A COMPARISON OF WATER CATCHMENT AND STORAGE SYSTEMS IN TWO MICRONESIAN ATOLL COMMUNITIES: LAURA AND NAMA

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Technical Report No. 50

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Project No. A-021-Guam, Grant Agreement Nos. 14-34-0001-0112-1112

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Project Period: October 1, 1981 to September 30, 1983

The work on which this report is based was supported in part by funds provided by the United States Department of the Interior as authorized under the Water Research and Development Act of 1978.

ABSTRACT

This technical report focuses on a discussion of freshwater catchment and storage systems in Micronesia. Particular attention is paid to the conditions within two small Micronesian atoll environments, the village of Laura on Majuro atoll in the Marshall Islands and the village community of Nama, a small Carolinian island lying outside of Truk lagoon. Both of the study areas lie within American jurisdiction in the western Pacific.

Fieldwork at Laura in August 1981 revealed that a paradox exists between the abundant availability of freshwater occurring as rainwater and groundwater on the one hand, and frequent shortages of freshwater on the other. Fieldwork on Nama in August 1982 revealed a similar abundant availability of rainwater, but freshwater shortages were rarely reported.

It is suggested that different levels of individual initiative and community response to the need for freshwater are apparent in the two island communities being studied. Particular variables such as access to the district center, availability of construction materials and supplies, community level planning and leadership or lack of the same, and time perspectives may be called upon to help explain variations between the freshwater catchment and storage systems found at Laura and Nama.

TABLE OF CONTENTS

LIST OF FIGURES

List of Figures Continued

LIST OF TABLES

INTRODUCTION

The focus of this report is upon freshwater supply and distribution systems in Micronesia. Particular attention is paid to the freshwater systems of two low island communities, the village of Laura on Majuro Atoll in the Marshall Islands and Nama Island in the Upper Mortlocks, Eastern Caroline Islands, in Truk State in the Federated States of Micronesia. Fieldwork in both of these communities, conducted in July-August 1981 at Laura and July-August 1982 on Nama Island, pointed out a paradox between the abundant availability of freshwater occurring as rainwater and groundwater, on the one hand, and frequent shortages of freshwater, on the other. In the course of earlier field research in the high islands of the Eastern Carolines, the same paradoxical condition was found to exist (Winter and Stephenson 1981).

The authors of this paper suggest that the paradox exists principally owing to inadequate management of water supply and water storage in Micronesia. It is further suggested that economic, technical and social factors may be called upon to explain this phenomenon. This report describes the study area in the Marshalls and the Eastern Caroline Islands; overviews local water supply and storage systems; examines attitudes toward uses of rainwater catchment versus groundwater; and then attempts to explain why rainwater, although preferred, is not utilized more effectively than it is.

OBJECTIVES

The objectives of this study were twofold. The first objective was to make an inventory of all presently used rainwater and groundwater resources in the island communities of Laura and Nama. Rainwater distribution and supply systems in both communities were observed and photographed, as were groundwater resources. In addition, groundwater sources in Laura were tested for the presence of chloride and bacteria wherever possible. Such testing of groundwater quality was not possible on Nama, owing to its remote location. The second objective involved interviewing as large a sample as possible of households in each community to determine present water use customs and practices as well as attitudes toward the use of freshwater from various sources. The frequency of use of water collected by means of rooftop rainwater catchment or storage tank versus the frequency of the use of groundwater, particularly as occurring in wells, was assessed.

The purpose of the fieldwork was to determine, first, whether freshwater supply systems currently used in Laura and Nama can provide a sufficient quantity of freshwater to meet the needs of local residents. In Laura, the project also attempted to ascertain whether its freshwater supply systems are of satisfactory quality for good health. Second, the fieldwork attempted to determine whether rainwater or groundwater was the preferred type of freshwater in the village, why people have such a preference, and possible implications of their attitudes toward the success of freshwater development projects in these areas in the future.

Many of these were used until the 1960's but then developed leaks and could no longer be used. Some of these are now used as shower rooms, people bringing in buckets of water to the facility to bathe in privacy.

An informant in Laura explained that his concrete tank was built through a Community Development grant-in-aid in 1974. Another such tank was reported to have been built in 1977. One informant said that his tank was built about a year ago by government development employees, with the government providing 75% of the funds and the community providing the remaining 25%. There was no more money left to build systems like his, though, he reported. Inflation was too high. Families could no longer afford to buy the needed supplies for catchment construction. One informant expressed some skepticism with regard to concrete catchment tanks: "They may leak, anyway."

In Nama, no makeshift devices for catching rainwater such as metal buckets, metal dish pans and plastic buckets were seen. Only one family reported that they did not collect rainwater at home because they..."got it from the other house." The household head had built that particular tank, so the family had full rights to use it. Semi-permanent containers on Nama were 55 gallon drum cans, most of which were placed in strategic spots to catch roof runoff of rainwater by means of gutters. Forty-six families (86.9% of the sample) had their own concrete water tanks. Of that number, 30 families utilized one to five drum cans for water catchment along with a concrete tank. Four families had more than one water tank at home. Gutter systems were elaborately constructed for most of the households on Nama.

Rainwater storage capacity per household in the village of Laura varied from none (7 cases) to 12,000 gallons (a very large cistern located outside of the community church). Six families reported they could collect and store approximately 50 gallons of water outside of their home. Ten families said their collection and storage capacity was about 100-200 gallons. Six families indicated they could collect 300-400 gallons of water. For eight families, it was possible to collect and store 500-600 gallons of water outside of their home. Two families reported that their cisterns held about 1,000 gallons of water. For the two remaining families in the sample, estimates of their water collection and storage capacity are lacking.

Clearly, as shown in Table 1, the greatest number of people in Laura utilized rooftop catchment along with a type of gutter and cistern system (19 cases out of 41). However, as the table indicates, a significant number of people in Laura relied upon a makeshift means of rainwater collection and storage without the use of a permanently installed gutter (36.6%).

On Nama, rainwater collection and storage capacity per household varied from none (one case) to approximately 12,000 gallons (two cases). Six families reported their freshwater collection and storage capacities outside of their homes to be approximately 500 gallons. Six families reported they could collect and store some two to four thousand gallons of water. Fifteen families reported their large concrete storage tanks

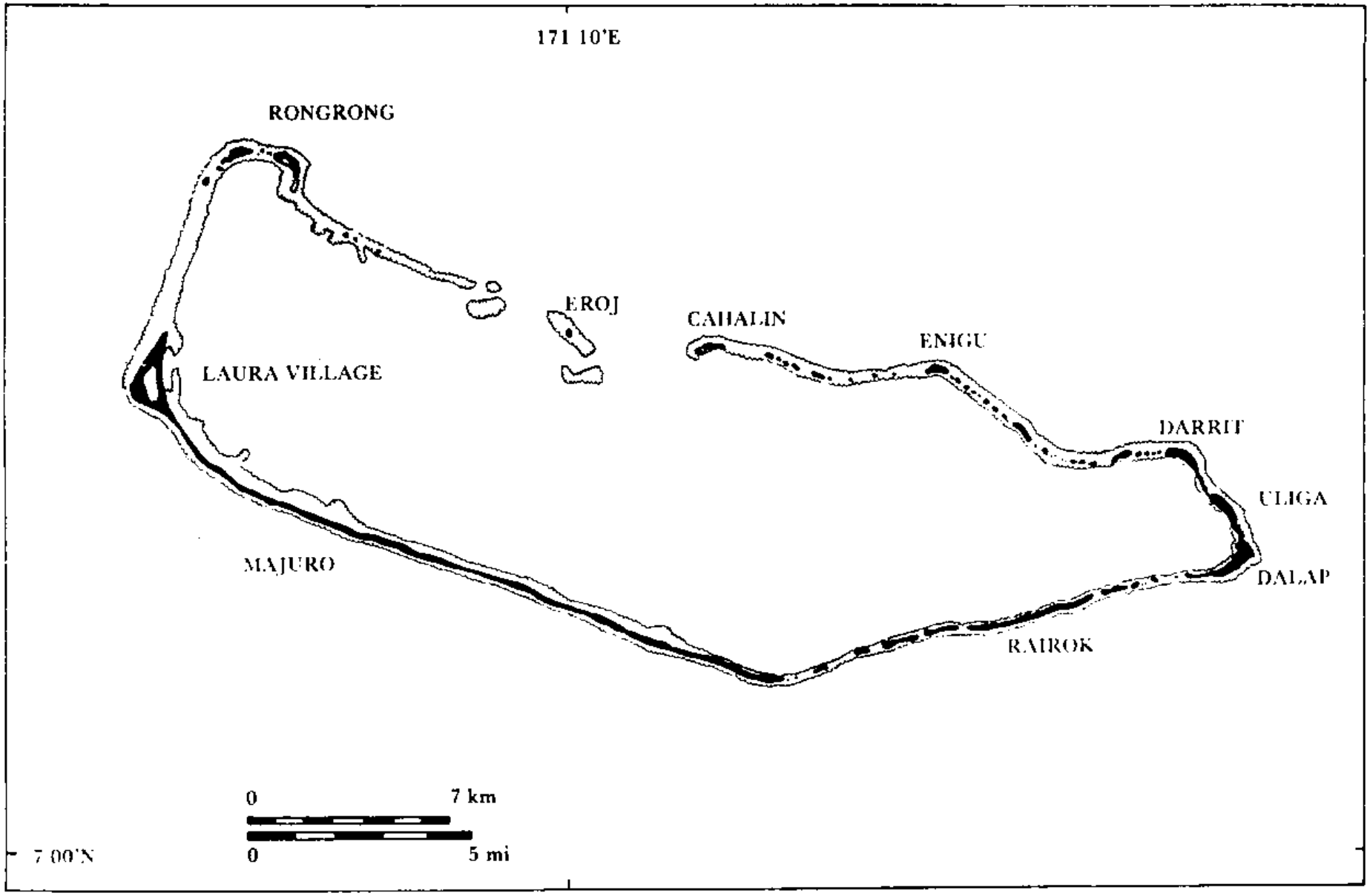

Figure 1. Map of Majuro Atoll, Marshall Islands.

Table 2. Seven types of wells in Laura, according to the construction and the frequency of occurrence of each type.

Type of Well	LAURA Frequency of Occurrence (%)
Sand Pit	1 (2.4%)
Coral Blocks	1 (2.4%)
Coral Blocks and Concrete	1 (2.4%)
Coral Blocks and Drum Can	1 (2.4%)
Cement/Concrete	4 (9.8%)
Drum Can (2 to 7)	32 (80.0%)
No Structural Data	1 (2.4%)
Total	41 (100%)

In 1935, the population was recorded as . . . "406 natives and no others" (Kramer 1935). The 1948 population was 490 persons. In 1970, the population was shown to be 1,127 people (Bryan 1971). Recently Nama is listed as having 156 households (U.S. Dept. of State 1981). A total population of 1,021 people is indicated, or a population density of 3,535 persons per square mile. Local informants said some 1500 Nama people can be counted in the present day, living on Nama, in Moen, and on Ponape. They estimate there are approximately 250 school children on Nama.

Three clan names are represented on Nama, Uanikar (having five ranks within it), Sopunipi (or Sapu) and Sor (Sar). Several subclans or "villages" are present. No subclan endogamy is practiced, according to informants.

There are no cars or trucks on Nama. There is no movie theatre. Two primary schools serve the needs of the island's children. There is one dispensary. One Protestant church is present; it seems to greatly influence island life. People live on the side of the island where it is easiest to launch a canoe, in times of the prevailing winds. Men's houses and canoe houses are used for public meetings. Cooking houses are located close to the sleeping quarters.

The people of Nama recall that one Japanese man stayed on their island during the Japanese occupation of the Central Carolines in World War II. He eventually married a local woman.

There is no public land on Nama. All the land on the island is privately owned. The chief, however, is the one who dictated where the dispensary, the school, and the like would be built.

Between 1952-1955, the Nama Trading Company was founded. An American family named Curtis helped the people of Nama to organize this company. The Curtis family are also credited with teaching the women of Nama to sew for commercial enterprises. The main store of the Nama Trading Company is located in Moen, Truk's district center. Canned food, fishing supplies, baby needs and such are sold there, along with garments and woven pandanus goods made on Nama.

Taxes that are collected are divided among the clans of Nama. Local titles of importance include church pastor, magistrate, community judge, senator to the government of Truk state, and community chief or community leader and councilman.

Nama has approximately ten small shops that conduct business if there are goods to sell. Three of the shops belong to the Women's Association, an island organization for ladies.

Burials take place on land on the opposite side of the village from where the families live. Informants reported that burial at sea was practiced in the old days. The community leader does not like to see graves covered with concrete,. . . "then no one can plant there for a very long time." A better idea, he suggested, was the older custom of planting a coconut tree above the burial of a dead person.

DESCRIPTION OF PROJECT SITES

Laura Village, Majuro Atoll, Marshall Islands.

Laura had been selected by the Trust Territory of the Pacific Islands' Office of Planning and Statistics on Saipan in 1981 as a site for the possible future development of a solar energy assisted water supply system. The project would involve, first, an assessment of groundwater resources. Second, a 50,000 gallon storage tank would be constructed. Third, a solar-powered (photo-voltaic) pump or pumps would be installed, to be controlled so that they would shut down when water being pumped reached a certain salinity value. Fourth, the effectiveness of the new system would be monitored and assessed.

