

Drinking Water Quality Monitoring and Community Outreach Activities in Majuro, Marshall Islands



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ABSTRACT

This project was conducted on Majuro, the capital island of the Marshall Islands. The islands have a warm and humid climate making rainwater catchment systems particularly vulnerable to bacterial contamination. Rain water is the primary drinking water supply for most of the islanders who cannot afford bottled drinking water. During the month of September, safe drinking water workshops were conducted to test participants' water samples and to educate the community about drinking water quality including construction and maintenance of wells, rainwater catchments, and water tanks. Prior to the workshops, over 100 sterile bottles were distributed to workshop participants including students from the College of the Marshall Islands and staff from the US Embassy. Water samples were tested for Total coliforms, *E. coli*, pH, Hardness, Total Dissolved Solids, Ammonia-Nitrogen, Ammonium, Iron, Zinc (+Copper), and Salinity. Of 100 water samples tested, 88 water samples were positive for Total coliforms and 55 samples were positive for both Total coliforms and *E. coli*. Most other parameters met standards suggested by the EPA except for 5 samples with higher total dissolved solids (> 500 mg/L), 54 samples with pH below 6.5, and 1 sample with pH above 8.5. Water test results and fact sheets in English or Marshallese were provided to help inform participants about the issues for their drinking water. The main problem noticed in many rainwater catchment systems was the lack of adequate screening leading into the water tank and a high level of contaminants in the first few minutes of rain collection. Based on these findings, fact sheets were developed to demonstrate how to update rainwater catchment systems with screens and first-flush diverters. We also installed first-flush diverters at homes on either end of the island to allow other residents to examine the systems. The CMI Land Grant Program funded video demonstrations of these diverters, translated in Marshallese, for island residents.



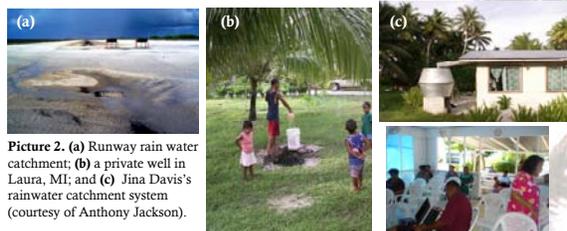
Map 1. Maps of Republic of Marshall Islands and the capital, Majuro (<http://www.worldatlas.com/webimage/countrys/oceania/mh.htm>).

INTRODUCTION

According to the USDA-SSPI HPIWQ004 Report (2005) drinking water is obtained from many sources in the Pacific Islands. As part of the water issues survey conducted in the Pacific Islands (Picture 1), almost 60% of residents responded their survey that they use bottled water or a rainwater catchment as their primary source of drinking water. Additionally, almost a quarter of the survey respondents receive their drinking water from city water systems. Community well systems, private wells, surface water, and reverse osmosis supply drinking water to smaller percentages of the population. Four percent of survey respondents did not know their primary drinking water source. Four percent of the respondents use surface water and reverse osmosis as drinking water supply.

Drinking water sources are island specific. Rainwater catchments are the primary source of drinking water in the Republic of the Marshall Islands; rainwater being 69% and city water being 13% (Map 1). As stated by the Marshall Islands Country Reports (2004) water sources for the Marshall Islands include a mix of rainwater, groundwater, and water from desalination and reverse osmosis plants (Picture 2). Normal rainfall is capable of supplying sufficient water, either collected directly or by the recharging the groundwater resources, however, rainfall is not consistent from year to year and the islands are subject to the periodic droughts caused by El Nino effect. According to this report, US government installed six desalination units in the islands, 4 on Majuro and 1 on Ebeye and 1 on Jaluit atolls to bring the water quality to within WHO standards for conductivity and chloride.

The agency responsible for water quality issues in the Marshall Islands is the Environmental Protection Agency (RMI-EPA) under the Ministry of Health and Environment to ensure the environment is not downgraded and the public water supplies are tested according to the Public Water Supply Regulations and National Water Policy. Along with the EPA, the College of Marshall Islands Cooperative Research and Extension Program has an extension agent in drinking water quality to assist EPA with the water quality monitoring and its assessments in the islands. The primary objective of this extension program was to conduct safe drinking water workshops to test participants' water samples and to educate the community about drinking water quality including construction and maintenance of wells, rainwater catchments, and water tanks.



