A COMPARISON OF FRESHWATER USE CUSTOMS ON ULITHI ATOLL WITH THOSE OF SELECTED OTHER MICRONESIAN ATOLLS

By

REBECCA A. STEPHENSON

UNIVERSITY OF GUAM

Water and Energy Research Institute of the Western Pacific

Technical Report No. 51

August, 1984

A COMPARISON OF FRESHWATER USE CUSTOMS ON ULITHI ATOLL WITH THOSE OF SELECTED OTHER MICRONESIAN ATOLLS

By

Rebecca A. Stephenson

UNIVERSITY OF GUAM

Water and Energy Research Institute of the Western Pacific

Technical Report No. 51

August, 1984

Project Completion Report

for

A COMPARISON OF FRESH WATER USE CUSTOMS ON ULITHI ATOLL
WITH THOSE OF SELECTED OTHER MICRONESIAN ATOLLS

U.S.G.S. Project No. G-837-03

Principal Investigators: Rebecca A. Stephenson and Hiro Kurashina

Project Period: June 1, 1983 to September 30, 1984

The research on which this report is based was financed in part by the United States Department of the Interior as authorized under the Water Research and Development Act of 1978 (P.L. 95-467).

ABSTRACT

Freshwater catchment, storage, and distribution systems, along with fresh water use customs, in particular areas of Micronesia are discussed. Special attention is paid to Ulithi Atoll in the Western Caroline Islands.

The average annual rainfall on atoll islands of Micronesia is high (over 100 inches). There are also significant groundwater resources. However, severe water shortages are often experienced, especially during the dry season. Water use customs that differ from those of Western nations often account for these difficulties.

The field work was undertaken at a time of drought conditions on Ulithi, at the end of the dry season in June, 1983. True freshwater shortages were apparent, but Ulithians carried out a variety of coping strategies that made the impact of the drought less severe. These included a strong sense of community spirit, with the sharing of community resources as an everyday way of life. In this way, Ulithi differed from the communities of Laura and Nama studied earlier by the same research team.

In small communities in developing countries, it is important to attempt to understand the human dynamics that govern the use of scarce resources. Similar studies must be conducted in several locations in order to begin to make generalizations. By gaining an understanding of water use customs, it is more probable that engineering solutions to water supply problems will be successful.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The focus of this technical report is upon freshwater supply, storage, and distribution systems in Micronesia. Particular attention is paid to the freshwater resources of Ulithi Atoll in the Western Caroline Islands. The research reported upon here follows closely on the heels of a similar study carried out in two other low-lying island communities in the Western Pacific. Fieldwork conducted at Laura Village on Majuro Atoll in the Marshall Islands in July-August, 1981, and on Nama Island in the Upper Mortlocks in July-August, 1982, pointed out what we have called elsewhere a paradox (Stephenson, Kurashina, and Winter, 1982; Stephenson and Kurashina, 1983). The paradox is the fact that freshwater occurring as rainwater and groundwater is abundantly available in these two locations, owing to the high average annual rainfall. Yet, especially in the dry season, freshwater shortages are frequent. This paradoxical condition was also noted in earlier field research in the high islands of the Eastern Carolines (Winter and Stephenson, 1981).

Members of the research team suggest that the paradox exists owing to inadequate management of freshwater supply, storage, and distribution systems in Micronesia. Economic, technical, and social factors may be called upon to explain this phenomenon. Laura and Nama, reported upon earlier (Stephenson and Kurashina, 1983), present two sets of contrasting attempts at explanation. With regard to Ulithi Atoll, a third attempt at explanation is presented.

In this particular technical report, the author describes the study area of Ulithi Atoll in the Western Carolines; overviews local water supply, storage, and distribution systems; and examines attitudes toward uses of rainwater catchment versus groundwater.

OBJECTIVES

The first objective of this study was to make an inventory of all presently used rainwater and groundwater resources on Ulithi Atoll. Rainwater catchment and storage systems were observed and photographed, along with groundwater resources. The second objective was to interview a large sample of village households on inhabited islands of Ulithi to determine present water use customs and practices as well as attitudes toward the use of freshwater from various sources. The use of rainwater, collected by means of rooftop rainwater catchment systems, was compared to the use of groundwater found in wells and also occurring in ponds or pools.

The purpose of the fieldwork was to determine, first, whether freshwater supplies available on Ulithi Atoll can provide a sufficient quantity of freshwater to meet the needs of the inhabitants. Second, the fieldwork attempted to determine whether rainwater or groundwater was the preferred type of freshwater in the Atoll, if, indeed, local people

expressed such a preference. Finally, the fieldwork attempted to ascertain how attitudes of local people might influence the success of freshwater development projects in the future.

DESCRIPTION OF PROJECT SITE

Ulithi Atoll is composed of a cluster of low-lying small islands, some 30 in number, in the Caroline Islands archipelago of the Western Pacific (Figure 1). The total land area is 1.8 square miles. The location of Mogmog, the highest ranking island in Ulithi according to local custom, is 10°05'N and 139°43'E. The islands of Ulithi appear to be arranged like beads on a necklace around a lagoon that encompasses a surface area of some 183 square miles. The large open lagoon has a maximum depth of 210 feet. Ulithi is located about 85 miles east-northeast of Yap. Guam lies some 380 miles to the northeast.

The climate of Ulithi is tropical with a average annual temperature of 83° F. The mean relative humidity is about 84 percent. Rainfall on Ulithi averages about 120 inches per year. The nearest approach to a dry season in Ulithi occurs from February through March, with an average monthly rainfall of less than 7 inches. Typhoons are uncommon in this region. Typhoon Ophelia (1960) was the last typhoon that caused considerable disruption (Lessa, 1964).

Falalop is the main island and seat of local government. Outer Islands High School is located there. Fassarai, to the southwest, the most remote of the inhabited islands of Ulithi, is about a mile long and less than a mile wide.

The population of Ulithi has been enumerated at various points in time, as indicated in Table 1.

RESEARCH METHODOLOGY

Field research for this project was conducted on Ulithi during the period June 10 through June 21, 1983. Initially, formal calls were made with the proper authorities in Colonia, the district center of Yap, seeking official endorsement of the project. The Governor's Representative on Falalop, Ulithi, served as the local coordinator of the project.

