpenter and Jones, 2004). Water resource management issues vary from country to country, however, some issues are common. Those facing PICs are:

- the need to provide adequate urban water supply facilities and services to meet burgeoning increases in urban populations;
- a shortfall in the provision of adequate sanitation in urban and peri-urban areas, with associated drainage deficiencies;
- provision of rural access to clean and safe water supply, either through piped scheme or wells and bores, including the management of such schemes through local groups;
- need to strengthen institutional capacity to manage water supply and sanitation at all levels, from urban reticulated schemes to locally managed village schemes;
- periodic threats to water resources availability from drought and climatic changes;
- sustainable use of limited water resources, in particular limited fresh groundwater where population increases threaten the quality of water;
- the threat to water quality from urban and industrial development and mining,
- threats to water quality, both surface water and groundwater sources, from local contamination including domestic and rural waste disposal, and
- health threats resulting from water pollution and contamination (Carpenter and Jones, 2004).

The following key issues, concerns and constraints were identified at the Pacific Regional Consultation Meeting on Water in Small Island Countries held in Sigatoka, Fiji Islands in 2002:

- Freshwater availability issues including increasing demands for water.
- Water quality degradation in surface water and groundwater catchments, with consequent downstream impacts on human health and the environment.
- Insufficient knowledge of island freshwater resources.
- Insufficient education, training and capacity in water resources.
- Inappropriate technology and methods, in relation to rural water supplies.
- Catchment management issues.

2.10 Variability of Water Resources in Fiji

Fiji has a large water resource, infact these water resources are not evenly distributed. It is not equally plentiful in all places, nor is water equally available at all times. Fiji has 34,690 m³ per capita of fresh water resources, which is one of highest in East Asia and the Pacific (WBED, 2004). As compared with the year 2000, its per-capita total actual renewable water resources (TARWR) increased by 4% (UNICEF, 2006). Interestingly, according to the Mundi Index (Indexmundi, 2006), as of 1987, Fiji had a 28.6 Km³ of total renewable water resources, which was fairly low. The variability is very dependent on geographical location, variability in climate conditions, and socio-economic and environmental developments.

A comprehensive study by Bronders & Lewis (1994), whereby they collected data during three years of fieldwork on small islands in Fiji, indicated that water resource problems, apart from climatological and geological constraints, are mainly due to water-use practices. The groundwater option is not an alternative, but a supplement to the existing water resources. These water resources can be divided into two major categories which is groundwater and surface water. The rainwater-harvesting system is a heavily under-utilized source of fresh water.

2.10.1 Groundwater

Groundwater in Fiji occurs on both the large islands as well as on small low-lying islands. However, its occurrence and challenges differ according to the different physical environments (Kumar, 2010). ‘Groundwater is found in superficial and medium-depth strata on the larger islands of Viti Levu and Vanua Levu and some large islands, in either fractured rock or sedimentary formations’ (SOPAC, 2007a). Across the country, there are a number of groundwater aquifers that vary in depth and volume.

Furthermore, most groundwater aquifers are being controlled by private water companies. Currently, Fiji has ten water-bottling factories that bottle these groundwaters and export them (Kumar, 2010). Many of the smaller islands have superficial groundwater lenses in sandbeds or coral formations, which lie on marine water. These sources are constantly under threat as

frequently they are not managed well. As stated previously, there is an uneven distribution of rainfall across the islands, and rainwater-harvesting using roof systems is widespread on these islands, but the psychology of rural people fails to take into account the possibility of extreme climate events and drought when there is relatively abundant water for most of the time (for instance, providing small-capacity storage instead of larger capacity).

A few of the 110 smaller islands rely constantly on government vessels to transport water from the mainland. To make things worse, these vessels are often late and the people on these islands have to ‘ration’ their water supplies with other families. In very extreme cases, ‘*coconut water*’¹⁷ can also be used as a substitute. In many settlements around Fiji, groundwater is the major source for drinking water. The Ministry of Multi-ethnic and Provincial Development office over the years has provided assistance for many of these projects. In many instances, boreholes are dug that may run 60 to about 180 feet underground. Submersible electric water pumps are then used to draw water from the *boreholes*¹⁸. However, it is significant to note that most of these boreholes are not regulated and in many instances the water quality is not inspected before the commissioning of such projects (Nuku, 2009).

2.10.2 Surface Water

Fiji, comparably with other smaller Pacific nations, has many rivers, creeks, a few lakes and some freshwater wetland. The majority of the urban water supply relies on surface water. Fiji also uses surface water for hydro-electricity generation. The largest hydro dam is the Monasavu hydro scheme, which was commissioned in 1983, consisting of four 20MW generators. It also has two smaller ones with a capacity of 8.8MW (Kumar, 2010). Surface water is also used by the agricultural sector, especially for irrigation and processing. In a few instances it has caused conflict based on priorities between direct consumers and agricultural users (Figures 10)

¹⁷ Is the clear liquid inside young green coconuts (fruits of the coconut palm)

¹⁸ A deep, narrow hole made in the ground for the purpose of extracting freshwater

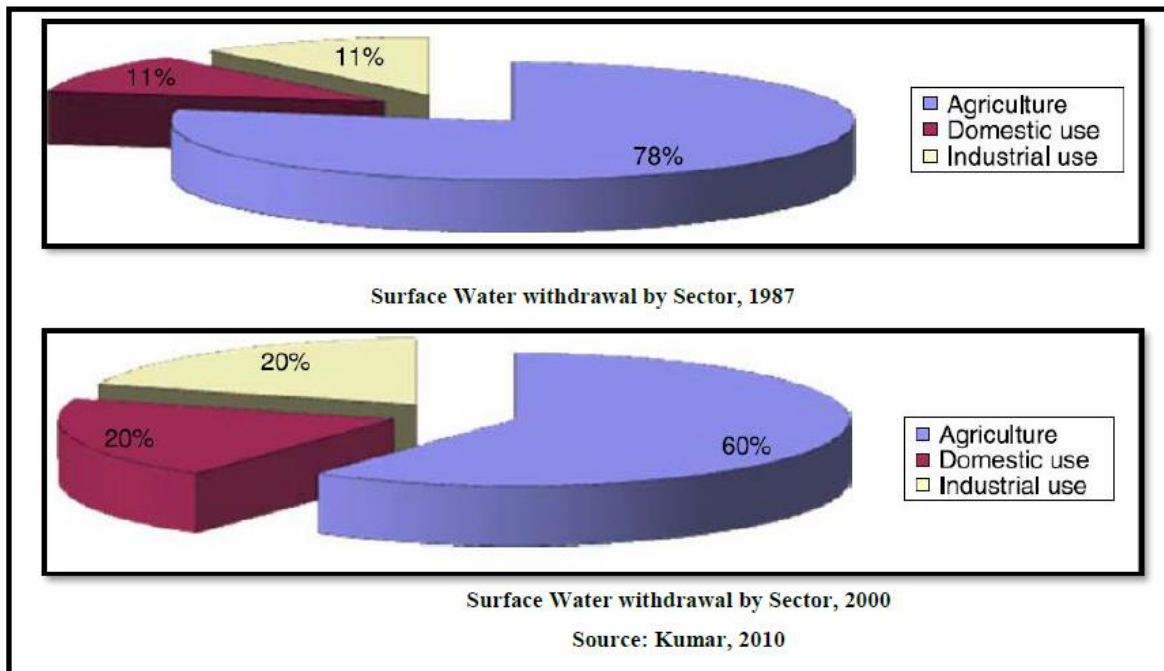


Figure 10 Fiji surface water withdrawal in 1987 and 2010

In general, given the rainfall and relatively intact forest cover that allows the capture and retention of water in underground aquifers, and the presence of several important *perennial rivers and streams*¹⁹, the larger islands within the Fiji archipelago have adequate supplies of water to meet the needs of the population (Kumar, 2010).

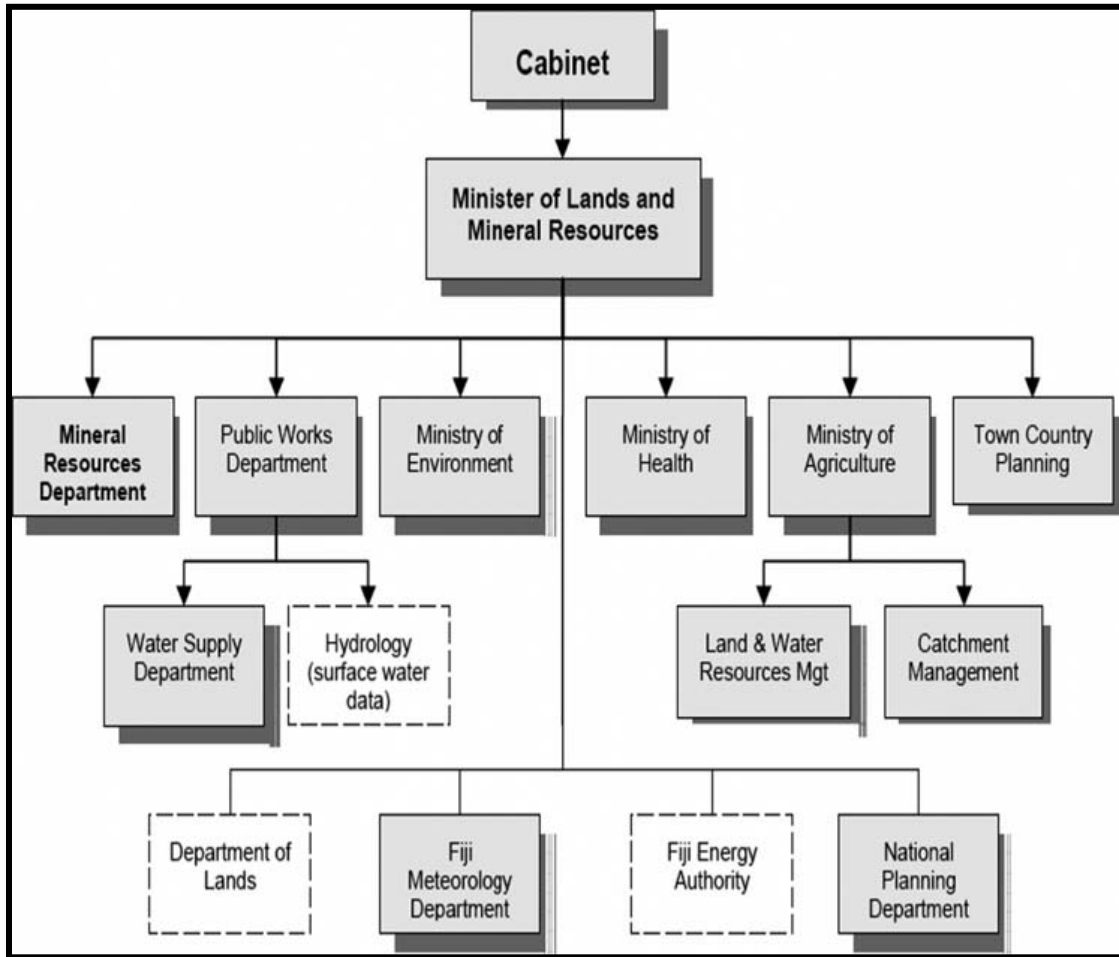
2.11 Transition in Control and Governing of Water Supply

Fiji is currently being controlled by an interim administration. A new Fiji Water Act that replaced the Water Supply Act of 1950 was endorsed in July 2007, and a new Fiji Water Authority was established (Figure 11). During the same year, the President of the Republic of the Fiji Islands established new functions and powers of the Water Authority of Fiji and its Board (SOPAC, 2007).

Recent legal developments have been: (1) the drafting of new legislation to establish the Fiji Water Authority which will supply water to all towns in the country; and (2) draft amendments to the Minerals Act, which (a) establish a requirement to obtain a permit to extract groundwater

¹⁹ Is a stream or river (channel) that has continuous flow in parts of its stream bed all year round during years of normal rainfall but cease to exist in times of severe drought.

(and to install bores and wells) within declared areas, and (b) limit polluting activities in declared areas, for the purpose of protecting the quality of groundwater. These drafts have been given cabinet approval to proceed, although they have not been through the parliamentary process (Kumar, 2010). It is important to note that election is expected to take place in September this year (2014) that will restore Fiji back to democracy and there might be changes made to the legislation depending on the government that will rule.



(Source: Kumar, 2010)

Figure 11 Water agency set up in Fiji. Note: The agencies or units in boxes not filled in are not formally members of the committee, but have important water-related roles.

2.12 Water Supply and Challenges in Fiji

Currently, the WSD of Fiji operates and maintains 32 public water supply systems nationwide. The supply system is divided into two major categories, the city and town regional water supplies that consists of 13 sub-systems, and the minor public system consisting of 19 subsystems. The whole water supply system of Fiji consists of 15 water-treatment plants and 110 service reservoirs and has over 2 200 km of underground water reticulation pipelines (Kumar, 2010). In 2004, the overall water supply coverage was only 47% (43% urban and 51% rural) as of 2004 (WHO, 2004). Later in 2007, the water supply stated that it serves around 600,000 (nearly 75% of the population) people nationwide (Water Supply Department, 2007). At the end of April, 2013, there are a total of 58 projects carried out in rural areas (Water Authority of Fiji, 2013). These projects either include construction of new system, upgrade of existing system, supplementary of existing system or installation of desalinization plant that is carried out in the Northern, Central, Eastern and the Western division respectively.

The capital, which has the highest demand, extracts its raw water from Waimanu River, and in future it intends to extract it from Rewa River, one of the largest rivers in Fiji. A large part of Fiji's economy (approximately US\$418 million annually in foreign exchange) is driven by the tourism sector. Nadi is the tourist town of Fiji that has many hotels and international resort chains. It is anticipated that developments in and around this area are growing at a significant pace. Currently, the major water source for these areas is a large dam at Vaturu, in the interior of Fiji, which was constructed in 1982. Most of the distribution systems in the towns and cities are designed to handle 150 litres of water/ per day/ per capita. However, most residents exceed this capacity, and on an average may consume from 200 to 500 litres/ per day/ per capita (Kumar, 2010). According to the Asian Development Bank (2003) 'the Water losses from leaking pipes or inaccurate or missing meters approached 55% of water supplied', and this has reached 70% in 2007 (Asian Development Bank, 2007).

According to the study carried out by Kumar in 2010, major loses of water are due to the following reasons:

- Unmetered uses include fire-fighting and training; flushing water mains; sewers.

- Stolen unmetered water.
- Leaks in water mains.
- Leaks from hydrants.
- Leaks from valves (supply system).
- Water meter measurement errors in properties.
- Unmetered water tanks.
- Evaporation from uncovered reservoirs.
- Unmetered filling of swimming pools most often through fire hydrants.
- Reservoir overflows.
- Incorrect bulk meter readings.

Over the past two years the reliability of the water supply has reached 100% (especially in the capital and surrounding areas). However, in recent years power blackouts and pump breakdowns have caused some disruptions, especially in the greater capital areas. One concern is that the supply capacities of the storage tanks for these areas can only last for 12 hours. To mitigate the immediate effects, water is carted to these areas in portable tanks. Elsewhere the problem remains, as occasionally the media highlights disruptions in the supply due to collapse of the main supply line or ‘burst’ in the underground pipelines. It can take significant time and resources just to locate these leaks as they occur at a certain depth underground, let alone meet the cost of repairs (Kumar, 2010). The sewerage systems in Fiji are maintained by the Public Works Department in the towns and cities. It is important to note that only certain parts of the water supply area are connected to the centralized waste treatment plants. For example, in the Suva-Nausori area (capital), which has the highest population density, only one-third of the population is connected to the centralized system, whilst others (270,000) are served by the septic tanks. The topography of these areas is rugged and the soil structure is impermeable, hence much effluent flows directly into streams and coastal water. Overflowing sewage from sewers—which in some localities are undersized and subject to blockages—and from poorly maintained sewage pumping stations also contribute significantly to water pollution (Asian Development Bank, 2002).

To add on, contamination of surface water continues to be a challenge when it comes to freshwater accessibility. Contamination occurs due to both point source and non-point source pollution. Point source pollutants are mainly those that are related to agricultural activities and development. For example, soil erosion and runoff resulting from exposure of the soil, leading to increased sediment discharges, high turbidity and color problems. On the other hand, point source pollution mainly occurs due to industrial activities, factories and activities carried out by households.

2.13 Water Quality and Conservation

Fiji has an abundance of fresh surface water and groundwater sources and the increasing rate of rechargeability suggests that there is less probability of a physical shortage of water. However, when one looks at both the point and the non-point sources of pollution in the country, it is more likely that the shortage would be due to pollution, or in other words, shortage of clean water (Kumar, 2010). Fiji does not have specific water quality standards. However, it currently uses the WHO Drinking Water Quality Guidelines (Figure 12).

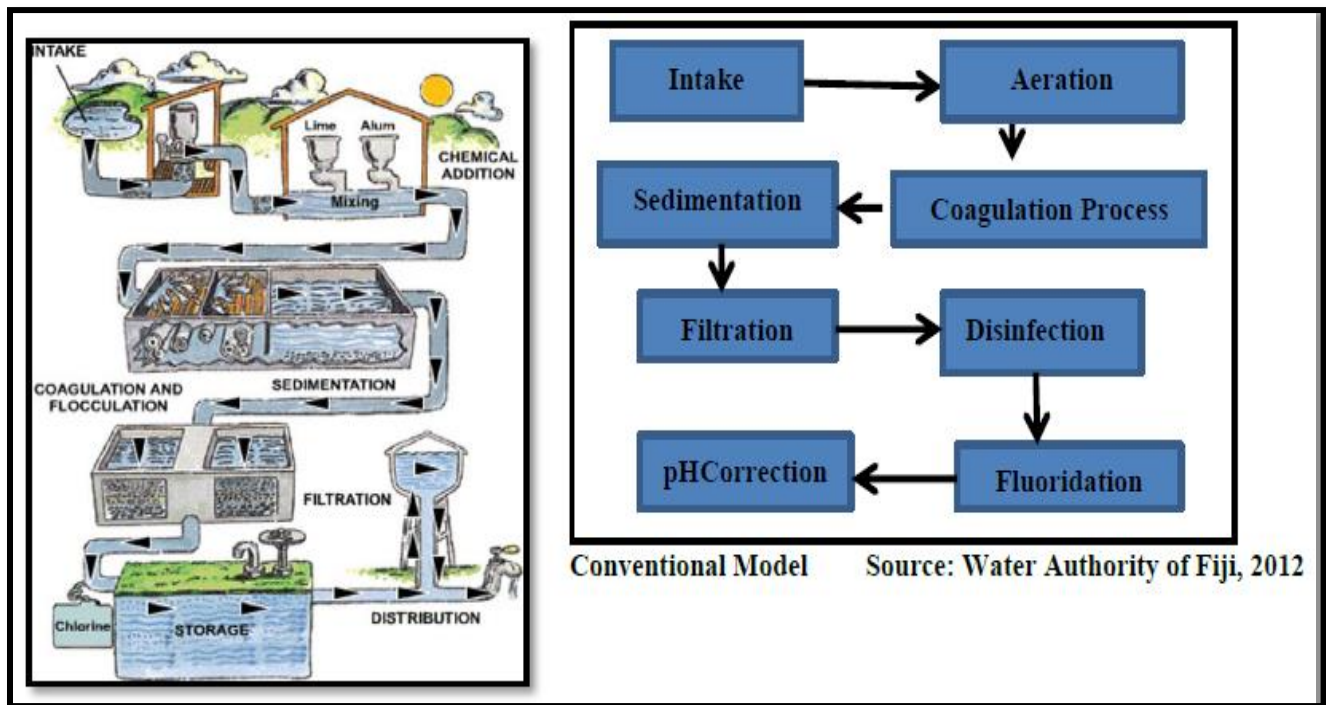


Figure 12 Process of water Treatment in the Reservoir (Source: WAF)

Process description

Intake

The intake screens prevent debris from entering the treatment facility. The screens are located off the bottom of the river to avoid bringing sediments into the treatment plant and below the surface to avoid bringing oils or other floating material into the treatment plant.

Aeration

Aeration process involves bringing air to contact with water to transfer volatile substances from the liquid to the gaseous phase, thus increasing the dissolved air

Sedimentation

Sedimentation is a physical treatment process that utilizes gravity to separate suspended solids from water. Floc settles by gravity to the bottom of a sedimentation basin. Then, clean water spills over to the filters.

Filtration

Filtration removes any remaining particles that are carried over after sedimentation. The force of gravity moves the water through filter media, usually, sand.

in water. It will improve taste and odor and also oxidize iron and manganese.

Cogulation Process

Chemical coagulants are added to react with the remaining small particles in the water to form particles large enough to settle out. Rapid mixing distributes the coagulant evenly throughout the water. While, flocculation basins gently mix the water with large submerged paddles so smaller particles collide to form large particles called "floc".

Disinfection

Chlorine is added to prevent bacterial contamination as the treated water flows through the distribution system to customers.

Fluoridation

Addition of fluoride to prevent dental caries and tooth decay

pH Correction

Adjusted pH to be 7.2 + at the outlet of contact tank by adding lime.

The Water Authority of Fiji has some 44 water treatment facilities in the country. All the major towns and cities have a full scale treatment known as the "conventional model" that is shown above. The Pacific Islands Applied Geoscience Commission (SOPAC, 2006) outlines the following principle, which is in line with the protection of water quality:

- Water sources of good quality must be protected from depletion and pollution by adequate protection mechanisms, consistent with the rights and interests of those who may be affected.

- The control of point sources of pollution of water must be applied comprehensively to ensure that receiving waters in Fiji are protected from all artificial discharges, including sewage and discharges from industry and mining.
- Measures for controlling water-quality degradation from non-point sources, such as soil erosion and catchment activities, need to be strengthened.
- Small-scale and fragile water sources (such as shallow island aquifers) which have value for drinking and domestic use should receive particular attention for their protection.
- The impact of rivers on the quality of coastal waters should be recognized and investigated and, where necessary, measures taken to prevent coastal degradation.

One way one can conserve water in Fiji is by pricing it 'right'. According to the European Union, the main and important goals of European Union water policy are the protection and improvement of the aquatic environment and the contribution to sustainable, balanced, and equitable water use. Water pricing is one in a series of possible tools to help achieve these goals (Roth, 2001). The challenges of ensuring that water is conserved and managed wisely are huge and no single agency can address them in isolation. Strengthening partnerships among stakeholders (governments, the private sector, NGOs, and donors agencies) is crucial for any policy implementation. Such cooperation can be factored into the action agendas and stakeholders' partnership agreements, which can be established to foster a sense of commitment and responsibility into any community-awareness programmes undertaken by government (Kumar, 2010).