Picture 2. (a) Runway rain water catchment; (b) a private well in Laura, MI; and (c) Jina Davis's rainwater catchment system (courtesy of Anthony Jackson).

WORKSHOPS AND DRINKING WATER TESTING

❖ Two water quality workshops and testing programs are conducted:

❖ on September 2, 2009, the 1st Workshop was conducted in Land Grant Program Arrak Campus, College of Marshall Islands for the residents living in the southern part of the island;

❖ on September 29, 2009, the 2nd Workshop was conducted in Community Center for the residents living in northern part of the island and was hosted by one of the Land Grant Extension Agents, Ms. Nelly Lakabung.

❖ Prior to workshops, Radio Advertisements were prepared and advertised in the Radio and the College of Marshall Islands, Campus Security Office was provided with sterile bottles to be available for the residents in surrounding areas.

❖ Mr. Jina David prior to 1st Workshop and Ms. Lakabung prior to 2nd Workshop distributed about 40 sterile bottles for each workshop in their neighborhood and surrounding areas.

❖ We had total of 22 residents during the 1st workshop and total about 40 residents during the 2nd workshop attended to the workshops and seminars (Picture 3).

❖ Some of the residents could not attend the workshops due to their prior obligations however dropped off their bottles with their drinking water samples during or immediately after the workshops.

❖ Total of about 100 residents' drinking waters were tested for the following water quality parameters: Total coliforms, *E. coli*, pH, Hardness, Total Dissolved Solids, Ammonia-Nitrogen, Ammonium, Iron, Zinc (+Copper), and Salinity (because of their proximity to salt ocean waters).

❖ Drinking water samples of the CMI Students and both local and US citizens of the US Embassy were also tested and included in this total.

❖ Seminars were given to the local residents during the water quality workshops (September 2, 2009 and September 29, 2009) and presentation was translated into the Marshallese language to ensure what were presenting was understood by locals.

❖ Few demonstrations of first flush system and information on the diverter regarding this hand-on activity were provided.

ACKNOWLEDGMENTS

Mrs. Diane Myazoe-DeBrum, Ms. Nelly Lakabung, Mrs. Annsey Keji, Mr. Harry, RMI EPA Staff, Mr. Thomas Maus.

WATER QUALITY TESTING RESULTS AND PROGRAM ACTIVITY

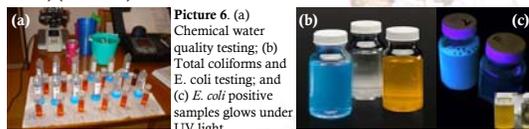
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Picture 4. Drinking Water Quality Test Results for the workshop participant in Marshallese.



Picture 5. News Article in RMI News Journal about the first water quality workshop in Majuro.

During the workshops and drinking water quality testing, water quality training and certification were provided to both CMI staff and students specifically on total coliforms, *E. coli*, pH, total dissolved solids, conductivity and chloride testing. Test results came out positive for total coliforms and *E. coli* were compared to the standard solution and instruction provided by manufacturer (IDEXX Lab., Westbrook, Maine, USA) (Picture 6).



CONCLUSION

The main problem noticed in many rainwater catchment systems was the lack of adequate screening leading into the water tank and a high level of contaminants in the first few minutes of rain collection. Based on these findings, fact sheets were developed to demonstrate how to update rainwater catchment systems with screens and first-flush diverters. We also installed first-flush diverters at homes on either end of the island to allow other residents to examine the systems. The CMI Land Grant Program funded video demonstrations of these diverters, translated in Marshallese, for island residents.



Picture 7. Views of bad and good roofs, ideal gutter, practical design for first flush diverter, and potential contaminant source for drinking water rain collection tanks and well waters (i.e. pigs).

FUNDING

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Picture 3. Pictures of workshops, water quality testings, student training, site visits and installation of first flush diverters.