Project team members were sent to Laura to assess the likelihood for success of such a project. The observations and the interviewing would round out the team's knowledge of freshwater needs and coping strategies in this small island community.

The settlement of Laura occupies an elbow-shaped islet at the southwest end of Majuro atoll (Figure 1). Code-named Laura by the Navy in the late 1940's, the settlement area is 2.3 miles long by 0.73 miles at its widest point; the maximum elevation is about 20 feet above sea level. Access to Laura village is by automobile across a long causeway that links Laura to the district center in Majuro, the Darrit-Uliga-Dalap area (locally known as D-U-D), Navy code-named Rita. Constructed in 1961, the causeway is 35 miles in length. It is the longest paved road in Micronesia at present.

Present day Laura village encompasses more than 300 households, a population of some 800 people, and is within the jurisdiction of an iroij "traditional chief" and an elected senator to the Nitijela, the Marshall Islands Assembly. The settlement of Laura is divided into wato, traditional land sections that lie in strips, extending across the island from the lagoon side to the ocean side. Wato are held and administered by individual matrilineage or descent line groups (Alkire 1977; Mason 1967).

Majuro atoll, where Laura is located, is composed of a low lying series of sand and coral islets surrounding a salt water lagoon. A typical atoll, Majuro's total land mass is about 3.5 square miles or about 917 hectares, encompassed within 64 separate islets. The average elevation of Majuro is only a few feet above sea level. Brackish groundwater generally occurs on Majuro in the form of a Ghyben-Herzberg lens, a thin subsurface freshwater lens that floats on the heavier salt water beneath it. Careful use of such a lens is critical, so that freshwater is not pumped out too fast. Such action would allow salt water to infiltrate and contaminate the freshwater lens. The coral-based soil of Majuro is highly permeable, which allows for little or no surface runoff following rains, in spite of the average annual rainfall of 151 inches. For this reason, and because of the small size of the islets, no freshwater streams occur on Majuro. Atoll residents must seek freshwater through other means.

Kramer (1935: 140) identifies seven main settlement areas for Nama and names them from south to north. Kramer shows thirteen location names on the map, including a key that identifies boathouses, living houses, and cook houses. The church is identified clearly.

Current names have changed to some extent. The research team interviewed householders in 17 named villages on Nama in 1982. Eight new village names appeared in our survey. Each was identified as a new division of one of Kramer's original villages.

Kramer wrote of the discovery of Nama, its land description, material culture, family life, kinship, death, dancing and games, religion, legends and such. Reproductions of photographs and drawings prepared by him were viewed with considerable interest by people of Nama during our stay on the island. Older informants remember seeing the weihegabenhanger bei Tanzen 'garlands for dancing' and commented "Those were heathen things." Kramer's drawings also made them recall the traditional style of wohnhaus 'living house', boothaus 'boathouse', doppe boat a/s Zauber 'double canoe with (a) magical charm,' and grabhaus 'gravehouse.'

RESEARCH METHODOLOGY

Laura

Field research was conducted at Laura for this project during the period August 1 through August 8, 1981. During the period August 1-3 formal calls were made in the district center of Majuro on the Acting President of the Marshall Islands, and on the Senator of Laura, seeking official endorsement of the project. The Director of the Ministry of Social Services served as local coordinator of the project. Mid-day on August 3, 1981, the project team members drove out to Laura and began the field research.

The field methodology employed was essentially household interviews using prestructured survey forms (Appendices A and B). The survey forms were designed to collect demographic data for each house, per capita water consumption estimates, freshwater sources utilized, water storage facilities, and technological efficiency of rainwater catchments. In addition, attitudes towards water distribution systems, perception of freshwater needs, preference for rainwater gathered through rooftop catchment versus groundwater wells, and such would be assessed. If some coconut trees in the village would have to be cut to provide sunlight to solar cells for the new system, would Laura villagers object? Would village people be willing to let their wells be used for monitoring of water quality? An attempt would be made to rank acquisition of freshwater as a problem in the village. If other problems were reported for the village, would they be seen as more severe?

A total of 41 households in Laura were consulted in the course of the field research. In order to be included in the sample survey at Laura, each

Despite the difficulties in obtaining freshwater, the Laura area appears to have been occupied for a long time. The earliest permanent settlement on Majuro appears to have been at Laura, with the most concentrated human settlement near the lagoon side. A firm baseline date of about 2,000 years ago is now known for Laura. Archaeological material collected here, consisting mostly of strombus shell, suggests that early inhabitants were intensive collectors of the marine resources. During prehistoric times, Laura had perhaps as many as 1,500 inhabitants. A total of 29 archaeological sites have been recorded in the village itself, and another 40 were strung out along the island's southern rim (Riley 1980; 1981).

Nama Island, Upper Mortlocks, Eastern Caroline Islands.

Nama was chosen as the second study site in 1982, because it appeared that Nama's freshwater storage and distribution systems contrasted sharply with those of Laura. Information reaching Guam's Water and Energy Research Institute of the Western Pacific indicated that Nama had a very effective freshwater management system. We wanted to observe the system and determine the reasons for its efficaciousness.

The distance from the southeast pass, Salat, at the edge of Truk lagoon to Nama, a single coral island, is approximately 38 miles (Figure 2). Nama's total dry land area is just 0.289 square miles. Round in shape, the average elevation of Nama is about twelve feet above sea level and attains an elevation of about twenty feet in the north. There is no lagoon around Nama. Access to Nama is by boat from Moen, Truk's district center. One main landing is used, near to the residence of the chief. But, actually, a landing can be made at any place around the island, so long as goods are carried in over the reef if boats are too heavily loaded. Passengers commonly walk in over the reef, as well.

The island lies at 7°00N., 152°35'E. Local people believe there were no interisland wars on Nama in the old days, only wars with other nearby islands. Severance has written the following concerning Nama's sociocultural heritage (1976:28):

> Extensive social ties no longer exist between Losap-Pis and Nama though Nama reputedly owed tribute to the chiefs of Losap in precontact times. The present population of Nama is derived largely from Mortlockese clans of Moch and Namoluk who repopulated Nama after the Nama-Losap war which decimated the population of Nama in the 1860's or early 1870's (Severance cites his sources as Mitchell 1967,1970; and Tetans 1958).

According to Bryan (1971), Nama has been known by the following names at one time or another: Nama to (Shima), Nemo, Nema Peace, Peace, San Rafael Isl, D'Urville-insel. Local informants told us the proper name for their island was "Nemuo."

WATER USE CUSTOMS AND PRACTICES

Household Data

There are approximately 300 households in Laura, with a total village population of some 800. Of the 41 households sampled, interviews were conducted with 34 male heads of households and 7 female equivalents. Their ages ranged from 22 through 75, with a mean of 47 years. A median of 47 was also recorded in the demographic data. There was one household head who claimed her age was 102. Census data showed that the family size ranged from 2 people to 23 people, with an average size of 10 individuals per household. Clearly, the demographic pattern reflects the more traditional pattern, that of large families. Since family size tends to be large, it may be expected that freshwater needs per household are significant. The population data showed that there were 213 children in Laura village under the age of 15 in the 41 of the households sampled. Adult men over the age of 15 were 87 in number; there were 101 adult females reported in the sample.

Time of residence in the individual households ranged from four months to seventy-five years. It is important to note that about 40 percent of the people interviewed had lived in their houses for less than one year. This phenomenon was largely caused by the catastrophe that occurred in December 1979, when a tidal wave generated by a storm some 1,000 miles to the east ravaged the D-U-D (Rita) area, the district center, causing millions of dollars in property losses.

Two years after this event, Rita was still being rebuilt. A number of people have not yet settled into permanent residences. Some Laura residents moved into Rita after the disaster in order to utilize home improvements grants on lands they held in Rita. Other D-U-D residents relocated to Laura. Data regarding household and land ownership in Laura, consequently, is inconclusive at this time and is not included here.

Nama's resident population is between 1,000 and 1,200 persons. On Nama, 53 heads of households responded to the sample survey in interview situations. Thirty-seven male heads of households were interviewed, often with their wives present and taking part in the interview. Sixteen women were interviewed in the capacity of heads of households. The ages of the heads of households ranged from 19 to 68, with a mean of 44.3 years. Family size ranged from two to 34 people (a household compound), with an average of nine individuals per household. As in Laura village in the Marshall Islands, large families are evident on Nama. Accordingly, freshwater needs per household must also be significant. In the sample, adult men were 90 in number; women over the age of 15 were 141 in number. There were 239 children represented under the age of 15 in the 53 households where interviews were conducted.

A precise count exists of the houses in Nama. In the Truk Department of Health and Sanitation government survey (1982), 207

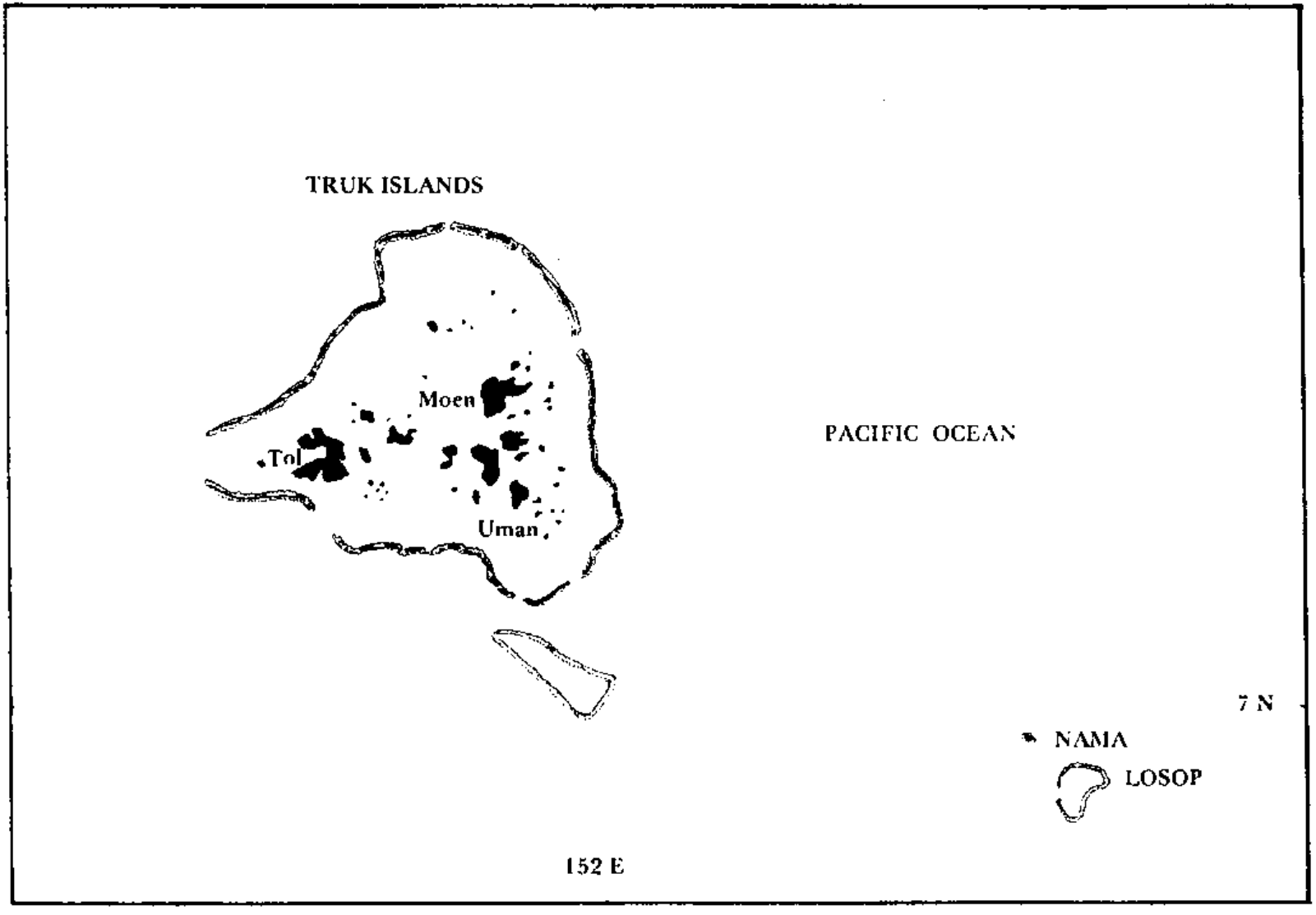

Figure 2. Map of Nama Island in relation to Truk Lagoon.

Table 1. Types of rainwater collection and storage systems in Laura and Nama and their frequency of occurrence.

Type of Rainwater System	Frequency of Occurrence	
	Laura	Nama
No device	7[17.1%]	1[1.9%]
Portable containers only	3[7.3%]	0[0%]
Semi-permanent containers	2[4.9%]	0[0%]
Incipient gutter, semi-permanent containers	3[7.3%]	0[0%]
Gutter, portable container	1[2.4%]	0[0%]
Gutter, semi-permanent container	6[14.6%]	6[11.6%]
Gutter, cistern	19[45.3%]	46[86.9%]
TOTAL	41[100%]	53[100%]

home had to have its own well. Wells surveyed were described according to their condition of upkeep, this information being supplied by informants and by the observations of the researchers. Rooftop catchment and wells at the households surveyed were mapped and photographed in the course of the interviews.

