

**WATER SCARCITY IN SMALL ISLAND COMMUNITIES: A CASE
STUDY OF YANUCA VILLAGE, FIJI ISLANDS**

by

Anne Geneviève Takako Hammill

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Dr. S.C. Lonergan, Supervisor (Department of Geography)



Dr. S. Tyler, Departmental Member (Department of Geography)



Dr. N. Turner, Outside Member (School of Environmental Studies)



Dr. M. McMahon, External Examiner (Department of Sociology)

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University of Victoria

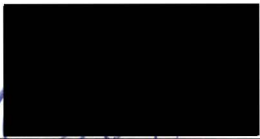
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Supervisor: Dr. Stephen C. Lonergan

ABSTRACT

While biophysical conditions play a role in determining water scarcity, so too does human activity. Although this study highlights both aspects of water scarcity, emphasis is placed on examining the social processes contributing to its occurrence in a small island rural community in Fiji. Specifically, this study examines the processes that influence how water (and scarcity) is managed in Yanuca Village through a detailed description of local water use patterns and the views and experiences of ten village women. In so doing, this research reveals that scarcity in part persists because of the way in which Yanuca Village chooses to respond to/manage (or not respond to/manage) the problem. The periodic and unpredictable nature of local scarcity, coupled with existing surface water sources, have encouraged the development of adaptive management measures which enable villagers to meet their immediate needs during dry periods. When added to a reliance on external assistance, an adherence to tradition, and gender differences within the village, the incentive and ability of the community to successfully adopt mitigation strategies is challenged.

Examiners:


Dr. S.C. Lonergan, Supervisor (Department of Geography)


Dr. S. Tyler, Departmental Member (Department of Geography)


Dr. N. Turner, Outside Member (School of Environmental Studies)


Dr. M. McMahon, External Examiner (Department of Sociology)

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A NOTE ON THE FIJIAN LANGUAGE

Rule	Example
B is pronounced “mb”, as in num <u>b</u> er	Labasa = <i>Lambasa</i>
C is pronounced “th”, as in <u>th</u> ere	Yanuca = <i>Yanutha</i>
D is pronounced “nd”, as in lan <u>d</u>	Nadi = <i>Nandi</i>
G is pronounced “ng”, as in sin <u>g</u> er	Degei = <i>Ndendgei</i>
Q is pronounced “ngg”, as in lin <u>g</u> er	Beqa = <i>Mbengga</i>

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CHAPTER 1

INTRODUCTION

1.1 SCOPE OF THE STUDY AND RATIONALE

Water scarcity is not a phenomenon popularly associated with small tropical islands. Whether it is the islands of the Caribbean, Mediterranean or the South Pacific, the very definition of an island (a tract of land, smaller than a continent, surrounded by water) suggests sufficient, if not bountiful supplies of water for its inhabitants. When I decided to focus my Master's thesis on water resource problems in the Pacific Islands, namely Fiji, I was met with confused looks and questions like, "what possible water problems could there be on a humid tropical island?" or "how can something that is surrounded by vast stretches of ocean be water scarce?" In this thesis I address these questions through a case study of water scarcity in Yanuca Village, Fiji Islands. As a lushly vegetated volcanic island located in close proximity to the mainland and receiving between 1397 and 2540 mm of rain annually, Yanuca seems an unlikely candidate for water scarcity. However, as this study shows, scarcity can occur in any type of environment and at any level of supply, as it is a relative concept describing the relationship between demand for the resource and its availability (Abrams 1997). While biophysical conditions play a role in determining the availability and consumption of water, so too does human activity. For this reason, water scarcity is partly a "social construct", a product of "affluence, expectations and customary behaviour" (Winpenny 2000:2).

The water situation in Yanuca Village highlights this multi-dimensional nature of water scarcity, demonstrating how biophysical and socio-cultural characteristics converge to create conditions of inadequate water supply. While I address the biophysical conditions contributing to water scarcity, the primary focus is on the social processes operating under these prevailing physical conditions that contribute to the problem. Specifically, I examine the processes that influence how water is managed in the village, and how this management can lead to – and perpetuate – conditions of scarcity. A characterization of these processes is developed through a combination of my own observations in the village and an examination of lay perceptions. Addressing the latter, understanding and

representing the views of those individuals and groups affected by water scarcity ultimately helps to explain the causes of and responses to the problem (McDaniels, Axelrod and Slovic 1996). Identifying both aspects of the issue – i.e., its perceived causes and responses – is important, because the way in which a social entity chooses to respond to or manage scarcity can exacerbate its occurrence, thereby allowing it to persist. Moreover, the views of those most directly involved in the daily management of water resources offer a unique insight into the problem being studied. In most small island rural communities, women are recognized as the primary resource users and managers. Thus, in order to understand how conditions of water scarcity are shaped and why they persist in Yanuca Village, the views and experiences of women villagers are examined.

A qualitative research process was used in examining women villagers' perceptions of local water resource problems using a case study design where detailed, in-depth data was collected through: 1) documentation (reports, studies, theses, etc.); 2) archival records (routinely gathered information such as census data, health records, etc.); 3) direct observation; 4) participant observation; 5) household water use surveys; and 6) semi-structured interviews with villagers exploring the perceived causes, effects, and responses to water resource problems. As stated previously, the study was carried out in Yanuca Village, Fiji over the course of two separate field seasons (August – December, 1999 and August 2000 – January 2001). Upon developing an interest in water resource issues on small islands, I decided to focus my research in Fiji for a number of logistical reasons, such as financial considerations and accessibility (i.e., there are more flights traveling to and from the country on a regular basis). Also, with the University of the South Pacific located in Suva, I was able to receive some institutional support for my research activities. Yanuca Village was selected as the case setting after a serendipitous excursion to the island where I learned about local water problems by talking to villagers and employees at one of the surf camps. I subsequently returned to examine how and in what ways water scarcity was experienced and understood by village women.

In this chapter, I present the purpose, objectives, and questions of this study on water scarcity. I then introduce the regional setting for this case study through a brief discussion of the Pacific Islands, and in particular the Fiji Islands. I conclude by summarizing the organization of the thesis.

1.2 PURPOSE, OBJECTIVES, AND QUESTIONS

The purpose of this study was to attain a more comprehensive understanding of the social factors and processes shaping water use and perceptions of water scarcity through an in-depth look at the views and experiences of women in Yanuca Village, Fiji Islands. In order to achieve this understanding, I devised three major research objectives and associated questions, outlined in Table 1.2.

Table 1.1 Research objectives and questions

Research Objective	Data Required/Questions	Data Source
1. Review the concept of water scarcity and its application to small islands	What is water scarcity? What are the factors and conditions that lead to water scarcity? What are the unique features of small islands that create conditions of scarcity?	Literature Secondary sources
2. Develop a general overview of the water resource situation in Yanuca Village, Fiji Islands	What is water used for on a daily basis? Where is it obtained from and how? What is household water consumption like? What are some of the water-related problems?	Interviews Household water survey Observations
3. Examine the factors shaping water scarcity in Yanuca Village	What is the nature of water scarcity in the village? What are the perceived causes (physical and social) of local water scarcity? What are the effects? Responses? Potential solutions? Why does scarcity persist?	Interviews Observations Secondary sources

The conceptual framework for this thesis is provided through an overview and discussion of the concept of water scarcity (Research Objective 1). Because it is a relative concept shaped by a wide range of environmental and cultural factors, particular attention is paid to scarcity issues on small tropical islands. While such islands exhibit a diverse range of physical and social characteristics that preclude too many generalizations, there are a number of common features which distinguish them from other types of environments and societies, and which have particular application to this study. The second Research Objective consists of developing a general overview of the water resource situation at the study site, Yanuca Village. This includes identifying the sources, collection, and uses of water in the everyday lives of villagers, as well as some of the water-related problems they experience. Following this, the third Research Objective involves a closer examination of one of these water-related problems in Yanuca Village, water scarcity. Drawing from the information gathered for the first two Research Objectives, this research explores the circumstances that have shaped scarcity in the village by looking at the perceived causes, effects, and responses to the problem. The first two objectives are concerned with providing a sufficient background and context within which to achieve the third objective. Thus, the third objective represents the overall aim of the thesis.

1.3 INTRODUCING THE SMALL ISLAND CONTEXT AND REGIONAL SETTING

In order to begin framing this study, I briefly discuss the unique and often interrelated characteristics of small islands and the humans occupying them¹. They cannot be treated as mini-continents surrounded by ocean, for they do not share the characteristics and problems of continental land masses. Rather, they are physically, demographically and economically different. Limited surface areas, geographic isolation, and susceptibility to natural disasters translate into fragile ecosystems and limited natural resources (arable land, freshwater, extractable minerals, and energy sources) (UNEP 1998). Moreover, for its human occupants, isolation and the widespread nature of many of their territories

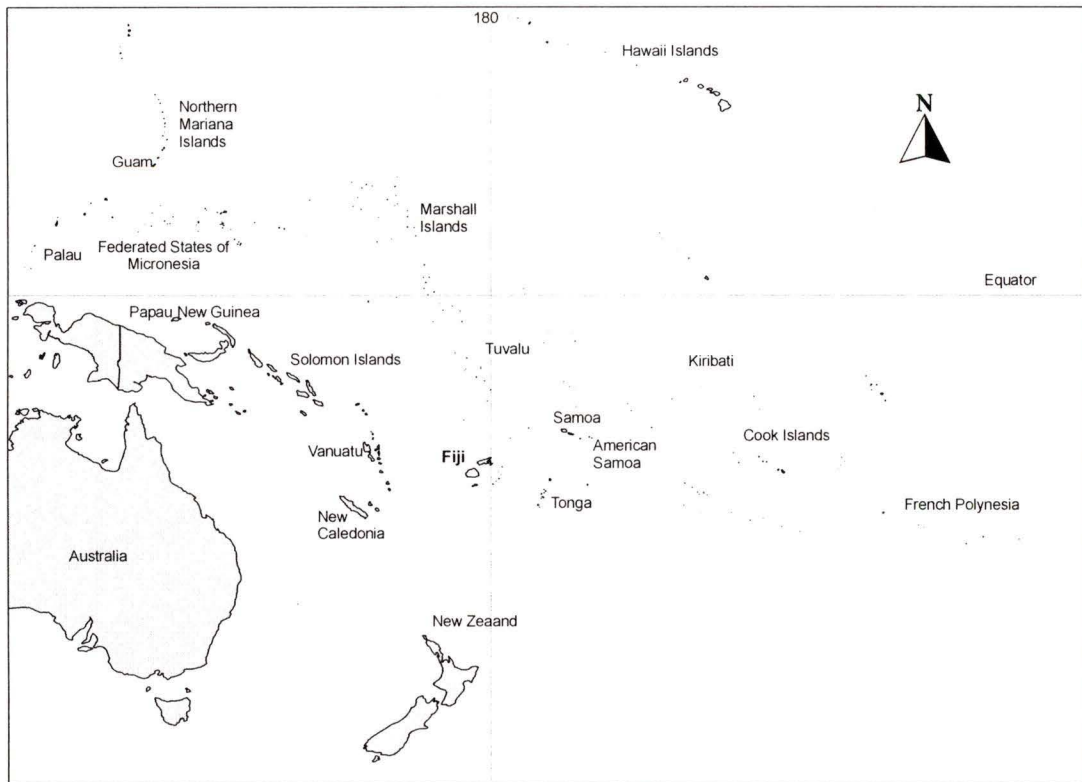
¹ The use of the terms 'small island' and 'very small island' is in accordance with the definitions provided by UNESCO whereby a 'small' island is one whose total area does not exceed 2,000 km² or where the width is no greater than 10 km, and a 'very small' island has an area no greater than 100 km² or a width no greater than 3 km (Falkland 1991).

contributes to difficulties of transportation, communication, and administration. Combined with high population densities and – in most cases – developing economies, small islands are biophysically and socially vulnerable to environmental changes and the vagaries of a globalized economy.

The estimated 30,000 islands that dot the Pacific basin have long been a source of human fascination and wonderment (Stanley 1996). Tales of unique customs, crafts and social relations have captured people's imaginations for centuries. Accompanying these engaging human histories have been descriptions and depictions of diverse and magnificent island landscapes and environments. The Pacific Islands region² is considered to be a site of 'lasts' – last to be settled by humans, last to be colonised, and last to be decolonised. There are just over 6 million inhabitants in the Pacific Islands region speaking some 1,200 languages (Stanley 1996). With such diversity, generalisations about the region are not easy to make.

The South Pacific (Figure 1.1) provides the regional setting for this study, and almost at the centre of this region are the Fiji Islands, where the research for this thesis was conducted. The following section provides a cursory look at Fiji's physical geography and society. It ends with a discussion of the freshwater resources and activities in the country.

² For the purposes of this thesis, the term 'Pacific Islands' or 'the Pacific Islands region' refers to the island states and territories in the North and South Pacific. These terms are less inclusive than the concept of Oceania, which generally incorporates Australia, New Zealand and all of the insular areas between the Americas and Asia (Henningham 1995).



Source: Department of Geography, University of the South Pacific (2000).

Figure 1.1 Map of the South Pacific region

1.3.1 The Fiji Islands

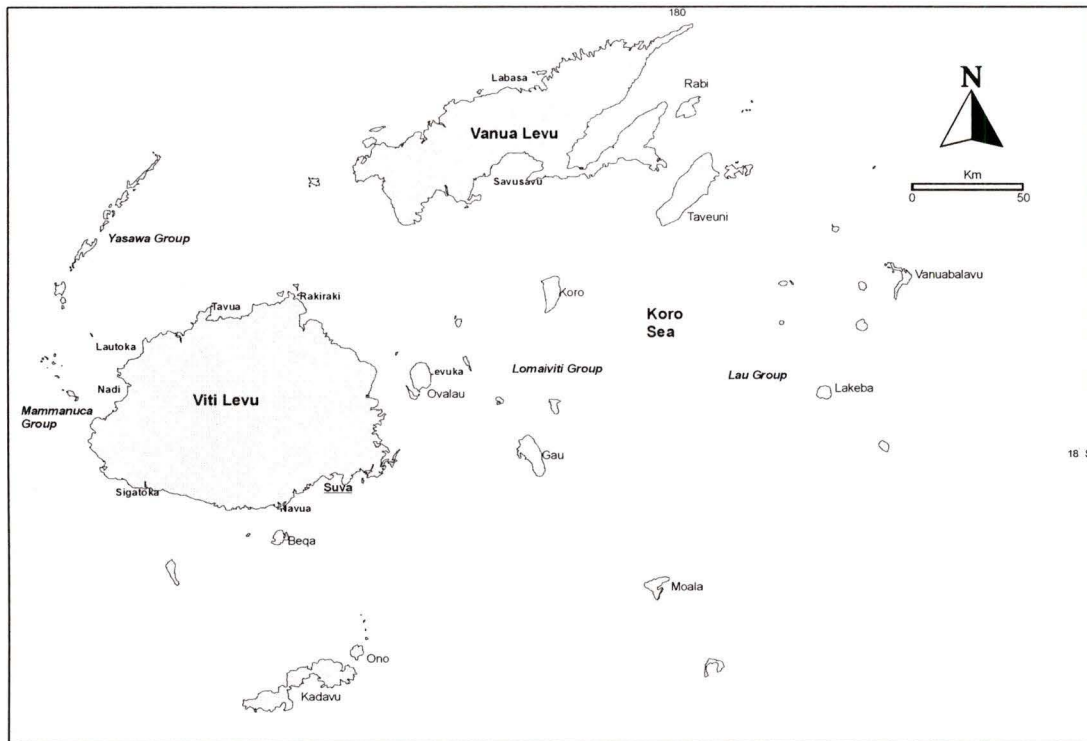
Table 1.2 Fiji at a glance

Area: 18,272 km ²	GNP per capita: US\$ 2,210
Population: 775,077 (1996)	Agriculture (% of GDP): 18.9
Population Density: 42.2/ km ²	Industry (% of GDP): 30.7
Urbanization: 46.4%	Services (% of GDP): 50.4

Physical Geography

Situated in the tropical southwest Pacific Ocean about 3,150 km northeast of Sydney, Australia, Fiji is an archipelagic nation comprised of 322 islands and islets, the vast majority of which are located between longitudes 176° 50'E and 178°W and latitudes 16°S and 20°S (Figure 1.1). Approximately 100 of Fiji's islands are permanently inhabited while the remainder are either prohibitively isolated or devoid of freshwater.

With a total land area of 18,272 km² scattered over 1,290,000 km² of ocean, the proportion of land to water is 13% (Simpson, Kumar and Raj 1994).



Source: Department of Geography, University of the South Pacific (2001)

Figure 1.2 Map of the Fiji Islands

Most of the islands in Fiji are of volcanic origin, remnants of a sunken continent that stretched through Australia (Stanley 1999). The smaller, outer islands exhibit a range of geologic compositions from mostly volcanic with small amounts of limestone, to entirely limestone islands such as those in the Lau Group (Rahiman 1993; Rao 1992). A diverse range of landforms and seascapes are found across the archipelago, including dense marshy forests, undulating coastal hills, lowland plains, mountainous ranges, fringing and barrier reefs, lagoons, and sand dunes. This diversity in landscape has translated into an impressive array of flora and fauna. Nonetheless, it is the reefs and surrounding open water that possess the country's richest store of life.

The tropical climate is controlled by southeast trade winds, which prevail from June to October. There are no great variations in temperature, with annual averages ranging from 20.2°C in the cooler interior highlands of Viti Levu to 27°C in Rotuma, which is situated

12 degrees south of the equator (Stanley 1999). Most of the rain falls during the summer months (December to April), which is also the season most prone to tropical storms and hurricanes. The eastern and southeastern portions of the large islands – the windward sides – receive 3,000 mm of annual rainfall along the coast and up to 5,000 mm inland. The drier leeward sides of the islands in the northwest get only 1,500 to 2,000 mm of rain a year (Simpson, Kumar and Raj 1994; Stanley 1999; Wickman 1984).

History and Society

The first people to reach Fiji's shores three and a half thousand years ago were probably Polynesians who originated in insular Southeast Asia. Joined approximately one thousand years later by Melanesians, the two culture groups blended to create the Fijian race. Indigenous Fijians bear a physical resemblance to Melanesians but maintain Polynesian cultural affinities (Stanley 1999).³ Thus, it is for this reason that the islands of Fiji are viewed as a transitional zone between these two culture groups in the Pacific Islands region. Pre-European society was characterised by a rich material culture and constant state of civil strife, where treachery and cannibalism were an intrinsic part of feudal struggles. In 1643, the Dutch navigator Abel Tasman became the first European to discover Fiji, as he searched for the great southern continent *terra australis incognita*. However, it wasn't until Capt. William Bligh's excursions after the 1789 mutiny on the ship *Bounty* that Europeans got a more accurate picture of Fiji (Fiji Government 1998). After the discovery of sandalwood by shipwrecked sailors in the early 19th century, a rush of traders and beachcombers arrived on the islands, changing the pattern of traditional Fijian life. Lawlessness and inter-tribal wars escalated as organized trade and foreign influences became more prominent, prompting leaders to cede Fiji to Britain on October 10th, 1874.

Fiji remained a British colony for nearly 100 years, regaining independence on October 10th, 1970. The era of colonial rule left an indelible mark on Fijian society as measures were put into place to protect communal land (upon which the chiefly system was based)

³ Like Polynesians, Fijians have hereditary chiefs, patrilineal descent, a fondness for elaborate ceremonies, and a relatively homogeneous language and culture (Olivær 1989; Stanley 1999).

and native lifestyles. Native land was deemed inalienable communal land that could be leased, but never sold, while indentured Indian workers were recruited to work on the prosperous sugar plantations. Today, 83% of Fiji's land is owned by indigenous Fijians, while the remaining 17% is either privately owned "freehold" land or Crown land (Stanley 1999). Such land rights have enabled indigenous Fijians to preserve their cultural heritage and provided them with a certain degree of economic security. Approximately 30% of native-owned land is leased, mostly to Indian sugarcane farmers descended from the original indentured labourers. Land rights remain a contentious issue in Fiji as many of the leases are expiring and Fijian clans are saying they want their land back to farm it themselves. By 2005, more than 5,000 leases will have expired and the potential social and economic fallout of this situation has become the most important issue in Fijian politics.

Fiji's multicultural society is one of colonialism's most important legacies. With a population of 775,077 (1996 Census estimate), Fiji is the second most populated country of the Pacific Islands, after Papua New Guinea. Almost half (44%) of the total Fijian population is made up of Fiji Indians or Indo-Fijians, who are concentrated in the cane-growing regions of the islands and live in isolated settlements, although a large proportion are now living and working in urban areas. Most indigenous Fijians live in villages along the rivers and the coast and are each led by a hereditary chief. Traditional systems of organization are hierarchical, patrilineal, and richly ceremonial. Land is communally owned but individually worked, and most rural Fijians lead subsistence lifestyles based on fishing and farming. Other ethnic groups in Fiji include Europeans, Chinese, Polynesians, and Micronesians. Fijian is the official language, although English is spoken by almost everyone. Hindustani or Hindi is the household tongue of most Indo Fijians. Representation of Fiji's different ethnic groups in the national government has been another source of tension, with the demand for the 'paramountcy of Fijian interests' leading to two coups in 1987 and another one in May of 2000 (Sutherland 1998).

Economy

Fiji's relatively diverse economy is based on tourism, sugar production, garment manufacturing, gold mining, timber, commercial fishing, and the export of coconut products such as copra (CIA 2000; Stanley 1999). While Fiji still possesses a large subsistence sector, it is one of the most developed economies in the Pacific Islands region. Even so, the relatively recent devaluation of the dollar, high unemployment, a 30% trade imbalance, and continued dependence on foreign aid are hindering Fiji's competitiveness in the globalized economy.

Water Resources in Fiji

The average annual renewable freshwater resources in Fiji is estimated at 28.6 km³/yr (Gleick 1998). Comprised of both renewable surface and groundwater supplies, this figure represents the average freshwater resources in the country. For comparison purposes, Canada's average annual renewable freshwater resources is 2,901 km³/yr. Table 1.2 presents a summary of water use data in both Fiji and Canada, highlighting differences between regions and sectors.

Table 1.3 Summary of water use in Fiji and Canada (total and across sectors)

Country (Area km²)	Total Freshwater Withdrawal (km³/yr)	Per- Capita Withdrawal (km³/yr)	Domestic Use m³/p/yr (%)	Industrial Use m³/p/yr (%)	Agricultural Use m³/p/yr (%)
Fiji (18,272)	0.03	37	7 (20)	7 (20)	22 (60)
Canada (9,970,610)	42.20	1,752	193 (11)	1,402 (80)	140 (8)

Source: Gleick 1998.

In Fiji, the central government is responsible for water supply, sewerage, and hydrological activities. These obligations are met through the Public Works Department (PWD), operating under the Ministry of Works and Energy. The Department employs a

combination of local staff and expatriate contract workers. The capital costs of new development projects, operation, and maintenance are part of the government's annual budget. However, there is also a substantial amount of overseas aid funding contributing to such efforts.

The different sizes and types of islands that make up Fiji's archipelago determine the sources of freshwater available for development and consumption. Cities and towns are situated on the two largest islands and draw much of their water from surface sources (catchments and rivers), although a small portion of the reticulated supply comes from groundwater (CSC 1984; Simpson, Kumar and Raj 1994). All metered supplies are treated to meet (or exceed) WHO Guidelines on water quality. Some peri-urban and rural areas are also connected to the public supply, although the water systems are much simpler in design. Approximately half of Fiji's population resides in small rural communities, often remote and difficult to access. In such communities, metered water supplies operated by the PWD are usually impracticable. In these situations, especially on small islands, ground water is used conjunctively with roof catchments and existing surface sources (Simpson, Kumar and Raj 1994). Since 1965, the government has assisted these rural communities in developing basic water supplies through a subsidised self-help programme. These supplies are largely operated and maintained by the local community. As a result, standardized treatment is not provided for such supplies and water quality may fluctuate considerably "because of such factors as rainfall and the degree of communal interest in the scheme" (CSC 1984:7). Legislation for PWD's water supply activities is provided by the by laws of the Water Supply Act (1955) (CSC 1984).