CHAPTER 3

STUDY AREAS

“If we pollute the air, water and soil that keep us alive and well, and destroy the biodiversity that allows natural systems to function, no amount of money will save us”.

David Suzuki

3. Study Areas

This research is based on the studies that are undertaken in two Fijian villages. The villages were Kalabu and Korovisilou. Hence, this chapter will discuss the background of the country where the study areas are located and above all, it will give a more detail glimpse of the two study areas.

3.1 Geography and Background of the Fiji Islands

Fiji lies in the heart of the Pacific Ocean midway between the Equator and the South Pole and between longitudes 174° East and 178° West of Greenwich and latitudes 12° S and 22° South. Fiji's Exclusive Economic Zone contains approximately 330 islands of which about a - third are inhabited. This covers about a 1.3 million Km² of the South Pacific Ocean.

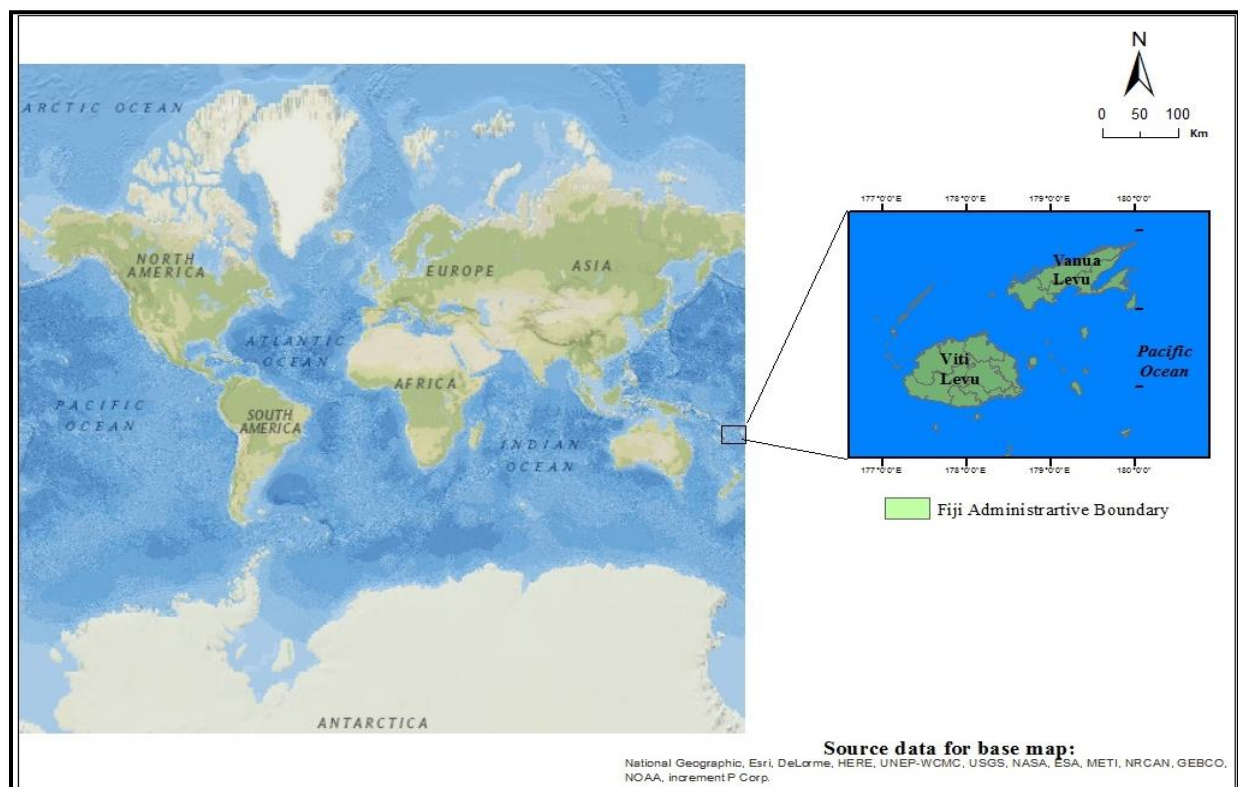


Figure 13 Location of the Fiji Islands in the World Map

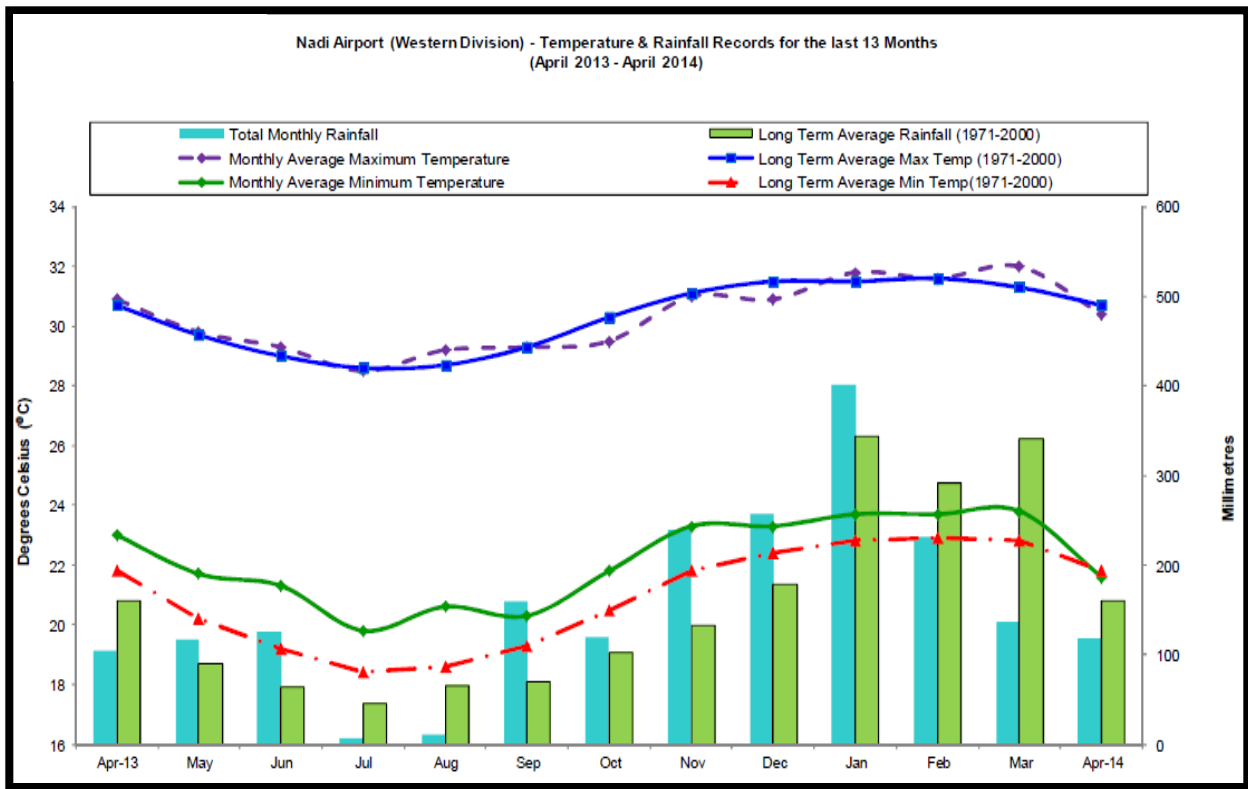
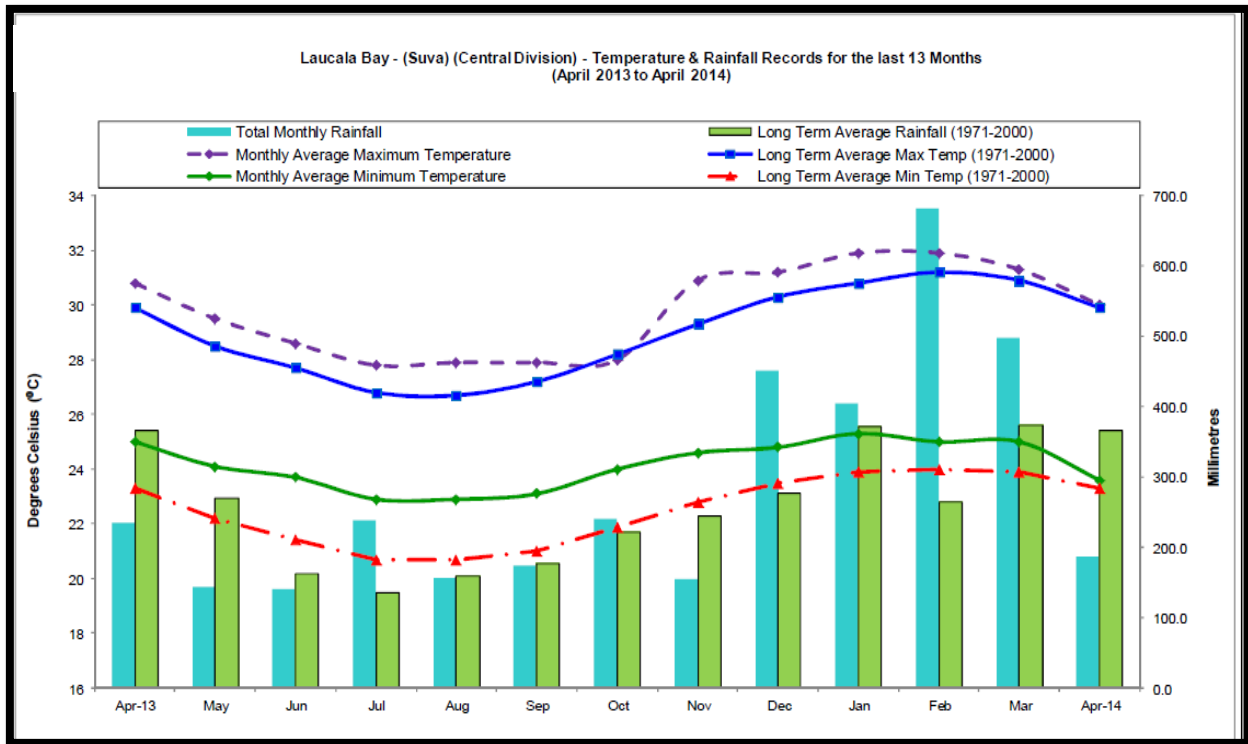
Fiji's total land area is 18,333 Km². There are two major islands - Viti Levu which is 10,429 Km² and Vanua Levu 5,556 Km² (Figure 13). Other main islands are Taveuni 470 sq.km, Kadavu 411 Km², Gau 140 Km², Koro 140 Km². Most of the smaller islands are made of coral reefs and are

low in elevation, thus unsuitable for habitation (Fiji Islands Bureau of Statistics, 2010). Topographically, Fiji is divided into three major classes: plains and valleys; low mountains and hills; and high mountains. These landforms are depositional—littoral or fluvial, erosional—fluvial erosion, mass movement or volcanic (Macfarlane, 2005). Indigenous iTaukeis own 87.9% of the land while 3.9% is State Land. Freehold land comprises of 7.9% and Rotuman land is 0.3%. The capital is Suva and it is one of the two cities in Fiji. The other is Lautoka City and both are located on the island of Viti Levu where most of the population also resides. English is the official language of the country. However, iTaukei and Hindi (both languages) are also taught in schools as part of the school curriculum.

3.1.1 Climate

Fiji lies in the oceanic tropical climatic zone. Hence, it has two major seasons, hot and wet, and cool and dry. The temperature during the hot and wet season, which falls between November and April, ranges from 27°C to 30°C. The cool and dry season is between May and October, and during this time the temperature ranges from 23°C to 25°C. Rainfall distribution is strongly influenced by the terrain of the islands because leeward sides of mountainous islands tend to be drier and windward sides tend to be wetter. On Viti Levu, for example, rainfall ranges from 3,000 to 5,000 mm on the windward side, and from 2,000 to 3,000 mm on the leeward side.

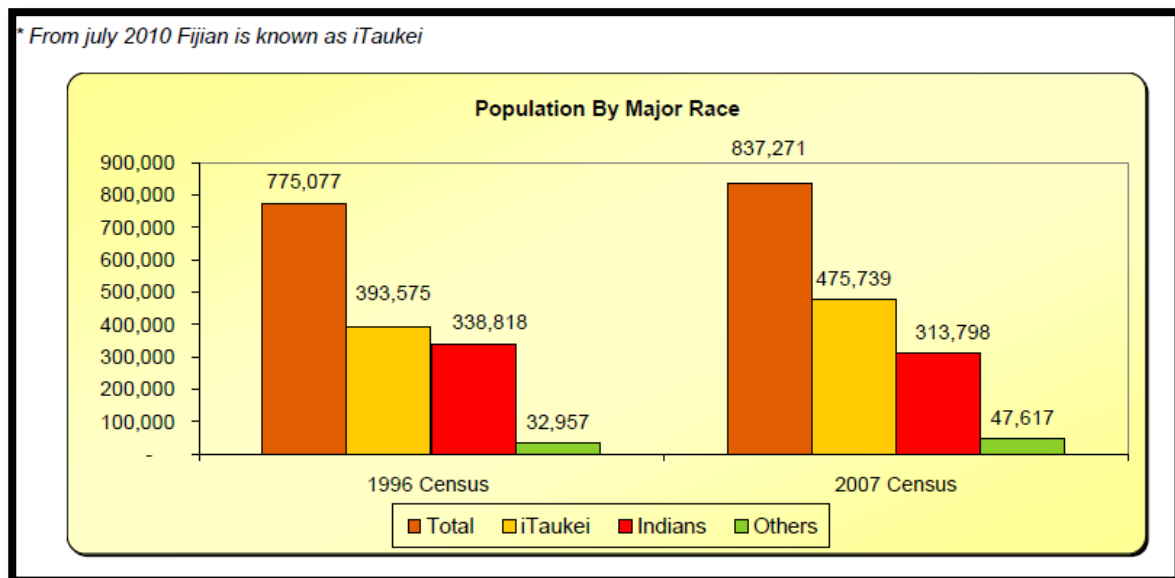
Average rainfall across the country is around 2,000–3,000 mm per annum. It is important to note that the ‘wet season’ replenishes water supplies for the subsequent ‘dry season’. The wet season occasionally brings in tropical cyclones, hurricanes and typhoons; floods and landslides are common during these times. Fiji has also experienced some severe droughts. One occurred at the beginning of the 1986 dry season and extended through the 1986/87 wet season; another occurred in 1997. Figure 14 shows a summary of rainfall and temperature records where the two study areas fall respectively, that is Korovisilou Village (Nadi Airport) and Kalabu village (Laucala Bay) from the period April 2013 to April 2014.



(Source: Fiji Meteorological Service, 2014)
Figure 14 Summary of Rainfall and Temperature records from Nadi Airport and Laucala Bay

3.1.2 Population

According to the latest population census of 2007, Fiji has a population of 837,271 people, that is equally distributed amongst the rural (49%) and urban (51%) populations. Unlike many developing and developed countries, Fiji has only 2.63% of its population above 70 years of age, whilst 83% of its population is below the age of 50 years. Figure 15 shows the total different racial groups in the Fiji islands for the year 1996 and 2007 census. It can be seen that only the iTaukei population increase from 1996 to 2007 while the other two racial groups (Indians and Others) population decreases. These changes can be attributed to different factors such as political, climate and demographic factors.



(Source: Fiji Islands Bureau of Statistics)

Figure 15 Population by Major Race in the Fiji Islands

According to the United Nations Development Programme Report 2007/2008 (UNDP, 2007), in 2005 Fiji had a Human Development Index of 0.762 and was ranked 92nd of the 177 countries. Furthermore, it was ranked 50th in terms of the Human Poverty Index, with a per-capita gross domestic product of US\$6,049. It is important to keep in mind that there is interdependence in most communities especially in rural villages and islands. People look out for each other and “blood ties” is regarded as utmost importance. Hence, can borrow and seek help from relatives and neighbors when the need arise. Demographic changes and internal migration also happens where there is movement from rural to urban areas (Table 3).

Table 3 Population in Cities and Towns of Fiji in 1996 and 2007 (Source: Fiji Islands Bureau of Statistics)

Major Towns	Census 1996 (August)	Census 2007 (September)
Suva City (capital)	77,366	74,481
Lautoka City	36,083	43,473
Ba	6,314	6,826
Labasa	6,491	7,706
Levuka	1,096	1,131
Nadi	9,170	11,685
Savusavu	2,652	3,285
Sigatoka	1,597	1,634
Nausori	5,744	24,919
Lami	10, 556	10, 752
Tavua	1,283	1,079
Nasinu	n/a	76,064

3.1.3 Household Income and Expenditure

Income has been used as the major indicator of poverty by the United Nations Development Program and the World Bank. The international benchmark for “extreme” poverty is set at under USD 1.00 per person per day, and “moderate” poverty under USD 2.00 per day (Sachs 2005). Definitions of poverty by the World Bank in Figure 16 show that there are three sub-classes of poverty (Kegley and Wittkopf, 2004).

Extreme poverty	Living on less than USD 1.00 a day. People in absolute poverty can not meet their basic needs and are chronically hungry, lack safe drinking water and sanitation, and have no access to basic health and education. It is estimated that over 1.1 billion people are living in extreme poverty and the majority of these are in Sub-Saharan Africa and Southeast Asia.
Moderate poverty	Living on USD 2.00 a day and just able to meet basic needs.
Relative poverty	Household income is below the national income level.

Figure 16 Definition of Poverty by World Bank

Economic surveys in Fiji indicate that over 50% of the population lives on less than FJD 25.00 a week, and cannot meet their basic needs. However, in communities where subsistence activities are the major means of sustenance, it is difficult to measure the standard indicators (Zann and

Zann, 2008). In Figure 17, the average household income gathered in a survey from 2002 and 2003 shows that the gap in earning by different racial groups living in rural areas is not really wide. This income is mainly supplemented by agricultural produce and to some extent sharing of goods and services in the community

Average Household Income	iTaukei	Indian	Others	All Fiji
All	12,972	11,902	19,105	12,753
Rural	11,082	9,653	11,066	10,559
Urban	16,539	13,593	21,877	15,267

(Source: Fiji Islands Bureau of Statistics 2010)

Figure 17 Fiji Household Income Survey for 2002-2003

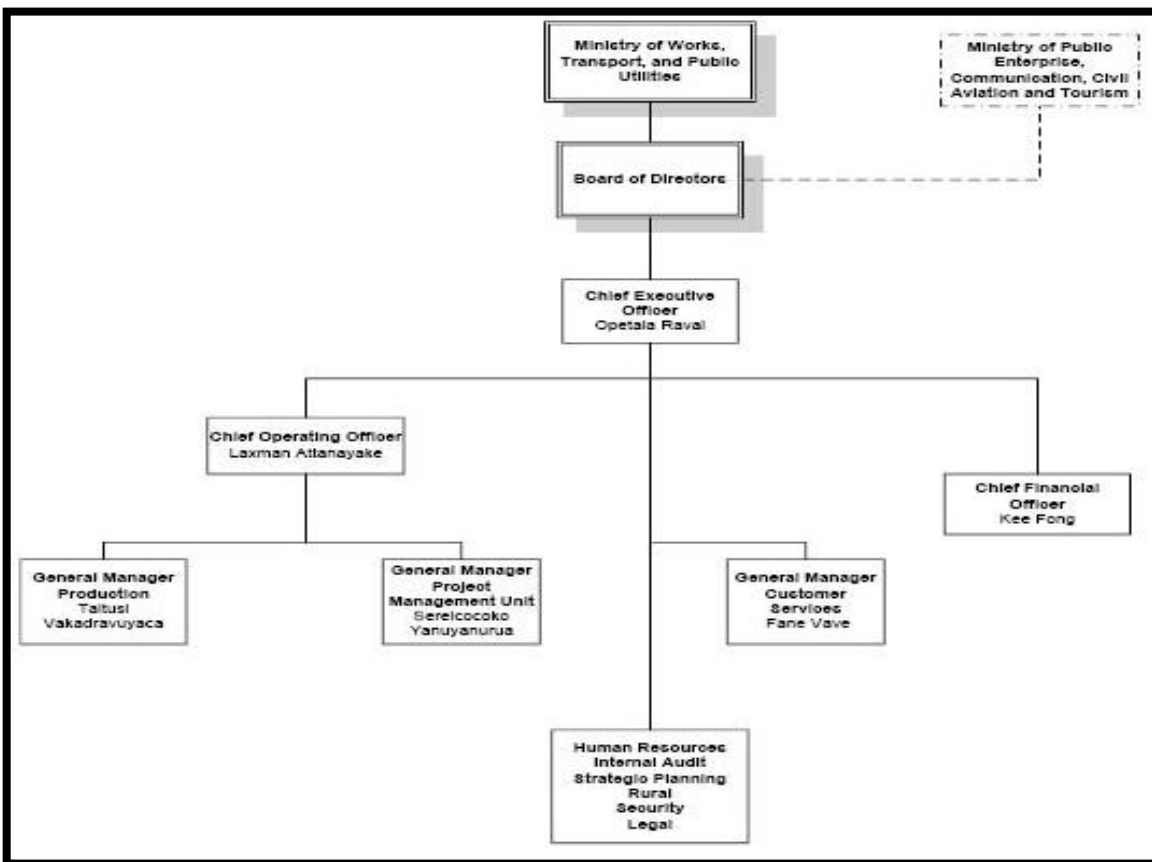
3.1.4 Water

According to the World Bank Environment Department (2004), Fiji has 34,690 m³ per capita of fresh water resources, which is one of highest in East Asia and the Pacific. As compared with the year 2000, its per-capita total actual renewable water resources (TARWR) increased by 4% (AQUASTAT, cited by United Nations Children’s Fund (UNICEF), 2006). Interestingly, according to the Mundi Index (Indexmundi, 2006), as of 1987, Fiji had a 28.6 km³ of total renewable water resources, which was fairly low as of that period.