Whenever possible, the household interviews were conducted in English. Two Marshallese research aides were dispatched from the Ministry of Social Services to assist the project by interpreting in interviews with Marshallese-speaking families. Wellwater samples were gathered in sterilized 250 ml plastic bottles and were kept refrigerated in an ice chest in the field. Samples for bacteria tests were processed within 24 hours of collection on Majuro at the Sanitation Laboratory by the local technician. Other samples were air freighted frozen to WERI on Guam by Air Micronesia for chloride testing.

Nama

Field research was conducted for the Nama portion of the project from July 31, 1982 - August 9, 1982. During the period July 31 - August 2, formal contacts were made with the Governor of Truk and other officials at Moen, the district center of Truk, seeking official endorsement of the project and approval to begin the fieldwork on Nama. Access to Nama was provided via the launch belonging to the Governor of Truk State. On August 2, the project team members arrived on Nama and began the introductory work.

The field methodology consisted of a series of household interviews, with selected homes divided roughly between the separate villages of Nama, seeking approximately five interviews in each of the major villages. Pre-structured survey forms were utilized to record the data ellicited by the household heads. The survey forms were designed to collect the same data as for Laura.

On Nama, a selected sample of 53 households were interviewed. Most of the interviews were conducted in Trukese, utilizing two local men as research assistants and interpreters. No water samples were gathered as there was no way to test the samples on site for water quality. Return to Moen, Truk, the district center on August 7 at the close of the fieldwork was via the government fishing boat, Mkorkor. August 8 and 9 were spent reviewing the research notes, debriefing with our principal informant, and paying a final call on the Governor of Truk to report on the project's outcome.

For the interviews, both at Laura and on Nama, photographic documentation was made using 35 mm cameras equipped with color slide, black and white print, and color print films. These were all commercially processed, either on Guam or in the U.S.A. Data from the household interviews were coded on standard fortran forms and were processed using SPSS on the IBM 4331 computer of the University of Guam Computer Center. The coded data are kept on magnetic diskettes at the University of Guam's Anthropology Laboratory. A narrative discussion of the research findings of the project will be found in the remaining sections of this report.

held between 5,000 and 6,000 gallons of water. Nineteen families stated their concrete tanks held more than 6,000 gallons. Five families reported their tanks could hold between 10,000 to 12,000 gallons of water. For one family, there is no estimate listed of their collection and storage facilities.

The Clean-Up List of the Federated States of Micronesia Division of Environmental Health and Sanitation (1981) for Truk shows 95 rainwater tanks to be present on Nama. In 108 households, rainwater is caught and stored in drum cans, often as a back-up to the tanks. The roof of the community church is used for rainwater runoff, we were told. Water from this source is piped into the Uref village community tank. There is, however, no tank at the main school. Children may go home from school to get a drink of water, it was reported.

Use of Roof Space for Rainwater Catchment

On both Laura and Nama, most people make use of their roofs for rainwater runoff purposes. As shown diagramatically, however, maximum use of the roof for this purpose is uncommon (Figure 3).

Clearly, few people in Laura (7.3%) utilize 100% of their roofs for rainwater catchment by building gutters along all roof edges. Data from Laura show that 31.7% of the people consulted placed gutters along one half of the available roof margins. Approximately one quarter of the roof has attached gutters in 17.1% of the sample while 12.2% of the same utilize less than one quarter of the available roof space. Surprisingly, almost one-third of the homesteads visited in Laura had no visible gutters attached to the roof. In one single case in Laura the roof of the house had no gutters but a nearby shed had a gutter that made use of half of the shed's roof. This case is shown as "other" in the diagram.

For Nama, more people utilize 100% of their roof for rainwater catchment by building gutters along all roof edges (13.2%). Over half of the informants in Nama reported that they use half of their roof surface for catchment (62.3%). In one case, a family made use of about 75% of its roof in this way. Five families used about 25% of their roof; another two families made use of less than 25% of their roof. Two families used none of their roof for runoff. For three families, data is not recorded with response to this question.

Groundwater Wells

Groundwater wells in Laura and Nama serve as true secondary sources of freshwater, supplementing rainwater. Approximately 200 wells are located in the village of Laura (Figure 4). The 41 households sampled for this project were chosen because all have wells in the immediate vicinity of their living quarters. Wells in Laura have been divided into seven categories of technological sophistication for the purposes of this study. The table below delineates the seven types of wells, according to the construction and the frequency of occurrence of each type (Table 2).

concrete houses with tin roofs were reported on Nama, and eight houses with thatch roofs. The same survey identified 190 cook houses and 10 meeting houses. Time of residence in the individual households ranged from two months to 38 years in our sample. The average length of time which families in our sample had lived in their house on Nama was 13 years.

Sources of Water

Informants at Laura and Nama were asked to identify the sources from which they obtained their freshwater. Two primary sources of freshwater exist, rainwater and groundwater. Villagers utilize both of these sources to obtain needed freshwater. In the rainy season, approximately June through December, both rainwater and groundwater sources are plentiful. During the dry season, approximately November to March, however, acute rainwater shortages are often experienced at Laura. Some informants reported that their rainwater storage devices may be empty and their wells may have little or no water in them. On Nama, people reported that there was less water available in the dry season. Rainwater tanks may have little water in them and wells may be low. Uses of rainwater catchments and groundwater wells are now discussed in detail.

Rainwater Catchment Systems

In Laura and Nama, rainwater is collected in a variety of ways. Basically, rainwater is obtained by means of roof run-off. A considerable amount of technological variation exists, however, in Laura and Nama with regard to the percentage of roof space effectively utilized, efficiency of gutter systems, and the devices used for rainwater collection and storage systems. We have divided rainwater supply systems into 7 categories in order of technological sophistication, including a beginning category for "no rainwater storage device." Table 1 shows the seven types of rainwater collection and storage systems in Laura and Nama observed and their frequency of occurrence.

In Laura, portable containers included metal buckets, metal dish pans, plastic buckets, plastic ice chests, and the like. Semi-permanent containers most commonly used were 55 gallon drum cans, but also included discarded airplane fuel tanks strategically placed to catch roof runoff. Also present were Japanese style metal tanks that had been made available in the D-U-D area after the disaster. Some of the semi-permanent containers had what we call "incipient gutters," i.e., sections of gutter temporarily propped or wired into position to deliver rainwater from the roof to the storage device below. Some portable containers were placed beneath the permanent gutters which were affixed to house roofs. Other semi-permanent containers were sometimes seen strategically located under permanent gutters. Our 7th category is the combination of a permanent gutter leading to a permanent cistern. Cisterns observed in Laura were made of metal (1 case), rubber (1 case), or, most commonly, concrete (17 cases). Old tanks, no longer in use, were visible. Some were described to us as having been built during the Japanese administration, perhaps in the 1930's.

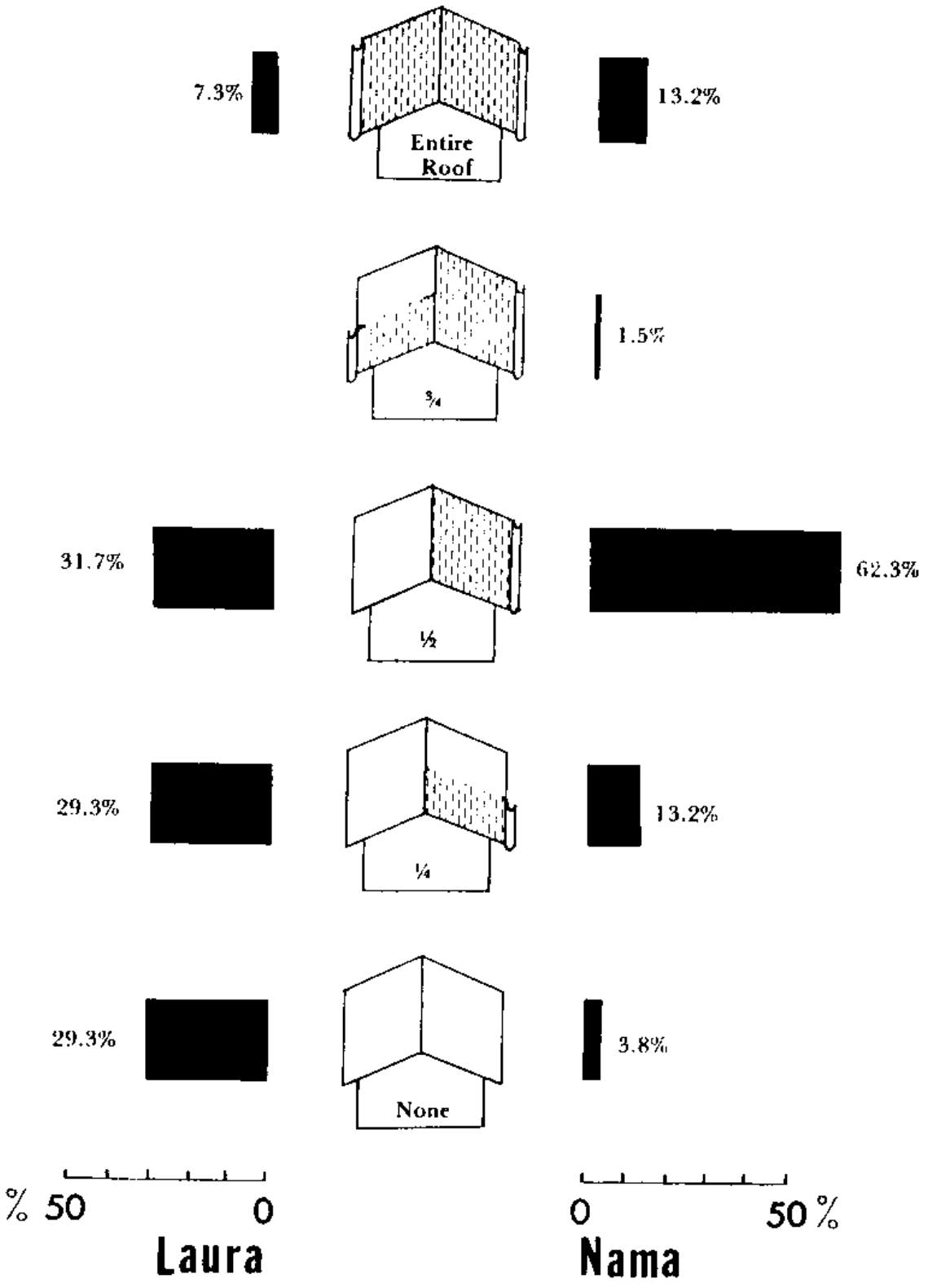

Figure 3.
THE USE OF ROOF SPACE FOR RAINWATER CATCHMENT

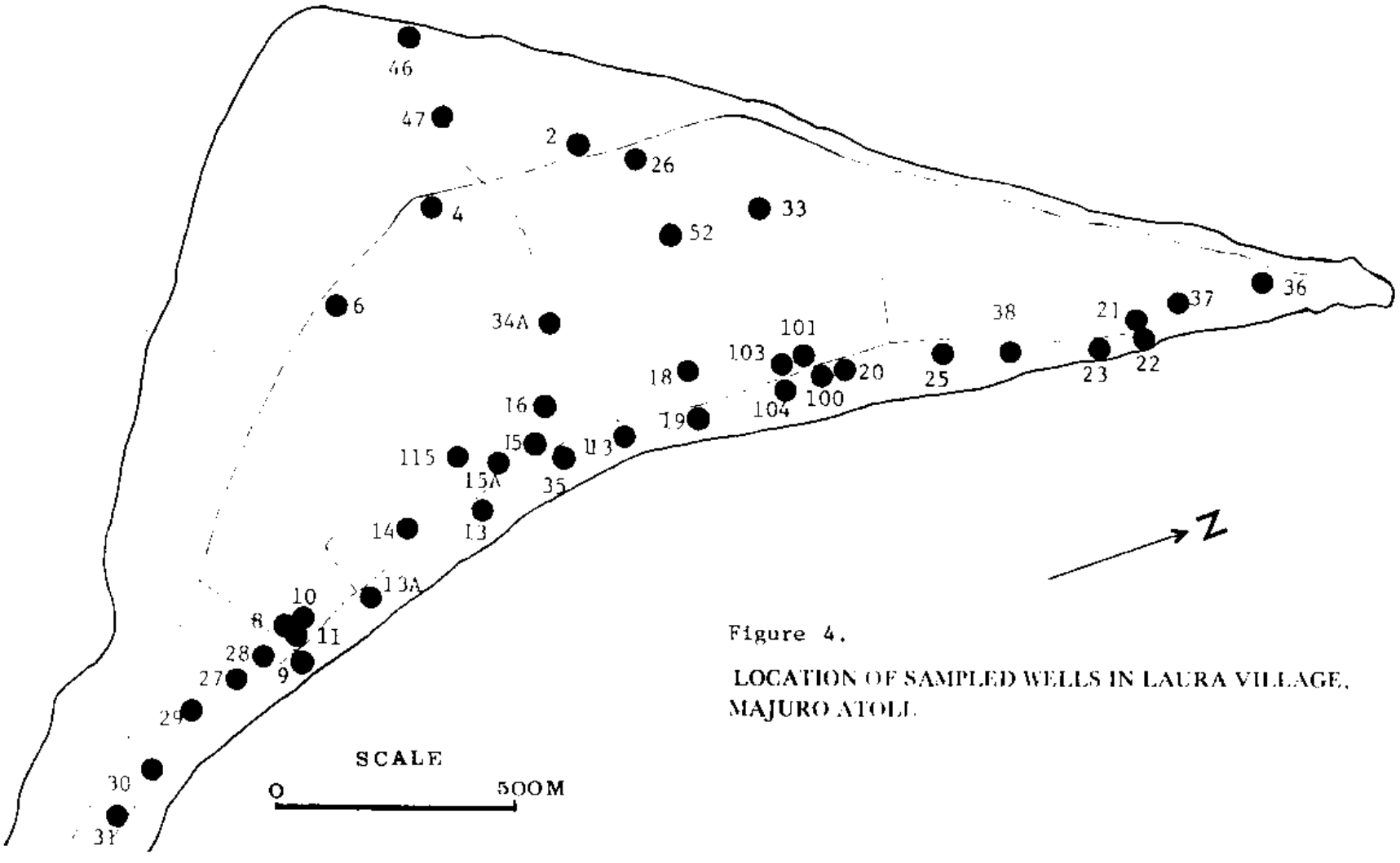

Figure 4.