1.4 ORGANIZATION OF THE THESIS

The preceding sections have provided a brief overview of the issues and questions that will be addressed in this thesis, as well as an introduction to the broader setting of the study. Having presented a brief overview of the topic under study, in Chapter 2 I discuss the conceptual framework of this thesis by examining the meanings, causes, and management measures associated with water scarcity. This discussion also applies these various components of water scarcity to the small island context. In Chapter 3, I

introduce and describe the physical and social characteristics of the case setting, looking at the physical geography, history, and socio-economic characteristics of Yanuca Village. The methodological framework for this study is discussed in Chapter 4, which includes a summary of the rationale for adopting a qualitative case study approach as well as the specific data acquisition methods employed during my two field seasons in Fiji, and especially my stays in Yanuca Village. This chapter also addresses the methodological concerns of researcher subjectivity and potential research limitations through an anecdotal account of my living arrangements and experiences in the village. Chapter 5 presents the empirical results of my research, including an overview of the local water resource situation, findings from household consumption surveys, and the themes generated from my analysis of semi-structured interviews with village women. These themes serve to highlight the views and experiences of women villagers in understanding and dealing with water scarcity. In Chapter 6, I discuss what these case results demonstrate about the various aspects of water scarcity. The concluding chapter, Chapter 7, summarizes the empirical results and theoretical implications of this thesis, and offers suggestions for future research.

CHAPTER 2

CONCEPTUAL FRAMEWORK

2.1 INTRODUCTION

The primary goal of this study is to develop a more comprehensive understanding of water scarcity in Yanuca Village through an examination of the views and experiences of some of the women villagers. Because the questions asked in this study are guided by the concept of water scarcity, an in-depth discussion of its meaning and various components is necessary. In this chapter, I examine the definition, causes, and response measures associated with water scarcity, with particular attention paid to the unique circumstances presented in small island contexts. In so doing, I reinforce the belief that water scarcity is a complex and dynamic concept conditioned by a wide range of physical and social factors. Moreover, this chapter traces the theoretical shift in understanding water scarcity as a natural resource shortage to viewing it as a socially constructed problem. By recognizing and identifying the role of social processes in creating scarcity, the approaches to understanding and addressing it are greatly expanded. Thus, the conceptual framework outlined in this chapter has informed my choice of research methods, analytical approaches, and overall understanding of the gathered data, that are presented in later chapters. Through the findings and results of this case study, in turn, I also seek to reflect and enlighten the explanation of water scarcity. Figure 2.1 depicts the ensuing two-way research process characterized by the relationship between the conceptual framework and the selected case study.

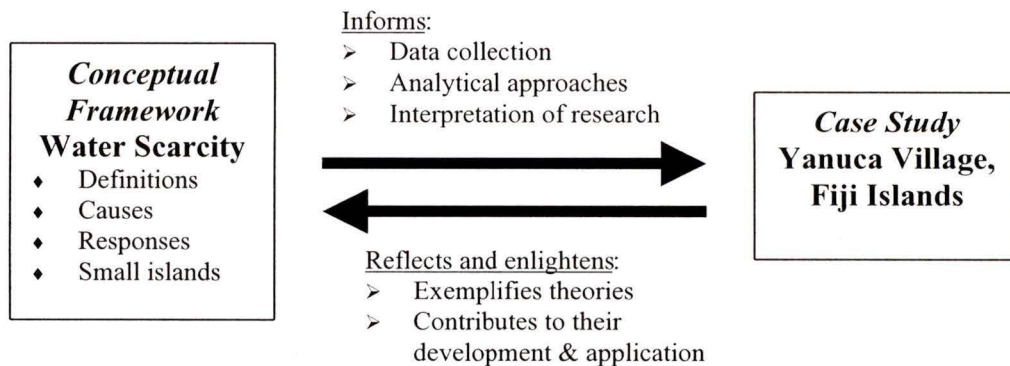


Figure 2.1. Schematic representation of the relationship between the conceptual framework and the case study

This chapter is divided into three sections. The first examines the shifting meaning of water scarcity and establishes a working definition for the purposes of this study. The next section describes the various causes of scarcity, highlighting both its physical and social determinants, with emphasis placed on the latter. In order to demonstrate the relevance of these issues to this study, I highlight their application to small island contexts. Following this, I outline some of the response measures that have been developed in managing water scarcity, again with particular mention of some of the strategies and issues associated with small islands. This then sets the stage for Chapter 3, which describes the specific case setting, and therefore the localized context of water scarcity.

2.2 WATER SCARCITY: DEFINITIONS

The most common usage of the term ‘water scarcity’ refers to a situation where there is insufficient water in a useable condition to satisfy normal requirements (Falkenmark and Lundqvist 1998; Warner 2000; Winpenny 2000). This seemingly straightforward definition is subject to many interpretations and debates as it is a relative concept difficult to capture in single indices. What is meant by ‘insufficient’, ‘useable’, and ‘normal requirements’? These are all terms that are qualified by context, as what is deemed sufficient by a particular social entity may be insufficient for another. The word ‘useable’ also reveals scarcity not only as a function of quantity, but of quality as well. A community living with an abundant supply of polluted water is just as water scarce as a community experiencing a physical absence of the resource. Winpenny (2000) further highlights the relative nature of the term by arguing that there are degrees of water scarcity, varying from absolute, life threatening, seasonal, temporary, and cyclical. Moreover, the distinction between ‘blue water’ and ‘green water’ demonstrates the multiplicity of water perceptions, thereby compounding efforts towards conceptual clarity (Cosgrove and Rijsberman 2000; Falkenmark and Lundqvist 1998; Lunqvist, Falkenmark and Ohlsson 2000).⁴

⁴ ‘Blue water’ is defined as the renewable water resources available in streams, lakes and aquifers, which constitute the main source for human withdrawals. ‘Green water’ is soil water– the main source of water for natural ecosystems and rainfed agriculture (Cosgrove and Rijsberman 2000).

Also contributing to the confusion in defining water scarcity is the common misuse of the term, where it is employed interchangeably with the terms water shortage and water stress. Water shortage is concerned with water availability and describes an absolute resource shortage where certain defined minimum requirements are not met (Abrams 1997). The actual measure of a per capita minimum may vary between places. The Food and Agriculture Organization (FAO) has provided a starting point for establishing a benchmark level, suggesting that annual levels of internal water availability of less than 1000 m³/capita pose a severe constraint on socio-economic development and environmental protection (1993). Water stress, on the other hand, is the symptomatic consequence of scarcity or shortage which may manifest itself as increasing conflict between users, declining standards of service and reliability, crop failure, food insecurity etc. (Abrams 1997; Winpenny 2000). While water shortage, water stress and water scarcity are all obviously interrelated, they also possess practical distinctions.

For the purposes of this study, water scarcity is concerned with the imbalance between supply and demand, or availability and consumption patterns, under prevailing physical and social circumstances. Because demands are taken into account, scarcity can occur at any level of supply, not only under conditions of absolute water shortage. Populations characterized by high levels of consumption may experience scarcity more readily than those who are accustomed to using much less water. While a benchmark level of 1000 m³/capita may be a useful comparative tool, it is not necessarily illustrative of scarcity conditions, or lack thereof. For example, Tunisia, Algeria, Kenya and Rwanda are all characterized by availability levels less than 1000 m³/capita, but current water use levels fall well below this supposed threshold. Thus, it is more useful to describe and determine water scarcity through qualitative approaches rather than adopting quantitative figures and indicators. As a condition determined both by availability and use, both of which are determined by a large number of factors, the point at which water scarcity occurs may vary widely between different countries and regions, seasons and years (Abrams 1997; Gleick 1993; Lundqvist and Gleick 1997; Young, Dooge and Rodda 1994).

2.3 CAUSES OF WATER SCARCITY

One approach to understanding a problem or phenomenon is to examine its causes. The complexity of water scarcity is therefore demonstrated by its multiplicity of causes, which are both natural (hydroclimatic) and anthropogenic in origin. In some cases, the impact of natural processes can be exacerbated by human responses (Winpenny 2000). For example, humans can alter the environment in such a way that water availability decreases, or populations may increase demand so that consumption outstrips the amount of naturally available water. Thus, the various causes of scarcity can operate independently or in conjunction with one another, which only serves to problematise our understanding of its occurrence. Falkenmark (1992) offers a useful framework for analysing the causes of water scarcity by distinguishing four different modes of its occurrence, which are presented in Figure 2.2.

Table 2.1. Falkenmark's four modes of water scarcity

Type A: <i>Aridity</i>	Evaporative demand > rainfall	}	Hydroclimatic
Type B: <i>Erratic rainfall</i>	Rainfall patterns leading to recurrent dry spells and drought years		
Type C: <i>Disturbed permeability of soil surface</i>	Reduced recharge and altered flows	}	Human-induced
Type D: <i>Increased population pressure on finite sources</i>	Too many people per flow unit of available water		

By differentiating between causes that are hydroclimatic in origin and those that are human-induced, scarcity can be created through both natural and anthropogenic processes. This section expands upon Falkenmark's framework by discussing in greater depth the varied causes of water scarcity, including an elaboration of the different modes or types presented above and their particular application to small island contexts. While these modes offer a practical means of classifying the origins of water scarcity, they do

not necessarily reveal the potential complexity of the problem. Rather, they are largely deterministic in nature and overlook some of the less definable social processes that cause scarcity. These processes, which are often inter-related and not easily discerned, will also be discussed in this section, as they help to explain the social construction of water scarcity.

2.3.1 The Natural Determinants

Although water is one of the most abundant resources on Earth, less than one percent is reliably available for human consumption (FAO 1993). The physical determinants of this water availability include hydroclimate, geology, topography, soil conditions, and vegetation cover (Falkenmark 1992; Falkenmark and Lundqvist 1998; Falkland 1991; Gleick 1993; Hirji 1999; Young, Dooge, and Rodda 1994). In other words, the quantity, distribution, and overall occurrence of water resources independent of human association result from the interaction between climate and Earth surface characteristics. The environmental features that characterize different regions of the world have led to an unequal distribution of water, with some areas experiencing an absolute or 'genuine' water scarcity. Falkenmark (1992) characterises these areas, typically located in the dry-climate tropics and subtropics, as either arid (Type A scarcity) or drought prone (Type B scarcity). In countries with limited supplies of water (such as those in Africa and the Middle East), development of new resources is usually prohibitively expensive or practically impossible (El Quosy 2000). In such cases, it could be argued that water scarcity has its roots in water shortage (Winpenny 2000).

Natural Determinants in Small Island Environments

Referring to the unique physical environments of small islands, limited water supplies are not normally associated with places like Fiji. As small and oftentimes remote land masses surrounded by vast stretches of ocean, small tropical islands would seem to be in a much more favourable position for meeting water needs than the aforementioned desert regions of Africa or the Middle East. Lush and bountiful depictions endorsed through the popular media and by the tourism industry have certainly contributed to this illusion. However, in actuality, some of the unique physical features so often associated with

paradisaal notions of small tropical islands render many of them prone to conditions of water scarcity. Characteristics such as small sizes, geologic and orogenic complexities, isolated locations, and tropical climates determine freshwater occurrence on these islands (Depledge 1996; Falkland 1991; UN 1989; UNEP 1998).

Owing to their limited surface areas, the total amount of rainfall captured by small islands is restricted. The smaller the island, the less likely it is for a permanent surface water scheme to exist – i.e. rivers, lakes and streams. Furthermore, smaller surface areas translate into reduced total recharge of a fresh groundwater body. Precipitation that is captured is often lost to evapotranspiration and runoff (UN 1989). Groundwater is not necessarily available on small islands either, as the turnover time is short. As a result, freshwater lenses and perched aquifers can rapidly deplete during dry seasons (Falkland 1991). The thickness of the freshwater lens depends on both the width of the island as well as the permeability of the rock formation where the wider the island and the higher the rock permeability, the thicker the lens. On high islands, topographical and hydrological conditions conducive to significant natural water storage capabilities seldom exist. For low-lying islands (usually limestone), the capabilities for large-scale surface storage are even less likely.

Small tropical islands exhibit a wide array of geological characteristics, determined by their composition and origin (Dahl 1984; Depledge 1996; Falkland 1991). In the Pacific region, they range from ancient continental islands of mixed rock types, to more recent volcanic islands, to limestone (calcareous) islands such as raised or coral atolls. Generally speaking, volcanic rocks of high islands do not form good aquifers, and in the few cases where porous rocks do occur, ground water can only be reached through deep drilling (UN 1989). Ground water that can be located at shallow depths is typically located close to shorelines where there is a risk of saltwater intrusion. Water resources on volcanic islands can be obtained from roof catchments (rainwater tanks), streams and springs, hand dug wells, boreholes, infiltration galleries, and skimming tunnels (UN 1989). For limestone islands, the highly permeable rock formations allow rainfall to drain rapidly downwards to the freshwater lens. Where small impermeable depressions exist,

rainwater that is captured disappears quickly due to high evaporation rates. Thus, many of the geological features of small tropical islands limit the availability of freshwater resources.

Furthermore, the location of tropical islands in relation to global circulation patterns exposes them to difficult climatic conditions. Such conditions include erratic rainfall (leading to distinct wet and dry seasons) and vulnerability to natural disasters such as hurricanes and typhoons. Thus, water availability can be seasonal, at best, and drastically affected by extreme weather events.

2.3.2 The Social Causes

While local and regional disparities due to naturally determined maldistribution can predispose certain populations to conditions of scarcity by limiting the available water supply, there are also a number of inter-related, social and political processes involved in the creation of the problem. The social aspect of scarcity is a relatively new area of interest. The pioneering work of Malin Falkenmark (1989) is credited with bringing it to the forefront of water-related research and policy discussions when she suggested that population pressures were responsible for the accelerating global water scarcity.

Subsequent dialogue has expanded our understanding of how certain social forces induce scarcity. Listed below are some of these forces that affect the availability or consumption of water (or both). They can be divided into two general categories: direct human modifications to the natural environment that affect water supply, and the underlying human trends and practices that promote these, and other, scarcity-inducing conditions.

Modifications to landscapes and land use

Some of the human-related factors contributing to water scarcity include those activities that modify the physical environment and therefore reduce the supply of usable water. The reduction of vegetation cover through deforestation or the draining of large wetlands can disturb soil surface permeability, thereby reducing the amount of rainfall that infiltrates into the root zone to recharge soil moisture and groundwater supplies (Falkenmark's Type C scarcity). This increase in runoff translates into heightened

erosive activity, and in some cases flash floods, which reduce the water storage capacity of dams and lakes through siltation (Abrams 1997; Gleick 1993, 1998; Postel 1997; Seabright 1997; Winpenny 2000). Land use changes can also alter microclimates, leading to lower humidity (Abrams 1997). Inappropriate land use and animal husbandry practices also play a role, as storage and diversion projects may deprive natural sources of their usual flows of water and interrupt the hydrological cycle (Winpenny 2000).

Pollution

Pollution from industrial effluent, agro-chemical run-off, and the release of untreated sewage compromises the quality of usable water supplies, forcing users to either reduce consumption or turn to alternative sources. In the developed world, much of the contamination is from industry and agriculture. Rising nitrate concentrations in groundwater, acid deposition and high levels of phosphorus in surface waters, and microbiological contamination from hormonally active compounds and persistent organic pollutants are some of the existing and emerging concerns with respect to water quality. In the developing world, insufficient wastewater treatment, poor sanitation infrastructure, and agricultural fertilizers/pesticides are polluting ground- and surface-water sources (Falkenmark and Lundqvist 1998). Water pollution in developing countries is not only a poverty-related phenomenon however, as rapid industrial development in newly industrialized countries is increasing the pollution load. In discussing the risk for serious water quality degradation, Falkenmark and Lundqvist (1998:38) note,

Eventually, pollution loads will outstrip the self-purifying capacity of water systems. If no counter-measures are effected, anthropogenic assault will gradually lead to a situation where water is not only the source of life and human ecosystem wellbeing, but also a source of disease, ecosystem disruption and societal disorder. Such a scenario may be aptly termed hydrocide.

Climatic change and variability

The anticipated onset of human-induced climatic change and variability can also affect water availability and therefore scarcity. The Intergovernmental Panel on Climate Change (IPCC) has concluded that there will be a 2°C rise in the global average temperature in the next 100 years, leading to climate conditions far beyond those experienced in the last 10,000 years (Gleick 1998). While the climate models used to

generate estimations of future conditions are far from offering accurate predictions, the general consensus is that climate change will alter the hydrologic cycle and therefore affect the worldwide distribution of water (Gleick 1998; Postel 1997). Associated changes in precipitation, evapotranspiration, runoff, and soil moisture will affect storm frequencies and intensities, and the occurrence of floods and droughts. The climates of some regions will become dryer, others wetter, and all more variable and unpredictable (Gleick 1998; Postel 1997; Winpenny 2000). Moreover, the predicted increase in global temperatures will also lead to rising sea levels and saltwater intrusion into coastal aquifers. The difficulty in accurately estimating a shifting global water budget presents one of the greatest challenges to long-term water planning and management.

Population Growth

Apart from anthropogenic modifications to the natural environment, there are other closely related human trends and activities causing water scarcity. Population growth is the most widely acknowledged social cause of water scarcity, which Falkenmark (1992) refers to as Type D scarcity. The literature on this subject is extensive and it is probably the most prevalent view on the causes of scarcity (Falkenmark 1991, 1992; Falkenmark and Lundqvist 1998; Gleick 1993; Postel 1997; Young, Dooge and Rodda 1994). The world's population is growing at an unprecedented rate and much of this growth is concentrated in the arid and semi-arid regions of the world. The past 100 years has seen the global population triple, and assuming a continued increase in prosperity and a trend towards lower population growth, the world's population will still increase by almost 2 billion in the next 25 years (Cosgrove and Rijsberman 2000). While direct consumptive demand will increase, it is the growth in the demand for food that will exert the most pressure on existing water resources, as irrigated agriculture is expected to meet this demand. Moreover, a growing population and its expanding needs will further exacerbate the other causes of water scarcity.

Water Demand

In addition to the increasing pressures of an expanding population, the overall failure to manage existing demands for water represents another factor contributing to water

scarcity. This growing and unmanaged demand is largely due to the misconception by many people that water supplies are abundant and “the only problem is getting it to the right place at the right time” (Abrams 1997:8). The pursuit of higher living standards and economic gain has perpetuated the view that water is a free resource available for wholesale use by modern society (Postel 1997). As long as this view persists, water managers will underestimate the implications of meeting the needs of an expanding global population. Further compounding management problems are the economics of supplying water to users. As long as a useful commodity, such as water, is offered free of charge or at a price well below its full cost of supply, it will undergo an artificially created scarcity where demand outstrips supply (Winpenny 2000). Heavy government subsidization of water services – including domestic and industrial water supply, wastewater treatment, and irrigation – has distorted the true and full economic value of water, thereby encouraging its wasteful use and growing scarcity (Cosgrove and Rijsberman 2000).

Financial and Institutional Obstacles

Financial and institutional capacities also determine conditions of water scarcity. Many countries lack the financial resources to explore, utilise, and maintain their water potential, as appropriate technologies and expertise come at too high a cost. Investment in freshwater augmentation technologies, such as drilling boreholes, building dams, constructing rainwater tanks, or even importing water, all require funds that are simply not available in many countries. Even the expansion and repair of existing systems can prove too taxing, thereby leading to the unequal distribution of local supplies and the loss of water through waste and leakage. During periods of water stress, a community’s ability to respond is dependent on their access to credit. Thus, as Abrams (1997:8) points out, “a given situation of water shortage will have more extreme consequences for the poor than for the rich – for one set of people it will spell disaster and for the other it will mean only inconvenience.” Institutional obstacles leading to water scarce situations include inefficient bureaucracies, corruption, and a lack of qualified professionals in the water sector. The end result is resources that could otherwise be used to mitigate water scarcity are unavailable to those who need it most.

Socio-cultural processes

Finally, the social and cultural realities of a particular society or community play a role in shaping scarcity situations. Increasing consumerism, rapid urbanisation, and political instability are but a few of the issues that have modified (and expanded) human needs for water. Some of these processes have also increased the disparity between populations in terms of access to usable water. For example, wealthier populations in urban areas supplied by municipal water systems rarely experience scarcity, whereas poorer populations living on the urban fringes are forced to purchase water or only have access to water that is unfit for consumption (Donahue and Johnston 1998). The management and development of transboundary water resources can influence water scarcity, as water containment and diversion schemes in one country can affect the quantity and quality available in other countries. Johnston (1998) states that the larger process of development, alienation, and dependence in a society has led to water scarcity in developing countries. The shift away from subsistence lifestyles, which is often accompanied by a rise in certain standards of living, may also reduce access and control over natural resources as people have less opportunities to interact with the natural environment and “fewer reasons to maintain knowledge of their natural surroundings” (306). Coupled with dependence on foreign technology and expertise, as well as dysfunctional governance regimes, water scarcity can be created and perpetuated. Other social phenomena such as racism, tribalism and civil war can lead to conditions of scarcity for certain sectors of the population. Abrams (1997:9) discusses such factors by citing specific examples from Africa,

The apartheid era in South Africa resulted in large proportions of the population suffering critical shortages of water whilst neighbouring communities enjoyed, and often wasted, an excess of water. The protracted civil wars in Angola and Mozambique have resulted in the already limited infrastructure being destroyed or lapsing into disrepair. The long-term economic and social impacts of these issues often predetermine the overall political and economic framework from which many of the other causes of water scarcity stem.

Thus, the changing context of daily life has led to new and evolving perceptions of the roles and uses of water. According to Warner (2000:6),

Human choice has a strong bearing on the physical local availability of water, not to mention the perception whether this amount is sufficient...human needs strongly depend on one's circumstances and socio-cultural background. While Bedouin crossing deserts may get by on one bottle a week, modern domestic use may run up to 2000 m³ p.a. for a household with a large garden.

Moreover, the cultural value and meaning of water may affect both the supply and consumption of the resource. In communities where water is seen as an un-ownable, God-given resource, it possesses little economic value. Water may also be strongly related to local history, symbolic rituals, and overall cultural survival (Warner 2000). Most importantly, because water is essential to life, prohibiting or limiting its use can be seen as morally inexcusable. The perception of water resources therefore translates into human behaviour that ultimately influences supply and consumption. Because the relationship between supply and demand characterises water scarcity, so too does human behaviour.

Social Determinants in Small Islands

Having addressed the unique, interrelated characteristics of many small tropical islands in Chapter 1, I refer to them in this discussion of the social aspects of water scarcity. The unique, and oftentimes fragile nature of the physical preconditions on small islands can intensify the environmental impacts of human activities. Many human activities are operating within the shifting contexts of modernization, urbanization, and economic development, all of which carry different uses and demands for freshwater. Moreover, combined with high demographic pressures and restricted economies, the impacts are further felt.

Examples of scarcity-inducing land use activities can be found in many small islands. For example, poorly kept roads and ad hoc land development on Rarotonga in the Cook Islands has increased erosive activity. The increased sediment load in the water supply has contributed to its poor quality (Depledge 1996). In terms of pollution, domestic wastes on many small islands continue to pollute surface and ground waters. Industrial activities – which tend to concentrate on the extraction and primary processing of natural resources (mining, fishing, petroleum), agro-industry (sugar and fruit), tourism, and some

manufacturing – discharge organic matter as well as non-biodegradable and toxic materials (Dowdeswell 1995).

While small island states have contributed comparatively little to the onset of climate warming, its impacts are of particular concern to tropical islands, as their effects will be felt more readily than on continental land masses (Meehl 1992). The implications for their freshwater resources are serious as some of the anticipated effects include: salt water intrusion of groundwater supplies, increased landward reach of storm waves (leading to the salinisation of surface water), changes in rainfall patterns and soil moisture budgets, and shifts in both the speed and direction of prevailing winds (Cocklin 1999; Hay 1997).

In addition to the human activities that explicitly alter the availability of freshwater, water scarcity in small islands is created and compounded by a number of other social processes. The drive for social and economic development, particularly on a limited natural and human resource base, has increased demands for water. For example, the tourism industry, upon which many island economies depend, brings with it increased and seasonal demands for water resources. Tourists are estimated to consume about 250 litres per person per day, and in luxury hotels, this total rises to 600 litres per day (German Federal Agency 1997). Moreover, because of the importance of the industry, more water can be allocated to meet the needs of tourists, therefore reducing the amount available for the local population. This speaks to the prioritization of economic interests over other matters, such as domestic water and sanitation requirements. As a result, there is often a lack of political will, legislation, and policies in the water sector. While draft legislation exists in some island countries, such as the Solomon Islands and Vanuatu, other countries utilise outdated colonial legislation. Regulations are not enforced and further compounding the problem is the issue of land and water ownership. Throughout much of the Pacific, landowners have customary rights to use and “carry out whatever activity they choose on their own land, regardless of the consequences to the water resources which flow over or under that land” (Depledge, 1996:10). Furthermore, financial and institutional limitations result in a lack of data, equipment and technical

expertise. Shortages in local human resource skills result in a reliance on expatriate contract staff. This can in part present challenges when implementing community-level water development projects by hindering effective communication and the overall understanding of needs and expectations. The end result can be high project failure rates.

