Report for 2002GU11B: An Alternative Model for Enhancing Access to Safe Drinking Water in Less-Wealthy Areas: A Low Cost, Equity-Oriented & Participatory Source Water Protection Plan for Chuuk, Federated States of Micronesia

- Conference Proceedings:
  - Smith Jr., William James, 2003, Applying the Human Right to Water in Micronesia Utilizing Geographical Analysis: Multi-scale Source Water Protection, 99th Annual Meeting 5-8 March 2003, Association of American Geographers, Washington D.C., 75.
- Dissertations:
  - Smith Jr., William James, 2003, THE HUMAN RIGHT TO WATER:FROM THEORIES OF GLOBAL NEOCOLONIAL COMMODIFICATION, TO LOW COST, LOW TECH AND PARTICIPATORY ALTERNATIVE PRACTICE IN CHUUK STATE, FEDERATED STATES OF MICRONESIA, Ph.D. Dissertation, Center for Energy and Environmental Policy, School of Urban Affairs and Public Policy, University of Delaware, Newark, Delaware, 413

Report Follows:

PROJECT SYNOPSIS REPORT

Project Title

An Alternative Model for Enhancing Access to Safe Drinking Water in Less-Wealthy Areas: A Low Cost, Equity-Oriented & Participatory Source Water Protection Plan for Chuuk, Federated States of Micronesia.

Problem and Research Objectives

Problem

The people of Chuuk State, Federated States of Micronesia suffer from inadequate access to safe water. In the case study sub-basin on the island known as Fefan, as in most of Chuuk, waterborne diseases are the primary concern. This is confirmed by the investigators vis-à-vis on-site surveys, a detailed literature review, and extensive interviews of local managers and regional scientists. Although technology exists to mitigate waterborne disease, such technologies are often not appropriate for least wealthy areas such as Chuuk due to concerns regarding cost, decentralization of technology and management across many small islands, difficulties concerning maintenance, level of Western education needed to operate in the long run, as well as environmental and cultural appropriateness. This scenario is worsened in Chuuk by a lack of governmental capacity for spatial analysis of the environment for the purposes of mapping community environs, inventorying their sources of water and pollutants sources, and laying the foundation for source water protection. On a village scale this is compounded by the fact that little outreach occurs from the government regarding environmental health education. Because decision-making in Chuuk is made mostly at the village, rather than state or federal scales, whatever capacity is built at the state scale has little impact without a deliberate attempt to translate gains into education that can be delivered to communities, leaders and schools. Thus, a simultaneous multi-scale approach to these problems is necessary.

Research Objectives

Objectives were to form a coalition capable of incorporating local knowledge of culture, technology and environment together with Western scientific understanding in order to:

1. Build capacity for spatial analysis and environmental management (especially of water resources) on a Chuuk State scale by working with the Chuuk State Environmental Protection Agency;
2. Work with locals at a village/sub-basin scale to find low tech, low cost and appropriate ways to mitigate the impact of waterborne disease, utilizing existing resources and environmental education whenever possible.
3. To bolster the capacity of the Chuuk Environmental Protection Agency to perform environmental health outreach as noted in objective #2, vis-à-vis the capacity built by achieving objective #1.

Methodology

In order to reach objectives 1 through 3 the Micronesian Source Water Protection Coalition was formed. Founding members include the Chuuk EPA, Bill Raynor of The

Nature Conservancy, William James Smith, Jr. of the Center for Energy and Environmental Policy at the University of Delaware, and civil society in Chuuk.

In order to reach objective #1 the Coalition applied for and won a Conservation Grant from ESRI. We installed the GIS from ESRI and utilized GPS and satellite data from the USGS grant to customize a training program for the Chuuk EPA staff (there was no GIS in Chuuk). The training program involved 1 trainer to 5 trainee mentoring that incorporated local examples on the desktop and in the field. Training in spatial analysis was mainly focused on source water protection (see William James Smith, Jr.'s dissertation resulting from this study at http://www.philippinefamily.net/fsmswpp.html for the details). Another primary focus was the production of environmental outreach materials and report making utilizing the technology. Simultaneously, Smith hand digitized vital base-line GIS data from high resolution IKONOS 1 and 4 meter imagery in Chuuk Lagoon, and L-Sat imagery for Chuuk as a whole.