LOCATION OF SAMPLED WELLS IN LAURA VILLAGE, MAJURO ATOLL

In Laura, water is drawn from wells in the village utilizing various devices. The most common device is a one-gallon tin can such as a flour can (31 cases). Other devices found near wells tested included a teapot and a plastic bucket attached to a line. Pumps were used in some cases, three in number, including a hand pump, a diesel-powered pump, and an electric pump (1 example each).

The depth of the wells in Laura was variable depending upon the location of the well. The depth varied from 1.37 meters to 3.66 meters to the limits of the freshwater table, with a mean of 2.61 meters and a standard deviation of 0.55 meters. The actual water depth in these wells was also variable during the time the field data were gathered, from 0 to 2.75 meters. The mean water depth was 58 centimeters with a standard deviation of 43 centimeters at the time the current tests were run. The wells stand about 10 feet above sea level, with the thin freshwater lens suspended in sand above the denser saltwater, a classic Ghyben-Herzberg lens.

As with rainwater systems described above, wells may be used by individual households or shared with other families. Nearly 50% of the households surveyed reported that they shared their wells with two or more other families. Eighteen families are the sole users of their wells.

For Nama, precise data on wells were not gathered because it was impossible to conduct water quality testing in this remote island location. When asked, "Is there a well near your house?", 34% of the families responded, "Yes", 52% of the families answered "No", and 13.2% of the families explained that a well was "rather near" their house. We asked, "Who owns the well?" Responses are shown in Table 3.

The Clean-Up List prepared by the Division of Environmental Health and Sanitation in Moen (1981) lists 19 wells on Nama, located in 16 villages. Eleven of these wells are described as individually owned. Wells observed by members of our research team were located away from residential sites and toward the beach. About 10 wells were observed. Wells were sometimes circular and sometimes rectangular in shape, either lined with coral rocks or with drum cans. A well in Lemete village, for example, was about six feet in diameter and appeared to be about six feet deep. It was located in a clearing in the middle of the island, about 50 yards from the community living area. Wells observed in Efeng village were about five feet in diameter and also seemed to be about six feet deep. A well observed in Lenom village was round in shape, about 4 feet across, and lined with coral rocks. It seemed to be about 12 feet deep, but it was located on higher ground, close to the houses in this area. No pumping devices were observed. At Nama, diesel fuel and generators are in short supply, but neither were hand pumps observed. Scooping devices varied, the most common device being a one-gallon tin can.

Sharing of wells was reported as very common. Four families reported that they were the sole users of their wells. Other responses varied from "neighbors" (15.1%) to "clan" (39.6%), "people of village" (13.2%), "relatives" (5.7) and not applicable (1.9%).[3]

Table 3. Details of well ownership and frequency of occurrence of each type on Nama.

Who owns the well?	NAMA Frequency of occurrence (%)
Household Head	5.7
People of Village	9.4
Family	30.2
Extended Family	1.9
Clan	30.2
Don't Know	1.9
Not Applicable	17.0
No Response	3.8
	100.0%

Table 4. Sources of water utilized for specific domestic purposes, Laura and Nama.

LAURA: SOURCES OF WATER

Specific Uses	Rainwater	Well	Rainwater and Well	Total
Drinking	95.0%	2.5%	2.5%	100%
Cooking	80.0%	12.5%	7.5%	100%
Washing Dishes	80.0%	12.5%	7.5%	100%
Bathing	26.8%	63.4%	9.8%	100%
Washing Clothes	30%	57.5%	10.0%	97.5%*

* The use of the public laundry in Rita by one household equals 2.5% which explains the difference in this figure.

NAMA: SOURCES OF WATER*

Specific Uses	Rainwater Catchment	Well (if necessary)	Rain catchment and Well	Total
Drinking	100%	0	0	100%
Cooking	98.1%	1.9%	0	100%
Washing Dishes	98.1%	1.9%	0	100%
Bathing	94.3%	1.9%	3.8%	100%
Washing Clothes	94.3%	1.9%	3.8%	100%

* The Clean-Up List of the Federated States of Micronesia Division of Environmental Health and Sanitation for Truk (1981) shows that, of the 19 wells on Nama, 17 are used for bathing facilities. Sixteen of the wells are used for washing clothes and dishes. Twelve of the wells are used to fetch water to cook with. One well has unknown uses. This demarcation probably speaks to usual year-around use, including both the wet and the dry seasons.

Sources of Water for Specific Uses

Informants at Laura and Nama were questioned as to the sources of the freshwater consumed by their households for specific uses. Table 4 summarizes the sources of water utilized for specific domestic purposes, as reported by Laura villagers and Nama residents. Table 5 indicates preferences regarding water uses as indicated by informants in Laura and Nama.

Some differences are apparent in the comparison of water use customs of Laura and Nama. Each separate category of water use is discussed below for the two communities.

Drinking

Rainwater is preferred for drinking water in Laura. The majority of the households interviewed (95%) rely exclusively on rainwater. Well water is used marginally for drinking; just one family reported that they drink well water. Another family reported that a combination of rainwater and well water together supplies their drinking water. Our findings reflect people's perception that rainwater is relatively safe to drink. However, over 60% of the respondents reported that they boiled their water before drinking it. Another 18.9% indicated that they boil their drinking water "sometimes". A few individuals felt that it was particularly important to boil the water that children would drink (5.4%). In 13.5% of the cases, people reported that they did not feel it was necessary to boil rain water.

Families on Laura were asked to estimate the amount of water their households used on a daily basis for drinking purposes. The average water consumption was reported to be 5 gallons per day per household.

On Nama, people also prefer rainwater for drinking. Of the sample households, 100% said they drink water from their catchment tanks. Responses varied as to whether or not families boiled their water before they drank it. Of the families questioned, 20.8% said Yes, 24.5% said No, and 20.8 percent responded, "Sometimes." Other categories of responses included "For the kids" (9.4%), "For babies" (13.2%) "If someone is sick" (3.8%), and "For coffee" (3.8%). Two families mentioned that they would boil water before drinking it if the water level was low in the well. This suggests occasional use of well water as drinking water, even though informants as a group did not state that they drank well water.

As in Laura, families in Nama were asked to estimate the amount of water their households used on a daily basis for drinking purposes. The average water consumption was shown to be 5.8 gallons per day per household.

Cooking

In the case of cooking, people consulted in Laura said they prefer to use rainwater for this purpose. The data show that 80% of the respondents maintained that they used rainwater for cooking. Well water seems to be

Table 5. Indicates preferences regarding water uses as indicated by informants in Laura and Nama:

Specific Uses	Rainwater		Well Water		
	Laura	Nama	Laura	Nama	
Drinking	+	+	–	–	
Cooking	+	+	–	–	+Preference
Washing Dishes	+	+	–	–	high
Bathing	–	+	+	–	–Preference
Washing Clothes	–	+	+	–	low

more preferable for cooking purposes than for drinking. Yet, only 12.5% of informants said they cook with well water. Another 7.5% mentioned that they use rainwater and well water in combination for cooking food. People reported that they used, on the average, 5.3 gallons of water per day per household for cooking.

On Nama, again, people prefer to use rainwater for cooking. Of the sample group, 98.1% reported that they cook using catchment tank water. Only 1.9% mentioned the possibility of using well water for cooking. On the average, the families interviewed explained that they used 18.5 gallons of water per day per household for cooking food.

Washing Dishes

For Laura, it is interesting to note that people are as willing to wash dishes with rain water as they are to cook with rain water. The number of houses using well water for washing dishes is still very minor; 12.5% reported that they did so. The differential use of all available water sources is identical with cooking. On the average, families use eight gallons of water per day for washing dishes.

On Nama, 98.1% of the people interviewed said they used catchment tank water for washing their dirty dishes. Just one family pointed out that they would use well water if necessary for dish washing. In this category, families use 14.9 gallons of water per day per household for washing dishes.

Washing Clothes

At Laura, washing clothes appeared to be a manual work effort performed by women. While collective washing activities were frequently observed in the Eastern Caroline Islands, particularly around streams or springs (Winter and Stephenson 1981), such group activities were not observed in Laura during our stay. The absence of streams on low elevation atolls must be one obvious reason. At Laura, a great deal of washing seems to be done individually using well water (57.5%). Rainwater is also used when such water is plentiful during the wet season (30.7%). Several household reported that they used both rainwater and well water for washing clothes (10.0%). One family reported that they did their washing in the public laundry in Rita, 30 miles away. Compared to other domestic activities, washing requires a considerable quantity of water. The data show that, on the average, nearly 50 gallons of water are consumed per household per day. Since groundwater is less limited than rainwater and there is no particular health hazard in using well water for laundry, this may explain why much of the wash water is obtained from wells.

On Nama, as rainwater from the catchment tanks is most frequently used for washing clothes (94.3% of the cases), women do this work around their own tank. Only one family reported that well water was their source of water for washing clothes. Two families indicated they use both rainwater and well water for washing clothes. As at Laura, washing dirty clothes requires large quantities of water. Families reported that they used an average of some 26.6 gallons of water per household per day for this activity.[4]

Bathing

In Laura, bathing likewise requires relatively large amounts of water, although not as high as the amounts of water required for laundry. About 35 gallons are used per household per day on the average for bathing purposes. Most families shower outside of their homes wherever convenient, depending on available water. Four families reported that they had installed Western style shower facilities in an indoor bathroom, obtaining water from their cistern for bathroom needs. Nearly two thirds (63.4%) of the households interviewed utilize well water for bathing. This is the activity which requires the least amount of rainwater, when compared with drinking activities, cooking, washing dishes, and washing clothes.

People of Nama like to bathe frequently. Families could articulate very specifically their bathing needs: ..."3 or 4 buckets for adults 3 times a day, 1 bucket for kids 2 or 3 times a day," and the like. In this, Nama residents are very similar to the people of Sapuk, Truk (in Winter and Stephenson 1981). Needless to say, strong feeling about the desirability of frequent bathing point to the use of large quantities of water for this activity. Since so many people said they used water from their catchment tank for bathing (94.3%), clearly, water tanks on Nama are reliable sources from which to take water for bathing. Only one family said they bathed with well water. Two families mentioned the use of both catchment tank and well water for bathing activities. On the average, families reported they used 75.9 gallons of water per day per household in taking their baths. This figure is about twice as much as the statistics obtained for Laura,[5] and indicates the importance of bathing in the Trukese culture.

Table 6 summarizes daily water consumption in gallons for Laura and Nama. The mean, and standard deviation, minimum and maximum gallons of water utlized per village are shown in Table 6.

Table 6. Daily water consumption in gallons, Laura and Nama.

	LAURA	NAMA
Drinking		
Mean	5.1	5.9
Standard Deviation	4.2	5.9
Minimum	1.0	0.5
Maximum	25.0	30.0
Cooking		
Mean	5.3	18.5
Standard Deviation	4.1	18.4
Minimum	0.5	2.0
Maximum		100.0
Washing Dishes		
Mean	8.3	14.9
Standard Deviation	5.5	27.4
Minimum	1.0	1.0
Maximum	28.0	200.0
Bathing		
Mean	35.1	75.9
Standard Deviation	19.6	132.4
Minimum	5.0	6.0
Maximum	75.0	656.0
Washing Clothes		
Mean	48.7	26.6
Standard Deviation	24.9	20.1
Minimum	5.0	2.0
Maximum	98.0	100.0
Total Consumption		
Mean	145.3	107.6
Standard Deviation	121.9	60.6
Minimum	22.0	19.0
Maximum	495.0	296.0

Discussion of Water Use Customs

Drinking

People do not drink a lot of water on a daily basis in Laura or Nama. In Laura, with an average of 10 individuals per household, the average daily consumption is about one half gallon per person per day. On Nama, where there was an average of nine persons per household, each person consumes a little over one half gallon of water per day. In both locations, young green coconuts are available as alternate sources of liquid refreshment. Soda pop and other canned beverages, however, are much more readily available in Laura than on Nama.