Although Fiji is fortunate to have a plentiful supply of freshwater with high rainfall from volcanic islands, droughts and floods over the last twenty years have caused major interruptions to the collection, treatment and reticulation of potable water supplies issues. The symptoms of these impacts have been most noticeable in the towns and cities of Fiji where major water supply shortages and breakdown have been the norm, but also on small outer islands that rely mainly on rainwater (Carpenter and Jones, 2004). Legislation related to water resources in Fiji is outdated but has generally served the nation well until recent times given the plentiful supply. Legislation identified as being in need of review to reflect current policy includes the Water Supply Act, Rivers and Streams Act, Native lands Act, Crown Acquisition of Lands Act and Electricity Act. The commercial use of water from groundwater supplies as well as resource management issues

in catchments including logging underlies the need for a comprehensive review of national policy followed by legislation.

The main statutory body (Figure 18) that looks after drinking water is the Water Authority of Fiji (WAF). This duty was formerly carried out by the Water and Sewage Department. In 2009, The Government of Fiji started reforming the Water and Sewerage Department to enhance the sustainable delivery of water and sewerage services to appropriate levels of service. The reform aimed at strengthening the then Water and Sewerage Department (WSD) before establishing the Water Authority of Fiji, which is dedicated to the delivery of water supply and sewerage services, autonomous and be able to mobilise the necessary resources to meet the demand, effectively and efficiently at required quality standards (Water Authority of Fiji, 2014). Thus, in January, 2010, WAF as a private organization took over the role of the Water and Sewerage Department (government owned).



(Source: Water Authority of Fiji, 2014)

Figure 18 Current Organization structure of Water Authority of Fiji

3.2 Case Study Areas

3.2.1 Kalabu Village

Located in the middle of the sprawling urban labyrinth of the Suva-Nausori corridor, hidden amongst a natural rock formation and hills sits the village of Kalabu, home to the Matanikorovatu people. Kalabu is a Fijian village that belongs to the province of Naitasiri. The village is situated approximately six (6) kilometers away from the Kings' highway that is about 7.5 miles away from Suva city. This village (Figure 19) own almost all land in the Nasinu region (one of the 13 incorporated towns in Fiji) that is the satellite town of Suva. Due to its geographical location (close to urban areas) village lifestyle is often caught up with the influence of modernization. However, Kalabu village still follows all traditional functions and the people are very intact with their culture.



Figure 19 Surroundings and types of Houses in Kalabu Village (Source: Ilaisa Naca)

Made up of seven clans or “*mataqali*”, their land is where the majority of Fiji's population lives. The *Suva-Nausori*²⁰ corridor is Fiji's densely populated areas, home to several thousand people

²⁰ Suva is the Capital City of Fiji while Nausori is a town

living in housing subdivisions, settlements and *peri urban*²¹ and farming communities, which have been etched out from the land of this “*yavusa*”. On how they came to be one of the biggest and possibly one of the richest landowning unit in Fiji stretches back many centuries. The “*yavusa*” Matanikorovatu traced their roots back to the great Fijian migration or “*tawa vanua*”²² led by Lutunasobasoba and later his son Rokomautu. According to the “*Liuliu ni Yavusa*” Matanikorovatu, Paula Rawiriwiri, their ancestors led by Qilukisawa came to Kalabu by following the Wainibuka, Wainimala and Rewa rivers after leaving the traditional Fijian seat of power at Ucunivanua Village in Verata.



Figure 20 Residents and Activities in Kalabu Village (Source: Ilaisa Naca)

Following the dispersion of the Fijian ancestral migration, the Matanikorovatu people (Figure 20) separated from the people of Nacovu, Naimasimasi before venturing inland to a place called Drevakai, which is believed to be somewhere near Lutu Wainibuka. While making their way down the rivers, this wave of migration left many people who permanently settled the places they came across. Like the people of Natavea who settled at a place called Nadereivalu and later the

²¹ the areas immediately adjoining urban areas i.e. between the suburbs and the countryside

²² Period referred to by Fijians as characterize by mass movement of people from one place to another

people of Drekeniwai who settled at Nagavugavu and later at Nawaidina where the people of Nasevou settled. They eventually came down to Naitasiri where they met up with the people of Nawavatu and Nayavumata. These two people are now part of the Yavusa Matanikorovatu. After leaving Naitasiri, the people of Matanikorovatu eventually came and settled at Vunikoro, which is their first village, on the shores of Laucala Bay. Today it is the site of the Kinoya Power Plant. Before the establishment of housing sub divisions, suburbs and the Housing Authority, the people of Matanikorovatu have been allowing Fijians to live on their land. Rawiriwiri says ever since the second “*liuliu ni yavusa*”, Iferemi Kubukawa, the “*vanua*” Matanikorovatu have allowed Fijians from all the 14 provinces in the country live for free on their land.



Figure 21 Social Gathering and Functions in Kalabu Village (Source: Ilaisa Naca)

These were the first forms of organised housing in Suva with Tovata, Delaitokatoka, Wakanisila, Vatuyalewa, Nepani and Tuirara being the first settlements. Rawiriwiri says some of these people have been living on their lands for two and three generations and it is of no use to change this again as they had lived on his land for a long time already. Whenever the “*vanua*” Matanikorovatu hosts a big village gathering (Figure 21), these settlements would contribute money or prepare food.

In times of village gatherings and functions, the host must ensure that water is stored in large containers and tanks. This is done to ensure that there is sufficient water throughout the day as water in the tap can stop at any time. In most occasions, villagers find themselves having to go and fetch water from the nearby aquifer when water runs out. This water will be used for cooking, mixing *kava*²³, drinking and sanitation purposes.

The village foundation is largely composed of sedimentary rocks. In the past, man extract soil from the nearby low lying areas and carry it to cover certain areas of the bedrock that later becomes a “*yavu*” . A “*yavu*” is a piece of land where houses are built that will be passed from one family generation to another. It marks a boundary of one household to that of another in a Fijian village. It is important to note that “*yavu*” are given names and this names will be used by the villagers to refer to members of household that reside in that particular “*yavu*” when it comes to village meetings and when addressing members of the household in a communal gathering.

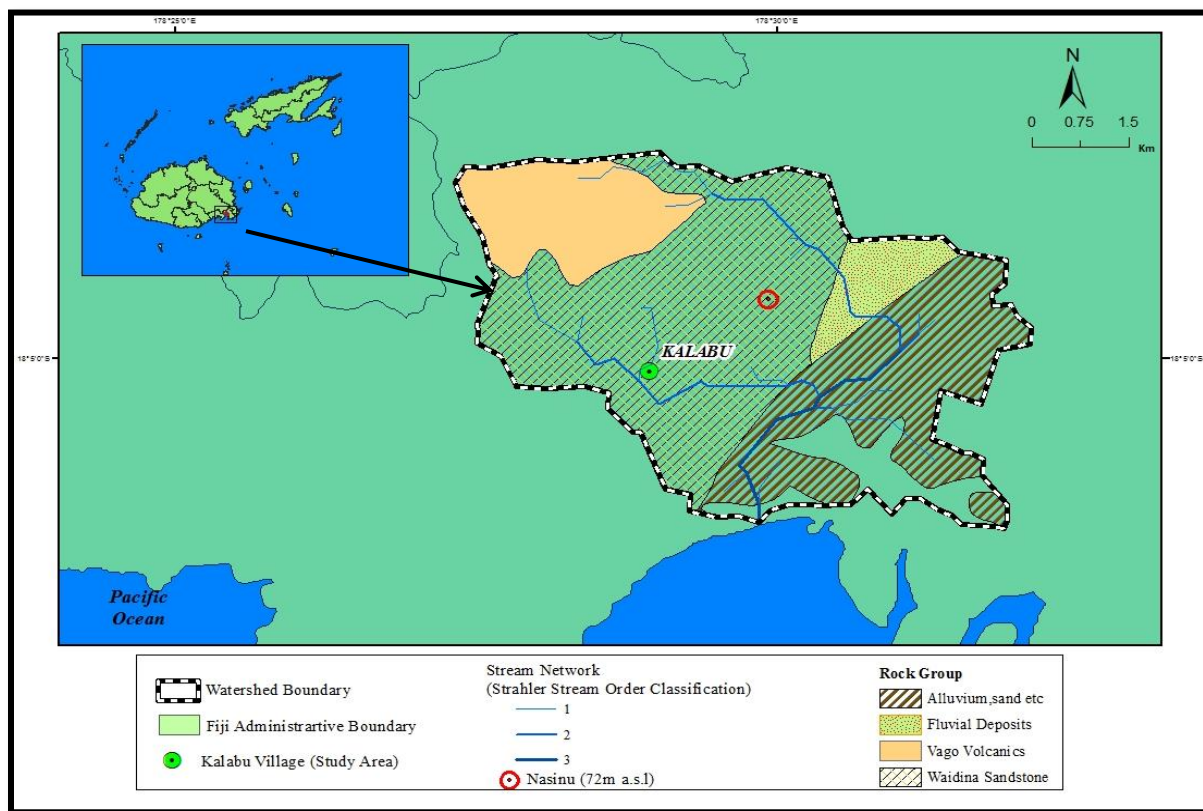


Figure 22 Geology Structure of Kalabu Watershed

²³Is a crop of the western Pacific. The name kava is from Tongan and Marquesan; other names for kava include ‘awa, ava, yaqona, and sakau. The roots of the plant are used to produce a drink with sedative and anesthetic properties.

The Geology structure (Figure 22) shows that there are four different rock groups that are present in the study area. This includes alluvium and sand, fluvial deposits vago volcanics and waidina sandstone. Over time, there had been continuous natural weathering that is accelerated by human activities causing sediments to wash into the Nasinu River making it shallow and changing color.



Figure 23 Tributaries in Kalabu Watershed (Source: Ilaisa Naca)

Along the rivers, one will find abundance of igneous rocks (Figure 23) that comes in different sizes. In the head waters, large boulders can be found but later when travelling downstream, more pebbles are found. Presents of sedimentary rocks cannot be ruled out as it is present in most of the rivers. On the other hand, Kalabu Village also has interesting sights when it comes to caves that are largely composed of limestone. Most of these caves have water passing through it while others provide sweet water spring that comes out from the rock and was the main source of freshwater for the villagers before tap water was introduced. Now, the spring is used as supplements to drinking water for people passing through on their way to the plantation or simply when there are water cuts, the whole village used it for their needs. It is important to keep in mind that the Nasinu River is really small since it only has nine (9) segments (Figure 24). Thus the water way is not only used by the villagers but other people in the Nasinu municipal that has the largest population compared to other municipalities in Fiji.

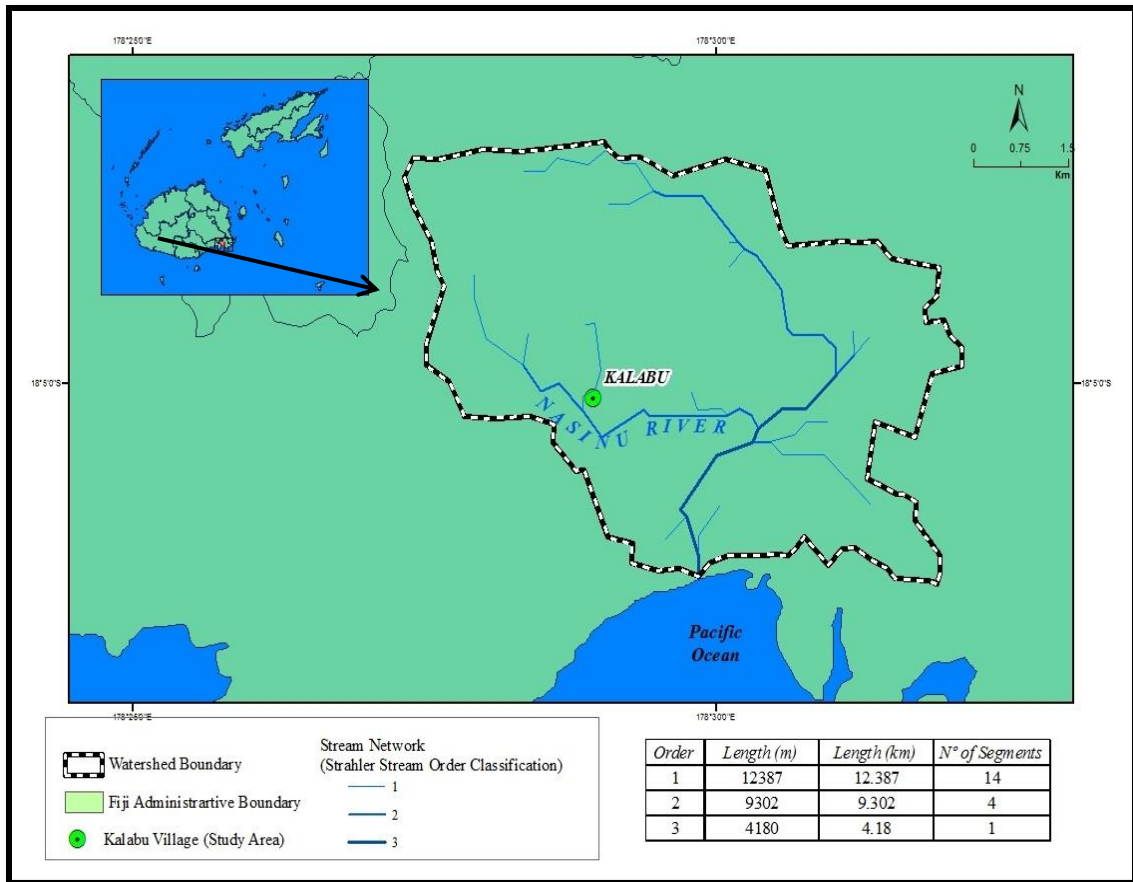


Figure 24 Hydrology Map of Kalabu Watershed

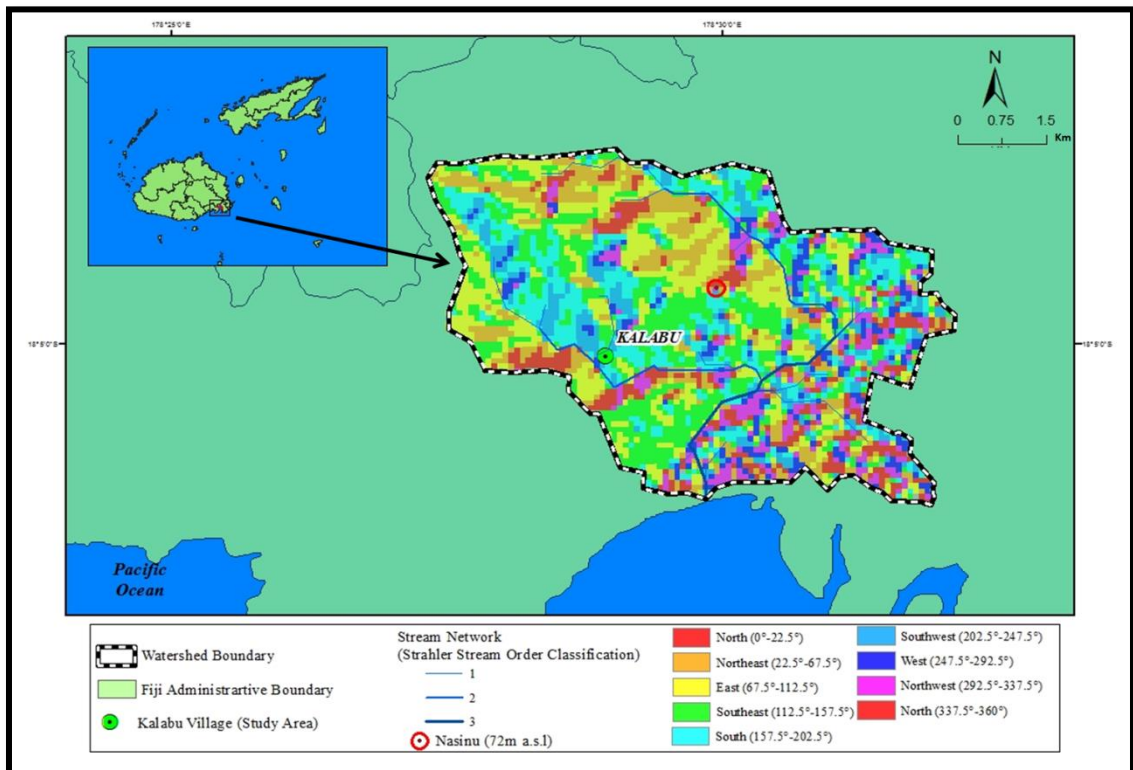


Figure 25 Solar exposure of Slope in Kalabu Watershed

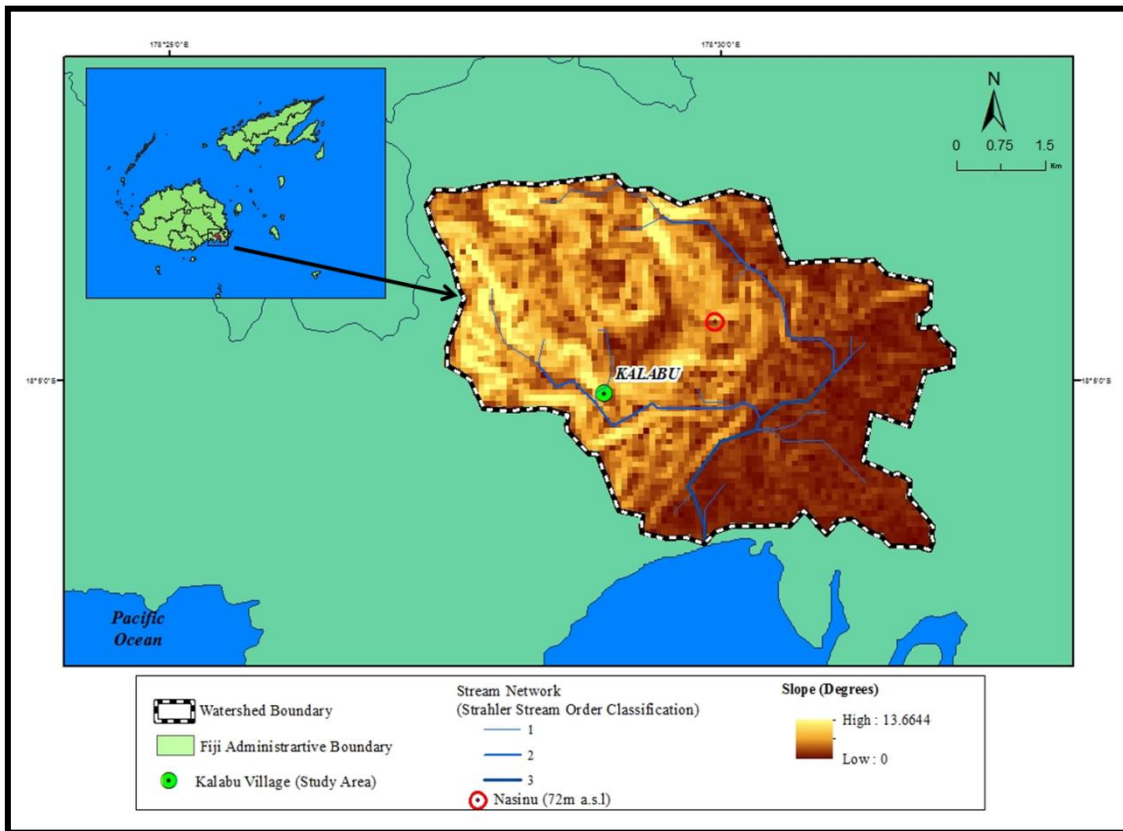


Figure 26 Slope degrees of Kalabu Watershed

In the summer period (November to April), the area is exposed to long hours of solar radiation (Figure 25). Hence, there is more evaporation during this period and a lot of people flock to the river to escape the hot season. The study area has very low elevation (Figure 26) since it is a plain. This causes water pressure to decrease and in most occasion some household will have to wait for water to come through the tap if other household are opening their tap (household near the main water pipes will have more chances of getting water than those further away)

3.2.2 Korovisilou Village

Korovisilou (*literally means "the village of the noisy birds"*) is a large village with over 400 inhabitants that are distributed into 88 household. The village (Figure 27) lies near the Queens Highway along the Coral Coast on the main island of Viti Levu. Korovisilou largest buildings include a Methodist church and the community hall. The churches are very active among this devout community. The community has its own primary, secondary and a health centre. There are three shops that serve the people of Korovisilou. Like Kalabu village, the dominant racial

group in Korovisilou is *iTaukei*. Most of the villagers speak Fijian and also English that is accredited to Education and modernization.