Thus, small islands possess a unique set of physical circumstances that render them vulnerable to conditions of water scarcity. Erratic rainfall patterns and limited ground and surface storage capabilities restrict the availability of freshwater. Their limited surface areas and technically challenging physical settings can hinder the exploration and implementation of augmentation technologies, while relatively high population densities enhance pollution problems (UN 1999). Added to these constraints are the so-called socio-cultural realities of many small islands, which are characterized by developing economies, limited technical capacities and inadequate management frameworks. While physical traits such as size, geology, orogenesis, location and climate can lead to an absolute lack of freshwater on many islands, for others these traits present constraints and complications to the acquisition and distribution of water, potentially predisposing communities to conditions of scarcity. For communities that do inhabit islands with limited freshwater resources, a number of adaptation and mitigation measures and/or technologies have been adopted, many of which will be considered in the following section.

2.4 MANAGING WATER SCARCITY

Many of the causes of water scarcity discussed above are capable of being alleviated or remedied. As Winpenny (2000:2) states, “A society confronting water scarcity usually has options. Scarcity is not necessarily inevitable or immutable.” Managing water scarcity by definition involves confronting the problem with the intention of overcoming it, either through supply-side increases or demand-side regulation (Ohlsson and Appelgren 1998). Just as the types and causes of scarcity are varied, so too are its associated management measures.

2.4.1 Supply – Oriented Measures

Traditional management measures associated with water scarcity have involved augmenting the amount of supply available for human use through more efficient collection, greater storage capacities, improved transfers, diversification of sources, and water treatment activities. Most supply management schemes have involved large-scale engineering efforts, sometimes called “heroic engineering” (Ohlsson 2000). Figure 2.3 lists many of these schemes, and while not exhaustive, it highlights the range in measures that have been developed – from those employing relatively simple technologies such as rainwater harvesting, to more elaborate methods such as iceberg towing.

Table 2.2 Supply-oriented measures for managing water scarcity

- ♦ *Surface water capture and storage* such as dams, diversions, and natural/artificial reservoirs;
- ♦ *Rainwater harvesting*;
- ♦ *Long distance conveyance and inter-basin transfer* via canals or pipelines;
- ♦ *Groundwater exploitation*;
- ♦ *Watershed management* to regulate flow of water to downstream users;
- ♦ *Conjunctive use* of surface- and ground-water;
- ♦ *Dual quality water standards* whereby water used for other activities, such as flushing toilets or watering gardens, is not treated to meet drinking water standards;
- ♦ *Desalination*, or the treatment of saltwater and brackish water;
- ♦ *Other non-conventional solutions* such as towing and melting icebergs or ocean transport of freshwater;
- ♦ *Pollution control*; and
- ♦ *New water-sharing agreements* through international treaties.

Most of the measures in Figure 2.3 have been applied to the small island context, albeit at a much smaller scale. Surface water capture, groundwater exploitation, rainwater harvesting, and conjunctive use of these sources have tended to be the most widely practiced augmentation measures (Burke 1996; Depledge 1996). Unconventional measures, such as importation and desalination, are often too costly for most island economies.

Important to this discussion of the use of freshwater augmentation technologies in managing water scarcity is the applicability and feasibility of these measures. Inappropriate technologies, designs and materials can lead to high project failure rates. Water development projects can be unsuitable for the environments and cultural habits of the population being served, and excessive costs and lack of training in operation and maintenance can hinder their effectiveness. Referring specifically to the Pacific Islands Region, Depledge (1996:8) states:

The Pacific is in fact a graveyard of many technologies tried and failed. Windmill pumps, solar pumps, handpumps, desalination plants can be found abandoned and in disrepair throughout the region. Many rain water tanks remain empty because of missing or unrepaired guttering and down pipes.

In order to circumvent such scenarios and ensure successful implementation of water resources development projects, community participation is crucial at all stages (UNEP 1998). Especially important is the genuine need and desire for the project on the part of the beneficiary community, which is often made apparent through the extent to which people participate during planning and implementation, as well as by the resources they are willing to allocate towards proper operation and maintenance.

2.4.2 Demand Management

The objective of demand management is to acquire more use out of the existing amount of accessible water, or as Ohlsson (2000:2) states, “more use per drop.” According to Winpenny (2000: 8), it starts with the recognition of water as an economic resource requiring optimised use and includes “market-oriented reforms in the way it is supplied, used, and disposed of.” He identifies three levels of action required for demand management: creation of enabling conditions for demand management; creation of incentives and promoting markets for the more rational use of water; and direct intervention by the government or water authority to enforce conservation through projects. The components of each level of action are outlined in Figure 2.4.

Table 2.3 Three levels of action necessary for water demand management

<i>I. Creation of enabling conditions</i>	
♦ Institutional and legal changes, particularly those removing ambiguities over ownership rights; ♦ Reform and privatisation of utilities; and ♦ Sector-wide economic policies	Establish an environment permitting the use of demand management strategies
<i>II. Setting incentives and promoting markets</i>	
♦ <u>Market based</u> ○ Water tariffs, pollution charges, groundwater markets, surface water markets, auctions, and water banking ♦ <u>Non-market</u> ○ Restrictions, quotas, norms, licenses, exhortations, and public education	Introduce tools to promote and enforce the judicious use of water
<i>III. Direct interventions and spending programmes</i>	
♦ Canal lining ♦ Leak detection ♦ Water-efficient user appliances ♦ Industrial recycling, reuse ♦ Water efficiency	Specific water conservation schemes resulting from government and water utilities involvement

Again, the success of demand management regulations and conservation measures is largely dependent on political and economic capacities of the implementing agents. Public cooperation is essential, which is in part dependent on the perceived fairness of the programmes. Furthermore, monitoring and enforcing associated policies and regulations require financial and human resources that can be lacking in developing economies, such as those of small island states.

Thus, the way(s) in which a society manages water scarcity is dependent on a number of factors, including the type of scarcity experienced (chronic vs. periodic, local vs. regional, pollution induced vs. drought induced), and the ability of a given social entity to mobilize resources to develop new supplies and regulate demand. These resources must

be available at all levels of society (from communities to central governments) and be suited to the particular needs of the social entity experiencing scarcity. However, the methods a community adopts in managing scarcity do not, for whatever reasons, always address the ‘root causes’, but serve to treat the symptoms. Thus, in this sense, managing scarcity does not always lead to its mitigation but to temporary relief from its effects. This can be attributed to some of the issues addressed above – inappropriate technologies; lack of participation, expertise, and finances; outdated and ineffective legislation; and cultural values. Scarcity can therefore persist in spite of efforts to alleviate it and as a result, the reasons for its persistence can be seen as causes of scarcity in and of themselves.

2.5 SUMMARY

This chapter has aimed to demonstrate the complex and multidimensional nature of water scarcity. There are various ways of understanding the problem, differing conceptual lenses through which to examine the causes of and responses to scarcity. Traditional approaches have largely concentrated on the physical absence of water and the natural (climatic) causes, and this is increasingly viewed as a limited and simplistic approach. While there are indeed instances of natural resource shortage outside of anthropogenic influence, the availability and use of water is greatly conditioned by a number of social processes that reflect human values, affluence, and policies. Scarcity is therefore not just an inevitable natural phenomenon, but also a social construct, a product of human behaviour, social customs, and institutions. Moreover, the responses to such conditions are also social constructs, shaped by levels of affluence, individual and group expectations, and accepted behaviour. As Ohlsson (2000:1) states,

The story of meeting the challenges of water scarcity is a social story. It is the story of societies employing different means of adaptation over time, at different states of scarcity, and in response to different perceptions of what constitutes the challenges to be met.

Understanding the social processes creating water scarcity often possesses more relevant and explanatory power (Aguilera-Klink, Pérez-Moriana, and Sánchez-García 2000). In this study, I examine some of the social processes related to the perceived water scarcity

in Yanuca Village, Fiji Islands. Specifically, I look at the perceptions associated with local scarcity, as they reflect some of the values, choices, and priorities within the community. How a community experiences scarcity is central to explaining not only the various aspects of the problem, but the measures adopted in response to it. These adopted responses, in turn, determine the ability of the affected community to either mitigate or perpetuate water scarcity. In the following chapter, I introduce the particular case being examined in this thesis through a description of Yanuca Village – a community facing water scarcity in the Fiji Islands.

CHAPTER 3

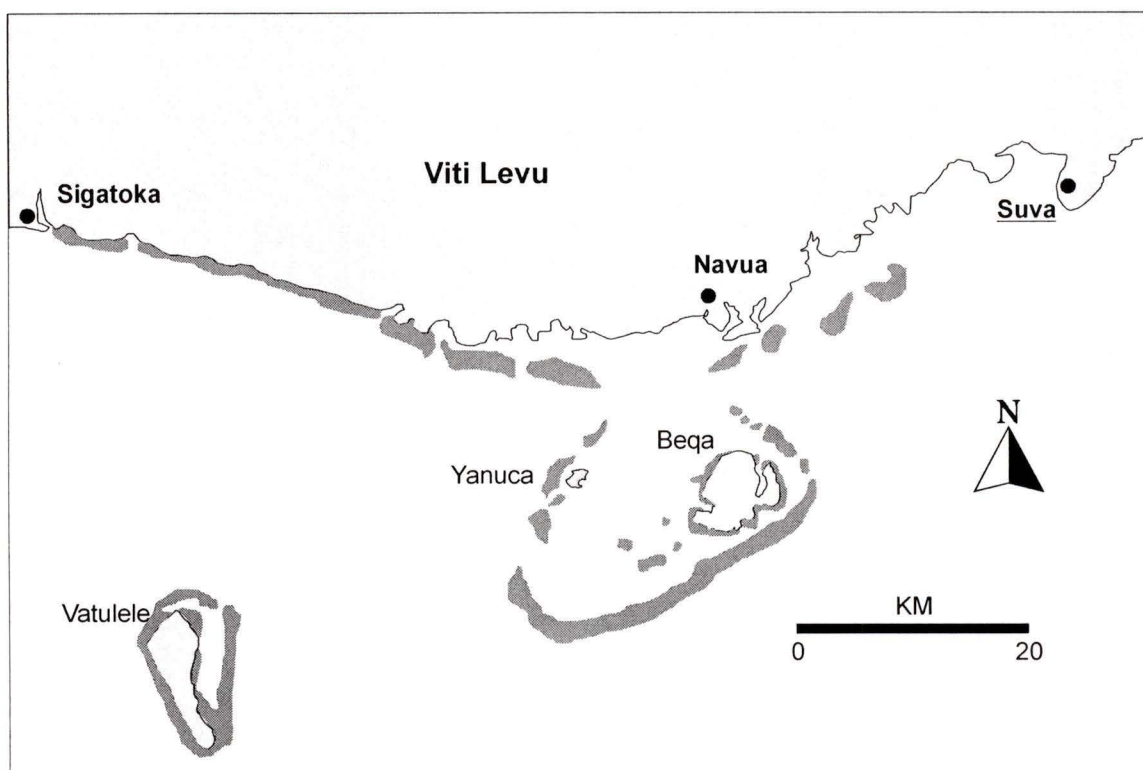
RESEARCH SETTING: YANUCA VILLAGE, FIJI ISLANDS

3.1 INTRODUCTION

The purpose of this chapter is to situate my study of water scarcity within its relevant physical and social context. As stated in the previous chapter, water scarcity is shaped by both biophysical and socio-cultural characteristics. Therefore, in order to achieve a more profound understanding of scarcity issues in a community, a discussion of its natural environment, history, culture, and society is imperative. Recognising that context is never static and that environments, societies, and cultures are in a constant state of flux, this discussion identifies some of their key elements as they relate to this study. Having already introduced the broader physical and social context of Fiji in Chapter 1, this chapter focuses on the study site itself by describing the unique physical features of Yanuca Island and the people who inhabit it. In so doing, I establish the parameters for the case study and set the scene for a closer investigation of water scarcity in Yanuca Village.

3.2 PHYSICAL CHARACTERISTICS OF YANUCA ISLAND

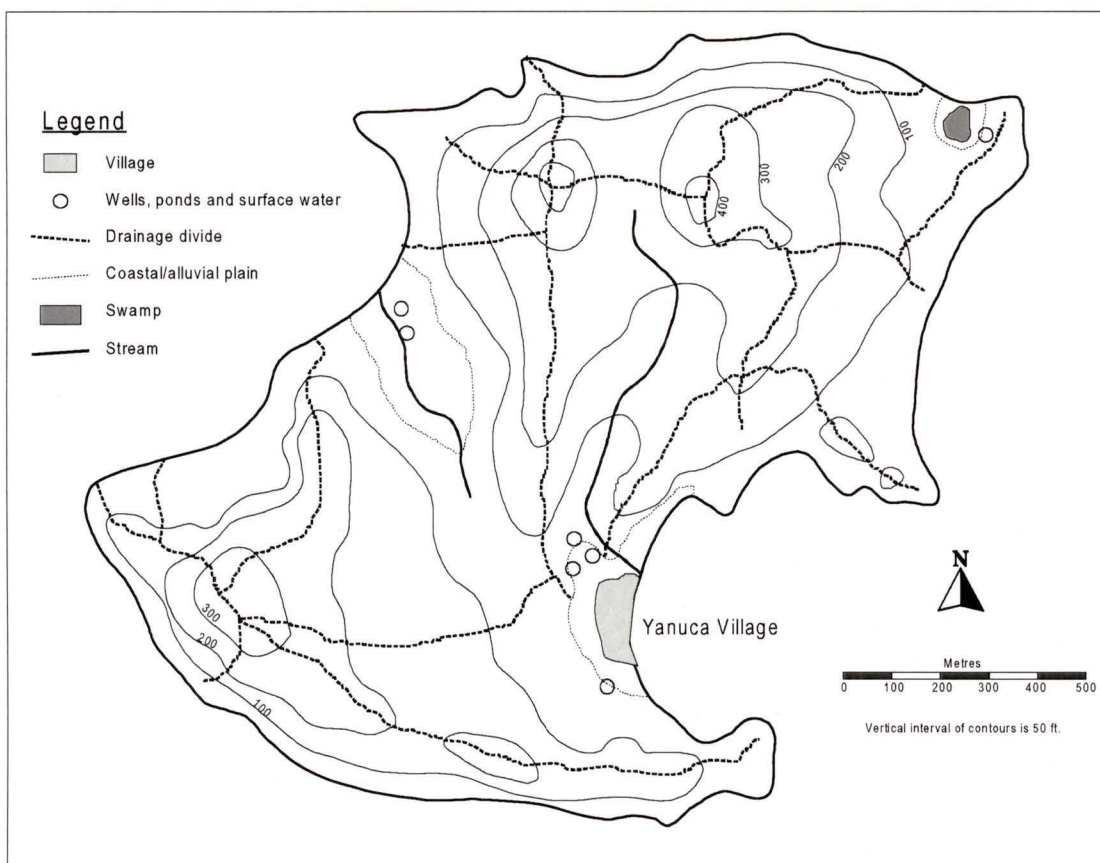
Yanuca (Yanutha) Island is a 1.52 km² low-lying volcanic island located approximately 10 km off the south eastern coast of Viti Levu, at 18°23' S and 178°00' E (Figure 3.1) (Lewis 1994; Nunn 1990). The island has a maximum elevation of 137 ASL and comprises two main hills separated by a valley within which Yanuca Village is situated (Figures 3.2, 3.3 and Appendix 1). The climate is characterized by a mean annual temperature of 25°C, mean annual rainfall between 1397 mm to 2540 mm, and distinct wet and dry seasons (Figures 3.4 and 3.5). The dry season lasts from May to October, part of which can be very dry (Lewis 1994). Tropical rainforest covers much of the island, although the village valley has been cleared and is now covered by grasses, shrubs and fruit trees. The rugged coastline is tempered by a number of small sheltered bays and sandy beaches, several of which have been developed for the tourism market.



Source: Department of Geography, University of the South Pacific (2001)

Figure 3.1 Southern Viti Levu and neighbouring islands

Yanuca and its neighbouring island to the east, Beqa (Mbengga), are enclosed within a single barrier reef, which delineates the southern and southwestern margin of Beqa Lagoon. The barrier reef has an unbroken length of 65 km and when exposed at low tide, its surface width varies from 0.8 to over 2 km (Band 1968). The lagoon itself is 29 km long by 18 km wide and encloses an area of 390 km². Recognised as one of the world's finest dive areas, Beqa Lagoon features multicoloured soft corals and a diverse and unique range of tropical marine life. On the west side of the barrier reef is Frigate's Passage, a renown surf break and dive site. Recent surveys of the reef systems in and around Beqa Lagoon have revealed instances of coral bleaching, which is attributed to rising sea temperatures. Whether the changing water temperature is the result of natural weather cycles or anthropogenically-induced climate change, coral bleaching represents one of the biggest threats to the health of reef ecosystems. Added to the pressures placed upon them by fishing practices and tourism-related activities, coral reefs such as those around Beqa and Yanuca face a precarious future.

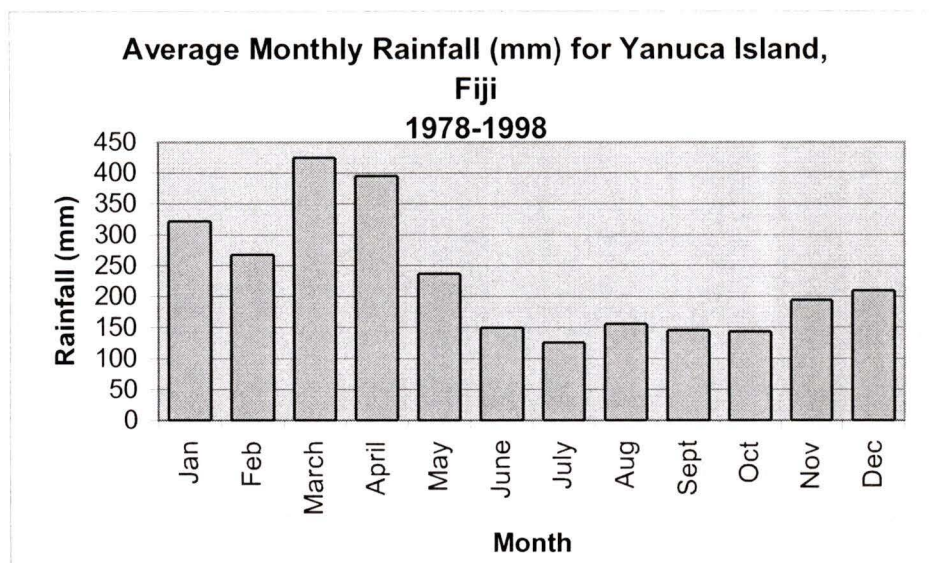


Source: Department of Geography, University of the South Pacific (2001); Mineral Resources Department (1994)

Figure 3.2 Yanuca Island

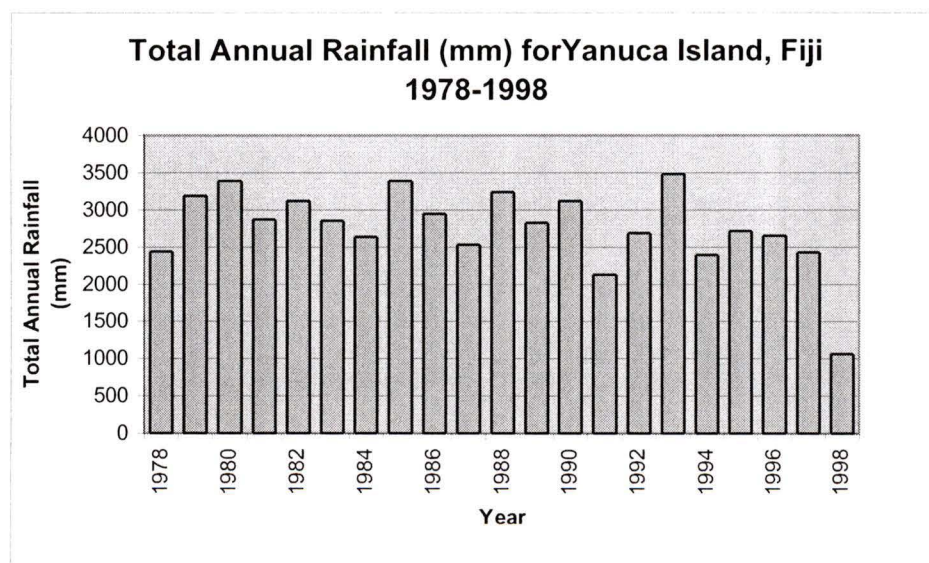


Figure 3.3 Yanuca Village, October 1999



Source: Public Works Department, Fiji

Figure 3.4 Average monthly rainfall for Yanuca Island



Source: Public Works Department, Fiji

Figure 3.5 Total annual rainfall for Yanuca Island

3.3 HISTORY AND LEGENDS OF YANUCA ISLAND

Like most inhabited islands in Fiji, Yanuca has a story of how it was first settled and acquired its name. While the majority of indigenous Fijians have been Christians for over a hundred years, they maintain a strong belief in the supernatural world based on ancestral gods and other spirits. Many of Fiji's myths and legends describe the power of these gods and spirits in affecting change in the mortal world, thereby shaping the physical environment and everyday lives of people on the islands. The recounting of these stories not only emphasises the importance of respecting one's ancestors, but also demonstrates how Fijians believe their circumstances are to some extent shaped by forces beyond their control (Ravuvu 1983). There are two legends that describe how Yanuca Island was originally settled and got its name. One of the legends has been passed down through generations in the village, while the other is more widely known and taught in classrooms throughout Fiji.

According to village legend, Yanuca Island was originally named *Yanuyanuca*, meaning 'bad island'. The island's negative namesake referred to its poor, nutrient-deficient soil which was unable to support the growth of fruit trees. Yanuca's original settler, Masilaca, who is said to have had the ability to appear in the form of a shark, decided to compete in a bamboo spear throwing competition with other ancestral gods in Fiji. Masilaca won the competition and as his reward, asked the other gods to bequest one fruit tree each to be planted on the island. The fruit trees flourished and the island's name changed from *Yanuyanuca* to *Yanuca*, which simply means 'small island'. It is for this reason all of the fruit trees native to Fiji grow on the island today. These include mangoes, bananas, papayas, and passionfruit. The selling of fruit from any of the trees believed to have originated from Masilaca's victory is strictly prohibited, as doing so will result in them bearing little or no fruit in subsequent years. I was told of one family who gave relatives on the mainland a heap of mangoes, who then sold them at the local market. The large mango tree from which they were picked did not flower or bear any fruit for three years following the incident. Because all of Yanuca's coconut trees and some additional fruit trees were planted by villagers in recent times, there is no taboo associated with their use for economic gain. Only a few of Masilaca's descendents are

alive today, one of whom is known for her effortless crab hunting abilities. Apparently, if you watch closely you can see a shark guiding the crabs towards her as she searches for and collects them along Yanuca's shores.

The other, more widely known legend associated with the origin of Yanuca Island's name tells the story of a chief and his only son who lived in a village in the hills near Deuba on Viti Levu. The son, whose name was Ravouvou, lived a sheltered and pampered existence, spending his days spear fishing, ignorant of "young women and their ways" (Reed and Hames 1997:52). On the other side of the range of hills lived another chief and his daughter, Raluve, who had had a more sensible and worldly upbringing. Fiercely protected by his father, Ravouvou was prohibited from venturing to the right of the hills along the coast whenever he went spear fishing. The restriction was imposed out of fear that Ravouvou would meet and want to marry a woman not of his father's choosing, especially Raluve, whose father was his bitterest enemy. Forgetting his father's orders one day, Ravouvou followed a shoal of fish along the shore to the right and swam towards the domain of Raluve's father. There, Ravouvou encountered Raluve, who was bathing in a small pool by herself. Without exchanging more than a glance, the two fell in love. Knowing that the discovery of their meeting was punishable by death, they began looking for ways to escape their fathers and spend their lives together. Gazing out on the horizon towards Beqa, Ravouvou saw a smaller island situated just west of Beqa and knew that it was uninhabited. Without hesitation, Ravouvou and Raluve got into a canoe and sailed across to the small island. Upon arriving on the island, Ravouvou decided to name it *Yacuva*, which means 'reach', for he and Raluve had reached the place that would be their home forever. Over the years, the name was altered to Yanuca, but the story of Ravouvou and Raluve continues to be among one of Fiji's most celebrated legends.