The field methodology consisted of a series of household interviews, with the selected homes being divided among Ulithi's inhabited islands. Pre-structured survey forms were utilized to record the data contributed by the household residents (Appendix A). The survey forms were designed to collect demographic data for the selected homes in Ulithi and per capita water consumption estimates. They also surveyed freshwater sources utilized, water storage and distribution systems, and technological efficiency of rainwater catchments. Groundwater wells were examined, measured, and photographed. Rooftop and other freshwater catchment and

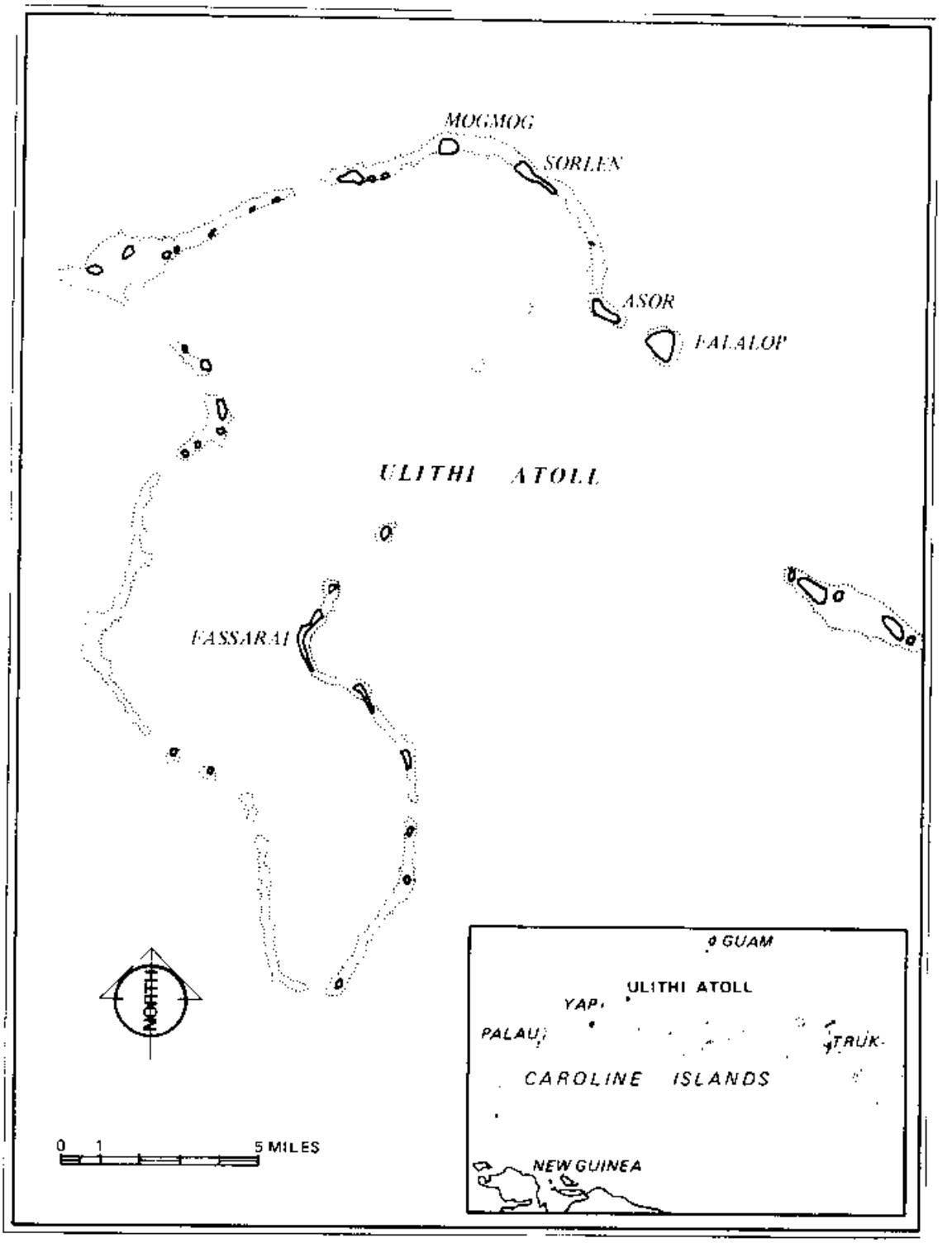

Figure 1. Map of Ulithi Atoll.

storage devices were noted. Attitudes toward water distribution systems, perception of freshwater needs, and preferences for rainwater as opposed to groundwater were assessed.

On Ulithi, the interviews were conducted in English wherever possible. One of the field team members spoke with elderly informants in the Japanese language. When necessary, a local man or woman provided assistance to the project by acting as an interpreter when informants could best express themselves in the Ulithian language.

WATER USE CUSTOMS AND PRACTICES

Household Data

There are 710 people residing at Ulithi Atoll according to the 1980 Census. In the course of this project, a total of 30 households were sampled, 10 on Falalop, 7 on Asor, 6 on Mogmog, and 7 on Fassarai. Of the 30 households sampled, interviews were conducted with 21 men and 9 women who served as heads of households. Their ages ranged from 20 years through 80 years, with 5 older people being unsure of their ages and reporting themselves to be "over 60". The ages of two of the men who served as informants were not recorded. Family size ranged from 2 people to 17 people, with an average size of 8 people per household. These figures probably represent commensal units, for men and teen-age boys often sleep in the men's house. The population data showed that there were 91 children in Ulithi Atoll under the age of 15 in the 30 households sampled. Adult men over the age of 15 were 70 in number; there were 69 adult women. Our sample, then, represents 230 persons, about one third of the Ulithian population.

When asked how long a family resided in their house, the responses varied from "one week" (a family who had just come in from an outer island) to "forever". Three families chose the response" forever" on their own initiative. Of the 26 families who reported a time residence in years, the average length of time stated was 8.3 years. The residence situation of one family remains unknown.

Several families live in household compounds, where more than one house is considered central to the family unit. Table 2 describes types of household construction observed in our sample and frequencies of each type.

Informants in our sample were asked, "Do you own your house?" Twenty-three people responded "yes"; seven said "no". The latter seven reported the ownership of their house as follows: a relative - 5 responses; the government - 1 response; the Ifalik people - 1 response. We also asked, "Do you own the land on which your house is standing?" Fifteen people responded "yes"; fifteen people indicated they did not. For those who said they did not own the land, thirteen people reported that the land

Table 1. Population of Ulithi by year and source.

Population of Ulithi	Year	Source
592	1731	Lessa, 1975
797	1903	Lessa, 1975
421	1949	Lessa, 1975
460	1958	1980 Census
514	1960	Lessa, 1975
710	1980	1980 Census

Table 2. Types of household construction.

Type of Household Construction	Frequency
Corrugated iron walls/corrugated iron roof	10
Wood walls/thatch roof	6
Thatch walls/thatch roof	3
Concrete walls/corrugated iron roof	3
Wood walls/corrugated iron roof	4
Wood and corrugated iron walls/corrugated iron roof	1
Wood walls/thatch and corrugated iron roof	1
Corrugated iron walls/thatch and corrugated iron roof	1
Corrugated iron walls/thatch roof	1

was owned by a relative. One person said the land was owned by a Ulithian man who was not a relative. One person said the government was the land-owner.

In terms of occupations, the heads of household interviewed identified their primary work efforts as indicated in Table 3. In this sample, gainful employment appears to take place in 12 of the 30 households.