Capacity building through development of a
GIS and GPS-based decision support system

ESRI's grant provided the GIS software necessary for improving capacity regarding spatial analysis of the environment and public health. An important underlying concept for this partnership idea was addressing in part the need to literally be *at* places across Chuuk to conduct environmental analysis by enhancing "desk-top analysis." In addition, GIS and GPS are flexible technologies. Thus, once basic skills are learned they can be applied creatively to address a variety of local issues with local data. GPS is especially important in this regard, as it allows data collection "on the fly" that can represent such things as:

- Physical features;
- Conservation areas;
- Locations of surveys within natural features;
- Inventories of resources, sources of pollution, or hazards;
- Patterns of water quality sample results interpolated from discrete points; and
- Patterns of the spread of waterborne disease, etc.

This data and tool-set can be applied at multiple scales, and thus, was an excellent companion to the research at the state and village scales. Partnering is also buoyed by such technology, as data and information become easier to share. In all these ways decision-making is supported through this tool-set if locals can take master it, avoid expensive upgrades, and keep software compatible (a reason to use ESRI's ArcView 3.2).

In addition, scale is an important concept in basin management. Through the collection, storage, retrieval and display of data scale can be understood as an important facet of daily life in basin management and environmental analysis. Map making is key to this process, and while it bolsters the learning process for managers "on the desk-top," in the village products can breathe life and deeper understanding into environmental outreach materials. This can be accomplished by showing locals their environment at previously unseen scales that support environmental processes they rely upon such as basin functions related to water quality.

The first basin delineations for Chuuk Lagoon were created utilizing re-rectified topographic maps and DEMs, as well as TINs. GIS data layers were created for Chuuk Lagoon by utilizing high resolution 4 meter color and 1meter panchromatic IKONOS satellite data, and L-Sat ETM data was to create land and reef layers for the entire state. Data created includes ArcView GIS Shapefiles of:

- All Chuuk State land
- All Chuuk State reef
- All lagoon beach
- All lagoon forest
- All lagoon grasslands
- All lagoon mangrove
- All lagoon streams (major)
- All lagoon sand
- All lagoon swamp
- All lagoon transportation (airport, boat ramps, paths, roads)
- All lagoon urban built

This aided in the source water study in Fefan by assisting in source water:

1. Delineation;
2. Inventorying; and
3. Addressing susceptibility

GPS enabled researchers to create layers informed by local knowledge for contributions to studies of water regarding:

- collection;
- treatment;
- storage; and
- consumption – including, our research demonstrates, untreated stream water.

Inventorying was conducted on a village scale, and the researcher created his own base-line data based upon the search for indicators of contamination -- as monitoring for the contaminants themselves was too resource intensive given fiscal and time restraints after a typhoon struck. Susceptibility was examined through a house-to-house survey of user's experiences and perspectives with a diverse set of sources of water and water collection, treatment, storage and collection technologies.

Environmental health, education and outreach

Logically then, an important part of capacity building that includes working with the grassroots is environmental outreach. Again, at the village and basin scale this can be done through schools, as well as through literature and posters at the community level, (which the team also has attempted). Local languages must be used in addition to a "universal" language such as English.

Focusing on a simple, direct and well-stated message that is portrayed in a light that is relevant by using local examples is important. To that end, local GIS/GPS products are excellent teaching aids. It is worth noting that "fancier" is *not* always better. Meanwhile, peer review involves people from the community the outreach is aimed at *during the process*, not just at the end, and should assist in keeping the material relevant and culturally appropriate to the village(s) and basin.

Selection of study area and techniques

Given the researcher's parameters for capacity building, the identification of regional concerns and gaps in knowledge, and formation of partnerships at the governmental and civil society scales, the MSWPC's selection of study area was a process that partners could easily agree upon. Criteria for the study basins were originally set for selecting multiple basins for comparative analysis, but devastation wrought by a powerful typhoon a week after the second training session ended made a multi-basin analysis of rural, mixed urban/rural, and urban environments impossible. The storm cost the team time by stranding a team member on an outer island for over a month, and also created terrible landslides that resulted in many deaths and community trauma. This also meant that indicators of threats to public health had to be used obtained vis-à-vis surveys of people and landscapes, as their was not an opportunity to arrange water quality monitoring over a significant period as previously envisioned. Criteria were set for a single rural basin that could more equitably represent most of Chuuk, rather than the one urban area with limited piped water.