3.4 VILLAGE PROFILE

Yanuca Village, located on the southeastern coast of the island, is the only permanent residential settlement on Yanuca Island. With the exception of a small diesel-powered generator feeding 19 of the 41 houses between 6 – 10pm, there is no electricity on the

island. Houses are constructed out of either sawn timber or cement blocks, and all of them have corrugated iron roofs. Most houses share toilet facilities, which are small corrugated iron shacks with water seal or pit toilets.⁵ The largest building in the village is the centrally located Methodist church, which is still under construction. The old church is situated directly behind the unfinished one, and a small Christian Mission Fellowship church sits at the southern end of the village grounds. There is one school located on top of a hill overlooking the village, teaching children in grades one through eight, and the teachers' quarters (consisting of 3 separate homes) are located next to the school. No formal health facilities exist on the island and there is one small phone post on the southeastern end of the village, which receives incoming calls during certain hours on weekdays. Two small, family-run shops sell basic foodstuffs such as flour, sugar, rice, powdered milk, and tinned meat as well as other products like mosquito coils, toiletries, benzene, kerosene, and cigarettes. While garden plots are not kept (except by the village headman), there are several small cassava plantations on the outskirts of the village. The grass on the village grounds is cut once a week in order to control mosquito populations.

As of October 1999, 237 individuals were residing in the Yanuca Village. This number rose to 240 by October 2000. The demographic breakdown as recorded by the village headman is presented in Figure 3.7.⁶

Table 3.1 Composition of the Yanuca Village population, October 1999 & 2000

	1 mo to 5 yrs		6 – 17 yrs		18- 60 yrs	
	1999	2000	1999	2000	1999	2000
Male	12	12	46	46	66	66
Female	11	11	41	41	61	64

The village social structure consists of two *mataqali* (sub-clans) hailing from the *yavusa* (clan) Nukutabua (Figure 3.6). The sub-clans are each further subdivided into two

⁵ There are 25 toilet facilities in the village and school grounds.

⁶ Although villagers over the age of 60 are not included in this village survey, based on my own observations, there are probably between 5-10 individuals falling within this age range.

tokatoka, with one (Batiluva) owning the beach land and the other (Daga) owning the village land, although legal rights to land ownership are recognised as belonging to the *mataqali*. The current chief of Yanuca Village resides in Deuba on the mainland. Interestingly, he is not from one of the original social groups who settled Yanuca. When the number of descendants from the chiefly *tokatoka* Tuinimarama dwindled and the remaining members were female, the *tokatoka* Batiluva was to provide Yanuca Village's next chief, as both groups originated from the same *mataqali*. However, because it was felt that Batiluva did not have enough elders to support a chief, a boy was brought over from the mainland and raised to be Yanuca's next chief. This boy was a member of the *tokatoka* Vunitavola, which was adopted into the *mataqali* Nukutabua as there were more elders in this sub-clan. The chief's son presently resides in Yanuca Village and acts as his representative in day-to-day affairs.

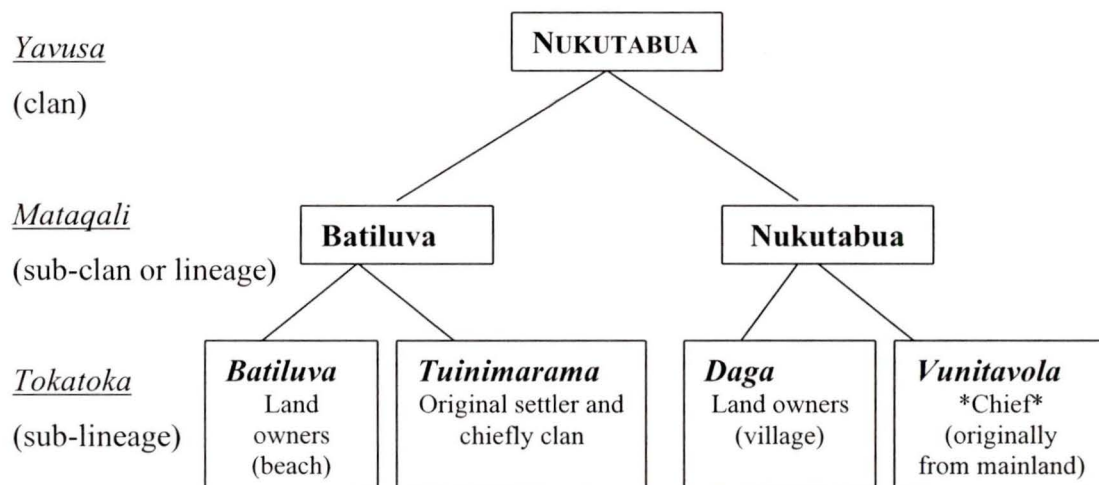


Figure 3.6 Social structure in Yanuca Village

General administrative duties in the village are carried out by the *turaga-ni-koro* (village mayor or headman). Appointed by the villagers, the *turaga-ni-koro* acts as a government representative in the village, overseeing the performance of social services such as village cleaning, housebuilding, and infrastructure maintenance. It can be a thankless job for he receives no remuneration and often struggles to find the time to contribute to his family's income. A village committee, consisting of the headman and two other appointed

villagers, regularly meets to discuss matters such as community events, village finances, and development projects on the island.

3.5 ECONOMIC ACTIVITIES

Yanuca Village's small cash economy is based on fishing, fire walking, tourism-related services, and coconut selling. Fishing has just recently been taken up as an income generating activity as it was previously practiced on a subsistence basis. Villagers stay out on the reef for days at a time catching snapper, rock cod, tuna, and mahi mahi and diving for *bêche-de-mer*. Most of their catch is sold on the mainland, usually at the Suva fish market, and families can earn somewhere between F\$100 - \$200 a week, depending on weather conditions and the grade of fish. Shells are also collected and sold to a local button manufacturer on the mainland for F\$4.50/kg. The second most profitable economic activity in Yanuca Village is firewalking. While the neighbouring island of Beqa is famous around Fiji for its firewalkers, this unique tradition is also performed by some of the men in Yanuca Village. The ritual involves the men walking around and standing in a circular pit full of white-hot stones while chanting traditional songs, immune to the pain and drawing strength and psychic power from the heat. Firewalking ceremonies are only performed at tourist resorts on the mainland, earning approximately F\$400 a show. The men travel out to the mainland on Monday mornings, perform at least one show a day for three days, and return to the village on Thursday afternoons. The money earned from the ritual is not pocketed by the firewalkers themselves but is given to the village as a whole. Because of the inconsistent demand for firewalking performances in the tourism market and the growing desire on the part of villagers for a more stable source of income, small-scale commercial fishing was adopted in the last few years and surpassed firewalking as the leading economic activity in Yanuca Village. In light of the recent political and economic instability following the May 19th, 2000 coup, firewalking has brought very little money into the village. Although there is not much economic incentive for firewalkers to incur the expenses of travelling to the mainland to perform one or two shows, they continue to do so in order to maintain their profile in the tourism industry.

Apart from firewalking, there are a number of other tourism-related activities that bring money into Yanuca Village. Because of the island's proximity to the popular Frigate's Passage surf break, there are two surfing camps operating on the island – Frigate's Surfriders and Batiluva Beach Resort. The owners of these camps compensate villagers for use of their land through lease and/or rental payments and also pay for use of the reef (F\$100/month). In addition, a small number of villagers are employed at these camps as cooks, boat captains, custodians, and general assistants. There are also a number of dive operators on the mainland who pay fees for use of the lagoon and surrounding reef (F\$150-200/month). All of the proceeds from reef fees go the village fund, while land payments are given to the proper land-owning *mataqali*, which in this case is Batiluva. Coconuts, which sell for F\$3/dozen, are another means of earning money in the village. While families do not rely solely on coconuts for income, they provides a decent supplement to other activities.

3.6 REVIEW

This chapter has provided the physical and social context for my study through a description of the land and the people of Yanuca Island. The aim of this chapter was to begin explaining the circumstances shaping local water scarcity, since both the physical environment and the people who inhabit it determine both the supply and use of water. Thus, as a semi-subsistence community situated on a small outer island of Fiji, Yanuca Village encounters a unique set of biophysical and social determinants of water scarcity. The factors that shape the availability and consumption of water are different than those encountered in other settings, such as in urban centres or other rural communities on larger islands. Moreover, my discussion of the research setting has also delineated the boundaries of my case study, outlining the context within which I conducted my research using the methodological rationale described in the following chapter.

CHAPTER 4

METHODOLOGICAL FRAMEWORK

4.1 INTRODUCTION

In this chapter, I discuss the methodological rationale and data collection methods used in framing and conducting my research. This study employs a qualitative case study design to examine the views and experiences of women in Yanuca Village as they relate to local water resource problems. I subsequently rely on these views and discuss them within their proper contexts in order to generate or develop ideas on water scarcity. Thus, this chapter is an outline of the steps taken in linking the concepts discussed in Chapter Two with the experienced reality of water problems in Yanuca Village. I begin with an explanation of the reasons for employing a qualitative research approach and the value of a case study design. An overview of the specific data types and acquisition methods (archival work, documentation, participant observation, direct observation, household water use surveys, and semi-structured interviews) ensues, which includes a summary of how they were analyzed. Finally, I address the methodological concerns of researcher subjectivity and potential research limitations through an anecdotal account of my living arrangements and experiences in the village.

4.2 RATIONALE FOR USING QUALITATIVE RESEARCH

Qualitative research is defined as a multimethod process of inquiry that seeks to explore human or social phenomena in their natural settings using an interpretive approach (Creswell 1998; Denzin and Lincoln 1998). It involves the collection and examination of a variety of empirical materials (such as personal accounts, visual images, and observational, historical, and interview texts) and attempts to “make sense of or interpret phenomena in terms of the meanings people bring to them” (Denzin and Lincoln 1998, 3). The use of multiple methods, or triangulation, is a means of achieving an in-depth understanding of the human or social problem in question. Unlike its quantitative counterpart, which seeks to measure causal relationships between variables or generate reproducible results, qualitative inquiry aims to reveal contextualised processes and meanings through interpretation. The data are mostly in the form of words, which are,

“relatively imprecise, diffuse, and context-based, and can have more than one meaning” (Neuman 1997, 420). Moreover, emphasis is placed on, “the socially constructed nature of reality, the intimate relationship between the researcher and what is studied, and the situational constraints that shape inquiry” (Denzin and Lincoln 1998, 8). Because this study used several methods to explore the views and experiences of women living in Yanuca Village, a qualitative research approach was employed. Such an approach enabled me to understand how these views and experiences on local water resource problems were created and given meaning.

4.3 CASE STUDY

The qualitative orientation of this research was guided by a case study design. Creswell (1998) defines a case study as an, “exploration of a ‘bounded system’ or a case (or multiple cases) over time through detailed, in-depth data collection involving multiple sources of information rich in context” (61). This ‘bounded system’ or ‘case’ is the object of study – i.e. an activity, a program, a group of individuals – which is bounded by time and place. The goal is to develop an in-depth picture of the case, where the general structure of the study includes: a) a rich description of the case(s) and its (their) context; b) identification and analysis of themes through triangulation, and c) assertions, or interpretations of “lessons learned” in the study (Creswell 1998).

This study, which focuses on local perceptions of water resource problems, consists of a single case bounded by the island of Yanuca over two separate field seasons (August to December 1999, and August 2000 to January 2001). The sources of information used in this investigation included observations, interviews, and documents and reports. The collection and analysis of these data enabled me to not only reveal local perceptions of water resource problems, but situate them within their proper physical, socio-economic, and cultural settings.

4.4 METHODS

The data collection methods associated with case study research are extensive, as multiple sources of information are used to develop a detailed analysis of the

phenomenon in question. Yin (1994) identifies six sources of information used in this process: documentation, archival records, direct observations, participant observation, interviews, and physical artefacts. The data acquisition methods used in this study relied on five of these six sources of information (physical artefacts were not collected for analysis). All five of these methods were employed during both field seasons of the study. Data were collected both in Suva, where I lived for the majority of my time in Fiji, and during my stays in the study site, Yanuca Village.

4.4.1 Documentation

The gathering and analysing of documents is an important data collection method as it is an unobtrusive means of developing an understanding of the issues, setting, and people being studied (Marshall and Rossman 1995). A variety of documents were used in this thesis to corroborate and expand information gathered from other sources. Such documents included government reports, conference proceedings, formal studies or evaluations of the study site, and relevant theses. An extensive document search and retrieval was conducted during both field seasons, whereby sources were found at the Mineral Resources Department (MRD), South Pacific Applied Geoscience Commission (SOPAC), and University of the South Pacific (USP). The second field season did not require as much document collection, but additional NGOs, such as the South Pacific Action Committee for Human Ecology and Environment (SPACHEE), and government offices were solicited for relevant information. It is important to note that documents were not analysed under the assumption that they contained unbiased or accurate accounts as they were produced for purposes and audiences other than those of the proposed study (Yin 1994).

4.4.2 Archival Records

Archival records provide data that are routinely gathered for a society, community, or organisation (Marshall and Rossman 1995). Examples include census reports, marriage records, survey maps, and telephone listings. In this study, I used a number of archival sources to supplement interview and observation data, including maps, aerial photos, census reports, rainfall data, village surveys, and school health records. The majority of

these sources were accessed during the first field season through the Government Map House, Land Survey Office, Fiji Meteorological Service, Public Works Department, and my stay in Yanuca Village. Additional records were gathered during the second field season including Yanuca Village surveys from the District Office. As with documentary evidence, archival information is produced for a specific purpose and audience not necessarily related to the proposed case study, and this was taken into consideration when interpreting such records (Yin 1994).

4.4.3 Direct Observation

Direct observation is an important source of evidence in case study research as they provide information on relevant behaviours and environmental conditions for the phenomenon being studied. It involves the systematic noting and recording of these behaviours and conditions in an attempt to understand the meanings attached to them (Marshall and Rossman 1995). While direct observations were made and recorded throughout the course of both field seasons, the majority were noted during my stays in Yanuca Village. Casual activities such as walking around the village, and formal settings like interviews and meetings, provided opportunities for observing the physical characteristics of the village (size, layout, condition of dwellings, location of water sources, surrounding vegetation etc.), as well as the gestures and behaviour of the villagers. This evidence was recorded in a field book, a personal journal, and through photography. The primary use of this data was to reveal complex interactions in natural social settings, and therefore develop a context for problem being investigated.

4.4.4 Participant Observation

While direct observations place the researcher in a passive role, participant observation demands direct, personal involvement in the social world being studied (Marshall and Rossman 1995). The goal is to try to experience reality as the participants might by becoming immersed in the everyday events of the study setting. There is considerable variation in the roles researchers assume within the case study situation, with differences in the extent, nature, intensity, and focus of participation (Jorgensen 1989, Marshall and Rossman 1995; Neuman 1997). While this form of data collection is criticized for the

biases it produces, it is nevertheless an effective means of examining the social meanings of everyday activities (and unusual occurrences) as they occur in natural settings.

I was able to undertake a more participatory form of observation during my time in Suva and Yanuca Village. While study focused on Yanuca Village, my time in Suva was important in preparing me for my village stay and informing my research questions and objectives. In Suva I experienced everyday life in several different, but not mutually exclusive, contexts. In one context, I assumed the role of a visiting researcher examining water resource problems in Fiji. Prior to my field seasons, I was in contact with the chair of the Geography Department at the University of the South Pacific (USP), who upon arrival in Suva wrote an introductory letter identifying me as a visiting researcher with the Department. This title afforded me access to the university facilities, a USP e-mail account, contact with faculty members and postgraduate students, accommodations in the international student housing complex (Waqavuka Flats) during my first season, and fewer problems in acquiring a research permit. I was also invited to participate in two undergraduate geography field trips, where I travelled to various parts of Viti Levu and stayed in Fijian villages. Apart from being an excellent introduction to Fijian village life and the diverse physical geography of the country, it also enabled me to interact with other students who were keen to share their knowledge of local customs and assist me in establishing research contacts. As a visiting researcher, I also acquainted myself with other international researchers, many of whom offered advice and related to some of my own experiences. Another context within which I was a participating observer was that of an overseas student. This role differed from that of a visiting researcher as my contacts and experiences were not governed by my research activities. Because the USP campus in Suva is the main campus for a regional school owned by the governments of twelve island countries, there is a large and diverse student scene in the city. My accommodation in the Waqavuka Flats provided me an opportunity to interact with students from Australia, Germany, the U.S., the Cook Islands, and the Solomon Islands, as well as with local Fijian students. I ate most of my meals with these students, went to movies, social gatherings, cultural outings and community events with them, thereby allowing me to experience Fiji as a student (in a social sense, since I was not enrolled in

any courses). Interestingly, because my physical features often led people to believe I was of Polynesian ancestry, there were times when I was made to feel more ‘local’ than foreign. This experience was important in familiarizing me with some of the social dynamics and nuances that characterize everyday life in Fiji. The third context within which I experienced my surroundings was as a tourist. Having never visited Fiji, I travelled to other parts of the country and stayed in tourist accommodations. Incidentally, it was on a weekend trip to Yanuca with a group of friends that I was introduced to the island and noticed some of its freshwater problems.

I continued my participant role during my stays in Yanuca Village, where I lived with a teacher and interacted with villagers during casual conversations, meals, church service, and leisure activities. I did not attempt to assume a role as a villager for it was neither plausible nor necessary. My entry into the village was such that I was introduced as a researcher (outsider) examining local water resource problems. This overt form of participation was the most appropriate approach to the study, as the aim was not to become an ‘insider’ and begin to perceive reality as a villager. Rather, I was seeking direct access to what villagers thought, did, and felt from multiple perspectives (Jorgensen 1989). My role in the village eventually became twofold: 1) a Canadian researcher studying water resource problems in the village, and 2) a ‘potential friend’ spending time in the village, sharing stories and interacting with others on a daily basis. The first role allowed me to walk around the village and survey water sources, take photographs, and ask questions. It also facilitated meetings with the village headman (*turaga-ni-koro*), school caretaker, and head teacher. The second role was instrumental in providing a more comprehensive (and perhaps a more ‘accurate’) portrayal of the problem as villagers shared their views and experiences with me in more casual settings than those of the interviews I conducted.

4.4.5 Interviews

As the favourite methodological tool in qualitative inquiry, interviews are one of the most powerful and widely used means of trying to understand other human beings (Fontana and Frey 1998). They are purposeful conversations aimed at eliciting information from

one or more participant(s) in the form of expressed views and experiences. Unlike structured interviews that seek to capture precise, codable data to explain behaviour within fixed categories, semi-structured or unstructured interviews are effective in uncovering a participant's meaning perspective (Fontana and Frey 1998; Marshall and Rossman 1995). In order to gain an understanding of the views and experiences of women in Yanuca Village as they relate to local water resource problems, the proposed study used two types of interviews: i) taped semi-structured interviews, and ii) untaped informal interviews. Both types of interviews were used during the first field season, and the second field season involved more of the latter type.

i. Taped semi-structured interviews:

Upon arriving in Yanuca Village, I spent several days observing, learning, and interacting with villagers to gain an overall sense of some of the local water resource issues. After preparing a more suitable list of interview questions based on these observations (see Appendix 4), I interviewed eleven villagers, ten of whom were women. The participants ranged in age, (the youngest being 22 and the oldest being 68), length of residency in Yanuca Village, and marital status. Interviews were conducted in the homes of the participants usually in the late afternoon. Some participants continued with their daily tasks throughout the course of the discussion (either weaving mats or preparing meals), while others happened to have a window of free time to sit down and talk with me. Five of the interviews were conducted in English, while the remaining six were conducted in Fijian with the help of a translator. They were between half an hour to one hour in duration, consisting of both specific and open-ended questions, semi-structured around the theme of water resources. The specific questions were designed to develop a general overview of the water resource situation in the village by identifying the sources, collection, and uses of water in the everyday lives of villagers. The more open-ended questions provided insight into some of the perceptions and experiences associated with local water resource problems. A wide range of views were expressed, all of which served to highlight the complexities shaping water resource problems in Yanuca Village.

ii. Untaped informal interviews:

A series of informal interviews and discussions were conducted over the course of my two field seasons in Fiji in order to supplement and corroborate information gathered through other methods. They included conversations of varying lengths with USP faculty, government officials, tourism operators, business owners, NGO workers, teachers, and other villagers who were not formally interviewed. These informal discussions were particularly effective in eliciting information from villagers, as they seemed more comfortable sharing their views and experiences with me in a more casual context. For reasons of feasibility and appropriateness, I did not take extensive notes during the course of most of these interviews. Instead, I later recorded what I could remember of these meetings in my field book or personal journal. The personal opinions and professional expertise offered during these conversations furthered my own understanding of the issues associated with water resource problems in Yanuca Village.

Sampling and contacts

The selection of interview participants during the first field season was accomplished through a snowball sampling technique. This type of sampling identifies potential participants through a third party's recommendation. In this study, selection was based on the recommendations of the *Turaga-ni-koro* and several village teachers, with whom I established close working relationships and personal friendships. The teachers in particular were well acquainted with my research questions and objectives, and based their recommendations on this knowledge. Upon discussion and consultation with these teachers I finally decided to focus my interviews on women villagers. This decision was based on a number of issues:

- a. Women were identified as the primary water resource users and managers;
- b. Women were more likely to be available for interviews as men spent most of their days on other parts of the island farming, or were gone for days at a time either out at sea fishing or on the mainland (Viti Levu) performing in fire walking shows; and

- c. For cultural reasons, I would probably establish a better rapport with women than with men.

With Yanuca Village being such a small community, the teachers knew almost every member of the community. I was escorted around the village on the days I conducted the interviews by a well-respected villager, who approached participants and explained in Fijian who I was and the purpose of my study. Upon expressing their willingness to take part in the study and their immediate availability for an interview, I verbally introduced myself and explained the reasons for wanting to conduct the interview. I subsequently presented them with a 'letter of initial contact' (Appendix 2) reiterating this information and answered any questions they may have had. Once there was a mutual decision to proceed, I described the conditions of informed consent and the interviewing process and structure. After obtaining the participant's signature on the consent form (Appendix 3) and their permission to tape record the discussion, I started the interview. The final number of interviews conducted for this study was determined by a 'saturation' measure whereby interview information became repetitive as little or no new data was being obtained (Creswell 1998). Concerns with time, data manageability, and financial constraints were also considered.

4.4.6 Household Water Surveys

According to Neuman (1997), "surveys are appropriate for research questions about self-reported beliefs and behaviours" (228). They provide quantitative information about the social world while also describing qualities about people and communities. In order to obtain a baseline understanding of the water consumption behaviour in Yanuca Village, five households were asked to participate in a weeklong survey whereby their daily water consumption patterns were recorded. Households were selected based on previous participation in the study. I approached the selected households, usually through the senior female, and explained the purpose of the survey and the conditions of participation. Upon agreeing to take part, participants were then instructed, sometimes through the use of a translator, to keep track of how much water they used for daily activities and record it on the survey sheet. Quantities were measured based on units and collection methods most convenient for the participants – i.e. pre-measured buckets and

jugs. I supplied each household with a 13-litre bucket, 1-litre jug and survey sheets (Appendix 5) at the beginning of the survey. Non-extractive uses of water such as bathing in a pond were not included in the household surveys. These quantified values were supplemented with socio-economic information on each of the households, including a profile of their members, the location of the home with respect to village water supplies, and some general information on self-reported water use patterns. The results of the household surveys provided a general picture of the water demand in Yanuca and enabled me to evaluate the relationship between consumption patterns and resource availability.

4.5 OPTIONS FOR DATA ANALYSIS

The data gathered in this study were analysed for the purposes of describing and explaining conditions of water scarcity in Yanuca Village. Much of data analysed in this study was *textual* data, based on observations, interviews and documents. The records, documents, field notes, journal entries, and interview transcripts collected using the five methods described above were first organized and processed (transcribed, corrected, edited, etc.) to make them available for analysis (Huberman and Miles 1998). These data were then examined and categorised through a coding process, which identified major themes in the case study. More specifically, a coding process involving three ‘passes’ through the raw data was undertaken (Neuman 1997). The first pass, called *open coding*, occurred soon after data collection. As regularities and recurrent ideas in the data were noted, codes or labels were assigned to these themes (Marshall and Rossman 1995). Their identification was guided by the initial research question and conceptual framework of the study. This process assisted in organizing the raw data and offered a preliminary look at some of the concepts shaping the research. During the second pass through the data, or *axial coding*, the initial coded themes were examined and revised to uncover relationships between concepts. This involved merging and subdividing existing themes or creating new ones as well as locating empirical evidence to support emerging core themes. The third and final pass through the data took place once the major themes of the research were identified and developed. This *selective coding* process involved reviewing all the data and previous codes to retrieve illustrations and elaborations of the

major themes. ‘Analytic memos’ documenting personal reflections on the coding process were recorded throughout my data analysis. Included in these memos were reasons for examining particular themes, lessons being learned, insights being provided, and suggestions for future action (Ely 1991). This then enabled me to forge “a link between the concrete data or raw evidence and more abstract, theoretical thinking” (Neuman 1997, 424).