Sources of Water

Informants on Ulithi were asked to identify the sources from which they obtained their freshwater. Two sources of freshwater are found on Ulithi: rainwater and groundwater. Villagers reported that they utilize both of these sources to obtain needed freshwater. Both rainwater and groundwater resources are plentiful during the rainy season, approximately June through December. In the dry season, approximately February to March, on the other hand, acute rainwater shortages may be experienced. Indeed, a severe drought was being experienced when the research team was on Ulithi (Santos, 1983). Rainwater catchment tanks had only a few inches of water in them. Portable rainwater storage devices such as 55 gallon drums, metal cylinders, and rubber ship's bladders were completely dry. The water level in wells and ponds was very low.

Rainwater Catchment Systems

On Ulithi, there are a number of ways to collect rainwater. Most often, rainwater is obtained by means of roof run-off on homes, public buildings, etc. that have corrugated metal roofs. As indicated in Table 2, 18 of the 30 homes that were visited could make use of rainwater run-off from the roof. Another two homes had corrugated metal and thatch roofs, allowing for partial collection of rainwater runoff. For the 10 homes in our sample that had thatch roofs, no collection of roof runoff was possible. A great deal of variation is found on Ulithi with regard to technological details of rainwater catchment systems. Percentage of roof space effectively utilized varies, as does efficiency of gutter systems and the devices used for rainwater collection and storage. On Falalop where the local governmental offices are located, a public water catchment tank at the dispensary, another at the church, and another at the home of the Governor's Representative supplied rainwater for seven of the ten families interviewed there. One individual had a private tank with a 5-6 thousand gallon capacity. The second individual relied heavily upon 55 gallon drums (5 or so) to provide needed rainwater, but reported that his family also went by boat to the nearby islands of Mogmog and Fassarai for drinking water if necessary. The third individual lived in a government-built concrete house; he had the benefit of piped drinking water.

Of the seven households contacted at Asor Island, six of them reported that they got rainwater from the one large community catchment tank (one individual mentioned she also occasionally got rainwater from the nearby

Table 3. Work efforts of household heads.

Work Effort	Number of Individuals Reporting
Fisherman	6
Housewife	6
Teacher	3
Medic	3
Village Chief	2
Retired	2
Graduate Student	1
Dental Nurse	1
Governor's Representative	1
Sanitarian	1
Doctor	1
Public Works	1
Plumber	1
Cook	1

Table 4. Size of public water tanks on Ulithi by island.

Island	Size and Description of Catchment	Quantity
Falalop	Small fiberglass 4' diameter and 5½' deep	1
Falalop	20' x 20' x 8' concrete	1
Falalop	40' x 20' x 8' concrete	1
Falalop	16' x 16' x 8' concrete	1
Asor	20' x 20' x 8' concrete	1
Asor	Fiberglass, leaking	1
Mogmog	Fiberglass	1
Mogmog	Fiberglass (not usable)	1
Mogmog	20' x 20' x 8' concrete	1
Fassarai	Fiberglass, 4' diameter and 5½' deep	1
Fassarai	36' x 16' x 10 concrete	1

island of Mogmog). The seventh individual reported that he used 55 gallon drums along with a metal flotation device that had been found on the beach to store rainwater. The device could hold about 300 gallons.

On Mogmog island, families reported they could draw rainwater from the community catchment tank at the church (4 cases) and also from the catchment tank located at the Doctor's residence (3 cases). Three families said they also used 55 gallon drums to store rainwater. Two families reported they made use of several metal spheres (about 300 gallon capacity each) that had washed up on the beach for rainwater storage and two other families pointed out the airplane fuel tank rigged up at their residence to store rainwater, with a 250 to 300 gallon capacity each.

On the island of Fassarai, the rainwater catchment tank located by the church provided rainwater for five of the families interviewed. Three of the families reported that they also drew water from the community tank located by the elementary school. Two families used 55 gallon drums, two families used airplane fuel tanks to store rainwater, and one family used a metal tank-like device they had found on the beach. One family had come upon a rubber container on the beach and brought it home for rainwater storage purposes.

On the inhabited islands of Ulithi, rainwater collection and storage devices varied as indicated above. Likewise, the storage capacity of rainwater per household and per community also varied. On the four inhabited islands of Falalop, Asor, Mogmog, and Fassarai, rainwater storage capacity at home varied from none (reliance on the community catchment system) to 6,000 gallons (household tanks). Several community tanks could hold up to 12,000 gallons (Table 4).

Groundwater Wells

On Ulithi, groundwater wells serve as secondary sources of freshwater, supplementing rainwater. Consult Appendix B for fieldnotes concerning wells located on Ulithi Atoll. Of the 10 families interviewed on Falalop, the use of seven different wells was reported. One of these wells was described as a community well with an electric pump and another was a government well. An individual owner was named for each of the remaining wells. Two household heads also reported that each was in the process of digging a new well near to his home. Thirteen water wells were sampled for physical and chemical water quality on Falalop (Clayshulte, 1983).

On Asor, one public well under the control of the local chief and two private wells were included in the sample. These and a fourth well were tested for water quality. On Mogmog, four different wells were identified as being used by informants. Clayshulte (1983) indicates nine wells and a taro patch were examined for water quality on Mogmog. On Fassarai, two wells were shown to members of the research team by the families being interviewed; these two wells, as well as a single well located on the island of Sorlen, were tested for water quality.

Table 5. Sources of water utilized for specific purposes by island.

	Rainwater	Well Water	Rainwater & Well Water	Rainwater & Sea Water	Well Water & Sea Water	Rainwater, Well Water & Sea Water	Total
Drinking							
Falalop	100%	0	0	0	0	0	100%
Asor	100%	0	0	0	0	0	100%
Mogmog	100%	0	0	0	0	0	100%
Fassarai	100%	0	0	0	0	0	100%
Cooking							
Falalop	60.0%	30%	10%	0	0	0	100%
Asor	71.5%	14.3%	14.3%	0	0	0	100%
Mogmog	0	50%	50%	0	0	0	100%
Fassarai	71.5%	0	28.6%	0	0	0	100%
Washing Dishes							
Falalop	40%	50%	10%	0	0	0	100%
Asor	0	85.8%	14.3%	0	0	0	100%
Mogmog	0	83.5%	16.7%	0	0	0	100%
Fassarai	0	28.6%	0	14.3%	57.2%	0	100%
Bathing							
Falalop	20%	70%	10%	0	0	0	100%
Asor	0	52.2%	14.3%	0	28.6%	0	100%
Mogmog	0	83.5%	16.7%	0	0	0	100%
Fassarai	14.3%	0	14.3%	0	57.2%	14.3%	100%
Washing Clothes							
Falalop	20%	70%	10%	0	0	0	100%
Asor	0	85.8%	0	0	14.3%	0	100%
Mogmog	0	100%	0	0	0	0	100%
Fassarai	0	0	0	0	57.2%	42.9%	100%

On Ulithi, water is drawn from wells utilizing various devices, such as a plastic bucket attached to a line, a plastic float with a hole cut in the top, or a one-gallon tin can. The depth of the water in the wells varied depending upon the location of the well, the size of the well, and the tidal condition. Of the 29 wells enumerated by Clayshulte (1983), 21 were reported to be owned by individuals, seven were described as community wells, and one was owned by Public Works.