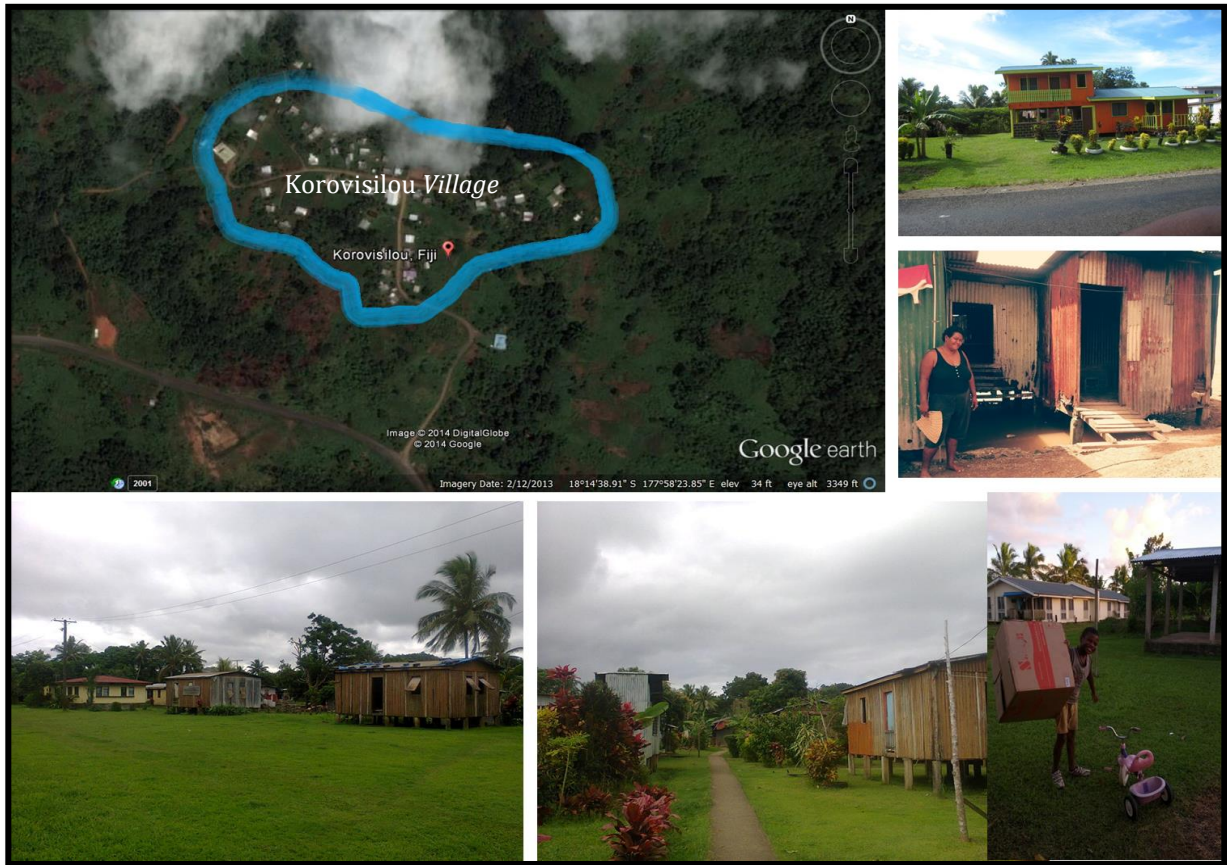


Figure 27 Surroundings and types of Houses in Korovisilou Village (Source: Asiveli Rokoua)

The village falls into the district of Serua and their chiefly title is referred to as “*Korolevu na Turaga na Vunivalu*”. The “*yavusa Nadruku*” is the only clan of Korovisilou village with a total of three “*Mataqali*” (clan) known as Bitolevu, Naviraki and Nukunitabua. History has it that the first settlers of Korovisilou village began their journey from the interior of Nadroga in search of a place to stay. They first settle in Laselase, a village that sits on the banks of the Sigatoka River, opposite Sigatoka Town and few kilometres from the estuary. From Laselase village, the settlers made their way to Navutulevu, a village that is now famous for tourism activities. Later on, they moved to Korovisilou village where they reside till today. The location was agreed upon by the clan due to its accessibility to resources which is especially true when it comes to basic needs such as food and water.



Figure 28 Residents and activities in Korovisilou Village (Source: Livanalagi Rovi)

In order to get to Korovisilou from the capital city (Suva), villagers usually travel by either minivan or bus that cost around FJD \$7 to \$8. Almost all household had their own gardens or plantation that provides a large portion of their meals (Figure 28). In the village, there is a Turaga ni Koro (village head man) who ensures that when it comes to village welfare and properties everyone has to help and contribute towards it. During every month, there are certain days that are allocated for village work. Such work usually include, clean up in the village and cemeteries, farming, weaving mats for women in the community hall, maintenance of properties owned by the community, assistance to widow and old people and other activities that might require the attention of the whole community.

The nearby health centre which has representative from the Ministry of Health also conduct village visits to ensure that health and sanitation is always prioritized. Unlike most other Fijian villages, Korovisilou has some advantage in education as the primary and secondary school are both located within a walking distance. In both the schools, teachers have their own residents

located within. The main water supply comes from an underground source which is an underground aquifer. This water is being channeled into two large tanks located in a hilly area that serves as a village reservoir (Figure 29). The water in these reservoirs is then diverted into the different households by water pipes purchased from local hardware shops.



Figure 29 Rivers, Streams and the Sea in Korovisilou Village (Source: Korovisilou Health Centre)



Figure 30 Social gathering and functions in Korovisilou Village (Source: Korovisilou Health Centre)

The village had gone through major natural hazards over the years. In 1980, there was a flood that captures the attention of the nation. It was one that took almost all villagers by surprise and the horror that struck that night is still remembered by the villagers till today.

In memory of the horrific event and life that was lost, a song was written and this will remind the future generation of the dreadful incident that struck Korovisilou. The flood that was said to have originated from a nearby creek was believed to be caused by blockage. There was logging near the river bank and accidentally some of the logs that was not used manage to make its way to the creek during heavy rain and in the process blocking the water way and creating a natural dam. Over time, as the water level rises, the natural dam burst its bank washing logs and other materials with it. Due to the location of the creek, water speed increases and this increases the intensity when it heat the village located at a lower elevation. All houses were washed away, plantation cleared and other source of livelihood were greatly devastated. Later on, the government assisted the villagers in getting back to their life. Houses were rebuilt and basic livelihood was restored. The villagers learned their lesson but unfortunately they learned in a hard way since a life had been lost. Nevertheless, the river continues to play a pivotal role to the lives of most household in Korovisilou village as it supplement water in most occasions. At times when there is a gathering (Figure 30) in the village, the river is flocked with people of all ages either to bath or cool down from the high temperatures that the area always received.

There are three rock groups that had been identified to make up the geological structure (Figure 31) of Korovisilou. This includes the Nubuonaboto Volcanics, Serua Conglomerate, and Tuvutau Greywacke. Within the rocks, there are some freshwater aquifers that later that runs down to merge with the main river. Settlement and human activities had to be concentrated near the coast since it is flat compared to the inland areas that is mountainous and hilly. The drainage basin in Korovisilou (Figure 32) is much smaller compared to Kalabu. However, it is more than enough to supplement water to the whole population who are currently living there. In Figure 33, the area is more exposed to solar radiation since it is located on the western side of Fiji. There are chances that there will be drought and water shortage at times. Korovisilou lies in a Plain (Figure 34) but the pressure of water is always high since their reservoir (untreated water) is located on a higher elevation.

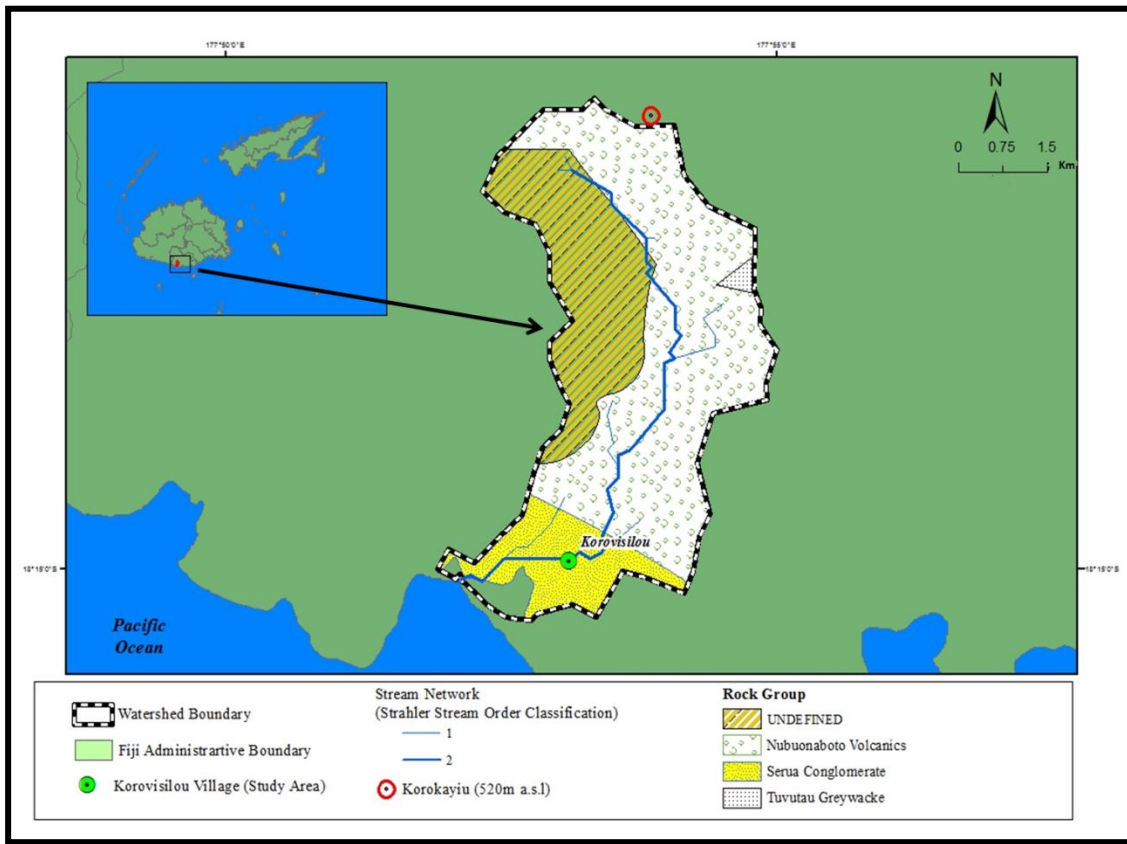


Figure 31 Geology Structure of Korovisilou Watershed

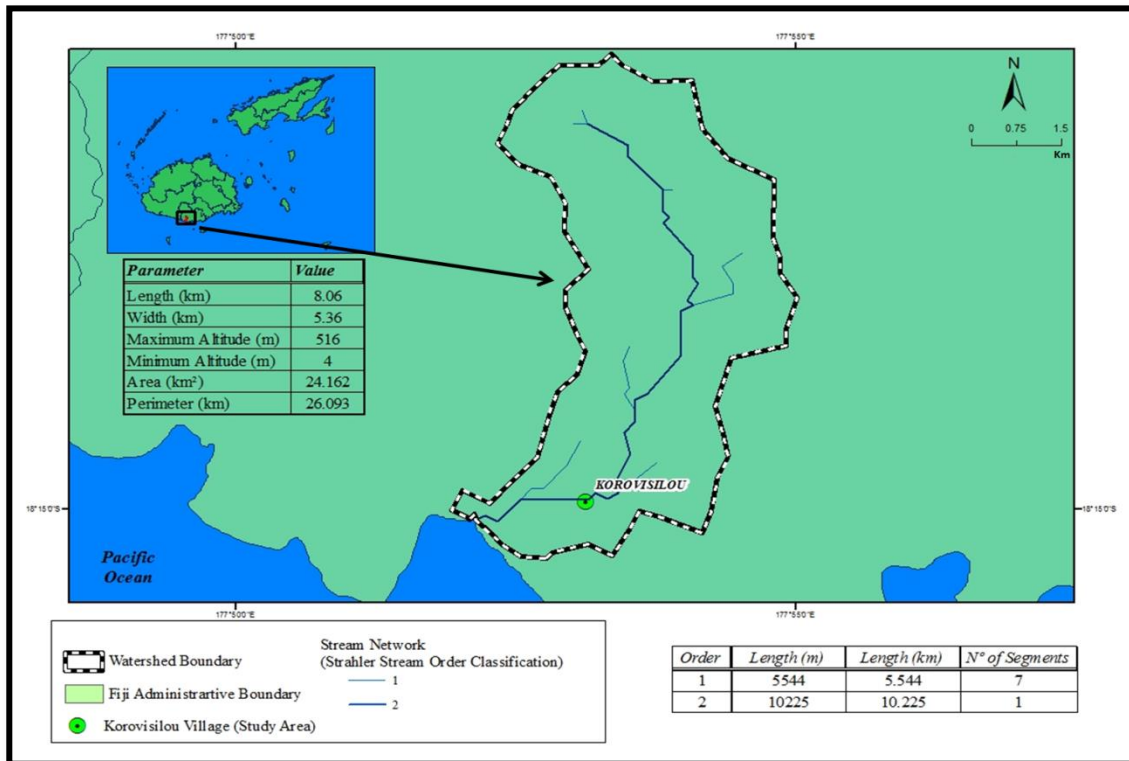


Figure 32 Hydrology Map of Korovisilou Watershed

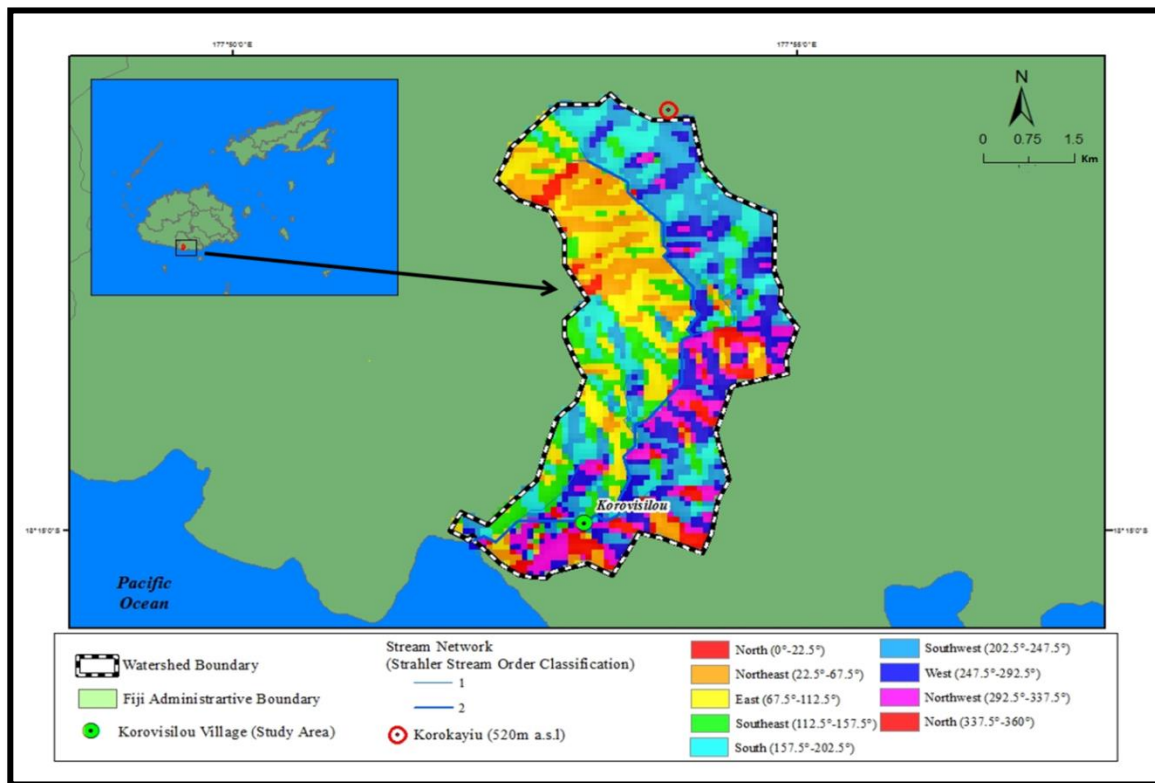


Figure 33 Solar exposure of Slope in Korovisilou Watershed

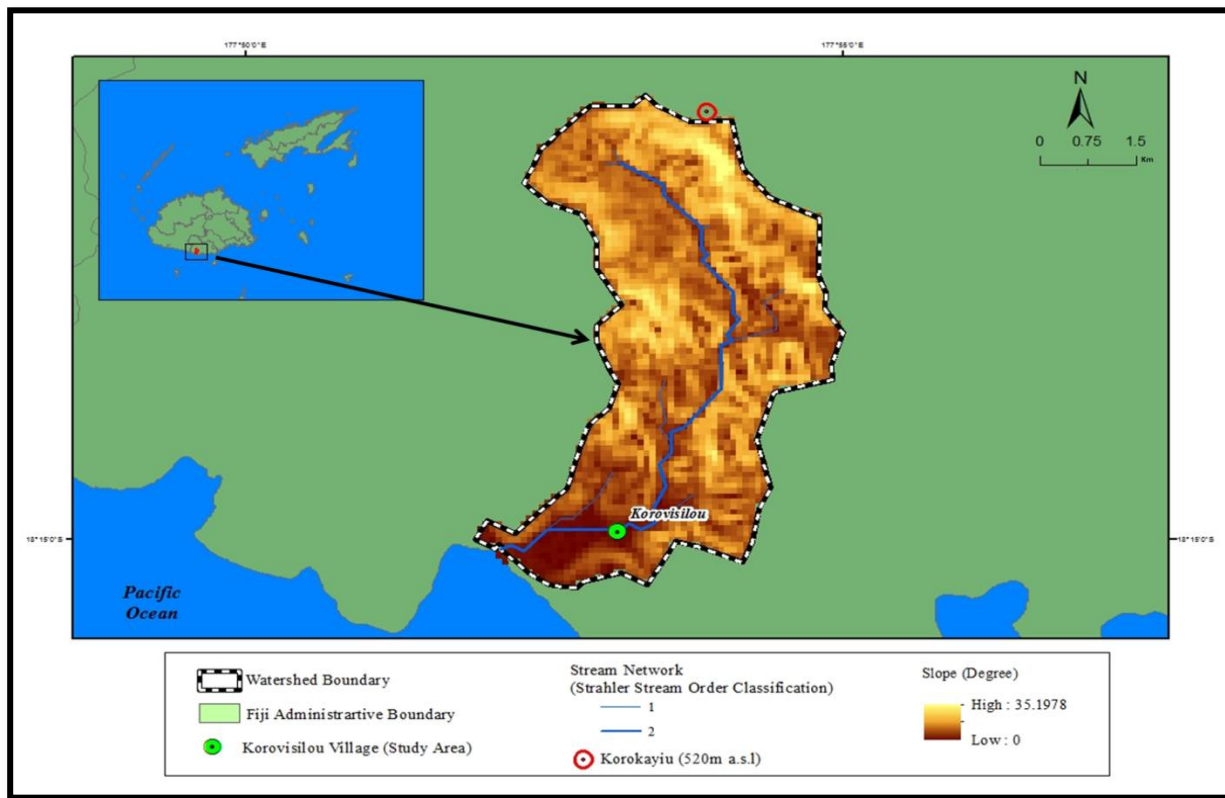


Figure 34 Slope Degrees in Korovisilou Watershed

CHAPTER 4

METHODOLOGY AND TOOLS

“Thousands have lived without love, not one without water”.

W. H. Auden

4. Methodology

The process of putting together a piece of good research is not something that can be done by slavishly following a set of edicts about what is right and wrong. In practice, the *social* researcher is faced with a variety of options and alternatives and has to make strategic decisions about which to choose. Each choice brings with it a set of assumptions about the social world it investigates. Each choice brings with it a set of advantages and disadvantages (Schutt, 2006). This research employs a collection of research methods that is trusted and used by various researchers in different academic fields to enable a broader understanding of the theme. Such being the case, this chapter will discuss the method and tools used in this research.

4.1 Literature Review

Like most research, Literature review is a need since it enables the researcher to understand more about the topic. This includes review of Government documents, policy reports, presented papers, academic journals, industry reports, lobby group reports, books and relevant websites. It was used throughout the research process to understand and describe the various linkages between water accessibility, human and the environment. The literature review involved the analysis of text, including core meaning, strategies and historical analysis. Hence, it is used extensively in all three objectives of the research design.

This method provides authentic, noncontroversial and general information regarding the subject matter. Together with that, it enables the evaluation and synthesis of information in line with the various research objectives. Through identifying the gaps in current understanding, the literature review provides a rationale of justification for the study.

To add on, weaknesses encountered in this method include some cases whereby the information was highly generalised, context dependent information not up to-date. Information found on the internet and in various other reports, it is often not peer reviewed (Schutt, 2006).

4.2 Case Study

The selection of Korovisilou and Kalabu village as a case study was to fulfil the research objective. Though the two case study area are both located on the main island (Viti Levu) they provide a good basis for comparative study in water accessibility when it comes to geographical location. Like most Fijian villages, data were not readily available and one has to employ means of data collection in order to get a clear picture of freshwater accessibility. Kalabu is also the researcher's home base and allowed for relatively easy networking amongst the people where Korovisilou has some readily available people that the researcher has some links too.

This method allows the use of a variety of sources drawing on a number of research methods to capture the complex reality under scrutiny (Denscombe, 2003). Multiple sources can also validate data through triangulation (Denscombe, 2003). The case study approach is appropriate for small scale research (Denscombe, 2003). Negotiating access to data can be challenging. Information may not always be up to date (Denscombe, 2003). Boundaries (geographical, market, regulatory, institutional) can be difficult to define.

4.3 Surveys and Sampling

As a social researcher, one cannot always collect data from everyone who is in the category being researched. Hence, there is random sampling of household to ensure that data is representative of the whole community that is being researched. This method rely on evidence from a portion of the whole household at the village in the expectation and hope that what is found in that portion applies equally to the rest of the 'household' and population for that matter. The survey and sampling was carried out in relation to the number of household and not the population. This follows the notion that in Fijian villages, things are done communally and this involves groups. Activities and task are done collectively rather than individually. For example, when washing clothes, women (usually mothers and daughters) are responsible for washing the clothes of the entire household. This also applies to other activities such as cooking, cleaning and others whereby one individual with do things on behalf of the household. Unlike urban areas where most families are nuclear, the rural Fijian villages are usually made up of extended families. Thus, the idea to have sampling of the household rather than population.

In most cases, there is an assumption “it is not good enough”, though, to assume that findings for the sample will be replicated in the rest of the population. The sample in the first place needs to be carefully selected if there is to be any confidence that the findings from the area to reflect the whole area. Nevertheless, both the case study areas have a common characteristics and that is they are both Fijian villages where livelihood strategies are almost similar. This support the decision to use sampling as a method.

4.4 Tools and Software

The rapid spread of electronic communications has the capacity to affect the quality and efficiency of basic education throughout the world in dramatic ways, both positively and negatively (Chapman et al, 2004). Tools and software is a major backbone when it comes to research in the modern academic field. This thesis is not an exception where tools and software used include the ArcGIS 10.1 version, Questionnaires, Statistical Package for Social Sciences (SPSS), Microsoft Office (word, excel, PowerPoint), Internet and others.

4.4.1 ArcGIS 10.1

A geographic information system (GIS) lets us visualize, question, analyze, interpret, and understand data to reveal relationships, patterns, and trends. This tool becomes so handy in order to understand more about the study area. It enables the construction of various maps representative of the actual ground without being physically present in the area. The diverse components of physical, political and cultural world can be understood using this tool. Hence, since this study is associated with Hydrology needs to take into account other factors that will affect water. This includes the river basin itself (hydrological map), general map of the area, geomorphology map, aspect, slope and other maps.