The household water survey results were analyzed in a different manner, whereby total household water use quantities were first normalized to per person/day values. These values were then compared across households using basic descriptive statistics to discern differences and similarities in water use patterns. Upon identifying significant trends and variations, they were qualified through the incorporation of household socio-economic information and examined in relation to the other data gathered for this study. The results of this survey served to corroborate the water use activities identified through my interviews and provide concrete examples of the behaviours that played a role in shaping water scarcity in the village.

4.6 SITUATING MYSELF IN THE RESEARCH: SUBJECTIVITY AND LIMITATIONS

Remembering that qualitative research aims to reveal contextualised processes and meanings through interpretation and emphasises the intimate relationship between the researcher and what is studied, the purpose of this section is to situate myself within the case setting, Yanuca Village, through a description of my own living arrangements, daily activities and firsthand experiences. By describing my method of entry into the case setting and my daily living circumstances, I address some of the situational realities and constraints that shaped my research activities. This is important for the soundness of this study relies to a large extent on my sensitivity to the challenges and limitations that present themselves throughout the research process. Thus issues such as power dynamics, representation, cross-cultural communication, and personal biases must be reflected upon for they influence the collection and interpretation of information in a study. However, in addressing these limitations through anecdotal accounts from my village stays, I also provide a rich context for the collected data presented in the

following chapter and highlight the unpredictable and dynamic nature of qualitative research.

4.6.1 Arriving

It is easy to forget just how close Yanuca Village is to the mainland Viti Levu. Although one can reach Pacific Harbour in an hour's time by boat and be in the bustling city of Suva forty minutes later, I felt like I was much further away. Village life was unlike anything I had experienced – relaxed yet busy, frustrating at times but less complicated than urban life, very social but never intrusive, and above all fascinating to a newcomer such as myself. I spent a total of five weeks on Yanuca, living in the homes of teachers, which were located on the school grounds overlooking the village. While my village stays differed from one field season to the next, my arrival and entry into the community followed similar procedures in order to demonstrate respect for the lifestyle and environment that I was entering and therefore facilitate my extended stays. Because of language barriers and cultural trepidations, I arrived in the village accompanied by a Fijian acquaintance who could properly introduce me to my hosts and communicate the purpose and overall circumstances of my visit. On both occasions, I enlisted the aid of Fijian men, as they had assisted me in establishing contact with the villagers and were comfortable in representing me.⁷ In seeking permission to stay in the village, both of my stays began with a *sevusevu*, a traditional Fijian ceremony involving the presentation of a bundle of *waka* (whole kava roots) “by the host to the guest, or the guest to his host...in respect of recognition and acceptance of one another” (Ravuvu 1983: 120). Participants of the *sevusevu* (senior male villagers) gathered at the village chief's representative's house and sat cross-legged in a circle in the middle of the main room, with a *tanoa* or wooden yaqona bowl placed on the inside edge of the circle. As the recognized guests,

⁷ During my first field season, I was accompanied by an education student I had met through a mutual friend at the University of the South Pacific in Suva. He graciously volunteered to help me make initial contact with the villagers and advise me on protocol issues in Fijian villages. Although I was much more comfortable with the idea of arriving in Yanuca Village on my own during the second field season, I was nonetheless accompanied by an communications engineer I had met in Suva through the village headman in September 2000. He was the headman's nephew and was in the midst of drafting a funding proposal to the Japanese government on behalf of the villagers for development projects. He felt that my research was relevant to the proposal and wanted to make sure the villagers understood the potential value of my study. He therefore felt it would be beneficial to have him formally reintroduce me to the community when I returned to Yanuca Village in October 2000.

my colleague and I sat across from the *tanoa*. The *waka* was presented by my colleague to the host and was accompanied by a short speech explaining the purpose of my visit. The chief's representative then received the *sevusevu* and acknowledged it with a short speech of acceptance. Upon receipt of the *sevusevu*, *yaqona* drink was offered to all participants and served in a specific order, with the chief's representative being offered the first *bilo* (a bowl made of half of a dried coconut shell). The ritual words, chants and gestures accompanying the presentation and acceptance of the *yaqona* were performed in a profoundly quiet atmosphere, with participants maintaining hunched and deferential postures as a sign of respect for the elders present in the room. After several bowls of kava and some introductory conversation, I left the kava session and returned to the school grounds to acquaint myself with my new surroundings and host families.

This ritualized method of entry into Yanuca Village initially complicated the representation of my research. Because the *sevusevus* were conducted in Fijian, I was not aware of what was being said on my behalf. During my first village stay, my colleague stayed up most of the evening drinking *yaqona* (kava) with the village men and left early the following morning. After several days in the village, it became apparent that there were misconceptions surrounding me and the purpose of my research. It turned out that my 'gatekeeper' had represented me as a Canadian water expert visiting Fiji with the explicit purpose of assessing the water situation on Yanuca. According to him, I had become aware of the village's water problems while in Canada and had deemed them serious enough for overseas travel and closer inspection. It was stated that my findings could potentially bring aid money to the village and eventually solve local water resource problems. This misrepresentation was further complicated by the coincidental fact that recent groundwater investigations on the island had been funded by Canadian aid money. After explaining to several teachers my uneasiness with my perceived role in the village and generating any false expectations, they set about spreading the word on the real purpose and nature of my stay. However, in order to assuage any disappointment, the teachers emphasised the potential value of my study in solving local water problems, informing them that they could refer to my 'report' when seeking assistance from relevant authorities. While this proviso may have led participants to exaggerate or

misrepresent their experiences anyway, it was probably to a much lesser degree than had they continued to view me as guaranteed solution to their water problems.

Moreover, as a formally educated single woman from the ‘developed’ world staying in a rural community in the ‘developing’ world, I had to be cognisant of the way in which I may be perceived by study participants in order to minimise power differentials. The unequal balance of power between the developed and developing worlds can sometimes be reproduced in research settings where participants feel an obligation to cooperate with the researcher (Robson and Willis 1994). This can translate into contrived responses and compromised rapport between the researcher and participants. During my village stays, I sought to avoid this situation by explicitly stating that cooperation was purely voluntary and that participants could withdraw from the study at any time with no questions asked. I tried to convey through words and actions my appreciation for the knowledge and experiences they chose to share with me, as well as a commitment to the lessons learned.

Also, I did not arrive in Fiji free of pre-conceived notions of what I might encounter and where my research might take me. My interest in Fiji was the result of learning about it through the popular media, academic literature, and personal accounts. My decision to focus on water resource issues stemmed from a personal interest in the social processes contributing to natural resource scarcity.

4.6.2 Living Arrangements

Prior to my arrival in Yanuca Village, a number of USP staff and students suggested I stay with local teachers, as they tend to be more comfortable speaking English on a regular basis and are well-respected within their communities. As a result, I would encounter fewer difficulties in communicating and associating with my host household and garner more credibility and support in conducting my research. Moreover, because teachers have achieved a higher level of education – especially compared to rural community standards – they were more likely to understand my research and therefore be in a better position to offer insight and assistance throughout my research process. Therefore, during my first field season in 1999, I stayed with Sera, a single 24 year-old

female teacher who had been living and working in the village for three years. She taught classes one and two (five and six year olds) and was just ending her placement on Yanuca when I arrived at the beginning of November. She lived in a small one-bedroom house constructed of plywood and corrugated metal with two of her male cousins, aged 14 and 17. Because Sera left Yanuca for a teaching placement in Suva shortly after my first field season, I stayed with another teacher, Luisana, during my second trip to the village in October 2000. As Sera's next-door neighbour and good friend, Luisana and I had become quite close during my first visit to Yanuca in 1999. Luisana and her husband Dan, both in their early thirties, taught at the school and were finishing up their third year on the island. Their six year old twins attended the school, and they had two other children at home – a two year old son and an eight month old daughter. Apart from teaching classes one and two, Luisana was also the leader for the Yanuca Girl Guide troop she started a year earlier, while her husband led the local Boy Scout group⁸. Her family lived in a house similar to that of Sera's, only the bedroom was divided into two smaller rooms using a large wooden wardrobe. In addition to the six family members living in the house, Avisaki, the 'housegirl', and her 3 year-old daughter were also part of the household, living in a room beside the kitchen. Avisaki was new to the village, having been recruited by Luisana through family members on the mainland to assist with daily household chores since Luisana worked at the school on weekdays. As a 23 year-old divorced mother of a young child, Avisaki's decision to live and work in Yanuca Village had less to do with financial incentives and than with her hopes of finding a husband. Needless to say, I was reluctant to impose myself on a busy household of five children and three adults, but I stayed at their insistence and it proved to be an enriching, and at times chaotic, experience.

Apart from the rewarding personal experiences of being received into a Fijian household, staying with Sera and Luisana offered a number of other advantages, as well as some

⁸ Luisana had previously taught classes three and four but was asked to takeover Sera's position upon her departure. There are a total of four teachers working at the village school. In 1999, there were two male teachers and two female teachers. The vacancy left by Sera was filled by a male, thereby leaving Luisana as the only female teacher at the school. Because women are perceived as being more capable of teaching younger children, Luisana was asked to take-over classes one and two and allow the newly arrived teacher to teach classes three and four.

potential drawbacks, to my research activities. On the positive side, because they were fluent in English and possessed a solid understanding of my research questions, they helped me in conveying the purpose of my activities and generally communicating with villagers. The relative ease of communication between the teachers and myself also enabled us to engage in many enlightening conversations on some of the local issues I observed in the village and how they influenced water scarcity. Thus, my ability to contextualise the gathered data and understand the links between what I observed and what I was told in the interviews was strengthened. Also, as well-respected members of the community, their support of my research lent a certain degree of credibility to my activities, thereby enhancing the willingness of villagers to participate in my study. However, the fact that the teachers were non-locals and had lived in Yanuca Village for only a few years presumably affected my understanding of the local context. In one sense, their perspectives were useful in gauging my own outsider perceptions, as often times they understood and corroborated my experiences with their own accounts. Nonetheless, they were less inclined to offer a localized historical framework for the social issues and processes I observed. Moreover, as professionals earning a regular income, they did not experience everyday life as the local, semi-subsistence villagers. Lastly, the actual location of the homes in which I stayed were physically separated from the villagers, as teachers resided at the top of a hill, beside the school. This served to diminish daily interaction with villagers and possibly my overall sense of village life.

4.6.3. Daily Routine and Adjusting

A day in my life in Yanuca Village followed a relatively simple routine. I would usually be up by 7am and spend an hour or so playing with the children or conversing with people as breakfast was being prepared. After breakfast and a quick bath using a bucket of rainwater, I began my day's activities. This included exploring the island, surveying the village, reviewing school health records, writing in my field journal, taking pictures of my surroundings, or talking with villagers. After some time in the village, when people became more comfortable with my presence, I was asked to assist in carrying out certain activities. For example, when the head teacher had to travel to the mainland during the middle of the week, I was asked to take over his morning mathematics class

and teach a geometry lesson to seventh and eighth grade students. On a separate occasion, the village headman asked me to provide a guided tour of the village to a Canadian couple who had anchored their yacht off the island and come into the village to perform a *sevusevu*.⁹ Lunch hour started at 1pm and was a time for the teachers to relax and regain some energy. The school children would head down to the village for their meals, and I would eat with my host family. After lunch, workday activities resumed and I would occupy myself until 4pm, when the teachers returned home. Most of my research interviews and survey follow-ups were conducted between 4 to 6pm with either Sera and Luisana oftentimes serving as translators. It was the most convenient time to formally meet with villagers as the workday was winding down, or was at the very least, much less hectic than in the morning and early afternoon. After spending time in the village, I would return to the house and relax with my host family, play with the children, and then eat dinner, which was served between 7 and 8pm, depending on how busy things were around the house. The remainder of the evening was spent socialising, which on some occasions included heading down to the village to drink kava or watch television at one of the houses connected to a generator, but for the most part consisted of sitting at home sharing stories and experiences with Sera and Luisana. These conversations not only enabled us to get to know each other on a more personal level, but, as mentioned before, also provided me with a great deal of insight into some of the issues that shape village life. Bedtime was usually between 11 pm and midnight, and I would retire to my room exhausted from all the fresh air and newly acquired information from the day's activities. I would spend an hour or so in bed writing in my field journal, recounting events, recording my impressions, and formulating a rough plan for the following day.

Living without electricity, running water, and other amenities certainly required some adjustments on my part. Bathing in a small corrugated metal shack with a bucket of rainwater (and tenuous privacy), or using water seal toilets, or even collecting water from storage tanks for such routine activities as drinking and brushing my teeth were all

⁹ According to Fijian custom, those who wish to use reefs or fishing grounds belonging to a particular village are first required to ask permission from the village headman through the presentation of a *sevusevu*. This applies to all non-villagers, whether they be tourists on a yacht or dive boat, or people from another village who want to fish locally.

conditions I got used to within my first few days in the village. Previous village stays in Fiji had prepared me to live without certain amenities and comforts. Nonetheless, there were several conditions I neither anticipated nor adjusted to easily and which necessitated more time (and humour) for me to become accustomed to. One such condition was the lack of lighting both in the house and the village in general. As soon as the sun set between 6 and 6:30 pm, I was entirely dependent on a kerosene or benzene lamp, or my flashlight. With only one lamp for the entire household, most rooms were dimly lit and any reading or writing I tried to accomplish was done using my flashlight. Apart from limiting my own work schedule and activities, the lack of light in the village restricted my movements. Venturing down the steep stairs into the village or heading out to the toilets at night became somewhat of an adventure, with dozens of frogs jumping out at my feet from every direction, not always knowing where or in what I was stepping, and tripping over obscured bumps and depressions in the ground. However, as I grew more familiar with the layout of the village and school grounds, I became less intimidated by the darkness.

Language barriers also took some adjusting to and presented some challenges during the interviews and in daily interaction with the villagers. Although I was usually accompanied by somebody who could translate for me, my inability to communicate directly with locals in their native tongue only reinforced my 'outsider' status. During the interviews, lengthy the responses to the questions, which sometimes involved an animated exchange between the translator and the participant, were translated into much briefer answers. Thus, the issue of an additional data 'filter' arose, whereby the responses I analysed were interpretations of interpretations.

Other conditions that required some getting used to had less to do with logistics and physical comfort than with adapting to a new social environment. Without movies, restaurants, cafes, and bars to facilitate social interaction, socialising became a much more intimate and subdued experience, often consisting of sitting in a home, sometimes around a bowl of kava, and talking. Subject matters could range from family gossip, to politics, to something as trivial as shoe sizes. No matter what the topic of conversation,

there was almost always laughter and teasing involved, interspersed with friendly taps and nudges as stories and opinions were exchanged. Because of this heightened level of social intimacy, confidentiality and anonymity were virtually non-existent, and news travelled fast in the village. I was constantly surprised by how much people knew about me before meeting them. This heightened awareness of other peoples' actions and words made me more apprehensive in dealing with villagers, particularly after my initial experience of being misrepresented as an independently wealthy water expert from Canada. I became conscious of what I said and did, not only out of fear of committing any cultural transgressions, but also because any comments repeated out of context could be potentially misconstrued. Still, I was also comforted and touched by the realisation that people were watching out for me, mindful of my whereabouts and concerned with my overall well being. For example, when I was robbed in downtown Suva several hours before I was to return to Yanuca, I called the village headman to inform him I would not be arriving as scheduled, explaining that I had spent the morning at the police station reporting the incident. When I did finally arrive on the island the following day, news of the mugging had already spread, and concerned villagers stopped by to see that I was okay, leaving offerings of fruit and fish at the house.

This unexpected and touching response made me realise the extent of the strong sense of community and caring that underlies social interaction in the village. In fact, my overall experience of the exigencies of village life provided me with a concrete understanding of some of the issues surrounding my study of water scarcity. Bathing with a bucket of rainwater and fetching water for routine activities underscored the limited and relatively inconvenient nature of the local water supply. Living without electricity and regular phone service emphasised my sense of disconnection from the mainland. Spending evenings playing cards or sitting in the kitchen conversing with women illustrated the heightened level of social intimacy associated with village life, as well as the differing gender roles. Thus, apart from personally experiencing a different lifestyle and culture, the new surroundings and daily encounters in Yanuca Village reinforced my observations and understanding of village life.

Furthermore, my first stay in Yanuca Village was relatively brief and unfortunately coincided with a rather inconvenient time for villagers. I arrived shortly after the death of a village elder and therefore did not want to impose myself on any of the villagers as they prepared for the funeral. Also, both village stays took place a month before the Christmas season and toward the end of the school year. Thus, villagers were busier than usual, thereby making me more apprehensive about approaching people for interviews and other types of information.

4.6.4 Limitations of the Survey

Apart from the potential biases and limitations stemming from my own subjectivity within the village context, the implementation and design of the household water use survey presented its own possible restrictions. The inconvenient demands of self-reporting daily activities may have compromised the accuracy and verifiability of the results. The participants were essentially asked to be fully aware of routine behaviours and to record values associated with seemingly menial activities. Such a task presumably required a shift in mindset, which may not have persisted throughout the duration of the survey period. Thus, some activities may not have been recorded or values may have been approximated at a later time when the participant remembered to document their water use. Moreover, the division of labour within the household may also have affected the survey values. For example, children carrying out certain responsibilities, such as preparing dinner, may not have recorded their water use.

4.7 REVIEW

In this chapter I identified the methodological framework of my case study on water scarcity in Yanuca Village. The design and implementation of this framework enabled me to examine the water resource situation at the study site, as well as its perceived problematization by local women. By outlining the various data collection methods, I described the different ways in which I sought to identify and understand these situations and perceptions. Moreover, by employing multiple methods, I was able to corroborate the results and strengthen the emergent research process. I also addressed the issues of subjectivity and potential research limitations. In recognizing these limits, I emphasize

the proximate and dynamic nature of qualitative inquiry, which lends itself to a different way of understanding a problem. The end result of my subjective inquiry of contextualised processes enabled me to develop a rich description of water scarcity in Yanuca Village, bringing the concepts and issues raised in Chapter 2 to a more intimate experiential level. In the following Chapter, I present the results of my research activities and begin discussing of the theoretical implications of these activities.

CHAPTER 5

CASE RESULTS

5.1 INTRODUCTION

As a resource required for human survival and development, water is an indisputable part of everyday life. Because it is such an essential part of our existence, we often take water for granted, not always aware of how it is collected, consumed and generally used in the daily functioning of our lives. Moreover, we are not necessarily cognisant of how our lifestyles, values, and choices affect the availability and consumption of water.

Remembering that water scarcity is not necessarily an objective reality and can in part be created through social processes, a comprehensive understanding of scarcity in a particular community warrants an examination of the choices, behaviours, and perceptions adopted by its members.

This study seeks to unveil some of these factors in a particular community through a number of qualitative methods, which were discussed in Chapter 4. Having provided a description of the social and physical context within which this study is situated, I now focus on the results of my research activities. The majority of my data was collected during the course of two separate village stays. Understanding that the local water supply was deemed insufficient, I sought to uncover why and in what ways this was the case. Thus, the purpose of these village stays was three-fold:

1. To identify the existing water resource situation, including an overview of the sources and uses of freshwater in the community;
2. To obtain a general idea of consumptive patterns and behaviour; and
3. To examine the ways in which women – the primary water resource users and managers in the village – identify, experience, and respond to water scarcity.

The organization of this chapter parallels the sequence of these three objectives. The first section provides an overview of the water resource situation in Yanuca Village, using information obtained through interviews, observations, and document reviews. This is followed by a summary of results from the household water use surveys, which offer a

general idea of consumptive patterns and behaviour in the study community. The final section presents the common themes that emerged from my analysis of the semi-structured interview data, highlighting the views and experiences of women villagers in understanding and dealing with local water resource problems. Analysing and interpreting all of this data helped me to uncover some of the behaviours and perceptions that influence how water is managed in Yanuca Village, and therefore explore the social processes that contribute to its scarcity.

5.2 SUMMARY OF THE WATER RESOURCE SITUATION IN THE VILLAGE

Before delving into an examination of the major forces that shape water resource problems in the village, namely scarcity, I first surveyed the local water resource situation by identifying, through interviews and observations, the sources and uses of water in the everyday lives of villagers. As mentioned in Chapter 1, Fiji experiences distinct wet and dry seasons. While the seasonal differences in rainfall in Yanuca Village are not as extreme as those in other parts of the country, such as in the Western Division, there are implications in terms of water sources and uses, especially in communities with limited freshwater.

5.2.1 Sources of Water

The sources of freshwater in Yanuca Village are limited and seasonal in nature, as rainfall is the primary determinant of the types and quantity of sources available for consumption. Owing to its small size, Yanuca Island has restricted groundwater and surface water supplies. Recent investigations conducted by the Mineral Resources Department in Suva identified three potential borehole sites that could tap into the groundwater supply on the island. The boreholes were drilled in late 1995 and pump tests revealed two of the boreholes as having low yield, while the third had good yield but poor quality. It was suggested that the high yielding well be used for bathing and other non-consumptive purposes, and the remaining two be used for human consumption with safe, strictly controlled abstraction. However, after further consideration by the district health inspector, it was concluded that the groundwater supply was too fragile, and overuse or misuse on the part of the villagers could lead to saltwater intrusion and

subsequently destroy the island environment by depleting the freshwater supply needed to sustain local flora and fauna. The boreholes, therefore, remain locked up and unused, much to the confusion and frustration of villagers. The surface water scheme on Yanuca Island consists mainly of small ponds, a hand-dug well, and a small stream running through the middle of the village. Much of this water is unfit for direct human consumption (see Table 5.1) and some ponds and the small stream are only temporary sources as seasonal rainfall determines their presence. Thus, villagers rely predominantly on rainwater harvesting to meet their water needs, with surface water serving as a supplemental source of water.

Table 5.1 Coliform Analyses for water samples taken in Yanuca Village

Sample	Total Coliforms c/100 mL	Faecal Coliforms c/100 mL
Pond 1 (seasonal)	TNTC ^a	14, 600
Pond 2 (permanent)	TNTC	5, 200
Well (permanent)	TNTC	1, 000

Note: In order to obtain a general idea of the quality of water in the village, five samples were collected from various sources during November 1999 for preliminary analyses on coliform content.

^aTNTC = too numerous to count, > 20, 000. According to World Health Organization (WHO) standards, the highest desirable level of total coliform is <10/100ml, and 0/100ml for faecal coliform.

Rainwater harvesting is achieved through the use of roof catchments, guttering systems and concrete storage tanks. The tanks are of various sizes, with the majority of them attached to the roofs of three or four households. They are scattered throughout the village and access to their use is unrestricted. With the exception of two older and larger communal rainwater tanks, which were built over thirty years ago, the storage tanks in Yanuca Village are approximately ten years old and were built through the subsidized rural self-help scheme. Through this programme, the government provides two-thirds of the material costs for the water supply and covers the full cost of technical assistance (survey, design, transport etc.) and supervision. The villagers are required to contribute the remaining one-third of the material costs and provide local unskilled labour. After an initial 'guarantee period' of six months, where the Public Works Department is available

to repair any problems with the newly installed water scheme, the villagers assume full responsibility for the water supply, including the costs of all future maintenance and repair. According to the village headman, the tanks are typically cleaned once a year, during the dry season, using coconut husks and water. Many of the tanks and guttering systems in the village are in poor condition, thereby compromising the quality and quantity of water supplied to their users. Of the 22 tanks in the village (including the two older tanks) and on the school grounds, 7 are wholly intact and operational while the other 15 are in various states of disrepair. The most common problems are broken taps, cracks and leaks around the bases, and broken lids that expose the contained water. The guttering systems are either disconnected from the tanks or broken and unable to transport water from the roof catchments to the tanks. The largest existing roof catchment in the village, on top of the original Methodist church, is not being exploited as it is connected to one of the older, obsolete tanks. A larger Methodist Church is being constructed directly in front of the old church and completion of the building is projected to take place some time in 2001, pending adequate financial support from the villagers. Should the exploitable roof area of this building be utilised, it will be a considerable addition to the village water supply.

During extended periods without rainfall, such as the 1997-1998 El Niño drought, villagers travel to the mainland to collect water from the Centra Resort in Pacific Harbour. There are at least two scheduled trips a week for water collection where families provide large plastic containers (20L each) to be filled with water for drinking and cooking. If there are boats travelling to the mainland for other purposes, water collection is incorporated into the agenda as well. In exchange for providing Yanuca villagers with water, the resort has been granted permission to use one of the beaches on the island for guest leisure activities such as picnicking and snorkelling. In extreme cases, when the rainwater tanks are empty and travelling to the mainland is insufficient for meeting water needs, the village requests government assistance through the shipment of emergency water to the island. The villagers' ad-hoc reliance on resort-provided water and government shipments is a result of the variable nature of dry seasons, as some dry seasons provide enough rainfall for the use of existing tanks and others do not.