Sources of Water for Specific Uses

Informants on Ulithi were asked to describe the sources of freshwater used at their homes. Table 5 summarizes the sources of water utilized for specific domestic purposes that they reported upon. The separate categories of water use are discussed below.

Drinking

One hundred percent of our sample on all the islands reported that they drink rainwater. They drew their rainwater from the following sources:

catchment tank at the church	7 responses
tank at home	6
community tank	5
church tank and Doctor's tank	2
church tank and dispensary tank	2
covered 55 gallon drum at home	1
55 gallon drums at home	1
church tank and tank at home	1
Doctor's tank	1
community tank and 55 gallon drum at home	1
church tank and private tank	1
church tank, dispensary tank, and private tank	1
from the cafeteria	1

Twenty two of our informants said they got their drinking water from some type of public water system.

We asked, "Do you boil freshwater before you drink it at home?" The answers were as follows:

yes	14 responses
for coffee	7
sometimes	6
for the kids, for coffee	2
most of the time	1

These responses indicate that freshwater is frequently boiled before drinking takes place.

Families were asked to estimate the amount of water their households use on a daily basis for drinking purposes. The responses were as follows:

Island	Average daily per capita water consumption
Falalop	3/4 gallon
Asor	1/2
Mogmog	1
Fassarai	1/2

Cooking

On Ulithi Atoll, rainwater, well water, and rainwater and well water in combination are used to cook food. On Falalop 60% of the people prefer to cook with rainwater. On Falalop, of the homes in the sample, eight of them had corrugated metal roofs and people were collecting the rainwater close to their houses. A breakdown of the amount of roof space used for runoff collection at these homes follows:

100% of the roof	1 case
nearly 100% of the roof	1 case
75% of the roof	1 case
50% of the roof	2 cases
less than 25% of the roof	2 cases
building a new system that will use 50% of the roof	1 case
building a new system, undefined	1 case
no runoff collected	1 case

For those people who used well water to cook with on Falalop, one well utilized was a government well on the campus of Outer Islands High School. The other well mentioned was a community well that had been dug as a Capital Improvement Project in 1978-79. People said this well could not be used at low tide. The well had a cover on it to keep the well clean. Households reported that they used an average of 6.3 gallons of water per day for cooking purposes on Falalop.

On Asor, the majority of people relied on rainwater for cooking. In our sample, although two people mentioned that they also stored rainwater in 55 gallon drums, the entire group that we interviewed stated they got their rainwater from the community tank. Two people indicated some reliance on well water.

On Mogmog, half of the people we interviewed said they used well water for cooking. The other three families indicated they used a combination of rainwater and well water. Rainwater could be drawn from several sources, including a tank at the Doctor's house, a tank at the church, and other

small metal containers at home. One family used an airplane fuel tank at home. Four separate wells were shown to members of the research team.

On Fassarai, in five of seven cases, people reported that they cooked with rain water. In two cases, families used a combination of rainwater and well water. For all of these families, the big tank near the church was relied upon. Several families also had smaller metal devices set up at home to store rainwater. One well in particular was called to our attention.

A young woman on Fassarai mentioned that if she was going to cook rice, she would use water from the water storage tank. If she was preparing to cook native foods, however, she would use well water. Several families commented that about twice as much water is needed for cooking native foods than rice. The chief on Asor observed that a great deal of water is needed to cook breadfruit.

For all of the inhabited islands of Ulithi, we attempted to determine the amount of water needed per household per day to cook food. As we found for drinking water, some differences were reported from island to island with regard to the amount of water needed for cooking. On Falalop, families reported they used about six gallons of water each day as they prepared their food. The estimate provided by the people of Asor was a little over two gallons of water per household per day. On Mogmog, families said they used about 6.5 gallons of water each day. The people of Fassarai estimated they used almost three gallons of water per household per day for cooking.

Washing Dishes

Most of the people of Ulithi wash their dishes with well water. On Falalop, where rainwater is more plentiful, 50% of the sample indicated they washed their dishes in rainwater, or a combination of rainwater and well water (1 case). On Asor, 6 out of 7 families used well water and on Mogmog, 5 out of 6 families. On Fassarai, 4 families used well water in combination with sea water and one family used rainwater in combination with sea water. We attempted to determine the number of gallons of water (type of water unspecified) needed per household per day on Ulithi to wash dishes. The average response given on Falalop was 21 gallons. On Asor, people reported 3 gallons of water. On Mogmog, the response given was 14 gallons. The people of Fassarai reported they used 4 gallons.

Bathing

The Ulithians that we surveyed confirmed that bathing is an important cultural practice. We asked, "How often do family members bathe?" Twelve people replied, "One to two times." Eleven people answered, "Three times". Two people gave "Four to five times" as their answer. Three people stated that it depended on the individuals. One person simple answered, "Many

times." One man, reflecting on the hardships of the dry season, gave his answer as "One time in three days!"

Wees (1950), the American medical doctor in residence on Ulithi at the close of World War II, wrote that he encouraged the Ulithians to bathe in the sea using salt-water soap. Lessa (1950) writes of women bathing in the sea. Wherever the custom came from, it certainly persists on Fassarai. Several people there told us they usually bathe in the sea and then rinse off with freshwater. On Falalop, 70% of the people bathe with well water. On Asor, again, well water is used for bathing, sometimes accompanied by rain water or sea water. On Mogmog, in five of six cases, people reported that they bathed with well water.

Accordingly, our attempt to determine how many gallons of water are needed per day per household for bathing purposes does not specify what kind of water people are bathing with. According to the data we were given, different amounts of water are used per island: on Falalop, 90.7 gallons; on Asor, 27 gallons (with one case missing); on Mogmog, 80 gallons; on Fassarai, 20 gallons (with 4 cases missing). On Falalop there are indoor showers in three of the homes in our sample. Water is generally available in greater quantities on Falalop; with more water available, people may tend to use more water for bathing. The large number of gallons being used on Mogmog speaks to a successful system of wells on that island, nine wells reported and three of them being community wells, for a population of 128 people. On Falalop, some 418 people share 13 wells, two of them community wells and one belonging to Public Works.

Washing Clothes

On Falalop, 70% of the households in our sample reported that well water was used for clothes washing activities. Two households utilize rainwater; both of these households have large 5,000 to 6,000 gallon capacity concrete storage tanks at home and catch rainwater off 3/4 of their roofs. One of these homeowners has a second smaller tank as well. On Asor, in 5 out of 6 cases well water was used, with one household using well water along with seawater for washing clothes. On Mogmog, 100% of the homes use well water. On Fassarai, well water, rainwater, and sea water are used in combination for clothes washing activities. On Falalop, households used an average of 25 gallons of water per day for washing their clothes; on Asor, 18 gallons. The people of Mogmog reported 33 gallons and the people of Fassarai, 11 gallons.