Cooking

People at Laura do not use a lot of water for cooking, either. With an average of 10 individuals per household, the average daily amount of water used for cooking per person per day is approximately one half gallon. However, at Nama, much more water is utilized for cooking food. With an average of 9 persons per household, the average daily amount of water used for cooking is approximately two gallons per person. This may speak for different methods of food preparation in Trukese culture and different foods prepared, with a good deal of boiling of food in huge metal tubs being commonplace.

Washing Dishes

At Laura, not quite one gallon of water is needed per day per person to wash the dirty dishes. On Nama, over one and one half gallon of water is needed per person per day for dish washing.

Washing Clothes

At Laura, five gallons of water are needed per person per day to wash the dirty clothes. On Nama, about three gallons of water were reported as needed in the same capacity.

Bathing

At Laura, 3.5 gallons of water are needed per person per day for bathing purposes. On Nama, nearly 8.5 gallons of water are needed per person per day for bathing.

Winter and Stephenson (1981) report the average estimate of gallons of water utilized per person per day at Nemwan, Truk to be 19 gallons. On Laura, our figures show that some 15 gallons of water are utilized per person per day. For Nama, we show 20.8 gallons of water utilized per person per day, closer to the Nemwan estimate than the Laura estimate. As mentioned previously, cleanliness and bathing are seen as very important in Trukese culture.

ATTITUDES TOWARD USE OF GROUNDWATER VERSUS RAINWATER CATCHMENT

On Availability of Freshwater in General

At Laura, in the course of the sample survey, over three fourths (76.9%) of the respondents indicated that they felt freshwater in general should be regarded as a limited natural resource. When asked under what conditions freshwater should be seen as a limited natural resource, 88.5% of the respondents answered, "In the dry season, particularly." Others (11.5%) spoke of freshwater as a natural resource that is limited in quantity at all times. Surprisingly, in response to the following question, "Does your family conserve water?", only a little over half of the informants (54.5%) replied in the affirmative. Just one individual mentioned he might take some water out of his well to plan ahead in the dry season. In light of the number of people who regard freshwater as a limited natural resource, it would seem that more of them would practice water conservation than those who actually do so.

On Nama, 51 families, or 96.2% of the families sampled, said they thought that freshwater should be regarded as a limited natural resource. Only one family answered "No" to this question, and one family responded, "Not sure." Families were then asked under what conditions freshwater should be seen as a limited natural resource. Forty-four families, or 83% of the sample, said, "In the dry season, especially." One family countered with the observation, however, that their well does not go dry in the dry season. Three families made the point that their tanks do not go dry, even in the dry season. Four families commented that the water line in wells is always lower at low tide, whatever the season of the year.

We then asked, "Does your family conserve water?" Of the sample group, 92.5% answered yes. Two families replied, "Not really." Two families had no response to the question. There is close correlation, then, for Nama, between the perception of water as a limited natural resource, the knowledge that freshwater resources are limited in the dry season, and water conservation efforts.

We wondered if families would report that they put a lock on the faucet of their water tank as a conservation measure. At Laura, we found only one such lock, on the faucet of the big tank near the community church. The church pastor reported that the lock was strategically placed to deter children from playing in the water and wasting it. On Nama, however, five families reported that they utilized a lock on their water tank. One household head (male, age 44) reported that he locked his tank and hid the key. His household water tank was very important to him: "A public tank creates problems. The one with the key, that's the person who gets the most water. If the one with the key goes away somewhere, how can you find him or her if you need a drink? No one cares to look after or repair the public tank in this area, so it is all broken down now and no one fixes it." Another household head (male, age 61) explained that he locked his tank because he wished all the families using his tank would take an equal share of the water, but not all are willing to share equally. A female household head reported that she ..."fastens the handle tight and then locks it..." on the tank she uses, because the tank really belongs to

her sisters, but they are staying on Moen now. She implied she wanted to make sure there would be water in the tank for them when they returned to Nama. Two families reported that they "sometimes" locked their water tanks, especially in the dry seasons. One household head explained that someone took the lock off his tank, so he can no longer lock it. In the dry season, the tank near the mission meeting house is locked, we were told.

Forty families on Nama reported that they tell or teach children in their household not to waste water. Twenty-seven families indicated they would scold or spank children who played in the water and wasted it. A male, age 61, explained that he would..." push their heads..." if children wasted water in his household. A female, age 34, said she would..."talk to them politely..." if her children were wasting water. A female, age 35, said she taught her children to use a cup to get a drink of water and not their hands, ..."because less water is wasted that way." A female, age 55, made the observation that ..." everyone is taught not to waste water (on Nama)."

On Rainwater Catchments

Rainwater as distributed in the form of above ground catchments seems to be the most highly desired type of water on both Laura and Nama. Rainwater is viewed as clean and pure. Likewise, rainwater is viewed as being convenient to use, being found in storage containers near the house or under the house eves where portable containers are placed to catch roof runoff. For Laura, all families in the households sampled had access to rainwater, some having access to more rainwater than others, owing to rainwater storage capacity. Nineteen families of the total sample size of 41 had cisterns in Laura. Much more diversity was seen in terms of storage containers, e.g., plastic buckets, metal dishpans, discarded airplane fuel tanks. Some families paint their 55 gallon drums to discourage rust. Table 4 (page 19) points out for Laura that rainwater is preferred for drinking, cooking, and washing dishes. A lower preference for the use of rainwater for bathing and washing clothes is probably coordinated with less rainwater stored and available for general use.

On Nama, all the families also have access to rainwater use. Some families have more rainwater stored than others, to be sure, but all families in the sample reported that they had water catchment tanks at home except one. That one head of household, however, reported he used the tank at the next house, which he himself had built. Table 4 shows that the families of Nama in the study prefer to use rainwater for all household activities: drinking, cooking, washing dishes, bathing, and washing clothes.

The Nama families in the sample prefer private, family owned tanks rather than public tanks. Reasons include: people may argue over use of the public tanks (8 reponses), if it's your own, you can get water anytime you want and regulate your family's use of it (19 responses), you will take better care of it if it is your own (10 responses), then you don't have to share (8 responses), the public tanks don't hold enough water for everybody (7 responses), the public tanks are for poor families; this

helps out the families with private tanks (1 response), nobody looks after the public tank (2 responses), afraid of sickness from the public tank (6 responses).

On Wells

At Laura, all of the houses encountered in the sample survey had wells as a part of the house compound. Yet, people seemed to take well water somewhat for granted. Riley (1981:55) refers to ..."the all-important well or above ground cistern (that) complete(s) these outer islet house compounds" ... This does not seem to be the case for Laura, however: people do not seem to view wells as equal in value to cisterns. Residents of Laura said that groundwater tends to be brackish. They pointed out that storms bring about contamination of well water.

With well water, people seemed to feel that more labor is involved in order to use it, since wells are more distant from houses than rainwater catchments. More importantly, most wells are deep, some as deep as 3 meters (9 feet). When the water level is low in deep wells, drawing out the water is physically demanding. A number of informants added that their wells had become dirty in the passage of time, e.g., "the water is contaminated now,"... "there is junk in the well," e.g., rusty cans, discarded zories, boards and planks, If wells may be used as convenient dump sites, it seems clear that people have mixed views as to the value of wells and well water on Laura. Twelve families, however, pointed out that their wells never go dry.

On Nama, most of the families consulted in the course of the sample survey did not have a well as a part of their house compound. Most, however, could identify a well that their family had access to in case of need. People seemed to view the wells as useful in case of water shortages in the public tanks. Most of the wells were kept rather clean and covered, but appeared to be in infrequent use. People made casual but not careless reference to the well to which they had access. Since only three heads of households said they were the owners of the well to which they had access, community use rather than personal use was seen as likely with regard to the presence of the wells. Few families seemed to take individual responsibility for any well on Nama.

The Clean-Up List of the Federated States of Micronesia Division of Environmental Health and Sanitation (1981) describes Nama's 19 wells to be in various stages of cleanliness:

Color of the soil/rather clear	5
Color of coffee	3
Color of coffee and mosquito larvae inside	2
Color of coffee and algae inside	4
Color of the soil	3
It's locked-cannot open to look inside	1
Rusty	1

At Laura, wells were associated with individual house compounds, as described above. While several wells were built only within the last 12

months, according to informants, over 15 wells were built 10 years ago. Some wells were reportedly built as long ago as "Japanese times." Clearly, many wells are viewed as old. Perhaps the water in the wells is viewed as "old," also. On Nama, the time during which the wells were dug reportedly varied from 1960 to 1981. Thirty six heads of households said they did not know when the well to which they had access was dug.

It is also important to point out that, at Laura, a number people pen their pigs close to their well and/or have their benjo located in close proximity to their well. One possible outcome is contamination of the well water. At Laura, 18 household heads reported that they had a benjo toilet (outdoor overland style) near their house. Twelve household heads indicated their families had no toilet. Three families reported they had a water seal toilet. Five families reported an outside, Western style toilet in their house. The situation of four families with regard to their toilet is unknown. It seems that many families use "the bush" for toilet activities. Perhaps this is another reason why rainwater is preferred over well water, in that people realize well water may be contaminated by animal or human waste material.

On Nama, wells stand in rather isolated locations. People mostly utilize cement-based water seal toilets, located in their bath houses and, accordingly, often near their rain water catchment tanks. The Clean-Up List of the Federated States of Micronesia Division of Environmental Health and Sanitation of Truk (1981) lists 51 water seal toilets on Nama, 6 overland toilets and no overwater toilets.[6] On Nama, then, the problem of contamination of wells seems less likely. Rainwater catchment tanks, however, even if located near a toilet, are so much more convenient to use than wells, in spite of the fact that well water may be quite clean.

Extent of Satisfaction With System

Informants at Laura were asked, "Are you satisfied with the present condition of your water supply system?" In the sample, 22 heads of households (55%) answered no. They were asked then how they might consider improving their water supply system at home. The data show that, in order of frequency of response, 36% answered that improvement of the physical plant, such as gutters and water catchment facilities, would be helpful. In the next category, 9.1% of the responses were pessimistic, in that they thought there was no way to improve their current water supply. Only one informant in the sample of 41 households mentioned fixing his well. Improvements of water supply systems for local people seem to be viewed in terms of repairing and enhancing rainwater facilities rather than well water facilities.

On Nama, when questioned, eleven heads of households (10.8%) said that they were satisfied with the present condition of their water supply system. Thirty-nine household heads (73.6 %) indicated that they were not satisfied; two heads of households said they were "not really" satisfied. When asked to consider how their water supply system could be improved, 33 informants (62.3%) said that they must build more rainwater catchment tanks. Six informants stated that they wanted their

own tank: these families have access to a water tank belonging to a relative, the clan, etc., but they want a tank that will be specifically their own. One household head explained that his family simply needed more water, but did not offer a suggestion as to how they might get more. Five household heads pointed out that any sort of improvements would be hard to come by, because they had no supplies to build with and no money to obtain supplies, either. Four household heads did not feel their water supply systems needed any improvements. In fact, upon visual inspection, this seemed to be the case. One concrete catchment observed and photographed, for example, had an overflow pipe built in to the top; the extra water was caught in a nearby 50 gallon drum. Three household heads had no ideas as to how they could improve their water supply systems.

On Nama, some families reported that disagreements over the use of local water resources may occur. Disagreements over the use of public tanks were thought to be likely, but not over the use of family-owned tanks among family members. Several informants pointed out that it was the job of the lady of the house to monitor her family's water needs. If disagreements occurred with regard to the use of public tanks, according to informants, the women would negotiate their differences among themselves. It might be likely, though, that public tanks would fall into disrepair, because technically no one individual or family is responsible for the tank's upkeep. People on Nama seemed to have sense of pride in their private water tanks. Most tanks had the date when they were built etched into the concrete. One was constructed in memory of a boy who died. No informants on Nama spoke of a wish to improve the quantity or quality of well water available to them. As at Laura, improvements to the water supply system on Nama are seen in terms of making use of rainwater catchment facilities, rather than groundwater.

ATTEMPTS TO EXPLAIN WHY RAINWATER IS NOT UTILIZED MORE EXTENSIVELY THAN IT IS

Since residents of Laura village seem to prefer to use rainwater rather than well water, it would seem that they would have very efficient rainwater catchment and storage systems. This is not the case. Of the 41 houses observed, only three make use of 100% of available roof surfaces of their buildings in the construction of permanent rain gutters. Of the remaining households, 31.7% utilized approximately 50% of the roof surface, usually just one side of the house being supplied with a gutter. The remaining households (25) use 25% or less of the roof surface (Figure 4).