5.2.2 Uses of Water

Water in Yanuca Village is used for domestic purposes – i.e. drinking, cooking, bathing, and washing. Although some villagers engage in small-scale subsistence agriculture (including cassava and garden vegetables such as carrots, green beans, sweet potatoes, and cabbage), water is not extracted from the village supply for these purposes. Villagers are entirely dependent on rainfall to sustain their plots. Water use in the village is seasonal with marked differences in the sources used to for certain activities. Table 5.2 provides a summary of the activities requiring water and the different/seasonal sources used to meet these requirements.

Table 5.2. Water use activities and sources in Yanuca Village.

Activity	Source		
	Wet Season	Dry Season	Drought
Drinking	Tanks	Tanks (until empty)	Mainland/ponds
Cooking	Tanks	Tanks (until empty)	Mainland/ponds
Washing/Laundry	Tanks/well/ponds	Ponds/well	Ponds
Bathing	Tanks/well/ponds	Ponds/well	Ponds
Toilets	Drums	Drums/seawater	Seawater/convert

During periods of regular or abundant rainfall, villagers use water from the storage tanks for most of their activities, although some continue to use the ponds and wells for washing and bathing out of habit and convenience. While rainwater is understood to be of superior quality, the volume of water needed for activities such as washing clothes and dishes or bathing, relative to that needed for drinking and cooking, often translates into more effort spent on transporting water from the tank to the washing/bathing site. Thus, many villagers continue to bathe in the ponds or do their washing beside the well during the wet season. The primary exception to this is infants, as they are only bathed and their clothes always washed in rainwater. Rainwater collected in empty drums beside houses is used to flush water seal toilets.

During periods of limited rainfall or drought, when water in the tanks is not being replenished on a regular basis, villagers use tank water strictly for cooking and drinking, and turn to existing surface water sources for other activities. Because many of the tanks have broken lids and therefore expose the contained water to mosquito breeding, much of this water is boiled prior to consumption. When the tanks run dry, drinking and cooking water is collected from the mainland, as mentioned in the previous section. This water supply is also used to bathe infants and wash their clothes. If the mainland water supply is depleted prior to a water run, some villagers use pond water for cooking and drinking. Upon collecting water from one of the cleaner, spring-fed ponds, they let it sit for a day in order to allow the sediment/suspended particles to settle to the bottom of the container. They then remove the cleanest, top layer of water, run it through a cloth sieve to remove any additional sediment, and then boil it before use. It was acknowledged that this was a last-resort measure, carried out during times of extreme need. Washing and laundry are done using pond or well water during dry periods, and toilets are flushed with seawater, although most toilets are converted to pit toilets, thereby eliminating the need for flushing altogether. Again, this measure is adopted out of convenience, as carting water from the sea to the toilet facilities is time-consuming and labour-intensive.

If women choose to do their laundry using pond water, whether it is during the wet or dry season, it is asked that clothes not be washed directly in the pond. Instead, water is collected in buckets and carried away to a separate location, where clothes can then be washed without any risk of further polluting the ponds with detergents. The same is expected of villagers who choose to bathe with pond water – they are to refrain from going into the ponds and must collect water in a receptacle. While this is the general rule in the village and should be followed out of consideration for others, this is not always the case.

5.3 HOUSEHOLD WATER CONSUMPTION: RESULTS OF THE SURVEY

The one-week household water consumption survey conducted during my second field season provided me with some basic insight into water use behaviour and patterns in the village. Because the survey was conducted at the beginning of the wet season, water

shortages were not a problem. Tanks and ponds were replenished on a daily basis, mostly during an afternoon rainfall.

All of the participating households lived in one bedroom houses constructed either of corrugated sheet metal or plywood. They were connected to a rainwater tank or located relatively close to one, and, with the exception of Household 2, were in close proximity to one of the village ponds. Households 2 and 4 lived on the school grounds while the others were situated in the village. All of the households had children, and in the cases of Households 1 and 2, this included infants. A summary of participating household characteristics is provided in Appendix 6, including age and sex composition, the number of generations living in the house, source of income, location of the house relative to ponds and tanks, and the water sources used in carrying out different activities.

5.3.1 Limitation of Reported Results

The results of the survey, which are summarized in Table 5.3, highlight a number of local water consumption issues. However, before addressing these issues, some of the limitations of the survey design and implementation must be addressed for they restrict the explanatory value of the results. As mentioned in Chapter 4, self-reporting surveys require participants to be continually aware of daily household water consumption. This can be particularly challenging in large households where daily personal routines often differ, depending on age and sex. Thus, while women are largely responsible for carrying out domestic activities, there are activities that can be carried out on a more individual basis and can be difficult to monitor. For example, men and older children bathe on their own and are more likely to engage in daily activities away from the home. Also, it can be difficult to take note of essential and seemingly monotonous activities such as drinking. Looking at the self-reported values for drinking, it is obvious that the participants did not closely monitor this consumption activity. If the weekly drinking water total for Household 2 is normalized to litres/day/person, each member is reported to have consumed 0.19 L a day! Such unfeasibly low drinking water estimates seem to have occurred with each participating household.

Table 5.3. Results of household water consumption survey

Activity and Totals	Weekly Water Consumption (Litres)				
	<i>Household 1 8 members 4mo – 49 yrs</i>	<i>Household 2 9 members 8mo – 32 yrs</i>	<i>Household 3 5 members 7 – 64yrs</i>	<i>Household 4 9 members 5 – 70 yrs</i>	<i>Household 5 5 members 11 – 45 yrs</i>
Drinking	49	12	26	33	27.5
Cooking	155.5	93.5	168	179	152.5
Washing	295	160	159	30 / D	123
Bathing	50	280	0*	0	86
Other**	107	210	0	135	0
Weekly Total	649.5	755.5	353	377	389
Per Person Per Day	11.6	11.99	10.09	5.98	11.11
Cooking & Drinking Per Person Per Day	3.65	1.67	5.54	3.37	5.14

*zeros indicate the activity was carried out using non-extracted water resources such as ponds

**other activities include: washing dishes, brushing teeth, washing hands, and flushing toilets

Moreover, due to the miscategorization of some consumption activities, all recorded quantities cannot be examined on a separate activity basis. For example, one household included water consumed for dishwashing in the ‘washing’ category, while the other households recorded them as part of the total for ‘other’ activities. The only activities that do not appear to have had any problems associated with reported consumption

values are cooking and bathing. Thus, because of these sources of inaccuracy in the survey, I will consider the results on a more general basis, drawing broader conclusions from the reported values. I will address the water consumptions issues raised by these results both in terms of the sources used in carrying out certain activities and the quantities consumed.

5.3.2 Sources Used

Addressing the first issue, water for drinking and cooking is obtained exclusively from the rain tanks. Four out of five households also use only tank water for washing/laundry (Household 4 uses pond water on almost every occasion, and on the one day where 30 litres of water were extracted for washing, it was taken from a drum at the side of the house). Bathing activities present a reverse scenario, where four out of five households almost always use pond water. Exceptions to this tendency are made for members with special needs – such as infants (Household 1) or individuals who prefer warm baths (Household 5). Only Household 2 uses tank water for all of its bathing activities. In fact, Household 2 is the lone household that uses tank water for all of its activities. The continued use of pond water during the wet season, when villagers have the option of using the rainwater system, shows a distinct preference. This may be attributed to a number of factors, such as the relative convenience of using surface water over tank water. Utilizing the latter involves more time and physical labour, particularly for those not directly connected to a tank. This is especially pertinent since pond water is used for the two activities that consume the greatest amount of water – washing and bathing. Also, whereas the tanks are a relatively new source of water, the villagers have always been using the ponds. Thus, pond water may be used simply out of habit – particularly for those women who have resided in the village for most of their lives.

5.3.3 Quantities consumed

Looking at the quantities of water used by participating households, a number of general trends can be discerned. When total consumption measures are normalized to litre/person/day values, four out of the five households reveal similar results. Mean litre/person/day water consumption is 10.15 litres, and the standard deviation is 2.44.

The four households yielding similar consumption results are within one standard deviation of the mean. Household 4's water consumption is much lower, with its litre/person/day value at 5.98 litres. This lower figure is presumably attributed to their higher pond use and the fact that they use a pit toilet, which does not require flushing. Also, they are located directly across from a seasonal pond that is not as frequently used by villagers, as it is situated away from the village grounds at the top of the steep stairs leading to the school grounds. Household 2's seemingly higher consumption could be attributed to relative distance from a pond, proximity to a large and fully operational rainwater tank, the number of young children in the household (five children under the age of six), and the fact that members of the household have only lived in the village for three years (i.e., they are not accustomed to the local water situation).

Interestingly, Bronders and Lewis (1994) estimate the average demand of a Fijian island village to be approximately 50 litres per person per day. This value includes water used for cooking, drinking, and bathing but also assumes the availability of some public standpipes in the village. Thus, this is probably an overestimation for Yanuca Village. The *Rural Water Supply Design Manual* (1984), prepared by the Government of Fiji's Public Works Department, uses a consumption value of 11.3 litres/person/day in its design criteria for rainwater catchment tanks. However, this value takes into account only basic cooking and drinking needs. Most households who participated in this survey had values slightly above or below this government standard, and with the exception of Household 4, this value included some washing and bathing needs. But, if the water used for cooking and drinking are added together, is standardized to per person per day values, and adjusted for under-reporting (i.e. add 2 litres to each value), the results are significantly lower than the government standard. Added to the fact that this survey was conducted during the rainy season, this is an indication that the participating households use much less water than what is accounted for in the government design manual. This, in turn, may be an indication of relative scarcity. However, as this study will show, the numbers belie a more complex reality and cannot be relied upon to provide an accurate portrayal of the water scarcity conditions in Yanuca Village.

Thus, in spite of its limitations, the survey revealed some useful information about the choices and management issues associated with everyday water consumption in the village. Generally speaking, the results corroborated the information I gathered during the interviews and my own observations in Yanuca Village. First, in spite of the relative abundance of rainfall and therefore tank water, most households continued to use the ponds for certain activities – namely bathing. Second, the per person/day consumption quantities were similar across most households. Moreover, if cooking and drinking amounts are standardized and adjusted for potential reporting inaccuracies, there is an indication that water use falls short of figures adopted in government design standards. Based on what I observed and learned in the village, the main difference in consumption behaviour during the dry season would be intensified pond water use –i.e., tank water would be used strictly for drinking and cooking, while all washing and bathing would be carried out using pond water. This is one of the many issues that was discussed in a series of depth interviews with a number of village women, the responses to which are presented in the following section.

5.4 VIEWS AND EXPERIENCES OF INTERVIEW PARTICIPANTS

In order to develop a deeper understanding of the water resource problems in Yanuca Village, I conducted a series of semi-structured depth interviews with ten women during my first field season. Because water scarcity is in part a social construct, whereby perceptions on the roles, uses, and problems surrounding water translate into practices affecting the supply and consumption of the resource, I sought to uncover some of these local perceptions. Coincidentally, my first field season took place a year after the 1997-1998 El Niño drought – one of the worst droughts in Fiji's recorded history. The impacts were widely felt and a disaster/emergency situation was declared with foreign and domestic aid channelled to emergency water shipments, food relief, and other forms of relief assistance. Thus, when I arrived in Yanuca Village in November 1999, water resource issues and concerns were at the forefront of most villagers' minds.

I started each of my interviews with questions about the participant's length of residency in the village, family size and structure, and a discussion of their daily routines. The

interview participants varied in age, marital status, and length of residency in the village (see Appendix 7). Most of the women identified themselves as housewives, but there were others who earned incomes outside of the home. Although it is customary for women to marry out of their village, three of the nine married women I interviewed remained in Yanuca for various reasons. Participant profiles included a young mother of two small children who was relatively new to Yanuca, an elderly widow in her fiftieth year of residency in the village, a middle-aged housewife and mother of eight, and a young, single elementary school teacher. This diversity in personal backgrounds generated a wide array of shared perceptions and understandings of local water resource problems.

Upon acquiring personal information on each of the participants, I asked a series of questions about the sources and uses of freshwater in their everyday lives, the responses to which were summarized in section 5.2. This then led to a discussion on water resource problems in the village, whereby participants were asked to identify and describe such problems including their perceived causes, effects, adopted response measures, and possible solutions. Table 5.4 provides a summary of the issues and themes that emerged in the interviews.

Table 5.4 Summary of interview responses

Problem/Cause	Effects	Response	Solution
<i>Biophysical</i> - Local hydrogeology - Seasonal rainfall - Varying nature of dry seasons <i>Infrastructure</i> - Insufficient and poorly maintained rainwater system <i>Behavioural</i> - Wasteful use of tank water - Pollution of ponds	<i>Time/labour cost</i> - Inconvenience - Physical demands of transporting water <i>Health problems</i> - Skin diseases - Gastro-intestinal ailments - Infections	<i>Adaptation</i> - Household conservation activities - Use of mainland water - Source shifting - Boiling of tank water	<i>Short-term</i> - Government assistance - Fix tanks - Build additional tanks <i>Long-term</i> - Maintain infrastructure - Practice water conservation - Prudent use of pond water - Village cooperation

The remainder of this section will be organized as in the table, starting with a description of the identified water resource problems and ending with proposed solutions. Each of the presented themes are elaborated upon and supported with quotes from the interviews and in some instances, my own anecdotal observations from these meetings.¹⁰

5.4.1 Identified Problems and Perceived Causes

The problems identified by the participants were all associated with the local water supply, referring both to the harvested rainwater stored in concrete tanks and the various ponds located throughout the village. Moreover, because water supply (and scarcity) is a function of both the quantity and quality available for use, both aspects were raised in the interviews. In describing this perceived shortage, they referred to several biophysical, structural, and behavioural issues in the village. These sometimes operated independently of one another, but most of the time operated in conjunction with each other to create conditions of scarcity.

Biophysical Features of Yanuca Island

As a small island community with limited surface water and high seasonal variations in rainfall, biophysical factors of water scarcity were a common theme in the interviews. Nanise¹¹ referred specifically to the island's small size and hydrogeology in talking about local water problems, particularly the brackish quality of some of the surface water sources she and her family had to use:

...I think the sea. Because it's a small island, it's just a small island and most of the time there's no pond water, so we have our bath in the well. And sometimes they are mixed together, the seawater and the freshwater.

More prevalent in the discussions was the recognized role of local climate conditions, especially seasonal rainfall patterns, in determining supply. Distinct wet and dry seasons, as well as the possible incidence of droughts during the latter, rendered the supply unreliable and vulnerable to fluctuation. As described in the previous section, this

¹⁰ Some of the quotes presented in this section are drawn from translated interviews (Anaseini, Viola, Nanise, Miriama, Mere, and Milika). They therefore represent indirect responses and are not necessarily the exact words used by the participants.

variability had implications in terms of consumption activities, as certain water sources were utilized during different seasons (Table 5.2). It also explained the seasonal nature of some of the described problems, most of which prevailed in the dry season. Several women specified that there was not enough water for drinking and cooking during some dry seasons, especially those with extended periods without rainfall. This view was expressed by Milika:

There are no problems during the wet season...during the dry season, the major problem is getting drinking water and cooking water...clean cooking and drinking water...The quantity of water in the village depends on the weather. So, when it's the wet season, we have much quantity.

Luisana, explained that prolonged dry periods not only resulted in a shortage of tank water but also reduced the amount of surface water (i.e. ponds) available for use by the villagers:

...the quantity (of water) on the island, it just really depends on the rain. As soon as we have a long...say for about a month there's no rain, then there's a shortage of water. All these ponds dry up, so very few little ponds are left for all these people to use – the school and the village.

Infrastructure

In addition to discussing the role of local biophysical features, the women also spoke of the infrastructure in determining the supply of usable water. Since they were dependent on rainfall for much of their freshwater needs, this also meant they relied on the ability of the rainwater harvesting infrastructure to collect, store, and dispense this water. As Sera explained, the poor condition of many of the roof gutters and storage tanks affected the village water supply,

We don't have enough water...there are a lot of tanks which have leaks on the side and even at the bottom. So, even though it rains, it doesn't collect enough water because it eventually goes out at the same time. And plus, not enough guttering to collect the water. For example, over here, this tank, right now we are not using it because it has leaks and besides that, we don't have enough guttering. This one is bad and if there were enough (guttering) we could have put some on the side so it could collect more water.

When discussing perceived changes to the village water supply, Miriama felt that poorly maintained tanks compromised both the quantity and quality of harvested water,

¹¹ Names of interview participants have been changed in order to protect their identities.

There has been a decrease in quantity mainly because of the problems with the water tanks, the leakage. The quality has (also) decreased...mainly because most of the tanks are not closed. So it becomes a mosquito-breeding place also. And also, leaves fall into the tanks.

In fact, the issue of malfunctioning tanks was more prevalent in discussions on water quality. Broken tank covers were explained as facilitating contamination from mosquito breeding and fallen dirt and debris. Mosquito breeding occurred only during dry periods, when water inside the tanks became stagnant and therefore ideal breeding grounds for the insects. Contamination from dirt and debris was year round as it resulted from leaves, bird droppings, and various other organic matter entering into the tanks through cracks and holes in the lids. Moreover, broken taps coupled with damaged lids often forced villagers to climb into the tanks to retrieve water, and contact with dirty hands and feet were also seen as contaminating factors. While the tanks were supposed to be cleaned annually in order to mitigate such problems, doing so placed villagers in a predicament. As Sera explained, tank cleanings required the use of water, an already limited resource needed for more immediate activities such as cooking and drinking:

they don't clean the inside of the tanks, so for years, you know sometimes its just dirty...because we don't have enough water also to clean it, and if you have to clean it you have to draw all the water out, so there won't be any water left.

Behavioural Problems

Apart from water quantity and quality issues associated with poor infrastructure maintenance, several women viewed the rainwater harvesting system as promoting wasteful behaviour. This view was mainly shared by those who had lived in the village prior to the construction of the current rainwater system, when there were only two large communal tanks for the entire village to use. Mere, a 63 year-old widow who had spent her entire life in the village, explained:

Quantity has decreased because they are just careless with the way they use water. Before, since they had little water, they were careful with the way they used it. But since they have more tanks, they waste. They're careless.

Anaseini, who married into the village 26 years ago, elaborated upon this view by describing how the construction of the smaller storage tanks enabled villagers to increase

their consumption activities, thereby facilitating its use for less essential purposes such as kava (*yaqona*) drinking. While this was sustainable during periods of ample supply, it became problematic during periods of shortages:

...the quantity of water has decreased. Before we had only two water tanks for the village, but we had enough...yeah, even in the dry season we had enough water. But now, since we have more tanks...the small ones that you see all around, [the villagers] just...they, they don't use the water, how can I say...they don't really preserve water. They use it carelessly, you know? Because before, since they had only two tanks, they only used it for drinking and eating. But now since they have a lot of tanks, they use...the increase activities, you know, the things that they use it for...use it for *yaqona* drinking, eh? When there's not enough water, they still use *yaqona*, you know? They still drink *yaqona* and use the water! Even if we, if we had to bring the water from the mainland...and many times even if it's the only water left in the house, they'll still use it for *yaqona* drinking.

Most of the women who felt that the tank water was being over-exploited also felt that the spring-fed pond water was being under-utilized. In other words, tank water should have been reserved for cooking and drinking purposes, while bathing and washing activities should have been carried out using pond water. But this presented a problem since, according to the women, the pond water was of poor quality. They had implicated the use of this water in the incidence and spread of certain skin ailments (which will be discussed in greater detail below). However, this was not an inevitable, pre-existing situation as poor pond water quality could also be attributed to imprudent behaviour. As Mere explained,

So the problem of water scarcity...is that we just don't have enough drinking water and cooking water. But the major problem that I see is caused by just careless using of water...the villagers use the tanks for washing and bathing when they shouldn't, when they're supposed to be using the pond...(Quality has decreased) because people are more careless...(the green pond used to be cleaner) because before, especially this pond, they usually drew the water out and bathed beside the pond. But now that everyone just jumps into the water, and plus they just throw anything they want into the pond, like rubbish. Especially small children who are not supervised, they just do whatever they want.

Viola, another lifelong resident of Yanuca Village, reiterated this view,

The pond water is good...it's like a spring, it comes up all the time, so it's clean water. It's that...the children misuse it. They jump into the pond instead of

getting the buckets to get the water and go outside and have a bath, and that's how the skin diseases spread because they all just, they just all jump into the pond.

When asked why they thought pond water was being misused, some women felt that the installation of the tanks had diminished the recognized importance of maintaining clean pond water. Villagers did not feel they were as dependent upon them for certain activities and therefore became lax in enforcing their sound use. Mere went even further by attributing such behaviour to selfish mentalities,

People are careless because they only think of themselves. You know, like for example, there are some families who are just using the tank water just for cooking and drinking, while the rest of what they do, they use the pond. Because they are thinking of the village as a whole, so that everyone can get enough water to drink and eat. But then for those who just use it carelessly, you know they're just not thinking of everyone. They're just thinking for them and for that time when they need the water. I guess, just selfishness.

5.4.2 Experienced Effects of Water Scarcity

In addition to identifying the water scarcity issues in the village and discussing them in terms of their perceived causes, the women also spoke of the effects these problems had on their everyday lives. However, the extent to which they experienced these effects differed. Some women described them as acute and requiring concerted response measures, while others explained that they were not always conscious of the effects of water scarcity. For the latter, it had become a way of life, a reality in their everyday living circumstances. This view was shared among those women who had lived in the village for at least several decades, if not their entire lives, as was the case with Mere:

For me now, (water scarcity) is not really a problem. Because I've lived here for a long time, I know where to get the water from. Even if I have very little, I know how to make use of it...to conserve water, all we use (tank) water for...is drinking and eating. That's all...oh, and we also use it for brushing our teeth.

Nonetheless, though they were accustomed to the problem of inadequate supply, they still saw a need for improvement. As Anaseini explained,

(Water) is not really a problem now because we are used to it, so since I've been living here for twenty-six years and been doing that, it's become routine...it's because I've just gotten used to the situation that I'm living in. Yeah, the thing is, although I'm used to it, and maybe to me it's no longer a problem, we still need water.

Sera, who was relatively new to the village offered a similar view,

[The water situation] is bad, I guess, yeah. But, I think if you look at it from the village side, since they've been using it for their whole life, they don't see the...its effects, that side of it. But for us who came, who come from the mainland and see how different it is, we see that it needs improvement.

Time/Labour Costs

The theme of adjustment and adaptation was raised in conversations about one of the effects of the inadequate local water supply – the physical burden and demands of collecting and using the resource. Milika reminisced about some of the hardships she encountered when she first arrived in Yanuca Village forty-nine years ago,

Well, when I first arrived (in the village), I found it really difficult...since I came from the mainland, it was the first time for me to encounter water problems. It was really a problem. So, the changes that I had to go through when I came over were just getting used to washing in the basin, washing in the big pond, collecting water from the pond and bringing it here, taking the washing over to the pond. But now that I've been here for forty-nine years, I have gotten used to all of that.

Sera, who had been living in Yanuca Village for only three years, expressed that she was experiencing frustrations with the dependence on tank water,

You have to get the water, then you come and wash the dishes, and if you run out of water, then you have to go to the tank again, collect water, then bring it back. Even for washing (clothes) you have to do that...bring the water...wash, then I have to go and collect water for rinsing again. You may need how many buckets for that? So, well, it slows our work, it takes up more time, that's one of the problems...Now I have to go and get the water. That's something that I hardly did before.

In discussing the physical burden and inconvenience associated with the local water supply, some of the women referred specifically to drought-induced circumstances.

Luisana spoke of the disruption to her daily routine,

(Water problems) have affected us a lot. For instance, firstly, I go late to school because I have to bathe my children in order to save water. If there was a lot of water, I would just send them to go bathe and then get ready. But with this water problem, I have to bathe them so that the little amount of water they use – at least in a drought – is a bucket of water. We have to share, me, my husband and my children so that the four of us bathe from a bucket of water before we go to school.

Other women talked about transporting 20L containers to and from the mainland during severe dry spells, as it was more time-consuming, and involved carrying greater volumes of water over longer distances (i.e., from the beach to the home). When boats were scheduled to collect water from the mainland, the women gathered their containers, travelled down to the beach to deliver them to the boatmen, resumed their daily activities without any freshwater while waiting for the boats to return at the end of the day, then transported the filled containers from the beachfront to their homes. This particularly affected Miriama, as her home was located at the top of the steep set of stairs that connected the village and school grounds.

Health Problems

Apart from the physical and logistical inconveniences associated with local water scarcity, health problems were frequently cited as an effect of inadequate supply. These health problems could be divided into two categories – those related to mosquito breeding in broken tanks and those resulting from pond water use. According to Leilani,

There are many sicknesses here caused by not enough water, like diarrhoea and skin diseases like ringworm, scabies, you know? Not enough good water, eh? They're not bathing in good water...children will get their bath in there, even small ones, I mean the infants.