RAINWATER CATCHMENT VERSUS GROUNDWATER

Lessa (1950) wrote the following concerning freshwater resources on Ulithi:

> Water is supplied by collecting rain from roof-tops and from trees whose trunks have been girdled with rope or leaves. Wells are used to

some extent, but their full potential has not been realized. It is true that on most islands the underground water is brackish; yet on Mogmog, for example, where well-water is fresh, only one well is in use. Another well was used before the war and has since been abandoned.

In the course of interviewing for the current project, the people of Ulithi seem to view freshwater as a limited natural resource. Rainwater appears to be the most highly desired type of water on Ulithi. Rainwater is described as being natural, clean, and pure. Rainwater is also usually convenient to use, collected in storage containers near to the homes. All families surveyed had access to rainwater and all reported rainwater to be their source of drinking water. Much diversity was noted in terms of rainwater collection and storage devices.

Because of the drought, care was taken with the remaining rainwater. Women on Falalop, Asor, and Fassarai admitted that people sometimes argued over the use of the remaining amounts of drinking water in the catchment tanks. But arguments were not allowed to escalate: "When sharp words are exchanged, we just walk away. No need to make trouble." On Mogmog, the highest ranking island, arguments over water were rare. People interviewed said: "We cooperate with each other here, just like in the old days." Women did point out that they had decided children would not be allowed to carry water during the shortage period out of concern that they might accidently spill or waste it. Women and youths were identified to be the water carriers during the drought.

The high chief on Fassarai keeps the key that locks the community tank and, during the drought, the community was on self-imposed water hours. The explanation given the research team was: "If we drain all the water out of that tank, the cement will crack." When asked, "What if someone wants water at another time?", the women responded, "Oh, well, then the chief will just give that person the water. We don't like to have bad feelings among ourselves."

People of Ulithi seem to prefer to use rainwater over well water. Ulithians described well water as brackish and salty-tasting. At the time the wells were sampled for water quality for this project (Clayshulte, 1983), the groundwater particularly lacked freshness owing to the drought being experienced and local people commented on this. Wells are shared on Ulithi, it was learned during the course of the interviews, whether they are community or privately owned. Wells on Ulithi were observed to be in a better state of upkeep than wells encountered in the Marshall Islands by the same research team (Stephenson and Kurashina, 1983).

As pointed out by Clayshulte (1983), nearly all atoll islands have shallow freshwater lenses. On islands the size of Falalop, Mogmog, and Asor, freshwater resources can be maintained through periods of low rainfall or drought. Groundwater resources can be especially valuable as a major source of potable water. Nonetheless, cultural practices can significantly affect groundwater quality. Clayshulte (1983) notes that a

primary problem with the use of groundwater as a source of potable water is an almost total lack of local knowledge about its physical, chemical, and biological qualities. Fieldwork by Ayers and Clayshulte in Ponape State and Truk state, Federated States of Micronesia (Clayshulte, 1983) indicates that groundwater can be easily contaminated by overland benjos, garbage pits, dish washing, clothes washing and bathing practices, and the application of fertilizer in taro patches. Stephenson and Kurashina (1983) point out that groundwater contamination may result from the penning of pigs close to a well.

Ulithians did not articulate a concern to the research team that groundwater might be contaminated. Their preference for rainwater seemed to be based on taste and convenience. Nonetheless, a better understanding by them of the relationship between cultural practices and groundwater quality might reassure them that groundwater can be a dependable source of water for all purposes, including drinking.

MANAGEMENT OF DROUGHT CONDITIONS ON ULITHI

Drought is a matter of great concern to the Ulithians and they articulated this concern to members of the research team during the field project. The drought they were experiencing in Spring 1983 had made a great impact on their lives. The coconut trees on Ulithi were visably very dry and young coconuts were falling to the ground. Taro was dying in the taro patches from lack of water. Water in catchment tanks and in wells was very low. People reported that they used less water in every capacity. Bathing, especially for adults, was infrequent or in the sea. People traveled by boat from island to island to collect water. Nonetheless, the mood of the people was optimistic and forward-looking. The problem could be weathered, with the help of relatives and neighbors at home and even on nearby islands of Ulithi Atoll.

Wees (1950) wrote:

> Ulithians share all things. If one fishing party from either of the villages brings in a haul of fish or a clutch of turtle eggs, the produce is divided among all the families of both villages. The little gardens of yams growing near every house are common property. A crop failure in east village would not affect the east village alone. It would be felt by the whole population.

According to Lessa (1966):

> Goals...[on Ulithi]...are dominated by work, group activity, and cooperation....enlightened self-interest demands communality and sharing of work and responsibility.

In the course of the field project it seemed clear that community water catchment tanks were the pride of the local community. Sharing is a way of life, according to the people of Ulithi. "What good would it do to build

your own cement tank?", one woman mused. "We share everything here. As other people come to use your tank, they would have to cross your land and they might cause some damage. Better to have a tank at the school, or the church, or the dispensary."

Lessa (1960) wrote that Typhoon Ophelia did not cause great damage to the water systems of Ulithi. The salinity level rose in wells,..."but these wells have little importance for the natives, who do not depend on them." The damaging effects of salinity, however, were noted in the taro pits. Because considerable rain fell, freshwater for drinking and cooking remained available. Lessa felt that the typhoon changed people's attitudes toward sharing, that people questioned their obligation to support individuals who were lazy and thus unproductive, and that a trend toward advancing the interests of the nuclear family had begun to develop.

In 1983, certain families seemed more individualistic, but most people articulated the point of view that Ulithi is a place where sharing is central to everyday life. A "we" feeling and community spirit seemed to run high, as well as a confident view of the future ("it will rain soon").

WATER RESOURCES MANAGEMENT AT LAURA AND NAMA: COMPARISONS

In contrast to Ulithi, water resources management at Laura village in the Marshall Islands and on Nama in the Upper Mortlocks takes a different form (Stephenson, Kurashina and Winter 1982; Stephenson and Kurashina, 1983). Fieldwork at Laura was conducted at the end of the dry season; rain had begun to fall again. The attitude portrayed by informants at Laura seemed to be one of a present-time orientation ("Why should we hang up a rain-water gutter now? We are catching plenty of water in the open barrel"), a measure of dependence ("We can get water from the neighbors, anyway"), and a certain degree of fatalism ("We have a dry season every year; we can't change that"). At Laura, many rainwater catchment devices were portable and make-shift. To be sure, informants interviewed at Laura were experiencing a shifting residence pattern owing to recent flooding in the district center and would not necessarily reside in Laura for long. The idea of more community storage tanks being built for the people of Laura had some appeal. Nonetheless, people interviewed stated that no one in their village would take any responsibility for the upkeep of such tanks if the tanks did not belong to anyone in particular.