Being a student and studying in a foreign country, the GIS tool truly assists in my research. Together with this, accessing this tool always gets interesting as it introduces researchers to new things associated with mapping. At the same time, comparison can be made between the two different study areas and with proper guidance of my academic supervisor, I sure did learn a lot with mapping in regards to Geographical Information System (GIS)

However, it is important to keep in mind that this map will depend on the geographical data available and it can only be constructed if the data for that particular thing is available. In my case, accessing data in order to construct these maps for my study area become quite challenging as the data is available in one organization only. The organization is called the Pacific Island Geoscience Commission (SOPAC) which is a regional organization and one of its main roles is to collect geographical information data of member countries to be used in planning, development and other fields. Hence, requesting data from the organization surely requires proof on what the data will be used for, a lot of patience and follow up. Most data needed to construct other maps and make comparison is also not available due to certain reasons.

4.4.2 Questionnaires and Personal Interview

A questionnaire is simply a ‘tool’ for collecting and recording information about a particular issue of interest. When it comes to reaching a group of targeted audience, questionnaires can prove to be one of researcher’s best tools. It can reach a large number of audiences within a short period of time and it actually save cost from travelling to the case study area and conducting the interview face to face. In this research, there is a great deal of distance between the researcher and the study area. Questionnaires also allow respondents to reflect back in time on their encounters and experience with water issues in the village especially when majority of the questions digs for those data.

The questionnaires designed for the responders in the two villages are being divided into twenty one (21) sets of questions and is later broken down into forty one (41) sets of questions when analysed in the Statistical Package for Social Sciences (SPSS). These questions were all based from the objective of the research that can be found in Chapter One. At the beginning of the questionnaire, personal information of the responders was collected to ensure people from different household are answering the question without repetition. Majority of the respondents can read and write in English as it is the main means of conversing in school and public places but a second language for all the responders.

Furthermore, the questionnaires tend to use a lot of close ended questions. A closed-ended question is a question format that limits respondents with a list of answer choices from which they must choose to answer the question. This was made from the experience learned in the past whereby people live blank spaces when open ended questions are asked even though they

understand the question being asked. Open-ended questions are ones that require more than one word answers. The answers could come in the form of a list, a few sentences or something longer such as a speech, paragraph or essay. Close ended question was also encouraged in the questionnaire so that responders do not navigate away from the questions being asked but make them stay in the subject of discussion. However, responders are not limited to close ended questions only but have other areas that have open ended questions that allow them to give their views and show their understanding towards the issue being questioned.

4.4.3 Statistical Package for Social Sciences (SPSS)

SPSS is a Windows based program that can be used to perform data entry and analysis and to create tables and graphs. SPSS is capable of handling large amounts of data and can perform all of the analyses covered in the text and much more. It is commonly used in the Social Sciences and in the business world. The idea of using SPSS came about while conducting literature review as most researchers used this tool to go about with their research.

This tool enables questions in the questionnaire to be broken down to encourage simplicity. At the same time, this gives a broader and diverse outcome of the data that reflect more about the case study area. For example, when data is entered, it can analyse it into, frequency, percentage, valid percent and cumulative percent that can also give the user the option to convert it into statistics or graphs given the need of the research. Data can be stored in the system as long as it can be but limitation is that such software has expiry date and the user needs to renew the license if the software has to continue functioning. The software can be used by any researcher as guideline and instructions for use is available in booklet and help videos provided in various websites such as YouTube and others.

Nevertheless, SPSS requires certain types of data to be entered by the user if it has to produce the right output. This means that when dealing with a given set of data, values must be assigned for each and when processed by SPSS, the user will have options from a range of data on how the output can best be represented. Therefore, it is important that when researchers are designing the questionnaires, they should always keep in mind the best available means that will later be used in SPSS to derive the type of results they need. At some point, it becomes time consuming when questionnaires are not well structured that gives challenges when entering data into SPSS.

4.4.4 Microsoft Office

This include all Microsoft office essential software such as word, excel, powerpoint and others.

4.4.5 Internet and Search Engine

Science and technology had really changed the way people live their life since its first invention. Generations gad come and gone with contribution being made in the field. This contribution in the field of science and technology advances almost every year and there is always something new at the market. Infact,

“no generation is more at ease with online, collaborative technologies than today’s young people “digital natives”, who have grown up in an immersive computing environment. Where a notebook and pen may have formed the tool kit of prior generations, today’s students come to class armed with smart phones, laptops and iPods (Economist Intelligence Unit, 2008).

Such being the case, internet and various search engines are also being used as a tool in this research to gather, process, disseminate, and store data.

CHAPTER 5
DISCUSSION AND ANALYSIS OF
RESULTS

*“In rivers, the water that you touch is the last of what
has passed and the first of that which comes; so with
present time”.*

Leonardo da Vinci

5. Analysis and Discussion of Results

This chapter presents the findings from the two case study areas. Through the use of Statistical Package for Social Sciences (SPSS) software, questionnaire data are being recorded and analysed. Findings from the two villages are processed separately and later results are compared. Together with this, strength and weaknesses from these two case study area are also accounted for while taking into account their different geographical location and distance from the main

Central Business District (CBD) as this usually determines whether household can get access to tap water that is provided by the Fiji Water Authority (FWA) or from other water source available to them.

The questionnaires were distributed based on the number of household in the two villages (Table 4). Household were asked if all members could contribute to the answering of questions and giving their views where necessary.

Table 4 Distribution of Questionnaires in the two Villages

Village	Number of Household	Number of Questionnaires Distributed
Kalabu	36	25
Korovisilou	81	51

In order to get a fair view of the changes that had taken place in water accessibility over the years at the study areas, household were requested if the person who had stayed in the area for the longest period could be consulted. This is usually the parents or the grandparents. The questionnaires were given to the household with the expectation that both males and females (refer to Table 47 and 48 in Appendix A) would give their views and these also apply to the different age groups that are present in the respective households.

5.1 Perception and Knowledge on Freshwater Accessibility

As a developing country, most people in Fiji, irrespective of location, have in one way or another experience development. In the research undertaken, it was quite interesting to see the response of people when it comes to changes and development that are taking place around the water sector especially when it is a basic need that affects all areas of lives.

Table 5 Peoples Knowledge on Supply of Water in Kalabu Village

Do you know who controls water in Fiji?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	5	20.0	20.0	20.0
No	20	80.0	80.0	100.0
Total	25	100.0	100.0	

Table 6 Peoples Knowledge on Supply of Water in Korovisilou Village

Do you know who controls water in Fiji?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	17	33.3	33.3	33.3
No	34	66.7	66.7	100.0
Total	51	100.0	100.0	

The result in Table 5 and 6 reveals that only a small proportion of people in both villages know exactly who controls water supply in Fiji. Table 43 and 44 in Appendix A shows the level of Education in the two villages. In the case of Korovisilou, it would be understandable that people would not know the main supplier of tap water since their main source of water comes from groundwater and the village is located further away from the city. However, for Kalabu, this data is quite surprising since they have tap water and the land where the main water authority is located is owned by this village. 80% of the people in Kalabu who answered the questionnaire reveal they do not know who control the supply of water in the country and this number is greater than Korovisilou which is 66.7%.

The Water Authority of Fiji (WAF) which began operation in 1st January 2010, was established by the Government of Fiji to provide efficient and effective water and wastewater services in an

environmentally sound and sustainable manner. This duty was formerly carried out by a government body known as the Water and Sewage Department (WSD). The authority is responsible for providing access to quality drinking water and waste water services to over 144,000 residential and non-residential metered customers reaching over 800,000 people nationwide. This includes Rotuma, rural areas and the outer islands. Nevertheless, not all areas in this location receive tap water due to certain barriers that is present to both the authority and the people.

There can be different reasons why there is a large portion of people in the two villages do not know who controls water in Fiji and some of this can be due to:

- Less awareness and outreach made by Water Authority of Fiji and even the government to let the citizens know who controls the supply of water
- Changing of the management of water (it takes time for people to realize changes especially people living in rural areas)
- People do not keep up with current affairs and recent trends of development. To some extent, there is a mindset that when it comes to decision making and authority over resources, people think it only has to do with those who are in control and have power.

Table 7 Availability of Water in Kalabu Village

Is what supply abundant or scarce?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Scarce	7	28.0	28.0	28.0
Valid Abundant	18	72.0	72.0	100.0
Total	25	100.0	100.0	

Table 8 Availability of Water in Korovisilou Village

Is what supply abundant or scarce?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Abundant	51	100.0	100.0	100.0

Villagers in the two case study area were asked if there is abundant or scarce water in the place they are staying. In both the areas, the response was in favor of water being in abundance. It was quite impressive to see that for a village like Korovisilou (Table 8) that does not get any access at all to tap water and only one main river nearby, it actually has an abundance of freshwater. The 28% of respondents from Kalabu village (Table 7) based their reasons as water being scarce in the place they are staying due to:

- Water shortage in times of dry weather where water level in the reservoir decline
- Low water pressure at times especially in peak hours when most people are at home doing household work that are associated with water usage
- Water cuts due to pipe leakage and maintenance carried out
- Rivers being available but considered unsafe to drink due to water pollution and other reasons.

Unlike most countries where there is shortage of water supply and people do not have access to rivers and streams, Fiji is an island nation where people can easily either get to the sea, rivers, streams and can even drink from plants that store water such as Coconuts and others. In relation to other Pacific Island countries, Fiji has so many advantages when it comes to drinking water. However, there are still some communities both in urban and rural areas who do not have access to clean and safe drinking water. Due to that, a question was posed that with respect to the many rivers in Fiji, is it possible to provide tap water to all household. The response can be seen in Table 9 and Figure 35.

Table 9 Whether Tap water can be provided to all household in Fiji with respect to the number of rivers available (Kalabu Village)

	Frequency	Percent	Valid Percent	Cumulative Percent
Yes	8	32.0	32.0	32.0
No	10	40.0	40.0	72.0
I do not know	7	28.0	28.0	100.0
Total	25	100.0	100.0	

Figure 35 Whether Tap water can be provided to all household in the country given the number of Rivers available (Kalabu Village)

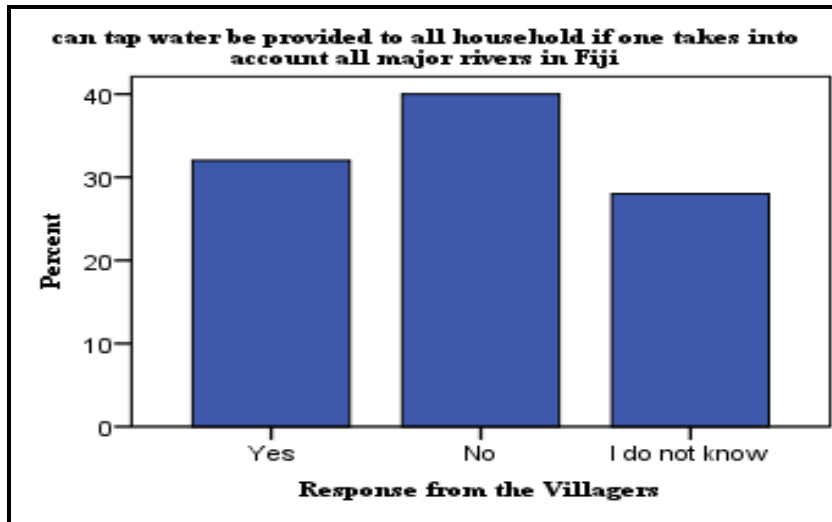


Table 10 Whether Tap water can be provided to all household in the Country given the many Rivers available (Korovisilou Village)

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	36	70.6	70.6	70.6
Valid No	1	2.0	2.0	72.5
Valid I do not know	14	27.5	27.5	100.0
Total	51	100.0	100.0	

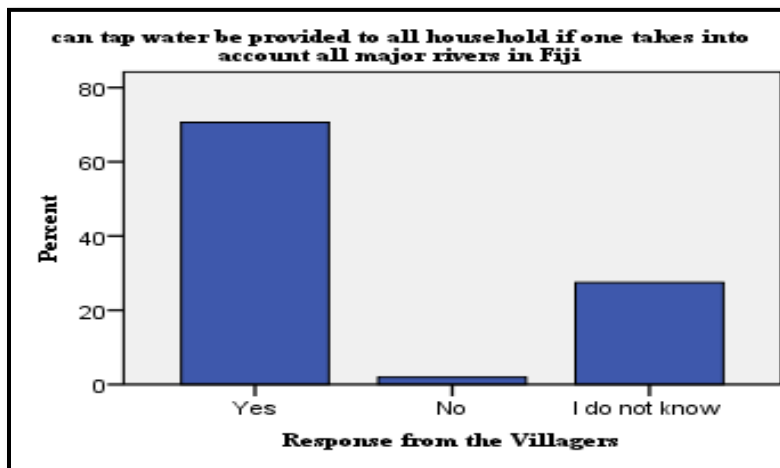


Figure 36 Whether Tap water can be provided to all household in Fiji given the number of rivers available (Korovisilou Village)

Based on the responses, it can be noted that the people in Korovisilou (Table 10 and Figure 36) believed that tap water can be provided to all household in Fiji given the many rivers and

streams. However, for Kalabu village (Table 9 and Figure 35), there seems to be a mixed response and at the end more people think otherwise (tap water cannot be provided to everyone). These different responses can be attributed to the different experience that the people face in their residents based on the type of water source that they rely on. It is important to note, that most people do not take the time to explore and get to know their natural surroundings and this deprived them of the chances of getting freshwater in times of water shortage. In places such as these case study areas, people are quite lucky to have accessed to nearby rivers and streams.

Table 11 Number of Rivers within 2km near Kalabu Village

How many rivers can found 2km near this village?

	Frequency	Percent	Valid Percent	Cumulative Percent
Two	18	72.0	72.0	72.0
Four	1	4.0	4.0	76.0
Valid More than five	5	20.0	20.0	96.0
Not sure	1	4.0	4.0	100.0
Total	25	100.0	100.0	

Table 12 Number of Rivers within 2km near Korovisilou Village

How many rivers can be found 2km near this village

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid One	51	100.0	100.0	100.0

Hence, when it comes to knowledge and finding out about the interaction that people had made with their natural surroundings, it can be noticed that there was an inconsistency in terms of respondents answer on the number of rivers available in Kalabu (Table 11). A large portion (72%) said two rivers, 20% said more than 5 rivers, and 4% said four rivers while the remaining 4% are not sure of the numbers of rivers that is present within 2km of the village. In comparison to Korovisilou (Table 12), all of the respondents agreed that there is only one river. This uniformity from the Korovisilou respondents' shows that majority of the people shares a common perception on their interaction with their surroundings.

Such being the case, it can be seen that when people have more development and good services around them, they tend to have a loose tie with their surroundings. Kalabu is located closer to the main City (Suva) while Korovisilou is further away so when it comes to natural resource knowledge and the environment, it would not be surprising if the people of Korovisilou gave a more consistent answer than the people of Kalabu village.

5.2 Accessibility to Rivers, Streams and Other Water Sources

Early settlers in Fiji choose their settlement based on its accessibility to rivers and streams. Most of this settlement and villages still exist today and one can actually prove that locations are based on the presents of waterways. This is the case for both Kalabu and Korovisilou village that are both located near a river. This rivers and streams had sustained the villagers since the first settlers arrive and continue to serve for the same purpose till the present day. Along these rivers, there are lush evergreen forests with different varieties of seasonal fruit trees. Plantations and farms are also located near waterways to allow crops and other produce to access moisture.

Table 13 How often do People in Kalabu use the River?

Number of times responder use the river

	Frequency	Percent	Valid Percent	Cumulative Percent
	More than twice in a week	7	28.0	29.2
	More than twice in a month	4	16.0	45.8
	I do not use the rivers at all	4	16.0	62.5
Valid	Less than twice in a week	5	20.0	83.3
	Less than twice in a month	1	4.0	87.5
	Others	3	12.0	100.0
	Total	24	96.0	100.0
Missing	99.00	1	4.0	
Total		25	100.0	

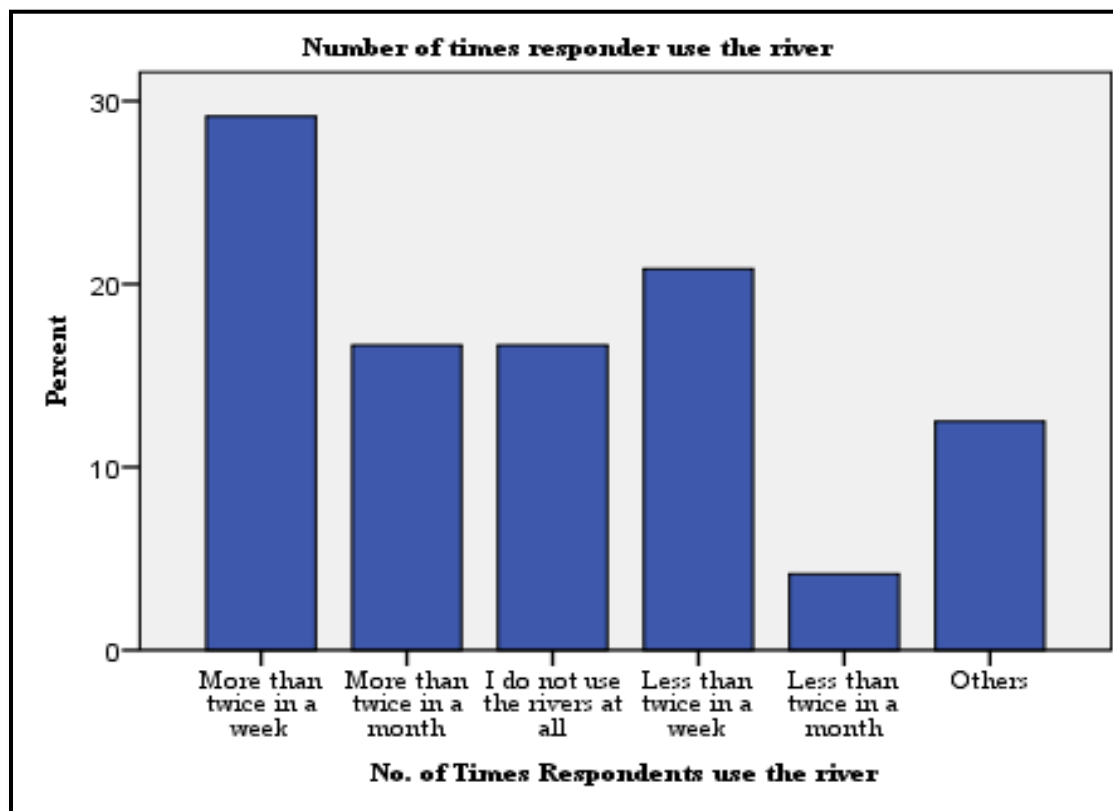


Figure 37 How often People in Kalabu use the River?

Table 14 How often do People in Korovisilou use the River?

Number of times responder use the river

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
More than twice a day	9	17.6	17.6	17.6
More than twice in a week	17	33.3	33.3	51.0
More than twice in a month	13	25.5	25.5	76.5
Less than twice in a week	4	7.8	7.8	84.3
Less than twice in a month	8	15.7	15.7	100.0
Total	51	100.0	100.0	

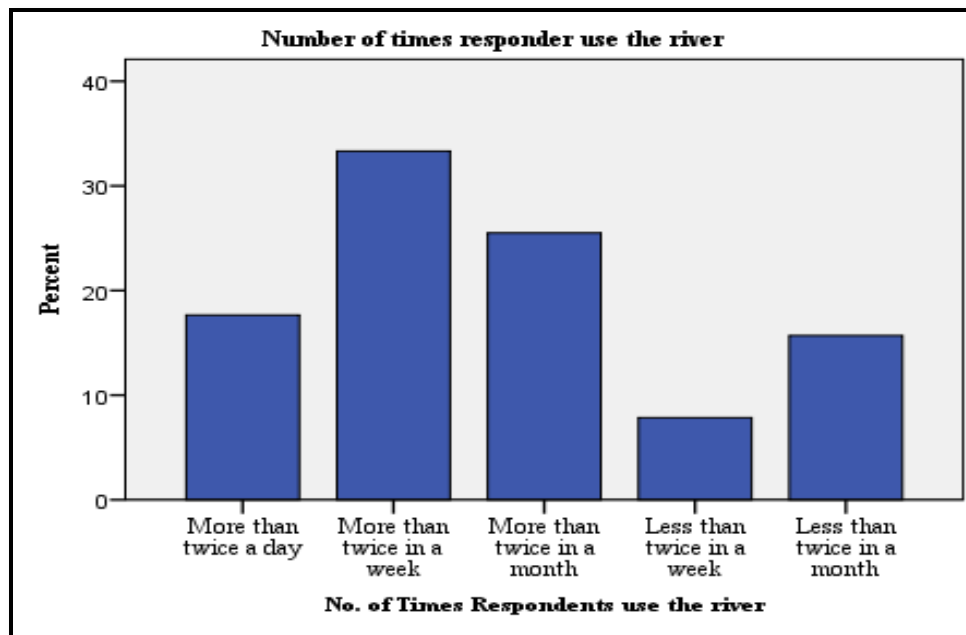


Figure 38 How often People in Korovisilou use the River?

In both villages (Table 13, 14 and Figure 37, 38), people need the river. Not only does the river supplement water in times of water shortage from the tap or even from underground water in times of drought, it provide a more meaningful purpose to the lives of people in both Kalabu and Korovisilou village. Under the Fijian custom, rivers provide a form of identity to the people. It is often associated with the term “*qoliqoli*” (fishing ground) that separates a “*mataqali*” (clan) area of fishing from that of another. Also in the river, is an individual “*ika*” (fish) which again is another form of identity that tells more of a native Fijian when categorizing people into clans or groups.

While analyzing the questionnaires, it can be noted that age also plays a factor when it comes to the usage of river. This is especially true for Kalabu village where few of the respondents who are over fifty (50) years of age say that they do not use the rivers at all. Unlike the older generation, the younger generation prefers to use the river more often even though they have available water in their respective household. Most of this young people use the rivers for fun and a place where they can socialise with their friends and peers. The river provided a place for “hang out” and even at times it is a place where one can get freshwater fish, prawns and other food source that is present there.

Table 15 Distance traveled by villagers in Kalabu to get Water

How far do you travel to get freshwater?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than half a KM	5	20.0	83.3	83.3
	More than half a KM	1	4.0	16.7	100.0
	Total	6	24.0	100.0	
Missing	99.00	19	76.0		
Total		25	100.0		

Table 16 Distance traveled by villagers in Korovisilou to get Water

How far do you travel to get freshwater?