At Laura, people were asked specifically, "If less than 100% of your roof is used for water catchment, why?" The reasons for not making maximum use of the available roof surfaces are many and varied. Some of the reasons seemed to be of an economic nature. In the sample survey, 40.5% of the household heads implied that they could not afford to purchase additional gutters and/or barrels: "not enough gutters here" ... and/or..."no extra drum cans." Financial reasons were directly stated in 8.1% of the sample: "No funds available for repairs"... Lack of supplies seemed to be a reason in one case. A household head stated he had made several trips to the Mobil

Oil distribution center in Rita, trying to get 55 gallon drums, but he had been unsuccessful. No one, however, spoke of gaining extra water by roof runoff through "making do" with wooden troughs or make-shift gutter-like devices of corrugated iron.

At Laura, two categories of responses about rainwater catchment improvements spoke to the physical features of the house in the sample. Of the responses recorded, 10.8% or 4 persons indicated that the house they lived in was still under construction. Presumably, this was their reason as to why gutters had not been installed at 100% of the roof edges. The building process, however, had apparently been going on for some time. Apparently, no need was perceived to build a temporary gutter. One informant explained the lack of gutters on his house by pointing out that it was a very old house. It seemed as though he was saying that repairs to the house were no longer desirable or necessary. Three persons (8.1%) indicated that such a home improvement was not a high priority by this statement: "We can get water from the neighbors." It seemed that they saw no immediate need to improve their own systems. Other people, however, stated that they did not like to have to ask neighbors for water.

A lack of technical skills needed to design and construct an effective gutter and catchment system for rainwater was implied when several women and children who were serving as informants mentioned that the male head of their household was deceased, or was not living in Laura at the time of the study. The same lack of technical expertise was implied by informants who were older men, saying that they had no plans for further household improvements. A key social factor may be mobility of the population of Laura. People shift about to different homes within the community, to outer islands, and into Rita for indefinite periods of time. This has led to a potential problem in Rita, that of high use being placed on the temporary sewage system installed in the district center after the damage from high waves and tides in November 1979. Water problems are critical in the district center. Case (1983:18) points out that improper sewage disposal in Majuro through the use of the temporary system could contaminate the fresh-water lens.

Finally, on Laura, in eight separate situations, or 21.6% of the cases, people showed no apparent awareness that they could readily improve their fresh water supply by installing more gutters. These people did not perceive that their water supply systems were inefficient and did not perceive a need for further improvements to their rainwater catchment systems, in spite of the fact that 100% of their roofs were not utilized for catchment purposes and that much of their potential water supply was not captured.

On Nama, village residents also seem to prefer to use rainwater rather than well water. The families of Nama, however, unlike Laura, have excellent rainwater catchment tanks, nearly one for every household. Their catchment systems may be traced back to several model tanks that were built on Nama around 1973-74. A certain community leader who was conscious of the ongoing freshwater needs of the people of his home island encouraged all of the local families to build their own tanks, with the justification that Nama is an isolated island. If freshwater is scarce, there is nowhere else

to go to look for another source. No surface water in the form of streams or springs is present on Nama. Wells can be dug, but the freshwater lens is small. The obvious solution is rainwater storage tanks that are big enough to store up rain to last through the dry season.

The efficient rainwater catchment and storage systems of Nama are not based upon 100% use of available roof surfaces of buildings for the placement of permanent rain gutters. Permanent rain gutters are found on most of the roofs, but they are gutters that utilize only a portion of the available roof surfaces. Of the 53 households visited, only seven households used 100% of their roofs for runoff. Just one household used about 75% of the roof. Thirty-three households used 50%. The remaining households utilized 25% or less of their roofs for runoff. Reasons as to why less than 100% of the roof was used for rainwater runoff were many and varied. Nine householders said they had no money for improvements such as an extension of their gutters. Eight household heads said the gutters already in place were sufficient to capture rainwater for their families' use; they did not perceive a need for more gutters. Four informants explained that they were still in various stages of building their houses. Two informants said they could not catch any extra water because they had no extra drum cans. Two other informants said no further water catchment was possible because they had no additional catchment devices. One informant stated that the tank his family received water from was a public tank. Since his family did not have exclusive use of the tank, he apparently felt his roof did not need gutters on 100% of the roof edges. Twenty-one household heads could cite no particular reason as to why they did not make use of 100% of their roofs for rainwater runoff. Some of these household heads were women who reported that their husbands worked in Moen, the district center, and were not in regular residence on Nama. Others were younger couples living in a house that they were not really responsible for, because it belonged to some other relative.

In both Laura and Nama, some problems are noted with regard to availability of construction materials and supplies in order to improve the freshwater catchment systems. People spoke of the need for drum cans, metal gutters, corrugated iron for roofs, cement for building catchment tanks, and so forth. Construction materials and supplies are also needed if wells are to be dug.

Access to the district center in order to try to obtain construction supplies is much easier for the people of Laura than for the people of Nama. Travel from Laura to Rita requires an overland trip of approximately forty minutes via a vehicle on a public road. Travel from Nama to Moen, however, requires an overwater trip. At least six hours of travel time are required if the trip is taken in a small boat. In rough seas, uncertainty of time for departure for Moen and return to Nama, as well as the general risk of making the trip, compound the difficulty of getting the needed supplies.

Nonetheless, Nama's freshwater catchment system seems far superior to that of Laura. Forty-six families (86.9% of the sample) had their own concrete water tanks on Nama, while just nineteen families (45.3% of the sample) had their own concrete cisterns in Laura.

In the course of the earlier summer 1981 field research at Laura, in an attempt to explain Laura's water situation, we have suggested elsewhere (Stephenson, Kurashina and Winter 1982) that the time perspective in Micronesia is different from the Western model. We suggested that a present day orientation seems to prevail in Micronesia. The past is already gone and the future is an unknown quantity, so that making plans for the future is not a worthwhile activity. Perhaps this explanatory framework is valid, we said, for attempting to understand why rainwater is not captured more effectively in the individual households in Laura. Looking ahead to the future may be practical in plant cultivation (Klee 1976). However, in household matters, we stated, daily requirements take first priority. If enough rainwater is available for today, why worry if a sufficient amount of rainwater will be available in the dry season? Why hang up an extra rain gutter today, when it is not raining? On a rainy day, why go out in the rain to hang up an extra rain gutter? Such a daily coping strategy, we pointed out, may be tempered with a certain degree of fatalism: "The dry season will come when it comes, anyway... Can't be helped"...

However, on Nama in the course of the Summer 1982 field research, we noted that rainwater collection and storage systems are permanently installed and are very effective. The time perspective model as stated above does not seem to be an effective attempt at explanation. It seems that the residents of Nama have made particular efforts expressly to plan ahead. Water catchment tanks are numerous, nearly one for every household. Such a successful effort in the development of rainwater storage systems, it seems, for Nama, has come about because of the influences of the strong community leader mentioned above. In 1973, a project was established by the Trust Territory government to demonstrate the use of ferrocement. The community leader, a government employee in Moen, was in charge of this project. He had noted that the people of Nama experienced difficulties using well water, since the wells were located so far away from the housing areas. It made good sense, he thought, to encourage the building of water tanks in the villages on Nama using ferrocement.

The first cement tanks were built on Nama in 1974, as demonstration models. Supplies were purchased through the Nama Trading Company in Moen. Credit may have been extended where necessary. The chief of Nama liked the project, and encouraged each family to build their own cement tank. It was to be a five year plan, whereby each family could gain a tank in the near future.

In 1974, federal monies became available through Title I for Capital Improvements projects in the Trust Territory. The people of Nama received direct benefit. It is possible that the Nama people also made handicrafts to sell at this point to raise additional money. People really supported the tank building effort. The community leader explained to us that, on Nama, if one person starts something, everyone will follow. He stated that the following epithet applies to Nama: ... "fonuen appuru" ... "an island where everybody follows one person."

Perhaps Nama has no other options. If local residents wish to reside on Nama, in such an isolated setting, they must effectively make use of its resources. If resources are lacking, counter measures are called for.

Severance (1976:96) has written about what he calls a basic set of values that are common to greater Trukese culture. He describes these values as a set of competing attitudes about behavior which individuals strive to maintain and value in the actions of others. Important values include a competition-industriousness (emphasis ours) and a humility-respectfulness which when exhibited toward older kinsmen increases affect and respect. Perhaps it is this competition-industriousness that accounts for the proliferation of individual catchment tanks among the householders of Nama.

With regard to improvements, all of the people of Laura that were consulted were in favor of the proposed effort by the Marshallese government to improve their freshwater supply system. A number of the people indicated that the proposed project could help Laura by means of ..."more financial assistance" ... and ..."any improvement the project can provide." People indicated that they were willing to let their wells be monitored if necessary. Clearing of a few trees which may be required for the construction of the proposed solar cell panels would also be accomodated. The land to be cleared is normally used for growing breadfruit and coconuts.

At Nama, no proposed changes in the water supply system seem to be required at this time. Groundwater wells could be made more efficient, however, and more of them could be dug.

SOCIO-ECONOMIC PROBLEMS OF LIFE IN SMALL ATOLL COMMUNITIES

At the end of the interview in each household in Laura, we asked, "What are the major socio-economic problems in this village in order of magnitude?" Our informants identified 15 different categories of needs, including the categories of "no problems" and "no response." The six categories mentioned most frequently, in order of occurrence, were improvements to the water supply system (31 responses), need for electricity in the village (27 responses), general island clean up (21 responses), housing improvements (11 responses), building of benjos (11 responses), and improvements to the food supply (9 responses). People were asked to rank order their needed improvements in Laura. Electricity was cited as most important by 7 informants. Five people said their greatest needs were in the area of housing. Three people identified general island clean-up as their village's most serious need. One person mentioned that the village's principal need was in improved food resources. No informants identified the building of benjos as their greatest need, but four informants labeled it second in importance.

The major socio-economic problems in Nama that were identified in the interviews are summarized below:

Problems Identified	Number of Responses
food supply[7]	47
water system[8]	43
health care	19
housing	15
shipping	15
clothing	8

It is clear that water supply is of major concern on Nama.

SUMMARY AND CONCLUSIONS

In this paper, the status of freshwater resources in Micronesia is examined. Particular attention is paid to Laura Village on Majuro atoll in the Marshall Islands, and Nama, 35 miles outside of the Truk lagoon in the Eastern Caroline Islands. Through fieldwork in these two atoll communities involving household interviews and systematic data analysis, it is clear that people's perceptions and preferences with regard to fresh water resources must be taken into consideration for the implementation of development projects.

At present it seems that freshwater resources currently available in Laura and Nama should be of sufficient quantity to meet the needs of local residents, especially when taking into account the high average annual rainfall. Yet, a paradox exists. Water shortages occur regularly, especially in the dry season. The paradox between the abundant availability of freshwater on one hand, and water shortages, on the other, is carefully examined using ethnographic data. The study shows that water shortage problems are not solely caused by environmental factors, but also are induced by socio-economic factors to a considerable degree.

Laura and Nama villagers seem to take well water for granted. All households contacted have access to wells. Some families use well water for washing clothes; others use well water for bathing. A number of households reported, however, that their wells were old, or were contaminated.

People in Laura and Nama value rainwater. It is the type of water that they prefer to drink. Yet, it is clear that sufficient use is not made of roof runoff. All available roof surfaces do not have gutters, as described above.

A lack of systematic planning appears evident in a house by house examination of individual water catchment and storage facilities. Careful planning with regard to water storage and distribution systems at the household level should result in a more satisfactory water supply. A few

household heads have already recognized this situation. Some families have prepared adequate facilities for rainwater catchment and storage; these families generally do not experience water shortages. Families with less sophisticated catchment sytems, or no catchment systems to speak of, continue to have problems with fresh water supply.

While it appears that many of the water-related problems may be solved or reduced at the household level, facilitation for easier purchase and installation of gutters, and the building of large water storage devices such as concrete cisterns, could be undertaken at the community or regional governmental level. Likewise, public education could be useful in teaching local residents the extent to which groundwater is reliable. Groundwater wells could be more effectively utilized. It is important to point out that, as further modernization takes place in the remote villages and islands in Micronesia, water consumption will increase. Eventual introduction of flush toilets, showers, and washing machines in the villages will undoubtedly require more freshwater for domestic uses. Government plans should provide for increased water supply.

ACKNOWLEDGMENTS

The report presented here has resulted from the joint efforts of a number of researchers and support staff of the WERI at the University of Guam. A preliminary assessment of water conditions in Laura was undertaken in July by the Director of WERI, Dr. Stephen Winter, and Dr. Jerry Ayers, groundwater geologist. Russell Clayshulte of WERI helped with computer data processing, while Bill Zolan carried out chloride tests on water samples flown to Guam from Majuro.

During the field stay on Majuro, Mr. William Allen, Director of the Ministry of Social Services, served as local coordinator of the project. The Honorable Henry Samuel, Acting President of the Government of the Marshall Islands during the research period, met with project team members to discuss details of the project. Senator Toke Sawes of Laura served as the local representative between the people of Laura and the Nitijela, the elected assembly. Marshallese research aides Charlie and Harvey provided valuable help in the collection of the data in Laura. Harvey conducted bacterial tests at the Sanitation Laboratory in Majuro.

Finally, Ms. Suzanne Cowan of Trust Territory Office of Planning and Statistics on Saipan is acknowledged for acting as the coordinator between the Government of the Marshall Islands and WERI, encouraging WERI to undertake the work effort.