On Nama (Stephenson and Kurashina, 1983), the theme that emerged was one of competition. Each family wanted to have an individual private household storage tank and a number of families had already built theirs. Variations in size, shape, and style of the individual tanks were noteworthy. The inspiration for the success of the ferrocement tank project may be attributed to a community leader holding a chiefly title, who also serves as the Chief Sanitarian of Truk State. Born on Nama, he has been very conscientious in trying to have Nama set a fine example of water and sanitation practices for the other islands. Each household prefers to have its own tank, it seems, so that families do not have to

directly depend on anyone else to meet their daily needs. Other reasons given on Nama for preferring family-owned, rather than public tanks, the following: "People may argue over the use of the public tank;" "You will take better care of it if it is your own;" The public tanks are for poor families;" "We are afraid of sickness from the public tank."

Wells in Ulithi were carefully cared for. Wells were very clean, usually covered, and served as community focal points, especially for informal splash baths during the drought. In Laura, many wells were in a state of neglect, with the water appearing contaminated (muddy) and refuse noticeable inside (rusty cans, discarded zorris, boards, and planks). On Nama, most of the wells were kept rather clean and covered, but appeared to be used infrequently, perhaps because so many families have rainwater storage tanks by their homes.

SUMMARY AND CONCLUSIONS

In this report, the freshwater resources of Ulithi Atoll in the Western Caroline Islands have been examined. Ulithi, like other Micronesian atolls studied recently, experiences freshwater shortages in the dry season. The freshwater supplies available on Ulithi Atoll at present are not sufficient in quantity to meet the needs of local inhabitants (Freshwater quality needs improvement, as well). When the high average annual rainfall is taken into account, a paradox is noted. Water shortage problems on Ulithi Atoll, however, are not solely the result of environmental factors; cultural factors and human coping strategies have some bearing on the situation.

People of Ulithi Atoll, as at Laura and Nama, value rainwater. They prefer to drink rainwater. Rainwater collection, storage, and distirubiton is a private effect to some extent, but public facilities to collect, store, and distribute rainwater are central to community life. Ulithians value sharing and cooperation in their daily lives.

Well water is reliable in terms of quantity on Ulithi. All households have access to wells, and well water is shared. Wells seem to be valued more on Ulithi than has been reported at Laura and Nama.

House construction on Ulithi may inhibit the satisfactory collection of rainwater roof runoff in cases where the roof is made of thatch. Economic factors on Ulithi may prohibit the purchase of 55-gallon drums or materials to build a cement catchment tank; but community cooperation seems to mitigate these factors. Optimism seems to run high. Ulithians kept saying it would rain. On the last day of the field stay, the skies opened and rain came down in torrents! People enthusiastically cleaned and realigned rainwater collection devices and well covers were opened.

Although water-related problems on Ulithi in the future can be solved or reduced to some extent at the household level, the building of large water storage devices such as concrete cisterns is very desirable, owing to

local cooperation. Maintenance would be handled effectively at the community level. A problem with regard to community tanks, however, may be their distance from some of the homes. Difficulty in carrying water might be apparent if carrying devices are too big, too small, or too awkward for women and children to handle.

Groundwater wells could be utilized more effectively on Ulithi. In some places, groundwater quality is a problem; but, public education could be very useful in teaching local residents ways in which to protect the quality of the groundwater. Groundwater wells in general seem to be valued on Ulithi. More groundwater wells could be dug.

The Yap Community Action Agency reports in their Needs Assessment they find that the second most frequent request from all the islands in Yap State is for the building of water catchments (the first most common request is for repairs to public buildings). Strong support exists at the Yap State governmental level to improve water catchments in all the islands; but, the securing of local and federal funds continues to delay progress. The Yap State Five Year Development Plan, 1983-1987, indicates that the goal of the water development program is to supply each man, woman, and child in Yap State with a minimum of 20 gallons per day of potable water during 10 year drought conditions (i.e., 1969 and 1983 droughts). In terms of water catchments, this translates to roughly a 1,000 gallon storage capacity per person. Currently, there is less than 10% of this figure available.

The Yap State Community Development Block Grant Plan for Fiscal Year 1984 states:

> The utilization of contaminated water for drinking and cooking purposes is one of the reasons we have phenomenal rates of gastrointestinal parasites. For the past four years, health screenings conducted by Public Health and Head Start medical personnel have shown an average rate of gastrointestinal parasite infliction of 76% in 3, 4, and 5 year old pre-school children in both Yap proper and the outer islands.
>
> We believe that having sufficient supplies of potable water coupled with water-sealed toilet projects and village clean-up projects will enable Yap to substantially reduce our endemic health problems and, in particular, gastrointestinal parasites.

As further modernization takes place in romote areas of Micronesia, water consumption will continue to increase. Government plans must be prepared to address local needs for improved water quantity and quality.

ACKNOWLEDGMENTS

This report is the result of joint efforts of researchers and support staff of the Water and Energy Research Institute (WERI) at the University

of Guam. Russell N. Clayshulte was responsible for the well water quality testing efforts for Ulithi. Dr. Jerry Ayers and Russell N. Clayshulte supplied data concerning wells in other parts of Micronesia. The Director of WERI, Dr. Stephen J. Winter, supervised fieldwork details and oversaw the preparation of the final report. We would like to thank Dr. Winter for his patience in the face of time constraints that delayed the written portion of the work.

On Yap, we wish to thank Mr. Tim Thornburgh, Executive Director, Yap Community Action Agency, and Mr. Andrew Kugfas, Historic Preservation Officer, for their assistance to the project. Interest in and support for the project by the Governor of Yap, the Honorable John Mangefel, and Yap's Lieutenant Governor, the Honorable Hilary Tacheliol, are gratefully acknowledged.

Lt. Col. (Ret.) Erwin Ray, Mr. Earl Mowen, and Pilot Peter Reicher made it possible for us to fly from Yap to Ulithi and return. We are indebted to Pacific Missionary Aviation for their service to us and to other Micronesians.

Mr. John Rulmal, the Governor's Representative on Ulithi, coordinated general arrangements for the project prior to and during our time spent on Ulithi. We wish to thank him for his many efforts on our behalf. All of the chiefs on Ulithi kindly granted permission for this project to be undertaken on their islands and assisted with local arrangements. We particularly wish to acknowledge Mr. Bellarmino Hathey, the paramount Chief, Chief Richard Hachiglior of Asor, Chief Juan Yanger of Mogmog, and Chief C. Thing of Fassarai.

Mr. Phillip Nery and family facilitated our housing arrangements during our stay in Ulithi. We thank them warmly for welcoming us into their family and making us feel at home. Eulalia Harui-Walsh of Ulithi, a graduate student in Anthropology at the University of Guam, helped us prepare for the field research and acted as a research assistant, interviewer, and interpreter in the field. She set aside her own work to lend a hand to ours and we are grateful for her assistance. We would like to thank all of the people of Ulithi for their gracious hospitality and interest in the project, as well as their cooperation while we were in residence on their atoll.

Finally, we wish to thank Evelyn Paulino and Angie Duenas for their help in the preparation of the manuscript.

LITERATURE CITED

Census of Population. 1980. United States Department of Commerce: Bureau of the Census.