		Frequency	Percent
Missing	99.00	51	100.0

It can be seen that there are people in Kalabu (Table 15) who still travel some distance in order to access freshwater. This happens mostly in times of water shortage but at times people opted to do certain activities in the river for reasons such as:

- Washing clothes in bulk that is said to be easier as there is more water compared to low pressure of water from the tap
- Giving a chance to socialize and mingle in groups while washing clothes or doing other things
- Reducing water bills and other reasons.

On the other hand, data from Korovisilou village (Table 16) revealed that everyone in the village do not have to travel any distance at all to access freshwater. This is credited to the village reservoir that comes directly from underground water and channeled to the households through pipes.

5.3 Water Distribution, Ownership and Challenges to Accessibility

Water accessibility depends on the ownership of natural resources. Most communities are deprived of safe and clean drinking water because only a selected group of people have control

on water sources. At times, landowners or private individuals avert people from accessing water source that they owned simply because need compensation for the use of their resources.

Table 17 Distribution of Freshwater in Kalabu Village

Is water distribution uneven in the village?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	1	4.0	4.2	4.2
Valid No	23	92.0	95.8	100.0
Total	24	96.0	100.0	
Missing 99.00	1	4.0		
Total	25	100.0		

Since tap water is present in almost all households there is little evidence in Kalabu village to suggest an uneven distribution (Table 17) of freshwater. Together with this, the supply of water is controlled by an outside; hence, there is equality in water service and very little room for bias. Access to tap water is based on who can afford to pay both the installation and water bills that will come after every three month.

Table 18 Distribution of Freshwater in Korovisilou Village

Is water distribution uneven in the village?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	29	96.7	100.0	100.0
Missing	1	3.3		
Total	30	100.0		

In Korovisilou, the response is the same to that of Kalabu as respondents also reveal that there is no uneven distribution (Table 18) of freshwater. Even though, individual household is responsible for connecting their household pipes to the village reservoir, none of the household has any opinion or complain that one receive more water than another. In further investigating this matter, respondents were asked about the ownership of resources in the village, in particular land, that usually determines who owns the water ways.

Table 19 Type of Land ownership in Kalabu Village

Type of land ownership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Communally	24	96.0	100.0	100.0
Missing	99.00	1	4.0		
Total		25	100.0		

Table 20 Type of Land ownership in Korovisilou Village

Type of land ownership

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Communally	51	100.0	100.0	100.0

Approximately 83% of land in Fiji is Native Land. Typically a portion of each land area is set aside for the site of the village, and the rest is Native reserve. Land within native reserve may be made available for use and development by others through short or long-term lease. In order for development to take place on Native Land, the developer must obtain a lease. Leases of Native Land are available through the Taukei Land Trust Board (TLTB), a statutory authority which administers all such lands on behalf of the Fijian owners. All applications for leases of Native Land are made to the TLTB.

Any agreement or dealing concerning Native Land made with any other person or group has no legal standing. Once a TLTB lease has been issued, the land must go through a process of de-reservation before development can take place. Any application for development permission, subdivision, or rezoning of Native Land must be accompanied by a copy of the lease documents as evidence of the applicant's legal right to the land, and the TLTB's consent to the land's development. Development leases are issued for particular types of development (residential, commercial, tourism, etc) and if a lessee wishes to carry out a different type of development, the agreement of the lessor must be obtained. When it comes to communal ownership (Table 19 and 20), collective discussion by a group will be sorted out first that guarantees all individual voice is heard before any decision is made that deals with land and its resources. This system is practiced in both the villages and had been passed from one generation to another.

Table 21 Whether Resource Ownership is a factor preventing people from accessing freshwater in Kalabu Village

Does resource ownership prevent people from getting freshwater?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	5	20.0	20.0	20.0
No	16	64.0	64.0	84.0
I do not know	4	16.0	16.0	100.0
Total	25	100.0	100.0	

Table 22 Whether Resource Ownership is a factor preventing people from accessing freshwater in Korovisilou Village

Does resource ownership prevent people from getting freshwater?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid No	39	76.5	76.5	76.5
I do not know	12	23.5	23.5	100.0
Total	51	100.0	100.0	

Land disputes had often been contributing factor to resource being left idle without giving any returns. Infact, there are places where resource ownership prevents people from accessing basic needs such as water. In Kalabu village (Table 21), 5% of the respondents say that resource ownership prevents people from accessing freshwater, 64% disagrees and 4% do not know. With Korovisilou (Table 22), 76.5% responded that resource ownership does not prevent people from accessing freshwater and 20% do not know whether such situations exist or not.

Table 23 Challenges faced by villagers at Kalabu in gaining access to Freshwater

Challenges faced with water supply

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Finance	18	72.0	72.0
	Distance	2	8.0	80.0
	Pollution	5	20.0	100.0
	Total	25	100.0	100.0

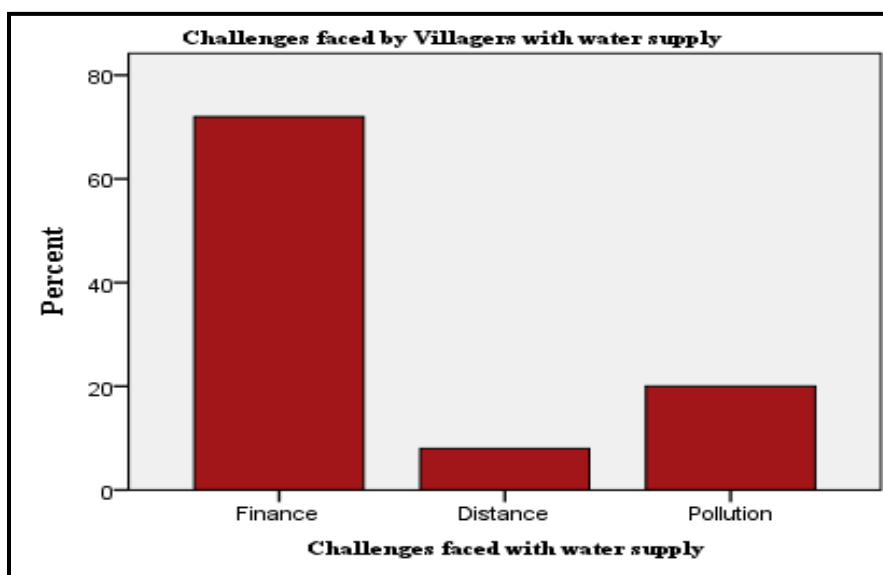


Figure 39 Challenges in gaining access to Freshwater at Kalabu Village

Table 24 Challenges faced by villagers in Korovisilou in gaining access to Freshwater

Challenges faced with water supply

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Finance	1	2.0	2.0
	Pollution	49	96.1	98.0
	Total	50	98.0	100.0
Missing	99.00	1	2.0	
Total		51	100.0	

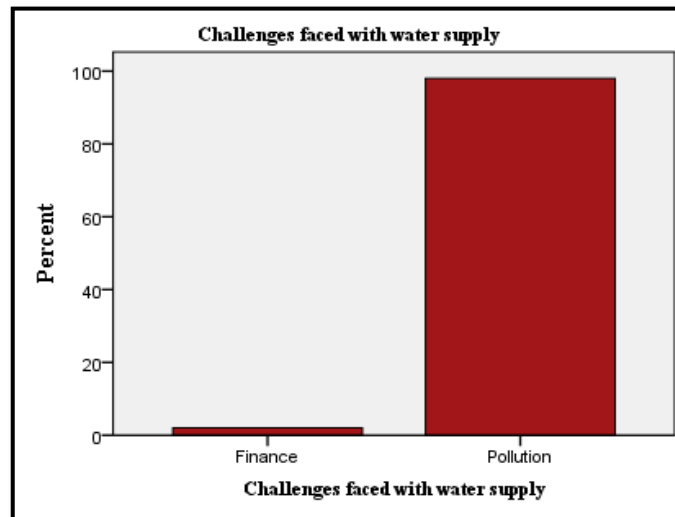


Figure 40 Challenges in gaining access to Freshwater at Korovisilou Village

In Kalabu village (Table 23 and Figure 39) where water is supplied by the Water Authority of Fiji, 72% of the respondents say that the main challenge is finance. On the other hand, in Korovisilou (Table 24 and Figure 40) where individual household are responsible for their own water supply had only 2.0% of its respondents who reveal that finance is a challenge and about 96% say that pollution is the main challenge. While taking into account the development that is taking place near Kalabu village and its effects on water supply, only 5% of the respondents believe that pollution is a challenge. There is considerable difference in the type of challenges that people reveal from the two case study areas when it comes to freshwater accessibility. Again, this challenge is determined by the type of water source present in the two different villages.

5.4 Water Cost and Standard of Living

Like urban areas, isolated rural villages need money in order to get accessibility to tap water. Household had to pay a price in order to get water meter connected (Table 45 and 46 in Appendix B shows the type of occupation present in the two villages). Together with that, materials that will be used to connect to the main water metre had to be bought by household themselves. Later on, water bills had to be paid after every three month. It is often seen that people see this expenses as a lot of money being lost and as a result, a number of household ended up sharing water sources. Changes in ownership of water supply from the hands of the

government to a private organization can also mean changes in water bills that will be discussed in the following.

Table 25 Number of Household sharing water source in Kalabu village

Do you share water source with other households?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	8	32.0	32.0	32.0
No	17	68.0	68.0	100.0
Total	25	100.0	100.0	

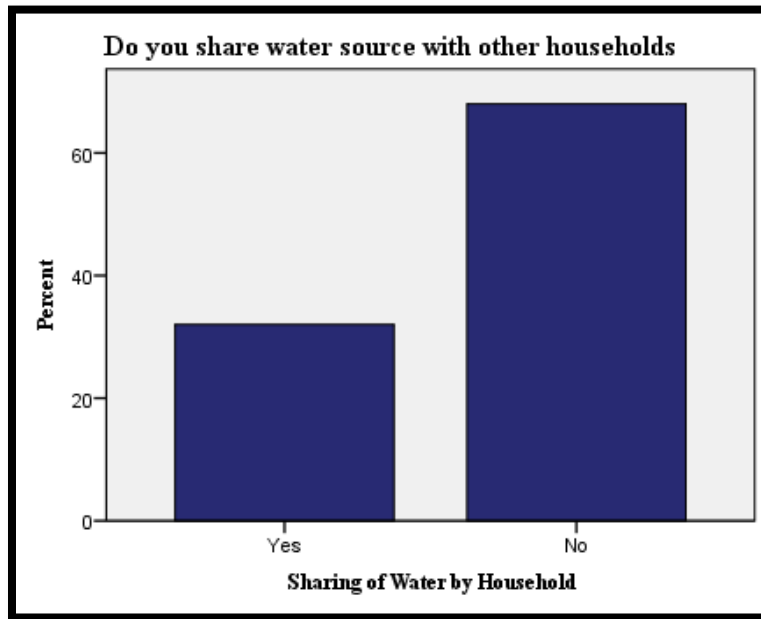


Figure 41 % of Household sharing water source in Kalabu Village

Table 26 Number of Household sharing water source in Korovisilou village

Do you share water source with other households?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	10	19.6	19.6	19.6
No	41	80.4	80.4	100.0
Total	51	100.0	100.0	

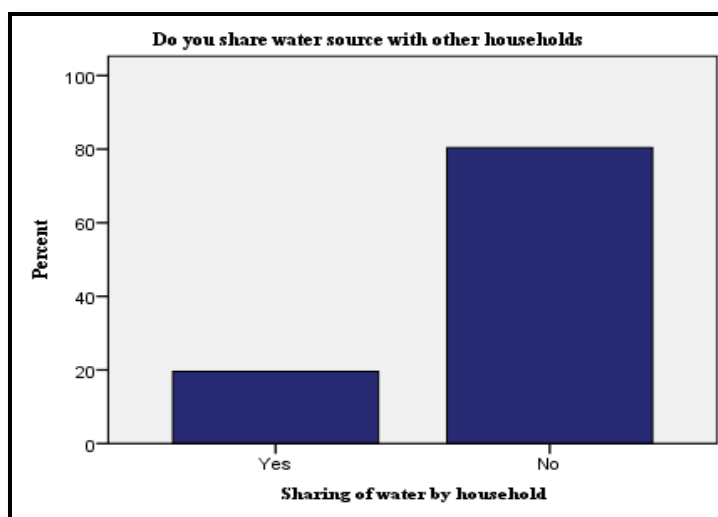


Figure 42 % of Household sharing water source in Korovisilou Village

A common characteristic of a Fijian village is the close ties between one individual to another, the bond between families and with it the links between clans. This feature is strengthened through sharing and people helping each other. There is interdependence and this is rooted by the core foundation of Fijian identity that is “*lotu*”, “*vanua*” and “*matanitu*” (religion, land and government). In both villages (Table 24, 25 and Figure 41 and 42), more than 50% of the household had their own water source. This means that more people do not share water source and is an indication of the availability of water in the area. However, the fact cannot be ignored that some household had to continue sharing water source due to certain reasons such as finance and others.

Table 27 Whether Water Bills is increasing in Kalabu Village

Are water bills increasing?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	12	48.0	50.0	50.0
Valid No	12	48.0	50.0	100.0
Valid Total	24	96.0	100.0	
Missing 99.00	1	4.0		
Total	25	100.0		

Like any other commodity offered through a service, there is always a price. When it comes to water bills, people often have different perception on whether there has to be a price for it or simply be classified as a free good that anyone can enjoy because it is a need and is provided by

nature. Unfortunately, people had to pay a price so that they can get the service needed. In Kalabu village (Table 27), 48% of the people responded that water bills are increasing while another 48% responded that water bills is not increasing. It is important to note that depending on the period a person stays in a particular place (Table 49 and 50 in Appendix B), it will give them the experience and idea whether bills are increasing or decreasing.

Hence, it can be noted that there is no definite answer to actually say that water bills had actually increased or decreases because most of this household do not keep records of their water bills after it is paid. However, this question can only be answered by the Water Authority of Fiji if records of water bills paid by household over the years are analysed or even by looking at the changes in water rates set by the controlling authority over the years.

Table 28 Range of water bills paid by Household in Kalabu Village

Water bills expenses

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid				
Less than \$10	3	12.0	12.5	12.5
\$10 - \$20	7	28.0	29.2	41.7
\$20 - \$50	6	24.0	25.0	66.7
\$50 - \$90	5	20.0	20.8	87.5
+ \$100	3	12.0	12.5	100.0
Total	24	96.0	100.0	
Missing				
99.00	1	4.0		
Total	25	100.0		

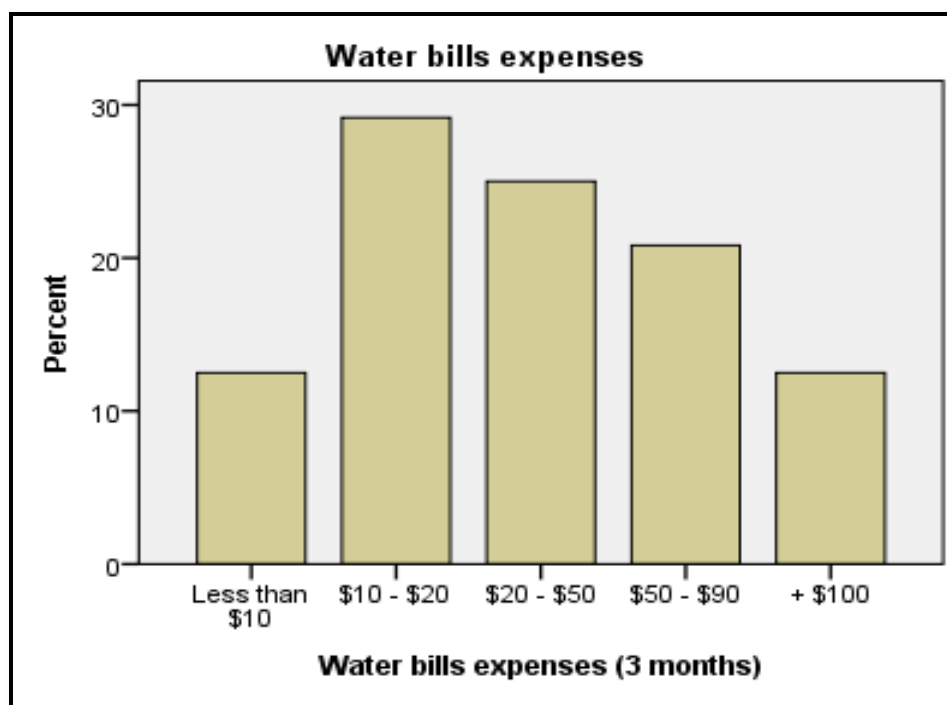


Figure 43 % range of water bills paid by household in Kalabu Village

Most of the household water bills fall between the ranges of \$10-\$90 (Figure 43). It is important to keep in mind that the average number of people in a household range from 5-8 people. These household bills tend to fluctuate at times especially when there is an occasion or function that happens in the household. Unlike Kalabu village, residents of Korovisilou do not pay any water bills at all since it is free of charge and is entirely owned by the individual household themselves.

Table 29 Whether Households in Kalabu Village are able to cope with their Current Water Bills

Are you able to cope with current water bills?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	20	80.0	83.3	83.3
Valid No	3	12.0	12.5	95.8
Valid 3.00	1	4.0	4.2	100.0
Total	24	96.0	100.0	
Missing 99.00	1	4.0		
Total	25	100.0		

Earlier data (Table 27) by the respondents reveal a mixed result where water bills is either increasing or decreasing in the case study area. In Table 29, the question was posed to household

whether they are able to cope with the current water bills and interestingly, 80% of the respondents reveal that they are able to cope with the current water bills. Only 12% of the respondents reveal that they cannot cope with the bills.

5.5 Water Conservation and Strategies for Reducing Expenses

Through the course of data gathering, it was important to gather data if people have ways of conserving water in a sustainable manner and have plans in place to reduce water bills. The difference between the use of free goods and economic goods is present when it comes to any community. In posing the question on whether there are strategies in place to reduce water bills, one is able to gauge if water is treated as a limited resources or an unlimited resources. On the other hand, it gives one an idea if household are really concerned on the amount of money spent on water bills.

Table 30 People in Kalabu village who have strategies to minimize water Bills

Do you have strategies and plans in place to reduce water bills?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	13	52.0	56.5	56.5
Valid No	10	40.0	43.5	100.0
Total	23	92.0	100.0	
Missing 99.00	2	8.0		
Total	25	100.0		

With the high cost of leaving and low average income of most household in the village, it would be interesting to find out ways employed by people to save money. Household were asked if they have strategies and plans in place that will enable them to reduce their water bills. Thus, in Kalabu village (Table 30), 52% of the respondents say that they have strategies and plans in place to help them reduce their water bills. Some of the common plans and strategies given by the respondents are as follows:

- Closing tap properly when not in use
- Using a basin to wash utensils to prevent tap from running throughout the entire period
- Repairing and maintenance of leaked pipes
- Filling buckets and bottles for drinking rather than opening the tap every now and then

- Minimizing the number of laundry times
- Using the river to wash clothes and bath for unlimited hours as it is free

There are about 40% of the respondents from Kalabu village who mentioned that they have no strategies and plans in place to reduce water bills. Again, in Korovisilou village, people do not pay water bills so the question does not apply to them but they have means and ways of conserving water. This is usually done in dry season where there is less rainfall and the water source decreases. In both villages, there are no plans available to cater for sustainable use of water.

5.6 Privatization and Control of Water Supply

It is often the case that control of water supply affects the relationship between household and water use. Since the control of water recently change from government to private ownership, it is vital to gather data on the experience of people. The selling of bottle water extracted from aquifers at a price should not be taken likely but explored more closely to ensure that the need for water is not undermine.

Table 31 Villagers in Kalabu Village who buy bottle Water

Do you buy bottle water?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	11	44.0	44.0	44.0
No	14	56.0	56.0	100.0
Total	25	100.0	100.0	

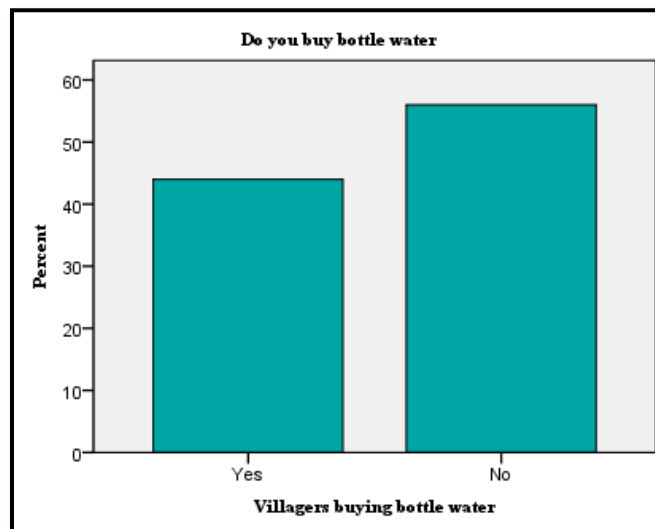


Figure 44 % of People in Kalabu who buy Bottle water

Table 32 People in Korovisilou Village who buy bottle Water

Do you buy bottle water?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	32	62.7	62.7	62.7
No	19	37.3	37.3	100.0
Total	51	100.0	100.0	

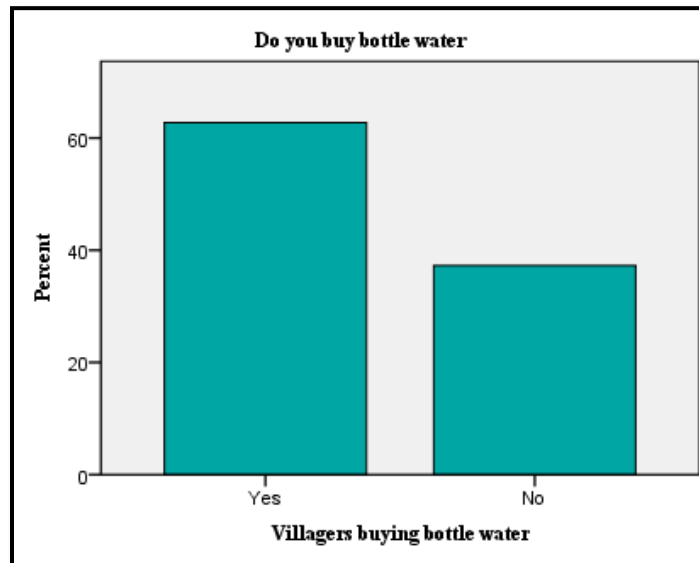


Figure 45 % of People in Korovisilou who buy Bottle water

Fiji has a limited number of products that is exported into the world market. One of the brands that stood out the most is “Fiji Water”. Villagers from the two case study area were asked if they buy bottle water. There are 62.7% of people in Korovisilou (Table 32 and Figure 44) that buy bottle water whereas 44% of the respondents from Kalabu village (Table 31 and Figure 45) buy bottle water. People have their own reason of buying bottle water but from the data gathered, it can be assumed that people who have access to tap water would prefer tap water than spending money on bottle water.