Leilani's comment raised several issues. First, skin ailments were viewed as pond water related; second, these problems were especially prevalent during dry periods when tank water is depleted and pond water use is intensified; and third, this was of particular concern for those with children, especially infants. Addressing the first issue, the women identified a number of sicknesses related to the village water supply, listed in Table 5.6. In fact, the topic of health problems was always discussed with reference to children, as they suffered the most from the identified ailments. The women explained that mosquito breeding was a major problem during the dry season when exposed tank water became stagnant. The resulting consumption of mosquito larvae led to vomiting and diarrhoea, which was particularly worrisome for those with infants. Skin diseases and other types of infections (especially those of the ear) were said to be caused by pond water and poor hygiene.

Table 5.6. Water-related health problems identified by interview participants

Health Problem	Perceived Water-Related Causes
<i>Skin diseases</i> ➤ Scabies ➤ Ringworm ➤ “Dhani” or chloasma	➤ pond water use ➤ poor hygiene due to lack of water
<i>Gastro-intestinal ailments</i> ➤ vomiting ➤ diarrhoea	➤ mosquito breeding in stagnant tank water, leading to the consumption of mosquito larvae
<i>Infections</i> ➤ ear infections ➤ “sores” or staph infections	➤ pond water use ➤ poor hygiene due to lack of water

The inadequate supply of freshwater in the village not only meant less water for personal hygiene, but also intensified the use of those sources that were designated for such purposes – namely the ponds – thereby degrading their quality. When asked about the effects of water scarcity in the village, Aliti, a married mother of two, simply stated, “Just my children are sick from lack of washing.” Nanise, who had two young children (a two year-old daughter and a four month-old son), talked about looking for clean water and even living on the mainland during extended periods without rainfall, in order to safeguard her children:

One of the major problems that I face is when there’s a lack of water, trying to get clean water for the baby. So most of the time, I have to go and look for clean water. I have to go to other houses which have tanks and ask them for clean water to bathe the baby in and wash the clothes. But sometimes, I even ask my husband if we could move...go to the mainland so that we can get enough water, mainly for the baby’s safety, and at least be there until they get enough water again over here, maybe when they get rain...So, sometimes we actually go over to the mainland (and stay) for weeks, a month.

Sera talked about some of her own observations of the school children, mentioning the foul odour that filled the air in her classroom whenever students had ear infections caused by bathing or playing in the ponds. Such infections could sometimes develop into serious conditions requiring hospitalization on the mainland. A review of school health records corroborated what Sera and the other women discussed in the interviews, as the illnesses listed in Table 5.6 were observed and documented on an annual basis, along with other problems such as trachoma, conjunctivitis, and dental caries.

5.4.3 Identified Responses to Water Scarcity

The various measures adopted by the women in response to local water scarcity were adaptive in nature and included water conservation activities, the collection of water from the mainland during extreme periods of dryness, shifting to different water sources for certain activities, and boiling water prior to its consumption. Luisana discussed some of the conservation measures she learned to employ during dry periods,

We've learned to use the water wisely, to conserve water. For instance, we will boil cassava, and after boiling the cassava we usually put the water away. We then use that water from the boiled cassava to boil something else – vegetables or fish, things like that. We watch how we use water in everything...washing plates, we can use the same water for washing dishes in the morning and lunch, and then we change the sink water during dinner. Washing clothes – usually we use the (bucket of water) twice rather than using it once, just in order to conserve.

While interviewing Miriama, I noticed dozens of plastic and glass bottles shelved along the walls, all containing water. When I asked her about the bottles, she explained that her family collected these empty bottles and filled them during the rainy season in preparation for water shortages during the dry season. These bottles were sealed and stored away from the sunlight. This behaviour was not mentioned or observed in most of the interviews, however.

The utilization of mainland water during drought conditions was a response measure discussed by each of the women. This included collecting cooking and drinking water from the Centra Pacific Harbour resort as well as performing certain chores on the mainland, such as laundry. As previously mentioned, some women talked about staying

on the mainland during such periods so as to circumvent water scarcity problems entirely. Another widely adopted measure, which again was discussed above, was the shifting of certain water-consuming activities to different sources, e.g., bathing and laundry from tanks to ponds. Finally, all of the women interviewed said they treated their drinking and cooking water during the dry season, when sources were especially prone to contamination. Women with infant children, such as Nanise, boiled their drinking water year round as a precaution, and hurricane season was also cited as another period requiring such safeguarding.

5.4.4 Possible Solutions

Naturally, in discussing the water resource problems in Yanuca Village, the women also talked about possible solutions. These solutions addressed the infrastructure and behavioural dimensions of water scarcity, both in the long-term and the short-term. Moreover, the issue of who was responsible for implementing such solutions was discussed. Most of the women saw a role for villagers and the government in resolving local water problems. Government assistance was mentioned for more immediate, short-term solutions such as repairing the existing rainwater tanks and building additional ones. Leilani expressed this view

Just if the government could see that they do something about this problem, because water problem is the main thing here...yeah, the government should see (to) this. We've been like this for so many years. The people have been going up to them, I don't know what they think about this...they should do something just to help us with this.

She went on to state that while financial assistance from the government would be helpful, it was their technical expertise and resources that were needed in fixing and building tanks.

However, most of the women acknowledged that such measures would not completely resolve the problems associated with water scarcity. Rather, they would be pointless short-term fixes if longer-term solutions were not put into effect. For example, what would be the point in seeking government assistance for constructing more rain tanks if

they continued to be poorly maintained by the villagers? Mere referred to the potential futility of government assistance,

We need help from the government. But the thing is, you know, although the government will provide water tanks to collect water, the people will still be careless with the way they use water. So...I guess it just depends on the people, you know? More tanks, more water – no! They just use it more!

Thus, short-term, government-assisted measures were often proposed in conjunction with other solutions – long-term solutions for which villagers were entirely responsible.

These long-term solutions included the proper maintenance of the rainwater harvesting infrastructure, practice of water conservation, prudent use of pond water, and village cooperation in addressing local water problems. Nanise raised the issue of a joint effort in alleviating local water shortages,

Just if the government could help with providing tanks, and also for people to use water carefully...it's both the responsibility of the villager and the government.

Miriama also shared this view

So, repairing of the water tanks by the villagers, that's their responsibility. The government has provided the tanks, but the village is responsible for keeping it proper...maintaining it. And if the government could supply more tanks.

Apart from properly maintaining the infrastructure, the women also felt that villagers needed to better manage (i.e. conserve) water resources. Anaseini addressed this in her discussion on possible solutions,

So, the first thing to do is at least...since we've got more tanks now, for all villagers to be careful with how they use the water. Be more careful of how they make use of the water. For those who have tanks by their house, at least if they could clean the tanks that (are) there. But again, it depends on the water. Each individual is responsible for the water problem. If everyone is able to conserve water then there wouldn't be a problem. I mean not (that) there wouldn't be any (problems), but the problems will be minimized.

Viola felt that stricter control measures needed to be implemented in order to manage the use of tank water

(Villagers) have to each have a time limit...each use the water tanks from this time to this time, it's when you should use water. And after that it's locked. They need to control, eh? Limit *yaqona* drinking. Water tanks would be used only for drinking and cooking, while you do the rest in the pond.

Ultimately, the women saw a need for the villagers to assume individual responsibility for managing water resources and cooperate with each other in resolving local water scarcity. Mere felt this also involved working within the traditional social structure in the village where village meetings and the village headman could facilitate this cooperation

In order to solve water problems, it's the individual, each individual just has to be careful on how they use water. Because often it is discussed, water problems (are) discussed in the village meeting and the *turagani koro* says if they could just minimize their water usage, and just use it for certain things, etc. So if they could listen to the *turagani koro*.

Mere ended her discussion by saying,

(The water situation) can be improved, especially by the locals who are here. We just need to work together.

5.5 SUMMARY

This chapter has presented an overview of the local water resource situation, the results of the household water consumption survey, and the key views and experiences of the interview participants with respect to water scarcity. Both the overview and survey results were important in providing a localized water resource framework within which to examine the widely understood and shared problem of water scarcity. Together, these findings reveal a complexity of issues (biophysical, socio-cultural) operating at various levels (individual, household, village, island), which shape the availability and use of water in Yanuca Village. Specifically, the following can be said about local water scarcity:

1. It is a function of quantity AND quality;
2. It is periodic in nature, with problems being pronounced during extended periods without rainfall;
3. It is largely the result of poor management of the existing supply under prevailing biophysical conditions; and
4. This mismanagement, in turn, is attributable to a number of social characteristics and processes operating at several levels.

Referring to the first three points, water scarcity in the village is not limited to a physical absence of the resource (due to naturally limited surface and groundwater sources, climatically induced shortages, or wasteful consumption), but is also a function of compromised availability due to contamination. Moreover, there is no question that the village is predisposed to periods of water shortages, as biophysical features play a large role in determining the absence or presence of the resource. However, as the interview responses revealed, the perceived inadequacy of the local water supply is in large part attributed to its mismanagement – namely, poor infrastructure operation and maintenance, and careless consumption behaviours. Thus, scarcity can also be socially induced – a circumstance created through choices and behaviours.

Moreover, in identifying and discussing the understood causes and experienced effects of scarcity in the depth interviews, the women proposed a range of solutions. These possible solutions revealed that scarcity could be mitigated or at the very least, tempered to some degree by those experiencing it. Yet, based on what I observed and learned, solutions were not implemented and water problems persisted. This was especially clear to me when I returned to Yanuca Village during the second field season. For example, while a poorly maintained harvesting infrastructure was blamed for many of the scarcity problems, no efforts were made at improving it during and between my two field seasons. Similarly, village cooperation and collective action were deemed necessary for improving the situation, but neither the village committee nor the village as a whole had held a meeting to talk about water issues since the 1998 drought. Meetings were held to discuss other matters such as church donations and local development projects, but not village water problems. Furthermore, some villagers had expressed a need for government assistance in addressing local scarcity – whether it was through technical support, financial aid, or the organization of local water conservation workshops. However, efforts towards approaching the government for such assistance were not made. The question then becomes, why? Why has the problem of water scarcity been allowed to persist in this community? Why has a community, which is already vulnerable to periodic shortages, not taken the necessary measures to ensure a safe and plentiful supply of water? The following chapter will explore this question through an examination of the

social processes I observed in my research, and their implications for addressing the problem of water scarcity in Yanuca Village.

CHAPTER 6

DISCUSSION: UNDERSTANDING WATER SCARCITY IN YANUCA VILLAGE

6.1 INTRODUCTION

In this chapter I reflect upon the information gathered during my two field seasons and seek to demonstrate what this study reveals about the various dimensions of water scarcity. I ended the previous chapter questioning the reasons for the persistence of water scarcity in Yanuca Village. Upon learning about the failure to adopt alleviation and mitigation strategies, it then became apparent to me that water scarcity in Yanuca Village was a result of both human action **and** inaction. Mismanagement of water resources in this case refers not only to wasteful and polluting activities, but also to neglect and apathy. This mismanagement is, in turn, a product of underlying social processes and characteristics, many of which I observed during my time in the village. Thus, water scarcity persists in large part because its social determinants persist. The purpose of this chapter is to examine the social processes creating water scarcity in Yanuca Village by weaving together the concepts presented in Chapter 2, the results of this study from Chapter 5, and supplementary personal accounts from the village.

6.2 SOCIAL PROCESSES OPERATING AT THE VILLAGE LEVEL

The failure to at least partially mitigate water scarcity, whether it is through upgrades to infrastructure or the practice of more sound water use, reflects a number of social dynamics within the village. The women I interviewed all agreed that there were problems with the local water supply, and discussed the associated inconveniences and frustrations. However, it was clear that little was being done to alleviate these inconveniences and frustrations. This apparent contradiction initially confounded me – if the local water supply was insufficient and problematic, why weren't solutions being implemented? Dreyer (2001:3) offers some insight:

Projects are implemented on the mis-conceptualisation that people don't have water. In reality people without water would be dead. They all have water. It may not be as clean and as plentiful as it might be. When they have some water, people may prefer to spend their scarce resources on other services, such as telephones and electricity. The successful projects tend to be in communities where there [is] a real need for water.

This quote raises one of the key issues relevant to this study, namely the factors that influence the allocation of resources (i.e. money, time and labour) within a community, which in turn can affect how water is managed. Dreyer reveals that communities with existing water supplies, regardless of quantity or quality, are less inclined to divert limited resources towards augmentation or development schemes. This appears to be the case in Yanuca Village. As a small, semi-subsistence fishing village, average household incomes are limited. However, as Rigietta stated in her interview, “there is money here (in the village).” When resources are pooled, the village is able to raise considerable funds for projects. This has been demonstrated through church fundraisers and traditional rituals. For example, at the end of my first village stay in November 1999, I was told that at the beginning of December, each married man had to contribute F\$200, and each single man F\$50, towards the construction of the new Methodist Church. The following year, each married woman was asked to contribute F\$100. Moreover, my second village stay followed an important trip to an outer island (Kadavu) whereby over 80 villagers hired two boats to visit a certain man’s paternal village for the first time. The estimated cost of the trip was over F\$2000. While conversing with one of the village women (who had not participated in the trip) about the considerable resources that were invested in the trip, she noted that before any traditional function, it was common to see villagers put extra effort into raising money by spending more time out on the reef catching fish, diving, and collecting shells. So, while money may be a scarce resource on a daily household basis, villagers do have the means of generating the financial support necessary to repair and maintain the rainwater system. Clearly, doing so is not a priority in the village. In this section, I discuss why this is the case by examining some of the social factors that diminish the importance of implementing long-term solutions to water scarcity, and therefore allow it to persist.

6.2.1 Existing Water Supplies, the Nature of Scarcity and Adaptive Management

First, obvious as it may be, it is important to remember that Yanuca Village has water, specifically in the form of ponds and ephemeral streams. Although the naturally occurring water sources are relatively limited, some of the women I interviewed revealed

that villagers have grown accustomed to the restrictive and varying nature of the supply. The only ‘real’ need for water in Yanuca Village is during extended dry periods, such as droughts, when water has to be obtained from the mainland and the quality of tank and pond water is poor. Most of the perceived effects of scarcity are more pronounced during prolonged dry periods. Thus, situations of absolute need are not chronic, but periodic and unpredictable. Yanuca Village therefore has at least some water most of the time.

Expanding on this, according to what I observed and what I was told, coping mechanisms have been adopted in order to respond to scarcity, thereby allowing the villagers to manage the problem – a type of ‘adaptive management’ (Latham 2000)¹². Sometimes these responses are developed through local knowledge of water resources and their everyday uses (i.e. household conservation activities, source shifting, or boiling water), and at other times through arrangements with external agencies (i.e government barging of water and collection of water from the mainland resort). While these measures are not long-term prevention and mitigation efforts that ensure a reliable local supply, they are sufficient in allowing villagers to meet their immediate needs. In addition, most of these measures are implemented on an ad hoc, or as-needed basis. The exception to this tendency is demonstrated by those households who prepare for potential drought conditions by collecting and storing water in bottles during rainy periods. Nonetheless, the emphasis with respect to water resource management tends to be on the short-term, rather than the long term. Thus, since the onset of drought conditions is periodic and unpredictable in nature and villagers have developed a means for responding to them when they do occur, the level of interest and commitment to implementing long-term solutions is lessened.

The condition of the rainwater harvesting system in Yanuca Village demonstrates this situation. While there is very little that can be done in the village to address absolute shortages during drought periods, the villagers have developed a means of augmenting their water supply during other times of the year through the construction of a rainwater

¹² The term ‘adaptive management’ here refers to, “the local strategies and tactics used by communities in their struggle to cope with the dynamics of their environment” (Latham 2000:2).

harvesting system. This system enables them to collect and store larger quantities of water during periods of abundant rainfall, thereby providing them with more water to get through dry periods. Yet, the effectiveness of the system has been compromised by its poor maintenance. Part of this can be attributed to the hydrologic cycle, the existence of surface water upon which the villagers depended prior to the construction of the system, and the anticipated development of local groundwater supplies through boreholes. As Mourits and Kumar (1994:1) note,

Villagers generally recognise rainwater as a valuable water source but tend to neglect rainwater systems where surface water or groundwater is available. As dry periods up to several months without significant rainfall are not uncommon on the smaller outlying islands and the northern leeward sides of the larger islands, villagers do not always perceive rainwater as a feasible option for water supply. They prefer to concentrate on surface water and springs, although the quality (biological) of these sources may not be suitable without treatment. On the other hand, villagers on those islands where surface water is not available (eg. limestone islands) put great effort into developing and maintaining rainwater catchment systems.

Reiterating what was stated above, seasonal rainfall patterns coupled with the existence of some permanent surface water sources have tempered the incentive for villagers to continuously invest in (i.e. maintain) the rainwater system. Moreover, as mentioned in Chapter Five, some villagers believe that the recently drilled boreholes will be opened up and available for use once funding is secured. The expected development of a more reliable and continuous supply of water may also dissuade infrastructure maintenance and expansion.

6.2.2 Reliance on External Assistance

The construction of the rainwater system and the drilling of the boreholes were both accomplished with the help of outside sources of funding. This raises the issue of the role external assistance has played in local water scarcity. The development of the rainwater system in Yanuca Village introduced a heightened level of government involvement in village affairs. Although the women I interviewed all felt that responsibility for ensuring an adequate local water supply ultimately rested with the villagers themselves, they also felt that the government assumed a certain degree of

responsibility in helping them achieve this goal. This view was more prominent amongst the men I conversed with, who often complained of inefficient government policies and the poor design and construction of the tanks. While this may be true, increased government involvement may have also shifted perceptions surrounding responsibility for the local water supply. The observed effect is an increasing dependence on outside assistance and decreasing self-reliance. Warner (2000:10) addresses this issue by discussing the challenges of government water projects:

...it takes 'water IQ' to actually utilize...resources in a sensible manner that fits the water problem at hand. Stories of hi-tech, turn-key machinery that does not work are legion – either the material on supply is incompatible with local situations or the local system is unable to adapt to what is available to it i.e. the (supply). Expanding government introduces control and dependency on public services. Such political clientelism crosscuts mutual aid systems, which are the stock of social capital. It breaks up social networks on which people depend and in so doing forces people to build up political capital rather than social capital.

Various reports and papers describing rural water supply schemes in Fiji also allude to this reality. Specifically, in describing the increasing demand for government shipments of emergency water, it is noted that

Apart from the cost and the disruption to normal government services, the ultimate availability of free water tends to weaken any incentive for the village to make adequate provision for their own needs. It must also be pointed out that prior to 1970, when landing barges first appeared in Fiji, the same communities were able to survive any drought (CSC 1984:9).

While this statement implies that water needs in rural communities are static – i.e. population growth and expanding demands are not taken into account – it also addresses the drawbacks of introducing outside assistance. However, a community's dependence on local government authorities for relief during emergency situations, such as extended drought periods, is somewhat understandable. But, in the case of Yanuca Village, drought relief is not the only basis for which government assistance is needed. Villagers also expressed a need for government assistance in repairing and, more importantly, expanding the rainwater harvesting system. While the terms of the government sponsored rural self-help scheme clearly place repair and maintenance responsibilities with the community, some villagers argued that they still needed government resources to carry them out. The greatest need for government assistance was in the construction of

additional rainwater tanks – a common solution raised by the women during the interviews. Although they recognized that this did not address the larger problem of poor infrastructure maintenance, they felt it would nonetheless be helpful in augmenting the local water supply.

This notion of decreased incentive in local self-sufficiency due to external assistance can also be applied to the dependence on resort-supplied water during drought periods. The availability of free clean water on the mainland during periods of extreme need reduces the motivation to invest time and money into repairing and expanding the village rainwater system. Granted, a fully intact and operational rainwater system may be of little use during extended drought conditions, but it would provide villagers with more water at the onset and therefore lessen the dependence on resort water. Fewer trips to the mainland for water would also reduce associated costs, such as money for boat fuel and the time and effort spent on coordinating such trips. However, these costs are evidently perceived as less taxing than those related to implementing long-term solutions.

The availability of foreign aid in funding rural development projects is also pertinent to this discussion, as Yanuca Village has been the recipient of such assistance. According to the teachers I spoke with, their living quarters were constructed with the help of hurricane relief funds in 1980s and, as previously mentioned, the boreholes were drilled with Canadian aid money. When I returned to Yanuca Village during my second field season, the villagers were in the midst of preparing a proposal to the Japanese government for village development funds. Following an unfortunate series of events whereby the villagers were swindled out of almost F\$700 by a gentleman claiming to work for the Japanese Embassy, the village committee decided to apply for aid money. The funding proposal was for a large-scale Yanuca Village development project that would support, among other things, the repair and expansion of the rainwater system. In discussing the effectiveness of donor assisted and community-managed development projects in the Pacific, King and Gannicott (UNDP, 1993:51-52) note:

Throughout the Pacific, similar conclusions have been drawn with regard to rural development projects. Very few donor-assisted projects which rely on commitment from beneficiaries have been sustained for a significant period after

donor funds have been expended. Even projects which have an objective of creating sustainable self-help...have failed to be sustained...The reasons behind the relative absence of self-help activities are complex, but a number of contributory factors stand out. One is a perception amongst communities that it is the responsibility of government to provide improved services and infrastructure. In many countries in the Pacific, a passive, recipient attitude has been influenced by traditional cultural values, by the impact of colonial administrations, and in some cases, by the relatively easy availability – at least at the national level – of large foreign aid flows.

The awareness of foreign aid availability can therefore contribute to community inaction, which in this case is the failure to maintain the rainwater infrastructure and effectively manage existing water supplies. Interestingly, according to the gentleman in charge of the proposal, representatives from the Japanese Embassy visited the village for the purpose of ascertaining its current condition. Apparently, the representatives expressed hesitation in providing any funds for infrastructure upgrades until there was indication that the villagers were taking some initiative in remedying the problems.

In addition to easing the onus on the local population to mitigate water scarcity by improving the infrastructure, the dependence and use of outside assistance has in some cases encouraged wasteful behaviour. As mentioned in the previous chapter, some of the women interviewed for this study referred to this in discussing the introduced effects of the rainwater system. The increased availability of water understandably promoted its consumption. However, this became problematic during dry periods when water use activities needed to be restricted for conservation purposes. Instead of limiting tank water use to cooking and drinking during these periods, many villagers continued to use it for washing and bathing as well – activities that could be carried out using pond water. Prior to the construction of the rainwater system, villagers were probably more cognizant of how they consumed water and this moderated the inconvenience of having to adjust consumption patterns during dry periods. Moreover, the introduction of rainwater harvesting diminished the careful use of pond water, thereby degrading its quality.

6.2.3 Adherence to Tradition

Related to all of these observations of attitudes, values, and lifestyle in the village is the issue of tradition. Apart from features such as hierarchical structure, patrilineal decent, clan affiliation, communalism, and land ownership that continue to characterize Fijian society, the salience of tradition is also demonstrated through ceremonies and events. The village trip to Kadavu mentioned at the beginning of this chapter provides an example of this. Over the course of my two village stays, I also observed the preparations, organisation, and rituals associated with a funeral for a village elder as well as an elopement ceremony. The continuation of time-honoured practices in life cycle events allows people to pay homage to their ancestors, reaffirm their identity within a highly structured and changing society, and maintained harmony and solidarity within the community. Neglecting such practices carries the risk of social stigma and discord.

These ceremonies require time and money—resources also needed in improving the local water situation. Culture, according to Qalo (1997:108), “is at the centre of the pooling and utilisation of resources in Fijian lifestyles.” Thus, the returns on investments made towards carrying out traditional obligations are deemed more valuable than those associated with improvements to the local water supply. This is not to imply that villagers must choose between maintaining tradition and improving the water supply, as the demands of both can presumably be met. Some of the women interviewed alluded to this reality. However, the development of local adaptive management strategies and availability of external assistance have provided villagers with the choice of diverting their resources to other activities, such as traditional ceremonies and events. As a result, the water resource situation in Yanuca Village remains unchanged.

6.2.4 Gender Differences

Although I was aware that traditional Fijian culture stressed the position and importance of males, this was made very clear to me in the village. In the ceremonies I observed and participated in, men assumed the primary roles and responsibilities. The higher status accorded to men was also evident in everyday activities such as eating. Men were served

their meals first and given the tastiest portions of the dishes. Gender differences were also emphasized in daily chores and social activities. As Ravuvu (1983) explains:

Some tasks are considered feminine and some masculine. Women's work includes cooking, baby sitting, household chores, washing clothes, fishing with nets, collecting shell-fish and in some localities weeding gardens and gathering food and firewood. Men clear land for gardens, plant food crops, build houses, weed and mow around the house and the village green, spear fish, hunt and carry out onerous tasks that need considerable effort and physical strength (8).