Clayshulte, Russell N. 1983. Limited Water Quality Survey, Ulithi Atoll, Yap State, Federated States of Micronesia. University of Guam, WERI Information Report No. 6.

Divine, David [Arthur Durham Divine]. 1949. The King of Fassarai. New York: Macmillan.

Hezel, Francis X, S. J. 1983. The first taint of civilization. Honolulu: University of Hawaii Press.

Lessa, William A. 1950. The Ethnography of Ulithi Atoll. Coordinated Investigation of Micronesia Anthropology report.

Lessa, William A. 1964. The social effects of Typhoon Ophelia (1960) on Ulithi. Micronesica 1:1-47.

Lessa, William A. 1966. Ulithi: A Micronesian design for living. New York: Holt, Rinehart and Winston.

Lessa, William A. and Marvin Spiegelman. 1954. Ulithian personality as seen through ethnographic materials and thematic test analysis. In University of California Publications in Culture and Society 2(5): 243-301.

Santos, Elaine. 1983. No relief yet from dry spell. Pacific Daily News 14(81):1.

Stephenson, Rebecca A. and Hiro Kurashina. 1983. A comparison of water catchment and storage systems in two Micronesian atoll communities: Laura and Nama. WERI Technical Report No. 50, Univ. of Guam.

Stephenson, Rebecca A., Hiro Kurashina, and Stephen J. Winter. 1982. Assessment of rainwater catchment and storage systems on Majuro. In proceedings of the International Conference on Rainwater Cistern Systems. Honolulu, Water Resource Research Center, Univ. of Hawaii.

Ushijima, Iwao. 1982. The control of reefs and lagoons; some aspects of the political structure of Ulithi Atoll. In Islanders and their outside world; Machiko Aoyagi, ed. Tokyo: St. Paul's (Rikkyo) University.

Wees, Marshall Paul. 1950. King-Doctor of Ulithi. New York: Macmillan.

Winter, Stephen J. and Rebecca A. Stephenson. 1981. The development of a village water supply system in Truk. WERI Technical Report No. 28. Univ. of Guam.

APPENDICES

Appendix A. The Questionnaire

ULITHI PROJECT SURVEY
WATER AND ENERGY RESEEARCH INSTITUTE
UNIVERSITY OF GUAM
JUNE, 1983

Interviewer:_____ Date:_____
Island:_____ House No:_____

I. HOUSEHOLD DATA

A. Name of head of household_____
Age_____ Sex_____ 1. M 2. F
B. Occupation of household head_____
C. How many people live here? Men [over age 15]_____
Women [over age 15]_____
Children _____
TOTAL = _____
D. How long have you lived in this house?_____years.
E. What is the house construction? Walls_____, Roof_____
F. Do you own this house? 1. Yes 2. No. If no, who owns the house?_____
G. Do you own the land the house is on? 1. Yes 2. No. If no, who owns the land?_____

II. WATER SUPPLY DATA

H. Fill in the blanks for the data concerning water supply during the wet season:

	WATER SOURCE	ESTIMATE QUANTITY	OWNERSHIP
Drinking	_____	_____	_____
Cooking	_____	_____	_____
Washing dishes	_____	_____	_____
Bathing	_____	_____	_____
Washing clothes	_____	_____	_____

I. Fill in the blanks for the data concerning water supply during the dry season:

	WATER SOURCE	ESTIMATE QUANTITY	OWNERSHIP
Drinking	_____	_____	_____
Cooking	_____	_____	_____
Washing dishes	_____	_____	_____
Bathing	_____	_____	_____
Washing clothes	_____	_____	_____

J. Is there a well near your house?_____ 1. Yes 2. No
Who owns the well?_____
How many people use it?_____
Who are they?_____
Who owns the land on which the well is located?_____

K. Is there a rainwater catchment tank near your house?_____1. Yes 2. No
Who owns the catchment?_____
How many people use it?_____
Who are they?_____
Who owns the land where the catchment is located?_____

L. Does your family ever experience a shortage of freshwater?_____1. Yes 2. No
Well water or catchment water/or both?_____
When under what conditions?_____
What happens then?_____
Does your family conserve water?____ 1. Yes 2. No
How?_____

M. Does your family ever get freshwater from other houses if you have a water storage?_____ 1. Yes 2. No
Which house/s?_____
Well water or catchment water?_____

.....

III. WATER STORAGE FACILITIES

N. How large is your well? Diameter:_____ Depth:_____
Type of construction?_____
Is there a pump?_____ 1. Yes 2. No
If yes, what kind?_____ 1. hand pump 2. electric 3. gasoline operated
Who build the well?_____
When was the well built?_____
Who provided the materials to build the well?_____
Who decides when the well needs to be cleaned or repaired?_____
_____
Who cleans and maintains the well?_____
_____
How often does it need to cleaned or repaired?_____

O. What type of rainwater catchment system do you use?_____
1. metal barrels [portable]
2. metal barrels [semi-permanent]
3. plastic containers [portable]
4. plastic containers [semi-permanent]
5. concrete tank
6. Other_____

P. How much freshwater [such as rainwater] can be stored outside your house?_____
Do your tanks [containers] ever overflow?_____1. Yes 2. No
If Yes, why don't you obtain a larger storage facility?_____
_____

Q. Who build the rainwater catchment system?_____
When was the system built?_____
Who provided the materials to build the system?_____
Who decides when the system needs to be cleaned or repaired?_____
_____
Who cleans and maintains the system?_____
How often does it need to be cleaned or maintained?_____

R. How much of the roof is used for water catchment?_____
1. 100% [both sides of the roof] 3. 25% 5. Other
2. 50% [only one side of the roof] 4. Less than 25%

S. If less than 100% of the roof is used for rainwater catchment, why?_____

IV. WATER CONSUMPTION

		WET SEASON	DRY SEASON
T.	How much water does your household utilize per day?	_____	_____
U.	What percent of water utilized is from rooftop rainwater catchments?	_____	_____
V.	What percent of water utilized is groundwater?	_____	_____

V. WATER USES

W. Do you boil freshwater before you drink it at home?_____ 1. Yes 2. No.
X. How often do family members bathe? Men___, Women___, Youth___, Children___, Babies___
Y. How often must you collect water?_____
Z. How much water do you take each time?_____
AA. Do you ever pay for the water you use, or contribute something in exchange_____
BB. Do other families ever get water from your system?_____
CC. What is the greatest amount of water other families can take from your system at any one time?_____
DD. What would happen if someone contaminated the water?_____
EE. What would happen if someone let all the water drain out?_____
Ee. Are children taught not to waste water?_____
ee. Are children scolded or punished if they waste water?_____

VI. ATTITUDINAL DATA

FF. Are you satisfied with the present condition of your water supply system?___1. Yes 2. No.
If No, have you considered improving your water supply system? How?_____
GG. Do you think freshwater should be regarded as a limited natural resource___1. Yes 2. No.
HH. Do you think a public catchment system is better than an individual system? Why or why not?_____
II. Do people ever disagree about who uses the water and when they use it?_____
JJ. How are disagreements handled?_____
KK. How did people get freshwater before this system was built?_____
LL. If someone needs a lot of water for a social purposes, does he/she notify the rest of the community?_____

MM. What do you think are the major socio-economic problems on this island [in order of importance]? 1._____ 3._____
2._____ 4._____
5._____

VII. PHOTOGRAPHIC DOCUMENTATION: Checklist

AA. Overall housing area_____ CC. Well_____
BB. Rooftop rainwater catchment_____ DD. Catchment tank_____

VIII. SKETCH MAP [reverse side]

Wells, pigpens, benjos, houses, shoreline, etc.