Taking into account the location of reservoirs that is owned by the Water Authority of Fiji, it can be seen that a number of this reservoirs lies in the land owned by Kalabu village and that had been leased. There are agreements in place about this lease but there is a need to look closer into this agreement to see whether the landowners are really benefitting from the condition that is currently in place.

Table 33 Whether People in Kalabu Agrees for water to be sold at a price

Should water be sold at a price?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	3	12.0	12.0	12.0
No	22	88.0	88.0	100.0
Total	25	100.0	100.0	

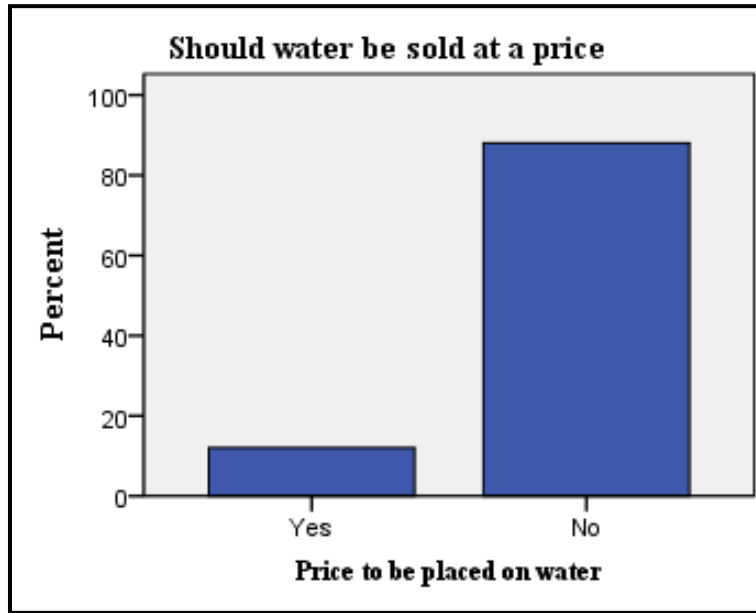


Figure 46 Response from Kalabu village whether water should be sold at a price

Table 34 Whether People in Korovisilou Agrees for water to be sold at a price

Should water be sold at a price?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	1	2.0	2.0	2.0
No	50	98.0	98.0	100.0
Total	51	100.0	100.0	

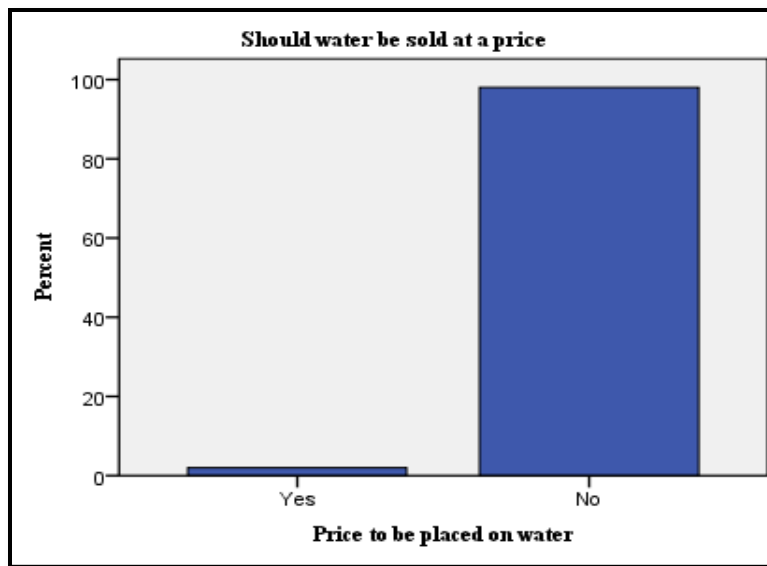


Figure 47 Response from Kalabu village whether water should be sold at a price

In both the villages (Table 33, 34 and Figure 46, 47), majority of the respondents argues that water should not be sold at a price. Majority gave the reason that water is provided by nature and should not be sold at a price. It is also a basic need which means that individual should have freedom of access to drinking water without any form of discrimination. In Kalabu, 88% of the respondents say that water should not have any price tag and for Korovisilou village, the percentage is quite higher that is 98% also in favor saying water must not be sold at a price.

5.7 Climate Change and Sustainable Development

Climate change had been an increasing issue that has stolen discussion in most of the world gathering platform. With that in mind, effects of climate on water cannot be ignored on issues surrounding water as it is a factor that determines the supply and demand of water. Villagers in the case study area were given the question on whether climate has any influence at all in the supply of freshwater.

Table 35 Climate influence on Freshwater Kalabu Village

Does climate influence the supply of freshwater?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	20	80.0	80.0	80.0
No	5	20.0	20.0	100.0
Total	25	100.0	100.0	

Table 36 Climate influence on Freshwater at Korovisilou Village

Does climate influence the supply of freshwater?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	40	78.4	78.4	78.4
No	11	21.6	21.6	100.0
Total	51	100.0	100.0	

The data shows that most people in the two villages believe that climate influence the supply of freshwater. In Kalabu (Table 35) 80% and Korovisilou (Table 36) 78.4% respectively that implies climate to be a major determining factor in the supply of freshwater. Discussion with the villagers also shows that there had been evidence of changes in the supply of freshwater in periods of heavy rainfall and the long period of drought.

Often at times of natural disasters, such as tropical cyclone and flooding, water supply is severely affected. However, people had their own coping strategies that enable them to go through things when it affects them. Since most of the household in the two villages rely heavily on agriculture, their livelihood is determined by changes in climate that shapes the supply of freshwater. There is scientific evidence which suggest that there had been frequent changes in rainfall and temperature pattern not only in Kalabu and Korovisilou but Fiji as a whole. People in the village had some fair idea regarding climate change and this is owed to education. It is usually the younger generation who understand more about changes occurring with the weather pattern and with the knowledge gained from school; they disseminate the information to their elders and family members. According to Sikeli Ladenona of Kalabu village “climate change is real and it affects us one way or the other”.

Table 37 Workshops and Awareness on Freshwater Issues at Kalabu Village

Do you have organised workshop and awareness programme on water in the village?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	15	60.0	60.0	60.0
No	10	40.0	40.0	100.0
Total	25	100.0	100.0	

Table 38 Workshops and Awareness on Freshwater Issues at Korovisilou Village

Do you have organised workshop and awareness programme on water in the village?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	6	11.8	12.5	12.5
Valid No	42	82.4	87.5	100.0
Total	48	94.1	100.0	
Missing 99.00	3	5.9		
Total	51	100.0		

As mentioned earlier, education plays a vital role in the dissemination of information. Respondents were asked whether they had actually attended a workshop organised in their village. In Kalabu (Table 37), 60% of the respondents said yes but in Korovisilou (Table 38) only 6% said yes. This difference can be attributed to the village location where Kalabu is located near the city and is easily accessible to health officials and other organizations that conduct awareness and workshops on issues relating to freshwater. Korovisilou on the other hand seems to be further away from the city centre which implies that there had to be a cost in travelling if officials had to travel there and conduct awareness and workshops.

5.8 Water Problems and Solutions

All problems associated with life needs a solution. The responders from the case study areas were asked if there are problems associated with freshwater accessibility and later they were asked on how those problems could be solved.

Table 39 Water Problem in Kalabu Village

Do you experience water problem?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Yes	9	36.0	36.0	36.0
Valid No	16	64.0	64.0	100.0
Total	25	100.0	100.0	

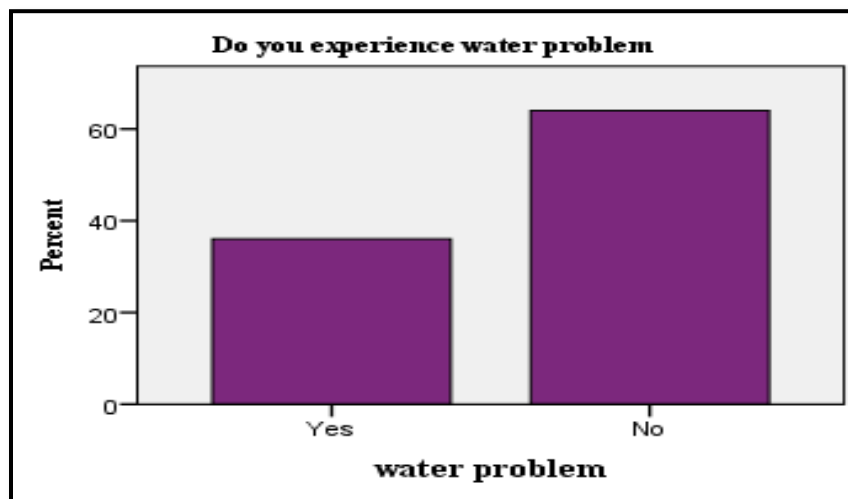


Figure 48 Whether there is water problem in Kalabu Village

Table 40 Water problem in Korovisilou Village

Do you experience water problem?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	51	100.0	100.0	100.0

There is no bar graph given for Korovisilou since everyone agrees that there is no water problem in their village (Table 40). Nevertheless, for Kalabu village (Table 39 and Figure 48), 64% of the respondents say that they experience water problem. With that in mind, it is important to understand the contrasting water source present in the two different villages. Together with this, population numbers had to be considered as well whereby in the case of Kalabu, there are actually thousands of household who are connected to the water main that transports water and is used by them before the water actually reaches Kalabu village. In Korovisilou village, individual household had their own water source that is not shared with other households. Like most problems, people have to find ways to solve it. In both the villages, some of the common solutions suggested by the people are:

- The need to have government assistance
- Individuals to work hard and sort out the problem instead of relying on others to do things for them; and
- Working together as a community and looking out for each other.

5.9 Freshwater Accessibility: Strength in the Case Study Areas

In both the case study areas, there is strength present that can be used as success stories when addressing issues in relation to water. Firstly, in Kalabu village, the landowners had to be commended in allowing the former and now the current water governing body to use water resources present in their land to supply water to other parts of Fiji. In return for the use of water resources and their land, the villagers receive land lease. Over the past years, there had been no history of resource conflict between the water governing bodies and the landowners. Most villages and communities in Fiji have no access to water because of land issues where landowners demand a high return from the use of their land. In some cases, even the landowners do not have safe and clean drinking water due to the fear of not being compensated if their resources are being used.

During the interview in this village, it was revealed that when the first reservoir was proposed to be built on their land, the landowners were given the option not to pay their water bills. However, this was turned down by elders in the village who strongly believed in equality and hard work that all household will pay for their water bills. Together with that, the elders wanted the people not to rely on outside parties but work hard and strive for things themselves.

Evidently, Korovisilou village does not have access to tap water provided by WAF but this is no reason for the villagers not to have access to clean and safe drinking water. All villagers interviewed revealed that they have no water problem but as a researcher one has to bear in mind factors that affect water both in the short and long run. When it comes to clean and safe drinking water, Korovisilou seems to be doing exceptionally well as results suggest no outbreak of water borne disease over the years whereas Kalabu village is an exception to this even though they access treated tap water.

Indeed, with the rising issue of climate change, it is important to note that more than 80% of people are aware of the issue. This is attributed to traditional knowledge for the elders and education by the younger generation. For this reason, adaptation and resilience method are being accounted for in case of access water from rainfall leading to flooding or in some cases drought that will result in water shortage. When it comes to untreated drinking water, Korovisilou villagers discourage development near their water source and this has proven successful over the years as water does not get contaminated.

5.10 Freshwater Accessibility: Weaknesses Present in the Case Study Area

Undoubtedly, the objective of this research intends to bring into light the weaknesses and barriers to freshwater accessibility that are present in rural and remote areas. Hence, in the case study areas, the weaknesses are noted as follows and discussed thereafter.

5.10.1 Geographical Location

In a developing country like Fiji, location of a place will determine the type of resources that the people can access and the possible service that can be provided. The contrasting location of the two study area provide a strong basis for this research as it intends to focus more on rural and isolated areas. Korovisilou village is located further away from a town or city which gives it more reason of little accessibility to water provided by WAF. On the other hand, Kalabu village is located near towns and cities but is still classified as a rural area since it does not receive all services required in order to qualify as an urban area.

Indeed, their geographical location determines their respective water source where Korovisilou receive underground water and Kalabu gets tap water. Being the sole provider of water, WAF will need time and capital resources in order to provide treated tap water for the people of Korovisilou. Located at a higher elevation, often the people in Kalabu experience water shortage. Together with this, there are leaking pipes that needs repairing and in most occasions there is often temporary water shortage.

5.10.2 Increasing Consumption

It can be seen from the above analysis that often at times there is temporary water shortage. Upon investigation, the people in Kalabu village who have had a lot of experience in this say that this happens during “peak hours”. This is the time when almost all household tap water is switched on and as the distance grew away from the main water pipes, those household further on will not receive water until the previous households started turning off their taps. Such situation usually happen on Saturday when most people are at home doing their household work associated with water and during the morning when people rush to work, school and later on in the evening when household prepare meals and people have their bath.

Subsequently, this situation seems to be repeated every year and it seems to get even worse as the time it takes to wait for water to start running again in the tap when the other household turned their tap off becomes longer. In the same manner, even when water is running, the villagers noticed that pressure seems to be low and this has also diminished over the years. This is a reason why most villagers prefer to wash clothes and do other activities associated with water in the nearby river. One does not have to be an expert in problem solving in order to see the root cause of this problem as majority of the villagers believe that population has increased over the years giving an increase in water consumption but the number of reservoirs continue to be the same.

5.10.3 Lack of Knowledge on Water Issues

Most people have very minimal knowledge about water issues at both local and national level, let alone issues affecting global water demand and supply. Studies have shown that people will only take action when they become aware of an issue. In Kalabu and Korovisilou village, one will be immensely surprised and impressed on the number of people that have access to electronic and communication devices. Almost all household have television, radio and above all, mobile phones.

However, given all those devices, people have little knowledge of issues related to water. This can be proved when respondents are asked “who controls water in Fiji” and the response was disappointing that more than half of the household in both the villagers do not know who controls water. Irrespective of location, water issues will be present in any place which means that people need to be aware on means and ways of dealing with these issues. In the same way, being knowledgeable about water related issues happening at local, national and at international level will make one realize the importance of drinking water and will influence them to conserve and sustain water even if there is abundance of it.

5.10.4 Water Laws and Policy

Water management acts and laws are not readily or easily accessible from certain locations and to certain citizens in Fiji. It is not surprising to see that few people do not wish to include the governing authority (WAF) when they need to inquire issues regarding water since they do not know the procedures and process to follow. Again, in Kalabu village where there is more

development taking place, rivers and streams are adversely affected. There are legal actions that landowners and people can undertake to address this issue. However it is sad to note that nobody is standing up for the protection of this resources simply because they thought there is no avenue to follow.

The fear of going to the authority and presenting a case associated with legal jargons and processes puts people back in their comfort zone rather than standing up to the issue. Some believe that they cannot do anything about it as these are powerful organization they are dealing with. For example, the Housing Authority of Fiji (HAF) dumps excessive sewage from houses that comes under their jurisdiction into the Kalabu river causing massive environmental problem.

5.10.5 Untreated Drinking Water

Households would go to any extent and turn to other source to provide water for their daily livelihoods. In Korovisilou village where the main water source is located underground, there is a risk of drinking water getting contaminated. From the underground aquifer, water is channeled by pipes to an elevated area where two cement water tanks stood that is ready to receive and store water. This water tanks that acts as reservoirs later transfers' water to the different household in the village. A large percentage (84.3%) of the household said that the water they are consuming comes from a secure place and that it is entirely safe to drink. This statement is further supported by the fact that the village had never had a disease outbreak associated with water in the past years (in accordance to the different age category who responded to the survey). However, from the literature review, it can be noted that similar situations also exist in other countries but later on as time progress, there is an issue of contamination. Even when dealing with treated water, there is still a chance of water getting contaminated. Hence, given the increase in population, trend of development that is affecting the village, natural process such as climate influence (acid rain and saltwater intrusion) and other factors there is a high chance of water source getting contaminated. Thus, the issue of untreated drinking water needs to be given attention and addressed in the near future.

5.10.6 Unsustainable Development

Freshwater accessibility is surely affected by development. The case study areas as mentioned earlier in this chapter had in one way or the other experience some form of development. A form

of development that exists in both villages is construction and those associated with modernization. In most cases, most development projects get approved really fast in the village especially those that come in the form of aid.

As a result, most of the development projects are cleared and given the “go ahead” sign without its implication on the environment being assessed. Industries are one that contribute a lot of adverse factors to any nearby water source. Hence, in the case of Kalabu village, this is happening as it is home to some of Fiji’s large industries including the Laqere quarry, Kinoya Sewage Treatment and Power Plant, Voko industries, Garment Industries and others. The area also has a Tax Free Zone and to make matters worse, all these industries and factories are located a few meters away from rivers and streams that later make their way to the sea. This makes one wonder if there are actually laws in place to protect the environment and for this research, water.

5.10.7 Unconventional and Misuse of Water

Whilst the discussion in the preceding chapters, water will surely become scarce if individuals continue to practice unconventional and misuse water source present around them. For most people, it has become a norm to expect that water will always be there until and when a situation struck them where there is no water then only will they appreciate the value of water to life. Apart from drinking water and household use, freshwater in the case study areas is also used in the area of agriculture, flower garden, animal husbandry and other uses.

A common sight present in both villages is that agricultural activities take place along and near the river banks. Pig pens are also placed near the rivers so that waste can easily be washed away by the river. Another common view is the location of toilets near the river and it is important to keep in mind that these are rural areas and they are not connected to the sewer lines that is only present in limited locations around the city. Hence, there are high chances that this waste will end up in the river or even seep to underground water source.

Accordingly, when there is abundant water, people tend to misuse it. Water tanks or storage devices can only be seen in a few houses at Korovisilou village but can hardly be noticed in Kalabu village. There is evidence of broken and leaking water pipes where water continuously runs off. Children using the tap for hours without being supervised giving them the idea that it is

alright to practice such activities. Together with other activities, these practices can be viewed as unconventional that surely leads to the misuse of water.

5.10.8 Financial Burden

Finance is a determining factor in receiving a service. In Kalabu village, half of the household that responded to the questionnaire says that water bills are increasing. Majority of these people already have financial burden and to make matters worse, most do not have a reliable source of income. At times, water metres had to be disconnected as bills are not being paid. Water bills in Fiji come every three months and in most cases, depending on the size of the family and average water use, households ended up paying hundreds of dollars. Budgeting is not common in village life and the phrase “*kana ni kua, qai raica mataka*” (to eat or use all today and see what will happen tomorrow) seems to be present in the way most people live their life.

When asked if there are strategies in place to help reduce water bills, 52% of the household said yes but this strategy is not guaranteed to surely reduce water bills. With that in mind, water bills are not always constant, there is a large difference in the sum of money to be paid when a household has occasions and celebrations. Most of the villagers wait for the water bills to arrive on the final date and hardly anyone makes their own calculation on a timely basis (week, fortnight, month etc.) based on the metre reading in their house.

5.10.9 Lack of Investment

There is very little investment placed on freshwater and the water sector as a whole. Evidence in support of this position can be found in Korovasilou village where villagers had been without treated drinking water since they settled there. Investing in science and technology that will further improve freshwater accessibility is a need for both the case study areas since the population is increasing rapidly. Given the impacts of climate change, investment in the water sector is a need for the nation. Investors prefer to invest in areas that will give them a higher return. In Kalabu village, there is a need to replace the main water pipes where households connect their water metres too as it has shown evidence of rust that had been worn out over the years.

5.10.10 Commercialization of Natural Water Source

This issue relates to bottled water that is sold at a price. During the survey, responders from the two study areas reveal that they sometimes buy bottled water. They were then asked with the question “if water should be sold at a price” and the response from the majority was that it should not be sold at a price. Hence, they were asked to give their reason and most of them say that water is a need and everyone has the right to access it.

Interview with the people also concluded that all water sources were once a free good but due to “greed” some people place a limit on it in order to make profit. Hence, there is limited freshwater accessibility when it comes to certain location. Private institutions tend to increase water prices in order to maximize profits and in the end, it is the consumers who bear the burden to this. A factor that is worth thinking about is that, if all resources owners decide to privatize water resources present in their land, the whole country would suffer as prices would “skyrocket” and surely some people will not have clean and safe drinking water.

5.10.11 Climate Change

In addition to the above weaknesses, another issue that does affect freshwater is climate change. Climate influence the amount of water in both artificial and natural reservoirs. In Korovisilou, household revealed that they do not experience water problem but 78.4% of these households said that climate influence the supply of freshwater. In the same way, 80% of the household from Kalabu village also agrees that climate influence the supply of freshwater.

Evidently, all people are affected by climate change irrespective of their location and current water source. During the dry season, villagers noted that there is usually shortage of water especially in Kalabu village but for Korovisilou, they had noted that water flow become really slow and pressure also decreases. There are also worries that climate change will lead to sea level rise that would mean saltwater intrusion for underground water source. There are chances that if dry season persist and continue for a long time, there are danger in most reservoirs being depleted heavily as most water source feeding the reservoir will dry out.

CHAPTER 6
RECCOMENDATIONS AND CONCLUSIONS

“In an age when man has forgotten his origins and is blind even to his most essential needs for survival, water along with other resources has become the victim of his indifference”.

Rachel Carlson

6. Recommendations and Conclusions

Results have proved from the previous chapter that there are barriers existing that hinder people accessibility to freshwater. As a result these barriers deprived people from getting accesses to clean and safe drinking water. Due to that, this chapter will provide recommendations that can be adopted by the people and relevant institutions to overcome the barriers. This will be followed by a concluding remark of the research.