We would like to thank Ms. Darlene Moore, M.A. candidate in Behavorial Sciences (Anthropology) at the University of Guam for her helpful assistance in collecting the field data on Nama. We are grateful to Mr. Sigaret Lorin, Chief Sanitarian, Dept. of Health and Sanitation in Truk, for his assistance in all phases of the project and for escorting us to Nama and overseeing the field data collection there. The Honorable Governor Erhart Aten of Truk mad

with project team members to facilitate the undertaking of the project and also for debriefing. Senator Kenchy James of Nama assisted us, as well as Community leader and Councilman Itto Sammy, Acting magistrate Pisa Mark, and Church Pastor Ilaisios James. Nama research aides Rysang Symina and Ruther James assisted us very ably with the data collection. Ynas Symina kindly coordinated our housing arrangements and meals while we were in residence on Nama. We would also like to thank the people of Nama for their cooperation and gracious hospitality during our fieldwork.

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

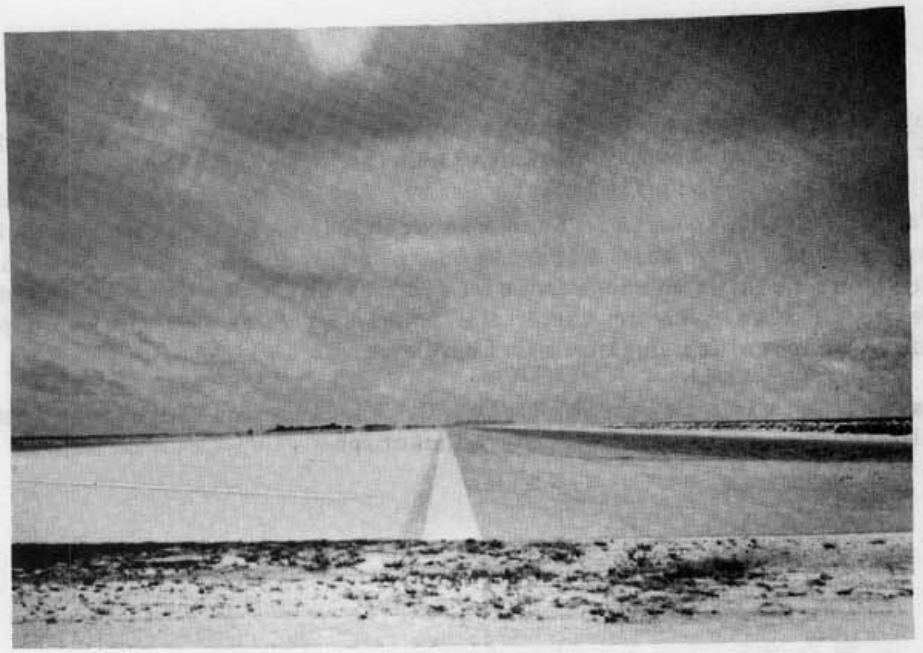

Figure 5. Airport runway at Majuro showing water catchment.

Figure 6. Lagoon view looking toward Laura, Majuro.

Figure 7. Main road in Laura, Majuro.

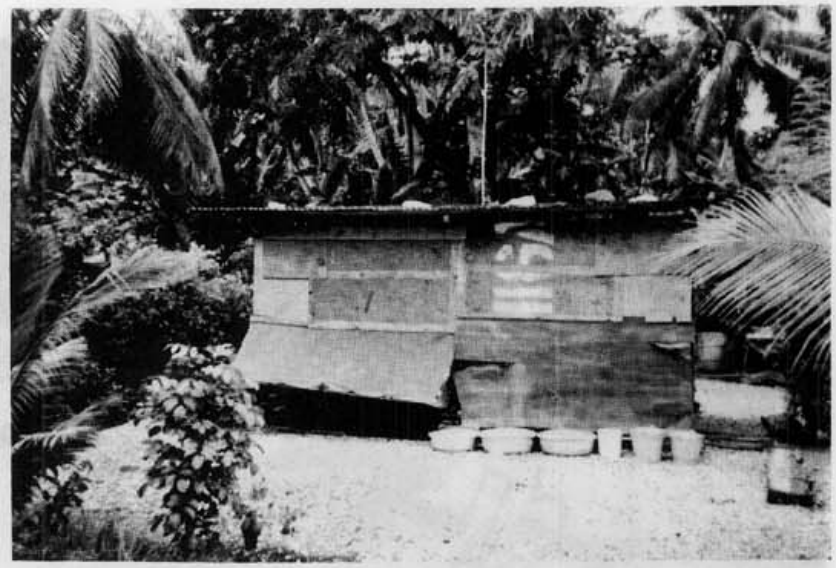

Figure 8. Rainwater catchment by means of portable containers, Laura, Majuro.

Figure 9. Rainwater catchment with an incipient gutter and semi-permanent container, Laura, Majuro.

Figure 10. Another example of incipient gutter and semipermanent containers, Laura, Majuro.

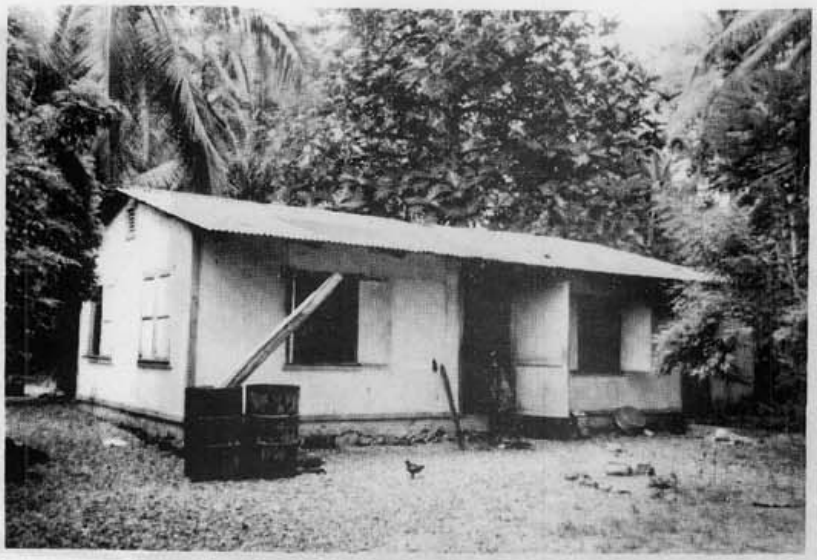

Figure 11. Another example of incipient gutter with semipermanent containers, Laura, Majuro.

Figure 12. Attached gutter with portable containers, Laura, Majuro.

Figure 13. Attached gutter with semipermanent container, Laura, Majuro.

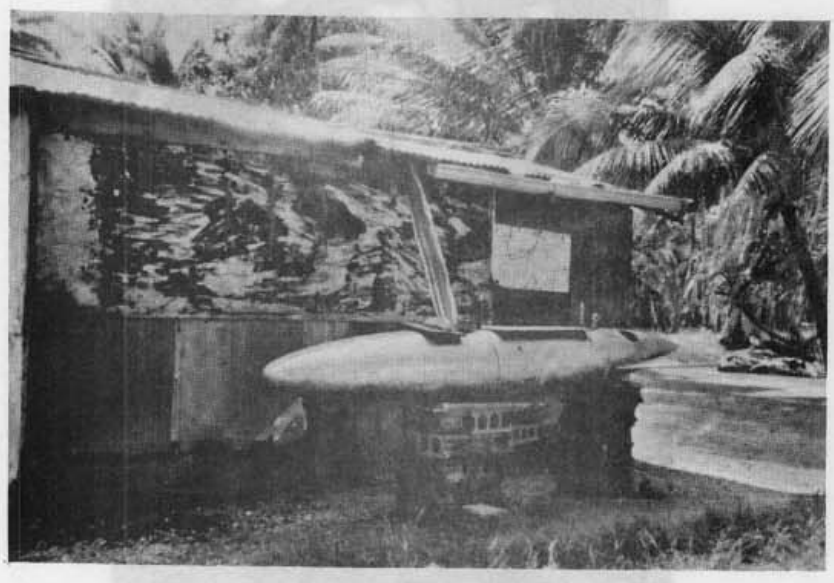

Figure 14. Attached gutter with semipermanent container, Laura, Majuro.

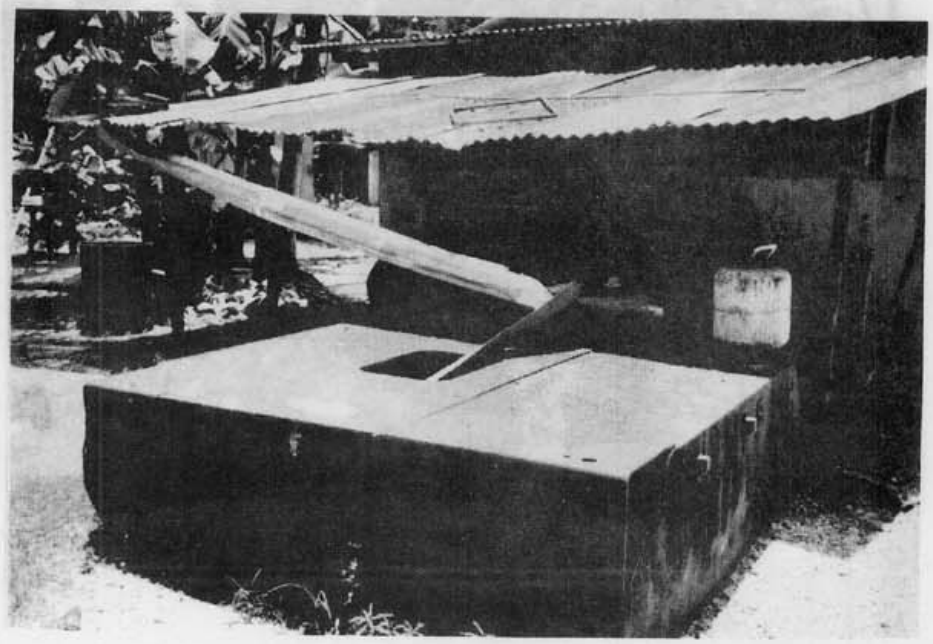

Figure 15. Gutter and cistern made of metal, Laura, Majuro.

Figure 16. Gutter and cistern made of rubber, Laura, Majuro.

Figure 17. Gutter and cistern of concrete, close to house, Laura, Majuro.

Figure 18. Concrete cistern apart from house with its own gutter, Laura, Majuro.

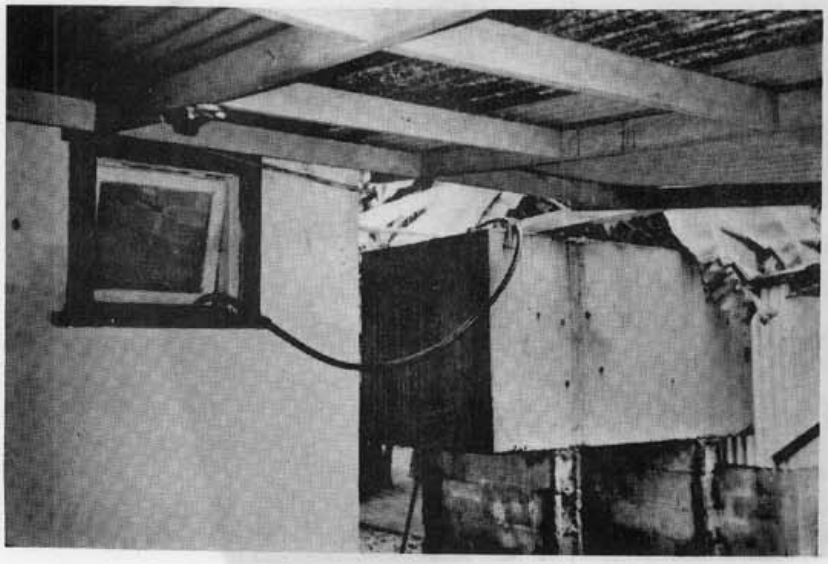

Figure 19. Concrete cistern close to house, with piping running to indoor shower facility, Laura, Majuro.

Figure 20. Concrete cistern with a raised metal water storage container on top to facilitate distribution of water. An electrically operated pump provides power for this system, Laura, Majuro.

Figure 21. Some families lock their cistern water faucets to prevent careless use of the water, Laura, Majuro.

Figure 22. Sand pit well overgown with vegetation, Laura well #38, Majuro.

Figure 23. Well lined with coral blocks, Laura well #105, Majuro.

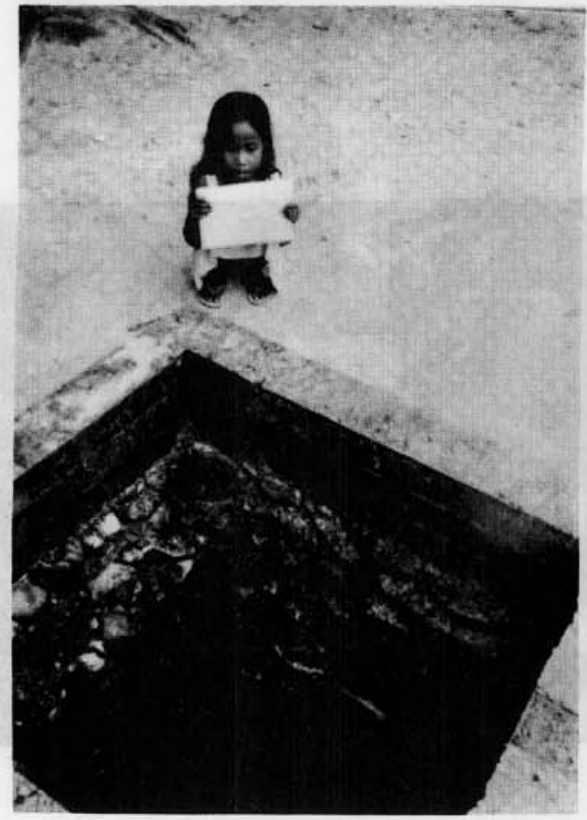

Figure 24. Well of coral blocks and concrete, Laura well #109, Majuro.