IX. QUESTIONS FOR THE MOTHER IN THE HOUSEHOLD

A. Do you care for children under the age of three in your household?__1. Yes 2. No.
B. When your child is small, do you breastfeed it? 1. Yes 2.No
C. How old is your child when you stop breastfeeding it?_____
D. When you are not breastfeeding your child, do you buy powdered milk or baby formula at the store?____1. Yes 2. No.
E. What brank of powdered milk or formula do you buy?_____
F. Do you think the powered milk or formula is too expensive at the store? 1. Yes 2. No.
G. If you do not breastfeed and do not use powdered milk or formula, what do you feed your baby?_____
H. If you make the baby's milk with water, where do you get the water? _____1. rainwater ____2. well water ____3. other
I. Do you use boiled water to mix the baby's milk?_____1. Yes 2. No.
J. Do you use hot water to sterilize the baby's bottle when you wash it? _____1. Yes 2. No
K. Do you use cloth diapers or pampers for your baby?____1. cloth_____2. pampers _____3. Other
L. Do you think pampers are too expensive at the store?____1. Yes 2. No.
M. If you use pampers, where do you dispose them?_____
N. If you use cloth diapers, what kind of water do you use to wash the diapers in? _____1. rainwater 2. well water 3. Other
O. Do you use hot water to wash the baby's diapers____1. Yes 2. No
P. Do you wash the diapers separate from other clothes?____1. Yes 2. No.
Q. Do you wash the diapers separate from dirty dishes?____1. Yes 2. No
R. Does your baby ever have diarrhea?____1. Yes 2. No
S. If Yes, what do you think causes the diarrhea?_____
T. What are the major problems you encounter in caring for your baby [in order of importance]?
1._____
2._____
3._____
4._____
5._____

Appendix B. Fieldnotes on Wells Located on Ulithi Atoll, by Island (numbering for research reference only).

Island	Well Number	Owned By	Description
Falalop	1	Public Works	Situated east of the Outer Islands High School, the well water is pumped by an electric pump and distributed to Outer Islands High School teachers' houses. The well is in concrete measuring ____x_____x_____in. (data missing). It has wooden boards/planks used as a lid. The inside of the well is immaculate.
Falalop	2	Private	Situated south of the airfield on the way to the village. The well is dug into sand. The diameter of the well is 70 cm. The well is lined with corrugated iron. The water is 80 cm. deep. The bottom of the well is 1.6 m deep from the ground. No debris.
Falalop	3	Private	Concrete well 4' x 4'. Depth 1.5 m. Water is 0.8 m. deep. Electric pump. Conductance reading is relatively low. Wooden planks are used as a lid. Water is used for drinking according to owner.
Falalop	4	Private	Concrete well, drum can inside. Water is .6 m deep; well is 2.2 m. deep from the ground surface. Wooden board covers the well. An electric pump (National PG208 AG) is attached to the board. Water contains debris.
Falalop	5	Private	Concrete square well, .64 x .64 x 2.4 m. Water is .8 m deep. Close proximity to a septic tank, 12 m. in distance.
Falalop	6	Community	Concrete square 0.8 m x 0.8 m. 2m. 30 cm. deep. Wooden planks as lid; electric pump and pressure tank.
Falalop	7	Community Well by Church	3.4 m. deep from ground and 4.2 m. deep from rim. Water was 80 cm. deep. Salty taste.
Falalop	8	Private	Located 50 m. inland from the high tide line. Coral and cement block lined, circular 2.5 m. diameter, 3 m. deep. Water only 50 cm. deep. Water level measured during high tide at 1500.
Falalop	9	Missing	Missing
Falalop	10	Private	2½ drum cans. 2.3 m. deep. Water only 10 cm. deep. Corrugated rusty metal lid. Electric pump.
Falalop	11	Private	2.4 m. deep. Well only 25 cm. deep during low tide. Square concrete well, 1 m x 1 m. wooden planks as lid.

Falalop	12	Private	Sealed concrete well 17" deep. Built 5 years ago. Pressure pump. Water around 1' deep for washing only.
Falalop	13	Private	Square concrete well, .9 m x .9 m x 3 m (deep). Water is 1.4 m. deep. Well dug into a basement rock. No lid. No. pump.
Falalop	14	Private	Rectangular concrete, .7 m x 1.35 m x 2.3 m. Wooden planks as lid. No pump.
Falalop	15	Private	Rectangular concrete, .4 m x .85 m x 2.6 m. Wooden lid. Electric pump.
Falalop	16	Private	Square concrete, .9 m x .9 m x 4 m. No lid. No pump.
Mogmog	17	Private	Square Concrete, 1.0 m x .8 x 2.3 m. Wooden lid. No pump.
Mogmog	18	Private	Rectangular, 1.2 m x 1.6 m x 2.6 m. Water is 1 m deep. No lid. Electric pump. Well dug through rock. Fish inside.
Mogmog	19	Private	No longer used. Rectangular concrete, concrete hatch cover. Lots of cockroaches. .7 x .8 x 3.6 m.
Mogmog	20	Private	.8x .8 x 2.4 m. Electric pump. No lid. Square concrete well.
Mogmog	21	Community	Right next to Taro patch. Pond dug through a limestone pavement. About 70 cm. deep.
Mogmog	22	Private	Close to Taro patch 1.8 x 1.8 x 1.0 m. Pit. No lid.
Mogmog	23	Community	7.3 x 4 x 1 (?) m. next to Taro Patch.
Mogmog	24	Community	.8 x .8 x 2.6 meters. Square concrete well dug through pavement rock. Wooden lid. No pump.
Mogmog	25	Community	Stone lined well dug through pavement rock .6 m x 1.2 x 2.5 m. No lid.
	26		Missing
Fassarai	27	Community	Square concrete well, .95 x .91 x 1.3 m. No lid. No pump.
Fassarai	28	Community	Square concrete well, .7 x .7 x 1.5m. Metal lid (airplane part) No pump.
Falalop	29	Private	Not used. Pit measuring about 1. m is dug into basement rock. Well is 1.8 m deep. Water is .4 m deep. No cover. No pump.
Falalop	30	Private	Square concrete well, .6 x .6 x 2.6 m. Wooden lid full of termites. No pump. Brand new house.