6.1 Solutions and Recommendations

Evidently, geographical location determines the type of water source that household will get access too. With the limited resources available with WAF, it would not be fair to ignore water service to some communities simply because of its remote location. Hence, with raw material (natural water source) readily available in most remote location the authority can include the community themselves in mitigation discussion. One will be surprised to find out that most villagers have untapped ideas and potential that can be used to provide clean and safe water supply. Most people would think as to why bring tap water to this remote location when they have rivers, streams and other natural water source, the answer is that, most of this water source have high chances of being contaminated over time. In mitigation discussion, other parties and institutions can be invited along to draft proposals on the issue and given the commitment placed by the global community on clean and safe drinking water, there is high chances that irrespective of geographical location, team work by this groups will not be in vain as clean and safe drinking water will be provided.

Population increase is not only a challenge when it comes to freshwater accessibility but in other areas of development as well. It is recommended that during census when population data is gathered, WAF and the other authorities that look into the water sector must work closely with the Fiji Islands Bureau of Statistics so that information needed from the general public related to water is all accounted for. This information that will be used by the planning authority for projections should be made in a way that population need for water should never exceed the amount of water available. A failure to provide water for the population is a failure on the part of planners that can bring chaos and loss of life. Since water affects the life of every individual, the

water authority cannot manage the issue of population growth alone. It will need the support of other organizations that specializes in different issues when it comes to dealing with population. Such organization includes the Ministry of Health who can collaborate with the Ministry of Education and the media in reaching out to the general public on means and ways of reducing population.

Managers, whether in the government or private sectors, have to make difficult decisions on water allocation. More and more they have to apportion diminishing supplies between ever-increasing demands. Drivers such as demographic and climatic changes further increase the stress on water resources. The traditional fragmented approach is no longer viable and a more holistic approach to water management is essential. This is the rationale for the Integrated Water Resources Management (IWRM) approach (Figure 49) that has now been accepted internationally as the way forward for efficient, equitable and sustainable development and management of the world's limited water resources and for coping with conflicting demands.

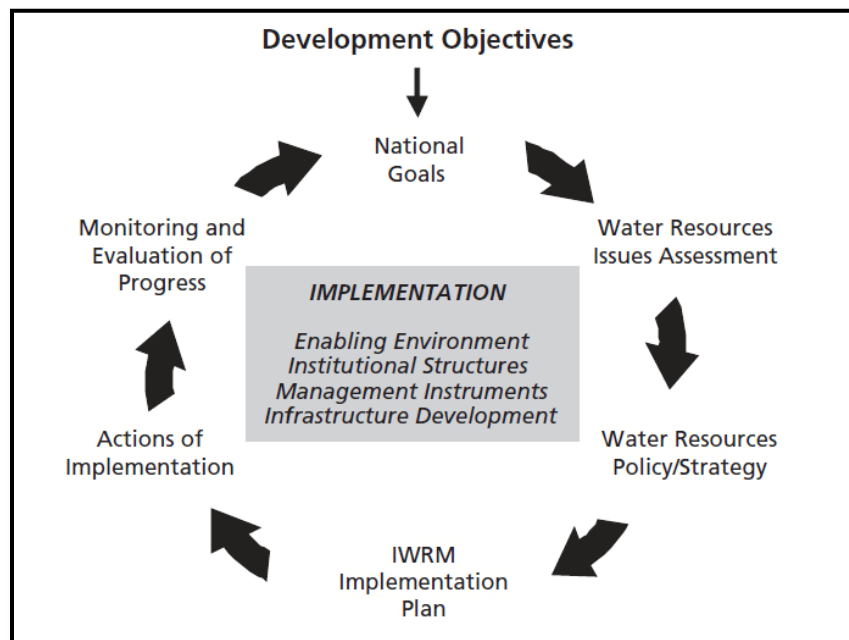


Figure 49 Water Resource Management Framework Approach (UNW, 2008)

Thus, water is only one of a number of vital natural resources and it is imperative that water issues are not considered in isolation. Through the application of GIS, isolated and rural areas that have barriers to freshwater accessibility can be identified and later actions can be undertaken.

Furthermore, it is vital that people are aware and have some knowledge on issues affecting water around them. It can be noted from the results that there is a poor representation on peoples knowledge regarding freshwater issues happening locally, nationally and globally even though majority of them have access to various media source and communication device. Such being the case, awareness and outreach must be undertaken by WAF, the government and other organizations for this isolated and rural areas to address the growing concern on issues affecting water. In the education sector, there are already curriculum in place that address issues affecting water but steps need to be taken further to ensure that students get to practice what they learn and become agents in disseminating such information to their household and communities.

Laws and policy are in place to govern the use of water. Given, the current high profile debate with regard to national growth, it is quite surprising that most of this debate has very little to do with water. This is simply due to the fact that most citizens have little knowledge and even worse no idea at all that there are laws and policy that are present to cater for both suppliers and consumers. Again, the issue of outreach and awareness is needed in this case. Translation of laws into the native language, “iTaukei” and “Hindi” to enable people to read and understand legal documents is of utmost importance in understanding steps and process of pursuing an avenue when confronted with legal issues.



Figure 50 Placing water scarcity response options within a broader policy context (FAO, 2008)

Figure 50 is an attempt to capture these different dimensions of the problem, and to acknowledge the broader environment in which a decision takes place. The supply and demand-side options

are by and large located at the level of technical planning and investment economics, but they are widely influenced by the overall context of governance, institutional framework and the policy environment.

Indeed, there is a need to ensure that all drinking water are treated and secured so that it is clean and safe to drink. There are many chemicals present in the environment that can cause contamination in water and the chance of this getting lethal is higher if water is untreated. Relevant authorities with the help of the government should monitor areas with untreated drinking water source. With the rising unsustainable development that are taking place in isolated and rural areas, water source will surely get contaminated and it is just a matter of time for the current generation to see this fear come true. A tougher law needs to be executed on the ground where water source is concerned. It is also important to note that most of the river basins are highly contaminated from various source of pollution and most of these rivers are just unsafe to be used for drinking water. Since most water ways are connected through the river basin, changes taken place in one channel affects the rest of the channel. Due to this, it is again vital that WAF and other institutions accelerate the process of bringing tap water (treated water) to isolated and rural communities that still use untreated water source.

Moreover, there is a need to find mitigation measures to prevent the unconventional and misuse of water. Water has become a scarce resource for most isolated and rural communities. Due to this, it is important that there are strategies in place for water to be conserved. Such measures are listed as follows:

- Collecting rainwater from roof gutter to be used for cleaning, washing clothes and others. As for agriculture, large drums and other water storage device can be placed at certain location also design in a way that it will collect rainwater that can later be used for crops, vegetables and other agricultural produce
- Educating children on the importance of water at an early age with means and ways of using minimal water especially if geographical location often presents a situation of water scarcity
- Fix leaking faucets since these drains out a lot of water.
- Do not let faucets run for washing or rinsing. Always fill a container with water for this purpose or use the sink by stopping the drain.

- Take shorter showers. Remember, the longer you are in the shower, the more water you use.
- Make sure that your toilet does not leak. For example, place a few drops of food coloring in the toilet tank. If the colored water appears in the toilet bowl without flushing, your toilet is leaking, have it fixed immediately.
- In case of animal husbandry, owners to ensure that animal are sheltered securely and are located further away from rivers and waterways. When cleaning the shelter and bathing animals, water has to be filled from the river or even water collected from the gutter can be used for such purpose.

Increasing financial burden is another barrier to freshwater accessibility. It is strongly recommended that WAF review the current water bill policy as to minimize the time frame it takes to pay for water bills. Majority of the rural household hardly have money to pay for daily expenses let alone budgeting for a week. If the authority could reduce the time frame from 3 months to about 1 month, then the burden of stressing over large amount of bills when it comes after 3 month will be greatly reduced. The fact is that, the value will just seem too much for most of the villagers when it comes out for this period of 3 months. Together with that, household need to develop strategies and plans that will maximize their chances of reducing their water bills. For instance, washing clothes in the river instead of the tap and even following some of the measures listed in the previous paragraph that will not only reduce water bills but will also contribute to sustainable water use.

There is a need to attract more investment in the water sector. Given the impacts of climate change and demographic issues, there should be alternative available when water shortage strike. Hence, it is vital that there are investments made by government, private institutions, organizations and individuals to encourage more means of providing water. This can be done by incorporating science, engineering, technology and other bodies that will help pave the way for new innovation in the area of water. It is important to note that the Fiji Islands is made up of various small islands that are occasionally challenged by freshwater problem, given their isolation. Therefore, this is the right time in trying to attract investors that are willing to invest in the area of water for the greater benefit of the country as a whole.

Moreover, the commercialization and privatization of natural water source needs to be reviewed closely by the present government. “Water is a need that comes directly from nature” as explained by most villagers from the two case study areas. Hence, converting it to a profit making organization is truly not acceptable. These ideas were given directly in response to bottle water that can now be found on most shelves along supermarkets and shops. This is a growing issue affecting freshwater accessibility as it limits the boundary where people can go to when they need water. If not taken seriously by the government and the people, a time will come when people will have to pay cash in order to have accessibility to a given water source. This happens largely on freshwater aquifer mostly located on native land but with attractive package, the water resources are being given away to private business that make millions of dollars from it on an yearly basis.

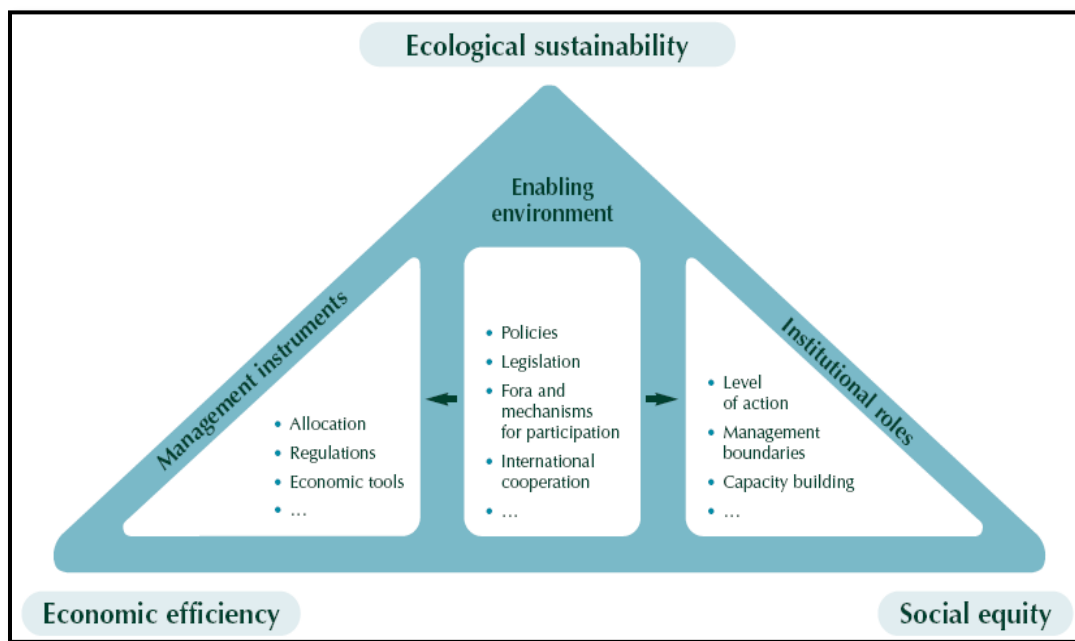


Figure 51 General framework for IWRM (GWP, 2000)

To add on, climate change also present a barrier to freshwater accessibility. Climate change had been around for many years and with that, mitigation and adaptation strategies have to be designed in order to cope with it. Hence, climate change being a broad subject requires the attention of a nation since it affects all lives and this can be approached using the IWRM general framework shown in Figure 51. Due to the environmental factor (climate change), rules had to be set by the government that include policies, legislation and other laws. It would also mean cooperation with other countries since climate change is a global issue. The rules determine and

guide the roles of institutions that will use the management instruments. However, all this depends on the existence of popular awareness and political will to act.

It is important that success stories from other local areas, regional and those from the global community are explored in overcoming the barriers to freshwater accessibility. Similar situations surely exist in other places and successful methods had been achieved to solve the problem that can also be used for the isolated and rural areas in Fiji. Diplomatic relations is vital when it comes to the exchanging of ideas and water being a need deserve all effort in getting the ideas across. Integrative mechanisms, such as collaboration, negotiation and water allocation that acknowledge interdependency between stakeholders and the environment are needed in order to sustain the region (Molle, 2007).

6.2 Conclusion

Water is a key driver of economic and social development while it also has a basic function in maintaining the integrity of the natural environment. The nature and characteristics of freshwater is such that it affects all areas of livelihood. Irrespective of geographical location, resource available and limited options that people may face, it is for sure that individuals will take any means available to satisfy their need for water. When it comes to providing water, it is not the duty of the authority alone or the government; individuals, given the available natural resources can explore means of generating clean and safe drinking water themselves. However, this does not mean that those who are involved in decision making regarding freshwater forgo a community simply because of its isolated and rural location. These decision makers have to keep trying and pushing until accessibility to freshwater is achieved and barriers eliminated for each and every communities.

Supply-side solutions alone are not adequate to address the ever increasing demands from demographic, economic and climatic pressures that are now present in almost all communities. “Grassroot” parties such as citizens themselves have to be consulted and included when it comes to dealing with barriers surrounding freshwater accessibility. Therefore, freshwater is only one of the basic needs that affect and can change the way people live without doubt. It is of utmost important that issues associated with its accessibility must not be considered in isolation. Every individual irrespective of gender, race or religion has a right to freshwater accessibility without any form of discrimination since “water is a need”.

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8. Appendix

8.1 Appendix A-Questionnaires

Freshwater Accessibility in Rural and Remote Locations of the Fiji Islands: A case study of Kalabu and Korovisilou Villages

Village: _____

Age: _____

Gender: Male Female

Note: Please tick the box where necessary

Level of Education:

- Postgraduate Diploma and Trade Certificate Primary
 Bachelor Secondary Other

Occupation:

- Agriculture Industrial Others: _____
 Commerce Government

1. How long have you been residing in this village?

- 40 - 50+ years 19 - 28years 5 - 9years Less than 1 year
 29 - 39years 10 - 18years 1 - 4years

b. Do you have any idea as who controls the supply of tap water in Fiji?

- No
 Yes (Who?) _____

2. Do you consider water being scarce or abundant in **supply** in this village (give reasons)?

- Scarce Abundant
-

3. Where does the water supply that you use for your daily livelihood comes from?

- Tap Water Rainwater Groundwater
 Surface Water (Rivers, Streams, etc.) Other Sources: _____

4. What are some other areas of your daily livelihood that involves a lot of water being used apart from those that are used in drinking; washing clothes, sanitation and cleaning eating utensils (**you can tick more than one box**)?

- Agriculture Animals Flower Garden/Backyard Garden
 Other Uses _____

5. Do you think that the water you are consuming comes from a secure place and that it is entirely safe to drink?
 Yes No not sure
6. From your experience, what contributes to the largest amount of contamination and pollution of freshwater in this village?
 Industrial Agricultural Household waste Municipal uses (sewage, effluent discharge etc)
7. a. How many rivers can we find 2km near this village?
 Only one two three four more than five not sure
- b. Does this rivers and streams belong to anyone?
 Yes No
- If yes, what is the type of ownership?
 Communally (Mataqali, Yavusa, Tokatoka etc) Individual Government Business
- c. How often do you make use of these rivers?
 More than twice a day Less than twice a day
 More than twice in a week Less than twice in a week
 More than twice in a month Less than twice in a month
 I do not use the rivers at all other reasons _____
8. Do you have to travel some distance in order to get freshwater?
 Yes No
- If yes, how far do you have to travel?
 Less than half a km More than half a km More than 1km
9. Do you think there is uneven distribution of freshwater in your village?
 Yes No
- If yes, why is there uneven distribution of freshwater?
 Due to geographical location of some household from the others
 Due to land ownership, those who own the land get access to water and restrict others from getting access
 Due to the price/water rates whereby only those who can afford gets water
 Other reasons _____
10. From your experience in this village, had there been a time where there is widespread of disease that is due to water contamination?
 Yes No
- If yes, what disease?
 Cholera Dysentery Typhoid Malaria others _____
11. What are some challenges that you face in gaining access to freshwater supply or water sources?

Finance

Distance

Pollution

Resource conflict

Others _____

12. Do you have to share your water source with other households?

Yes

No

13. a. Do you think that water bills are increasing?

Yes

No

b. Are you able to cope with your current water bills?

Yes

No

c. Approximately, how much money do you spend on water bills in a month (i.e. when the water bills comes out one or two months)?

Less than \$10

\$10 - \$20

\$20 - \$50

\$50 - \$90

+ \$100

d. Do you have a household strategy or plans on how to minimize your water bills?

Yes

No

If yes, list down this strategies and plans?

14. Do you buy bottle water?

Yes

No

If yes, how often do you buy it?

Regularly

sometimes

15. Do you think that water should be sold at a price by private organization? (Give reasons)

Yes

No

16. Does climate has any influence at all in the supply of freshwater?

Yes

No

17. Are there awareness programs and workshops organised by institutions and government organizations in the village to address the importance of freshwater and other issues associated with water?

Yes

No

18. Do you have water problems in your village?

Yes

No

If yes, how could it be addressed?

19. Taking into account all the major rivers in Fiji, do you think it is possible to provide tap water to every household in Fiji? How?
Yes No I do not know

20. Do you think that resource ownership could be a major factor that is preventing people from getting access of freshwater?
Yes No I do not know
If yes, in what ways?

21. Do you have any other comments or views regarding freshwater accessibility?

Thank you so much for your time!!!

8.2 Appendix B - Selected Analysed Data from Questionnaires

Table 41 Age of Responders in Kalabu Village

	Frequency	Percent	Valid Percent	Cumulative Percent
15.00	1	4.0	4.0	4.0
17.00	1	4.0	4.0	8.0
18.00	1	4.0	4.0	12.0
22.00	1	4.0	4.0	16.0
24.00	2	8.0	8.0	24.0
25.00	1	4.0	4.0	28.0
26.00	2	8.0	8.0	36.0
30.00	2	8.0	8.0	44.0
35.00	1	4.0	4.0	48.0
Valid 39.00	1	4.0	4.0	52.0
40.00	2	8.0	8.0	60.0
45.00	1	4.0	4.0	64.0
46.00	1	4.0	4.0	68.0
48.00	2	8.0	8.0	76.0
49.00	1	4.0	4.0	80.0
55.00	3	12.0	12.0	92.0
68.00	1	4.0	4.0	96.0
75.00	1	4.0	4.0	100.0
Total	25	100.0	100.0	

Table 42 Age of Responders in Korovisilou Village

	Frequency	Percent	Valid Percent	Cumulative Percent
	19.00	1	2.0	2.0
	22.00	2	3.9	5.9
	23.00	1	2.0	7.8
	24.00	2	3.9	11.8
	25.00	2	3.9	15.7
	26.00	1	2.0	17.6
	27.00	2	3.9	21.6
	28.00	3	5.9	27.5
	29.00	1	2.0	29.4
	31.00	1	2.0	31.4
	32.00	1	2.0	33.3
	33.00	2	3.9	37.3
	34.00	2	3.9	41.2
	35.00	4	7.8	49.0
	36.00	1	2.0	51.0
	38.00	1	2.0	52.9
Valid	39.00	2	3.9	56.9
	40.00	4	7.8	64.7
	42.00	1	2.0	66.7
	43.00	1	2.0	68.6
	44.00	1	2.0	70.6
	45.00	1	2.0	72.5
	46.00	1	2.0	74.5
	47.00	1	2.0	76.5
	48.00	1	2.0	78.4
	50.00	2	3.9	82.4
	51.00	1	2.0	84.3
	53.00	3	5.9	90.2
	56.00	1	2.0	92.2
	57.00	1	2.0	94.1
	60.00	1	2.0	96.1
	62.00	2	3.9	100.0
	Total	51	100.0	100.0

Table 43 Level of Education in Kalabu Village

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Other	3	12.0	12.0	12.0
Primary	6	24.0	24.0	36.0
Secondary	13	52.0	52.0	88.0
Diploma and Trade Certificate	3	12.0	12.0	100.0
Total	25	100.0	100.0	

Table 44 Level of Education in Korovisilou Village

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Primary	9	17.6	17.6	17.6
Secondary	25	49.0	49.0	66.7
Diploma and Trade Certificate	15	29.4	29.4	96.1
Bachelor	2	3.9	3.9	100.0
Total	51	100.0	100.0	

Table 45 Occupation of responder in Kalabu Village

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid Agriculture	1	4.0	4.0	4.0
Commerce	1	4.0	4.0	8.0
Industrial	3	12.0	12.0	20.0
Government	1	4.0	4.0	24.0
Others	19	76.0	76.0	100.0
Total	25	100.0	100.0	

Table 46 Occupation of responder in Korovisilou Village

	Frequency	Percent	Valid Percent	Cumulative Percent
Agriculture	14	27.5	27.5	27.5
Commerce	2	3.9	3.9	31.4
Industrial	12	23.5	23.5	54.9
Government	9	17.6	17.6	72.5
Others	14	27.5	27.5	100.0
Total	51	100.0	100.0	

Table 47 Gender of Respondents in Kalabu Village

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	14	56.0	58.3	58.3
Female	10	40.0	41.7	100.0
Total	24	96.0	100.0	
Missing	99.00	1	4.0	
Total	25	100.0		

Table 48 Gender of Respondents in Korovisilou Village

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	28	54.9	54.9	54.9
Female	23	45.1	45.1	100.0
Total	51	100.0	100.0	

Table 49 Period responder stayed in Kalabu village

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1-4 years	2	8.0	8.0	8.0
5-9 years	1	4.0	4.0	12.0
10-18 years	3	12.0	12.0	24.0
19-28 years	5	20.0	20.0	44.0
29-39 years	3	12.0	12.0	56.0
40-50+ years	11	44.0	44.0	100.0
Total	25	100.0	100.0	

Table 50 Period responder stayed in Korovisilou village

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid 1-4 years	1	2.0	2.0	2.0
5-9 years	1	2.0	2.0	3.9
19-28 years	12	23.5	23.5	27.5
29-39 years	16	31.4	31.4	58.8
40-50+ years	21	41.2	41.2	100.0
Total	51	100.0	100.0	