Figure 25. Well made of cement/concrete, Laura well #10, Majuro.

Figure 26. Well made of cement/concrete with a hand pump, Laura well #13A, Majuro.

Figure 27. Well made of drum cans, Laura well #31, Majuro.

Figure 28. Well made of a drum can, Laura well #27, Majuro. A maintenance problem is illustrated.

Figure 29. Well made of a drum can, Laura well #32. Drum cans frequently rust and need to be replaced.

Figure 30. Old Japanese style cistern on Arno, Marshall Islands. The cistern is still used for water catchment and storage.

Figure 31. Village Scene, Nama Island

Figure 32. Attached gutter with semipermanent container, Nama Island.

Figure 33. Bathing facility, Nama Island.

Figure 34. Attached gutter with semipermanent container, Nama Island.

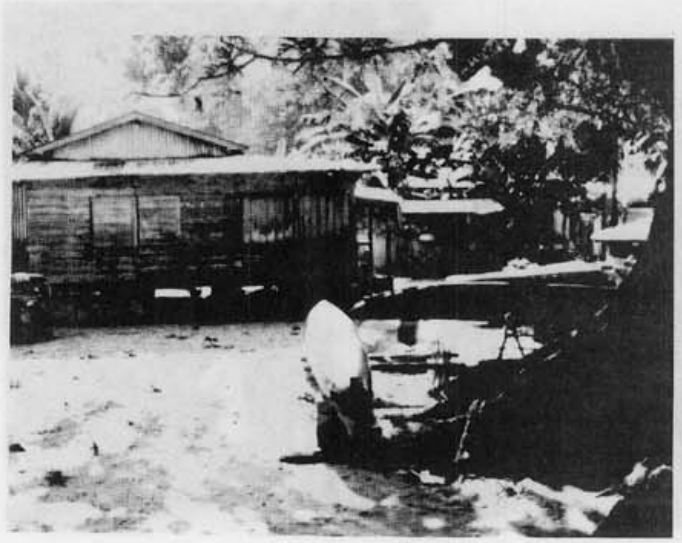

Figure 35. Village housing condition, Nama Island.

Figure 36. Concrete Cistern, Nama Island.

Figure 37. Concrete cistern, Nama Island.

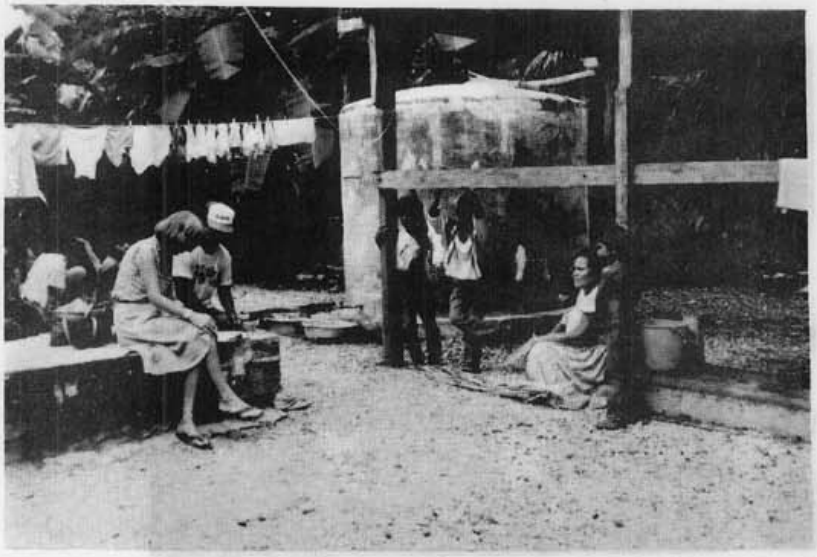

Figure 38. Concrete cistern and interview scene.

Figure 39. Concrete cistern and drum can connected to the roof by gutters, Nama Island.

Figure 40. Gutter and concrete cistern, Nama Island.

Figure 41. Toilet facility and concrete cistern, Nama Island.

Figure 42. Stone-lined well, Nama Island.

FOOTNOTES

[1] Ward (1955:184) referred to ..."a great material culture (on Nama) now rapidly disappearing ...exquisite belts, earrings and costume jewelry made from turtle shells, the giant clam, and the lip of the pink spandylus shell... (these) materials were formerly used in dancing and are now contrary to religious beliefs and practices."

Severance (1976:55) noted:

"The revivalistic movement that swept through Truk and the Mortlocks in 1904-1905 seems to have affected Nama more than Losap or Pis even though many Losapese did participate. Losap canoes were used to transport dancers from Nama to the Mortlocks, some of whom were killed in either the 1905 or 1907 typhoon. This disaster was perceived by at least some of those who favored Christianity as supernatural sanction for return to the forbidden activities associated with dancing. Such events, along with the advantages of material provided to the lay missionaries, apparently strengthened the influence of those who accepted Christianity."

[2] Ward (1955:230) wrote that on Nama in 1951, school children could get water for drinking and washing their hands from rainwater caught off the roof of the school and stored in drums.

[3] Ward (1955:307) noted there were 209 wells on Nama in 1951 and they were in "fair" condition. He described the condition of the drinking water as "fair", as well.

[4] Ward (1955:217) made the following statement about laundering in the Mortlocks: "The island women make a practice of washing their clothes every morning. They use wooden clubs to beat the clothes against stone slabs, a method which is hard on the flimsy cotton fabric."

[5] Ward (1955:143) writes the following about bathing in the Mortlocks: "The islanders of the Mortlocks group bathe frequently, often two or three times a day. They usually prefer fresh water for that purpose when it is available. On the low islands where there is a scarcity of fresh water, the islanders bathe in the sea, but they save rainwater to rinse the salt from their skins. Men and women usually bathe separately except for husband and wife, and both men and women commonly wear some article of clothing in the water."

Anne Fischer (in Gladwin and Sarasan 1953:76) writes about the bathing of babies in Trukese culture: " Young babies are generally bathed twice a day. In the early months, water will be heated for this purpose. One mother was very concerned about the temperature of this water and was eager that it should be just right for her child. The bathing process may be more or less elaborate, depending upon the equipment which the mother is able to afford. Any container may be used for the water; most generally in use is the wash pan which is also used for food. Most mothers do not have wash cloths, but one mother was observed to use one. Soap is also a luxury item, and greatly cherished for the baby, being somewhat concealed from other would-be users. If there is no soap, the mother simply rubs the baby over

with her hand with clean water. Some mothers seem to feel that their baby's hair should not be washed, and in most cases, it is oiled with a sweet-smelling hair oil, also used by adults. As a result of this kind of treatment, many babies' heads will be covered with a black, scabby-looking material which may be a mixture of dirt and cradle cap. On inquiring from the anthropologist what could be done for this and following the suggestion of washing the head, this came off. In the bath the baby is soaped or rubbed with water over its entire body, and then rinsed off. If there is a towel, it may or may not be dried with it. The mother generally wipes excess water off with her hands. She carefully wipes out the ears, where fungus is likely to grow, with her fingers. At all times during the bath the baby is held firmly. In no case did the baby appear to be afraid of this process or to feel that it was unpleasant. Some mothers protect wooden floors and the baby by spreading out a towel or other protection under the child."

[6] A general feeling of distaste with regard to the upkeep of toilets has been noted in the course of our fieldwork in Truk and in the Marshall Islands. Ward (1955:225) quotes from the Civil Affairs Handbook of the Office of the Chief of Naval Operations, Washington, D.C., 1944, that ..."The compulsory cleaning of latrines has (also) been found to be a highly effective punishment among natives."

Ward (1955:282) described the toilets on Nama in 1951 as follows:

"On the lee side of the island there were eighteen well constructed over-water benjos (toilets). That method of fecal disposal is the best available but leads to beach contamination in the area used by the natives for swimming and fishing. There are eight small benjos in the village area for use by the children".

[7] Ward (1955) comments on what he calls Nama's critical food supply problem, based on field research conducted in 1951. He points out difficulties in both breadfruit and taro cultivation. Since ancient times, he notes, there has been an agreement that the people of Nama may fish on the reefs of nearby Losap, since Nama lacks a sheltering reef and lagoon. Unless sailing canoes are used, however, the trip..."is long and arduous and is undertaken only during the breadfruit season when the sea is calm." Sarason and Gladwin (1953) also write about what they call food anxiety in Trukese culture.

[8] Ward (1955:281-282) described the sanitary conditions of Nama in 1951 as follows:

"Generally, the island was very clean, the grounds swept and refuse placed in clean open pits. Shallow fresh water wells were uncovered, however, and provided excellent breeding places for mosquito larvae. That water was used for bathing and laundry. Drinking water was collected from metal roofs and stored either in empty metal barrels or in Japanese-constructed cement storage tanks. These were moderately clean but insufficient in number.

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APPENDIX A

MARSHALL ISLANDS PROJECT SURVEY
WATER AND ENERGY RESEARCH INSTITUTE
UNIVERSITY OF GUAM

Date: 8/ /1981
Village: _____ 1. Laura
House No. _____ Well 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 (" " ") _____
Children _____
Total = _____

D. How long have you lived in this house? _____ years.

E. Do you own this house? _____ 1. Yes 2. No. If no, who owns the house?

F. Do you own the land the house is on? _____ 1. Yes 2. No. If no, who owns the land?

.....

II. WATER SUPPLY DATA

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

	Water Source	Estimated Quantity	Ownership
Drinking			
Cooking			
Washing dishes			
Bathing			
Washing clothes			

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

	Water Source	Estimated Quantity	Owndership
Drinking			
Cooking			
Washing dishes			
Bathing			
Washing clothes			

R. If less than 100% of the roof, why?

_____

_____

_____

S. What type of rainwater catchment do you use? _____

T. Do you store fresh water outside your home? ____ 1. Yes 2. No

What is the source of that water? _____

What do you store the water in? _____

1. Metal containers (barrels)
2. Plastic containers
3. Concrete
4. All of the above
5. Other

U. How much fresh water (such as rain water) can be stored outside your house? _____

Do your tanks (containers) ever overflow? _____ 1. Yes 2. No

If yes, why don't you build larger storage facility?

_____

V. How large is your well? Diameter: _____ Depth: _____

Is there a pump? _____ 1. Yes 2. No
If yes, what kind? ____ 1. hand pump 2. electric 3. gasoline operated
Who built the well? _____
When was the well built? _____

VI. PROJECT IMPLEMENTATION DATA

W. Would you let your well be used for monitoring of water quality?

_____ 1. Yes 2. No

In order to provide sunlight to solar cells for the new project, a few coconut trees might have to be cut down in this village. Do you think cutting a few trees might cause problems in this village? How and why? _____

_____

_____

APPENDIX B

TRUK PROJECT SURVEY

WATER AND ENERGY RESEARCH INSTITUTE
UNIVERSITY OF GUAM
August, 1982

Interviewer: _____

Date: _____

Village: _____

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 (" " ") _____
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	Estimated 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	Estimated 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? _____

When/under what conditions? _____

What happens then? _____

Does your family conserve water? _____ 1. Yes 2. No

How? _____

M. Does your family ever get fresh water from other houses if you have a water shortage? _____ 1. Yes 2. No

Which house/s? _____

Well water or catchment water? _____

II. WATER STORAGE FACILITIES

N. How large is your well? Diameter: _____ Depth: _____

Is there a pump? _____ 1. Yes 2. No

If yes, what kind? _____ 1. hand pump 2. electric 3. gasoline operated

Who built 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 be cleaned or repaired? _____

O. What type of rainwater catchment system do you use? _____

1. metal barrels (portable)
2. metal barrels (semi-pertinent)
3. plastic containers (portable)
4. plastic containers (semi-permanent)
5. concrete tank
6. other _____

P. How much fresh water (such as rain water) 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 built 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)
2. 50% (Only one side of the roof)
3. 25%
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 the water utilized is from rooftop rainwater catchments?	_____	_____
V. What percent of water utilizes 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? _____

_____

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 fresh water 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 special purpose, does he/she notify the rest of the community? _____

MM. What do you think are the major socio-economic problems in this village? (in order of importance) 1. _____ 2. _____
3. _____ 4. _____ 5. _____

.....

VII. PHOTOGRAPHIC DOCUMENTATION: CHECKLIST

AA. Overall housing area _____ BB. Roof top rainwater catchment _____

CC. Well

.....

VIII. SKETCH MAP (reverse side)

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

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