The existence of these gender divisions in the village play an important role in explaining local water scarcity. Water is used primarily for domestic activities and women are responsible for carrying out most of these activities. Thus, they are the primary resource users and managers. However, as noted by Bronders and Lewis (1994:406), "women are almost never informed, consulted nor do they have any decision rights at the village level." This discrepancy between stakeholder needs and participation can diminish the capacity of communities to design effective water supply schemes and respond to water scarcity. For example, while the women I interviewed all discussed the need for infrastructure repair, maintenance and expansion, the final decision to mobilize resources for these activities rests with the men in the village. This is not to suggest that the men did not recognize this need for infrastructure upgrade, as many of the men I conversed with raised similar issues. Even so, because they are not as inconvenienced and directly affected by water resource problems, the urgency for this need is somewhat tempered.

Differential gender roles as they relate to water resource issues are also demonstrated in social kava drinking. Kava drinking is a predominantly male activity and accorded a great deal of importance. The men I conversed with explained to me that as the only real organized social activity in the village, drinking kava was their preferred way to relax and catch up with friends. Furthermore, some kava sessions provided opportunities for the discussion of matters relating to the village as a whole, with the exchange of ideas and opinions on issues such as work activities and upcoming events taking place over the *tanoa*. However, the women I spoke with expressed resentment towards the prioritization of kava drinking. They felt that in addition to taking time and disposable income away from the family, it made those men who engaged in the activity on a regular basis

lethargic and less productive the following day. Moreover, several of the women interviewed cited this activity as contributing to water scarcity as it consumed resources that could otherwise be used for domestic purposes. This was especially problematic during extended dry periods when water use was restricted. I was told of an instance where a woman hid water under her bed as a conservation measure, only to find out the following morning that it had been taken during the night by one of her male relatives for a kava session. The prioritization of this activity over those for which women are directly involved and responsible exemplifies how gender dynamics can shape scarcity conditions.

6.3 SOCIAL PROCESSES OPERATING AT THE GOVERNMENT LEVEL

Although Yanuca Island is physically separated from the mainland, its residents are part of a wider social context where, among other things, they function as political clients of government policies and support programs. Because government involvement was a recurring theme in my village research, I reflected upon the ways in which its policies and capacities have potentially affected water scarcity in the Village. I considered a number of issues. The first was the general administration of Fiji's water supply and sewerage. As mentioned in Chapter 1, the responsibility for the management and maintenance of the country's water supply lies with the Public Works Department, under the Ministry of Works and Energy. With such a wide range of water supply, sewerage and hydrological activities in Fiji (i.e. rural and urban supplies; groundwater, surface water, and rainwater development; design, maintenance and monitoring of projects etc.), the department is separated into different divisions and sections. While rainwater has been recognized as a viable, valuable, and largely underutilized resource in Fiji, particularly in alleviating water problems in rural areas, there is no rainwater catchment systems programme in place. Rather, the development of these systems is overseen by a larger, over-worked rural water supply division. This, in turn, limits the resources that are directed towards equipment, training, and education in villages utilizing rainwater. Moreover, the absence of a specialized rainwater division may deter rural communities from seeking assistance, whether it be in the form of technical expertise and consultation or conservation workshops.

Inefficient administrations are related to financial limitations, and this is certainly an obstacle in the assessment, development, and management of water resources in Fiji. Apart from the restrictive nature of a developing national economy, the continuous struggle to compete in a globalising economy and achieve a heightened measure of economic success has put water concerns at the bottom of national policy agendas. Depledge (1996: 11) notes,

...in the Pacific, as elsewhere, water seems to have lost its interest as an urgent need both from within country and from [external support agencies]. Other areas of concern, such as the trade, the economy, and the environment in general have jumped the queue, disregarding the basic requirements of the water sector.

Moreover, the failure to increase water charges has resulted in a financial deficit whereby revenues from water rates are not covering annual operation and maintenance costs. The result is less funding for research and development in the water sector.

With relatively limited resources, cost efficiency becomes a concern. For example, providing financial and technical assistance to an island with five villages would be more cost effective than directing these resources to an island with only one village. The former would allow a wider populace to be served and therefore benefit from the investments made by the water sector. Thus, Yanuca Village may not be a priority for government assistance, especially during emergency situations such as droughts, as it is the only village on the island and is located in relative proximity to the mainland where villagers can seek immediate relief. This situation may therefore limit the options available to villagers in mitigating scarcity, and therefore allow it to persist.

One other process to consider is the communication between government and local communities. Although the women I interviewed for the most part understood that infrastructure maintenance was the responsibility of villagers, this was not always the case with other villagers. During the *sevusevu* performed at the beginning of my second village stay, my colleague explained to the local men present at the ceremony that it was up to them to repair and maintain the tanks. The looks of surprise and bewilderment on

their faces suggested that they were unaware of this arrangement. My colleague commented to me afterwards that he felt there had been poor communication between government representatives involved in developing the rainwater system and the villagers. Another example of this problem is the locally anticipated use of the boreholes. Apart from their mention in the depth interviews, they were regularly brought up in other discussions on village water supplies. At the beginning of my first village stay in 1999, I was given a tour of the village and shown its various water sources. I was taken to the borehole sites and told by my tour guide that they were awaiting funding for a generator and pump to deliver the groundwater to the village. Other villagers acknowledged the brackish quality of the tested groundwater but felt that it should be nonetheless made available for toilet flushing and laundry. I also encountered individuals who were well aware of the fact that borehole development was not an option. This range in understanding of the local water situation illustrates the ineffective communication that exists between government and villagers. It must be noted, however, that the government representative in the village, i.e. the village headman, was aware of the unavailability of the boreholes. Thus, this may be more representative of ineffective communication within the village social structure. Poor communication with respect to the local water supply has affected efforts in ensuring its proper maintenance and conservation. With some villagers understanding infrastructure repair being the responsibility of external agents and expecting the development of a groundwater supply, the incentive to invest in mitigation resources and monitor consumption patterns is trivialized.

6.4 SUMMARY

In this chapter, I have attempted to demonstrate the various social processes contributing to scarcity in Yanuca Village. These processes, operating at both the village and government level, have shaped the way in which local water resources are perceived, valued, and subsequently managed or mismanaged. This mismanagement has manifested itself not only through wasteful use of water and poorly maintained infrastructure, but through the failure to implement scarcity mitigation strategies. The forces shaping the perceptions that contribute to such mismanagement are complex and dynamic. They do not operate independently of prevailing biophysical conditions, as the nature of scarcity

(i.e. periodic and unpredictable) resulting from local rainfall patterns and the existence (albeit limited) of surface water have affected how villagers experience and adapt to scarcity. When added to a reliance on external assistance, subsistence lifestyles and mindsets, and gender differences within the village, the incentive and ability of the community to successfully adopt mitigation strategies is challenged. Moreover, the limited government financial and institutional capacities compound the problem by limiting the availability and convenience of scarcity mitigation options.

What emerges from this discussion then, is a deeper understanding of water scarcity in a small island community. By revisiting the empirical data presented in Chapter 5, and discussing it within the framework of the concepts and issues raised in Chapters 1 and 2, and the localized context described in Chapter 3, I have attempted to demonstrate the intricacies of water scarcity in Yanuca Village. It represents an articulation between physical and social systems, and this study has emphasised the importance of examining the latter.

CHAPTER 7

CONCLUSIONS

7.1 INTRODUCTION

This thesis has attempted to uncover how social processes operating at different levels and in different capacities shape water scarcity in a small island community.

Specifically, this study employed a qualitative case study design to examine the views and experiences of women in managing water scarcity in order to explain causes of and responses to the problem. Moreover, by describing the biophysical realities that shape and limit the availability of water in Yanuca Island, this study has demonstrated that the impact of natural processes can be aggravated by human responses. This final chapter summarizes the results and key findings of my research and addresses their practical and theoretical implications in terms of addressing water scarcity and implementing water development projects. I then conclude with some suggestions for future research.

7.1 SUMMARY OF RESULTS AND KEY FINDINGS

My first visit to Yanuca Island was not research related. In fact, my weekend getaway to the island was intended to be an opportunity to distance myself from Suva and my research activities, as I had become frustrated and dejected with my progress hitherto. I soon realised the futility of this purpose when I found myself using a rainwater catchment system and listened to some of the local villagers talk about problems with their water supply. Among the most prevalent issues discussed on this topic were the restricted and unreliable nature of the supply as well as some of the health problems stemming from its use. I had unknowingly stumbled upon my case study of water scarcity. I subsequently returned, this time with a very different purpose, and began investigating my newly defined research problem. In examining and explaining the factors shaping water scarcity in Yanuca Village, I needed to explore how and in what ways it was understood by local women. Moreover, I needed to frame these views and experiences within a localized framework addressing both the availability and consumption of the resource.

In so doing, the dynamic, multidimensional nature of scarcity in this small island community was demonstrated.

The biophysical factors shaping water availability were evidenced through the limited and seasonal nature of the local supply. With very little groundwater and surface water upon which to depend, the community relied on rainwater harvesting to augment this restricted supply. Water was used only for domestic purposes (with bathing and washing requiring significantly more water) and therefore women were the primary resource users and managers. Upon interviewing several of these women, it was revealed that while they acknowledged the physical preconditions contributing to scarcity, problems with the rainwater infrastructure as well as wasteful and polluting behaviours were equally, if not more, culpable. The associated effects included perceived inconvenience, increased physical demands in transporting water, and various health ailments. In an effort to respond and cope with the realities of local water scarcity, the women spoke of various adaptive management measures, such as source shifting, household conservation activities, the use of resort-supplied water, and water treatment (boiling). Most of these effects and response measures were said to be experienced during prolonged dry periods. However, this was not always the case, as the household consumption survey revealed. In spite of the health problems associated with the use of pond water, most participating household continued to use this surface water source during the wet season, indicating a preference over tank water. This apparent contradiction was reinforced in discussing potential solutions (both short-term and long-term) to local water scarcity. While the women I interviewed offered a range of measures (i.e., repair, maintain, and build additional rainwater tanks; practice water conservation; prudent use of pond water etc.), there were no signs indicating their implementation.

Thus, this study has found that water scarcity in Yanuca Village is a function of both quantity and quality, periodic in nature, and largely the result of mismanagement under prevailing biophysical conditions. Moreover, this mismanagement can be generally understood as inaction or failure in mitigating scarcity. Therefore, scarcity in part persists because of the way in which Yanuca Village chooses to respond to/manage (or

not respond to/manage) the problem. In this sense, the way in which scarcity is managed can be a cause of scarcity in and of itself. Thus, in seeking to understand the processes creating water scarcity in Yanuca Village, I examined the processes that discouraged or prevented its mitigation. The periodic and unpredictable nature of scarcity, coupled with existing surface water sources, have encouraged the development of adaptive management measures which enable villagers to meet their immediate needs during dry periods. Additionally, because the experienced benefits of their water infrastructure are dependent on rainfall, their supply continues to be somewhat unreliable. As a result, the amount of water provided by the rainwater systems is not a sufficient enough improvement on traditional sources to persuade villagers to allocate resources towards its repair, maintenance, and expansion. This disincentive in mitigating local scarcity is intensified by reliance on external assistance, adherence to tradition, and gender differences within the village. Moreover, these social processes operate within a broader context of governmental inefficiencies and limitations, which serve to restrict the availability and convenience of mitigation options for the village.

7.3 IMPLICATIONS OF THE RESEARCH

In researching this particular case of water scarcity, one of the most important lessons I learned was the value of an emergent research process. The very initiation of my research activities speak to this process, as my one and only weekend getaway in Fiji ultimately resulted in a Master's thesis. Nonetheless, particularly important to the emergent nature of this research was the incorporation of rich, contextualised knowledge. Had I relied solely on the interview transcripts and survey results in examining water scarcity in Yanuca Village, my understanding of the problem would have been not only superficial, but misleading. I needed to place these empirical results within their proper physical and social contexts in order to understand the meanings they conveyed.

At a time when government and overseas aid agencies are stressing the importance of bottom-up approaches in development projects and the need to suit such projects to the values, lifestyles and needs of beneficiary communities, the value of understanding local context is emphasized. In terms of assessing needs for water development projects in

communities such as Yanuca Village, this involves looking at the articulation between biophysical and social processes – i.e. examining the nature of water scarcity and the measures that have been adopted in managing it prior to project implementation. In looking at these measures, there should be an understanding of the perceived benefits and drawbacks associated with their utilization as it will highlight the needs and desires beneficiary communities. Also, local issues such as communication between different decision-making levels and stakeholders must be addressed – which invariably includes a look at gender differences and the need to engage local women at all stages of project design and implementation. The level of skill and commitment within the community must also be assessed, the latter being evidenced through increased levels of involvement and the willingness to mobilize and invest resources – both financial and human – in future operation and maintenance.

This study also highlighted the importance of looking at both the biophysical and social determinants of water scarcity. While emphasis in this case study was placed on the social aspects of the problem, they could not have been identified and fully appreciated without a solid understanding of their dynamic interaction with biophysical processes. The unalterable reality of limited groundwater and surface water sources subject to seasonal differences has lent itself to a particular type of scarcity, which has translated into specific ways of experiencing and managing its effects.

7.4 SUGGESTIONS FOR FUTURE RESEARCH

During the course of researching this case study, there were a number of issues that arose and were left relatively unexplored or superficially addressed. This section therefore offers suggestions for avenues of further study and contributions to the understanding of the dynamic and multidimensional nature of water scarcity. The first issue that, in my mind, warrants further investigation is the differences in perceptions between men and women. Although women are the primary resource users and managers, and therefore have a more intimate knowledge of the different sources and uses for water in everyday activities, they are not the decision makers. Moreover, men are expected to maintain the infrastructure, manage the collective allocation system in the village, and presumably set

and enforce rules regarding pond water use. Thus, while women manage the resource within the household, they do not necessarily manage its overall availability – both in terms of the rainwater system and pond use. The differences in perceptions was highlighted during casual conversations with men, when they expressed a slightly different understanding of the local water problem. Whereas the women I interviewed recognized the roles and responsibilities of villagers in alleviating scarcity, the men I spoke with tended to place responsibility with the government. Also, men were less inconvenienced in managing everyday water collection and consumption, as these activities were largely the responsibility of women. Thus, I began to see how these different perceptions played a role in the social definition of the problem and solution. Such issues must and should be addressed in understanding the persistence of water scarcity, as differences or tensions that exist between different stakeholders can determine the community's success in managing the problem.

Another potential avenue for future research focuses on differences between wet and dry seasons. Both of my field seasons took place during the rainy months of the year and therefore precluded a seasonal comparison of the sources and consumption of water in Yanuca Village. Obviously, an examination of behavioural differences during the dry season would corroborate the information gathered during the wet season and allow for a more comprehensive understanding of local scarcity.

Finally, in light of the recent political instability and consequent restructuring of the government in Fiji, the effects of a shifting political environment could be addressed in studying water scarcity issues. The lack of political urgency assigned to water issues has presumably been reinforced as the government struggles to recover economic losses and deal with the exodus of trained professionals. Moreover, the effects of these political developments are also felt at the local level. As I explained in Chapter 3, Yanuca Village's communal income was greatly affected by the May 19th coup last year as tourism experienced a sharp decline and the demands for their services – whether it was work for the two surf camps or firewalking shows – waned. This may have further diminished the importance of addressing the inadequacies of the local water system. The

linkages between the broader political context and localized experiences of water scarcity would certainly enlighten our understanding of the complex and dynamic nature of the problem and build upon the issues presented in this study.

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APPENDIX 1: AERIAL PHOTOGRAPH OF YANUCA ISLAND

Source: Government Map House, Suva, Fiji. (1994)

APPENDIX 2: LETTER OF INITIAL CONTACT

Thank you for your interest in my research. I hope the following information will assist you in your decision regarding your participation in my research.

I am a graduate student investigating the linkages between water and human security for the people living on Yanuca Island in Fiji. My research supervisor is Dr. Steve Lonergan, a faculty member in the Geography Department at the University of Victoria. The purpose of this study is to explore: a) the sources, collection, and uses of water resources in the everyday lives of individuals on Yanuca Island b) local perceptions of how and why the sources, collection, and uses of water have changed over time, c) the effects of water-related problems on the lives of local residents, and d) responses to water-related problems.

Contact with individual participants will involve interviews (conversations), lasting from one to two hours. The interview will be tape recorded, but only with the participant's approval.

Participation is completely voluntary and participants have the right to withdraw from the project at any time without explanation. Participants have the right to refuse to address any questions or subject matter they do not wish to address. If participants withdraw from the study, any information obtained from them will be deleted from the project research files.

Anonymity and confidentiality will be protected. The files will not identify you in any way. All data gathered will be kept in a locked cabinet in a locked room.

The results of this study will be prepared for presentation at a special meeting with my supervisor and other University of Victoria faculty members. A summary of findings will be made available to participants upon completion of the study.

If you have any questions or concerns about your potential participation in this study, please do not hesitate to contact me at the Department of Geography at the University of the South Pacific:

Department of Geography
School of Social and Economic Development (SSED)
The University of the South Pacific
P.O. Box 1168, Suva, Fiji
Telephone: 313900/212540

I look forward to your participation.

Yours truly,

Anne Hammill

APPENDIX 3: CONSENT FORM

I am a graduate student investigating the linkages between water and human security for the people living on Yanuca Island in Fiji. My research supervisor is Dr. Steve Lonergan, a faculty member in the Geography Department at the University of Victoria. If you have any questions or concerns about the project, you may contact Dr. Lonergan at (250) 721-7339 or lonergan@uvic.ca.

The purpose of this study is to explore: a) the sources, collection, and uses of water resources in the everyday lives of individuals on Yanuca Island in Beqa Lagoon, b) local perceptions of how and why the sources, collection, and uses of water have changed over time, c) the effects of water-related problems on the lives of local residents, and d) responses to water-related problems.

My contact with you entails one interview (conversation), lasting from one to two hours. The interview will be tape recorded, but only with your approval.

Your participation is completely voluntary and you have the right to withdraw from the project at any time without explanation. You have the right to refuse to address any questions or subject matter you do not wish to address. If you do withdraw from the study, any information obtained from you will be deleted from the project research files.

Your anonymity will be protected. The files will not identify you in any way. Confidentiality will be protected. Your name will not appear in any published results. All data gathered will be kept in a locked cabinet in a locked room. The estimated date of completion is September 2000. Tapes will be erased and all information collected on paper will be shredded one year after the end of the study.

The results of this study will be prepared for presentation at a special meeting with my supervisor and other University of Victoria faculty members. A summary of findings will be made available to you upon completion of the study.

If you agree to participate, please sign and date the bottom of this form in order to record that you have read this letter and agreed to participate in the study.

Thank you for your time and interest,

Anne Hammill

Name: _____

Signature: _____ Date: _____

APPENDIX 4: INTERVIEW QUESTIONS

- Name, age (optional), marital status, children
- How long have you lived in the village?
- What do you do (occupation)?
- Describe your daily routine to me.
- What do you use water for on a daily basis?
- Where do you get your water from for these activities?
 - Wet season
 - Dry season
- How do you collect and store the water you use?
- Do you have to treat any of the water you use? If so, when and how?
- Have there been any changes to the quantity or quality of the water in the village that you can remember? If yes, please explain.
- Describe the water resource problems you encounter
 - Wet season
 - Dry season
- What do you think are the causes of these problems?
- Tell me about how have these problems affected your everyday life
- What have you done to respond to these problems?
- What do you think needs to be done to resolve water problems in the village?
- Who do you think is responsible for resolving/fixing water problems in the village?
- Overall, how do you feel about the QUANTITY of water available in the village?
- How do you feel about the QUALITY of water in the village?
- Any final comments/opinions on the water situation here on Yanuca?

APPENDIX 5: HOUSEHOLD WATER CONSUMPTION SURVEY FORM**Household Water Survey**

Name: _____

Date: _____

Activity	Amount of Water Used	Source of Water
Drinking		
Cooking		
Washing		
Bathing		
Other		

APPENDIX 6: SURVEY HOUSEHOLD CHARACTERISTICS

Household 1

Number of members: 8

Sex/Age Breakdown: 5 males (49 yrs, 25 yrs, 17 yrs, 15 yrs, 11 yrs)
3 females (42 yrs, 21 yrs, 4 mo)

No. of Generations: 3

Source of Income: Fishing, diving

Other: House located on village grounds, close to large pond.

Water Use Patterns: House is not connected to tank, but located within 10 feet of another operational one. Tank water is used for all activities except bathing, which is carried out using pond water. However, the infant is bathed in tank water. “Other” activities include washing dishes and brushing teeth.

Household 2

Number of members: 9

Sex/Age Breakdown: 3 males (32 yrs, 6 yrs, 2 yrs)
6 females (32 yrs, 25 yrs, 23 yrs, 6 yrs, 3yrs, 8 mo)

No. of Generations: 2

Source of Income: Teaching

Other: Household includes full-time, live-in domestic assistant and her daughter

House located on school grounds

Water Use Patterns: Small, individual household tank is located beside the house but not attached to a roof catchment. Large school tank is used instead (approx 100 feet from house). Tank water is used for all activities. “Other” activities include washing dishes, washing hands, brushing teeth, and flushing the water seal toilet.

Household 3

Number of members: 5

Sex/Age Breakdown: 2 males (37 yrs, 30 yrs)
3 females (60 yrs, 28 yrs, 7 mo)

No. of Generations: 3

Source of Income: Fishing, diving

Other: House located on village grounds, close to large pond.

Water Use Patterns: House is connected to a wholly intact, operational rainwater tank. Tank water is used for most activities except bathing and washing dishes, which are carried out using pond water. “Other” activities not noted.

Household 4

Number of members: 9

Sex/Age Breakdown: 2 males (45 yrs, 10 yrs)

7 females (70 yrs, 36 yrs, 13 yrs, 13 yrs, 10 yrs, 9 yrs, 5 yrs)

No. of Generations: 3

Source of Income: Fishing, diving, government (modest income for male head of the household for carrying out duties as the village headman)

Other: House located on school grounds and within 20 feet of a small seasonal pond.

Members use a pit toilet (rather than a water seal toilet)

Water Use Patterns: House is attached to a small, individual household rainwater tank. Tank water is used for cooking, drinking and brushing teeth. Rainwater is also collected in a large, metal drum beside the house. This water is used occasionally for laundry (one day during the survey), washing dishes, and washing hands. Bathing and laundry are typically carried out using pond water. “Other” activities include washing dishes, washing hands, and brushing teeth.

Household 5

Number of members: 5

Sex/Age Breakdown: 3 males (43 yrs, 38 yrs, 18 yrs)

2 females (45 yrs, 11 yrs)

No. of Generations: 2

Source of Income: Fishing, diving

Other: One of the male members of the household spends part of the week on the mainland performing firewalking shows at tourist resorts. House located on village grounds and approximately 50 feet away from one of the larger ponds.

Water Use Patterns: House is not directly connected to a rainwater tank, but located within 10 feet of one. Tank water is used for all activities except bathing, although there are several days when tank water is drawn in order to heat water for a warm bath. “Other” activities, such as brushing teeth and washing dishes are not noted separately, but included in the “washing” category.

APPENDIX 7: DEMOGRAPHIC PROFILE OF INTERVIEW PARTICIPANTS

Name	Age (yrs)	Marital Status	Children (Age range)	Occupation	Length of Residency
Luisana	31	Married	3 (14m – 5yrs)	Teacher	2 yrs
Sera	24	Single	None	Teacher	3 yrs
Aliti	30s	Married	2 (2-4 yrs)	Housewife	11 yrs
Leilani	40s	Widowed	5 (9-23 yrs)	Housewife	Lifelong Resident
Anaseini	45	Married	8 (5-25 yrs)	Housewife	26 yrs
Mere	63	Widowed	9 (25-58 yrs)	Housewife	Lifelong Resident
Milika	68	Widowed	10 (30 – 51 yrs)	Housewife	49 yrs
Nanise	22	Married	2 (4mo-2 yrs)	Housewife	4 yrs
Miriama	35	Married	4 (9-15 yrs)	Housewife	18 yrs
Viola	54	Separated	6 (14-35 yrs)	Housewife/ weaver	Lifelong Resident

VITA

Surname: Hammill

Given Names: Anne Geneviève Takako

Place of Birth: Brussels, Belgium

Educational Institutions Attended:

University of Victoria

1998 to 2001

McMaster University

1993 to 1998

Degrees Awarded:

B.A. (Honours)

McMaster University

1997

Honours and Awards:

Centre for Asia Pacific Initiatives Student Research Fellowship

2000

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Anne Geneviève Takako Hammill

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