Criteria for the primarily rural basin included the following:

1. Able to be visited during all visits;
2. Local participation must be possible, and given the post-storm context the basin, a basin of one of the team members seemed a good choice if all other criteria were met;
3. Likelihood of experience with waterborne disease outbreaks relatively high;
4. No treated water system exists or may ever exist, due to lifestyle and economy;
5. Possibility exists that stream water, perhaps untreated, is being consumed;
6. Must be able to extrapolate from this experience to others in the region for greater lessons to be garnered.

Given these criteria a basin was chosen in Fefan. The resulting study follows.

Field study techniques and equipment inventory

Day 1. *Survey* and at the same time *collect GPS* data for mapping of:
- Survey location
- Source water
- Potential contaminants

Day 2. *Cultural and physical GPS data collection* for mapping of:
- Culturally important places
- Potential contaminants (again)
- Secondary and unmapped tributaries

Supporting maps, satellite imagery, and equipment were used into the field. Researchers entered the study area from Weno via boat and then proceeded in Fefan on foot. Below is an inventory of equipment found useful for the field study:

- 2 Garmin76Map GPS units (marine environments) (basin shapefile from ArcView uploaded via third party freeware)
- Spare rechargeable batteries
- Binoculars
- Compass (GPS does not tell direction when you are still and it is a back up for safety)
- Camera
- Digital camera
- Video camera
- Waterproof notebook for taking notes in the rain with pencil
- Canvas and plastic bags for equipment

A five person team was employed that included Joe Konno, Julita Albert, Ismael Mikel, EPA staffer Elmut, and William James Smith, Jr. One person administered the survey for raw data from interviews or source water or pollutant inventorying, while one recorded answers in English. One utilized the GPS unit, while another recorded notes corresponding with GPS points. The remaining member handled the camera equipment and left their GPS on without taking points, so as to have a complete record of our tracks. The survey and GPS recorders used common names and times on their forms so it would be simple to understand which GPS data matched a given survey record.

Analysis of core data and information with delineation

The approach to the fieldwork is described in this section. Surveying mostly required hiking up the mountain slopes of the study area from home to home, beginning from the top of the basin, tracking the sources downward through communities.

Nine surveys were conducted on October 17 and 18, 2002. Respondents represent 89 persons on the island of Fefan in eastern Chuuk Lagoon in sub-basin “FefanJulita” (in the EPA GIS database), covering portions of Onnongoch, Fongen and a small part of Fein villages. This basin is home to Julita Albert, one of the researchers, and she was kind enough to facilitate our traveling in the community. This population lives in a rural and small village context in relation to the "urbanized" areas of Weno. More information pertaining to lifestyles of the people in this basin can be derived from the data and information in the Appendix of the full dissertation.

The study area has a perimeter of 2.66 miles and an area of .37 square miles (basin delineation from USGS re-rectified quad including shallow reef) (Figs. 1, 2, 3, 4, 5 & 6). The population lives in a mostly forested basin, with the exception of the coastal area, wherein occurs the highest population density. In coastal areas the people of Fefan live on either side of the main road/dirt path, with mangroves on the outside and forest towards the interior that rapidly climbs fairly steep, but mostly inhabitable, slopes. There is a small portion of the population living in the Mangrove area. The geology is of volcanic origin, providing for a shallow ground water lens that is unconfined and therefore under fairly direct influence of activities on the landscape. As is the case with all of Chuuk State, precipitation levels are typically high, averaging close to 140 inches per year, so the assumption is that water *quality* is the most pressing issue, but at times quantity is also a problem due to El Nino events. Livelihoods mainly include fishing and sustainable farming of local foods such as taro and coconut.

Eight surveys were given in the village of Onnongoch and one in Fongen, in western Fefan. The lead respondents for families were:

- F01 Monica Kanas, female, age 31.
- F02 Pet Xyman, male, age 37.
- F03 Anna Ekom, female, age 70.
- F04 Skeichy Albert, male, age 50.
- F05 Elena Kanas, female, age 53.
- F06 Aniwisia Etin, female, age 57.
- F07 Teresia Roke, female, age 30.
- F08 Felixia Joseph, female, age 39.
- F09 Koson Andrew, female, age 64.

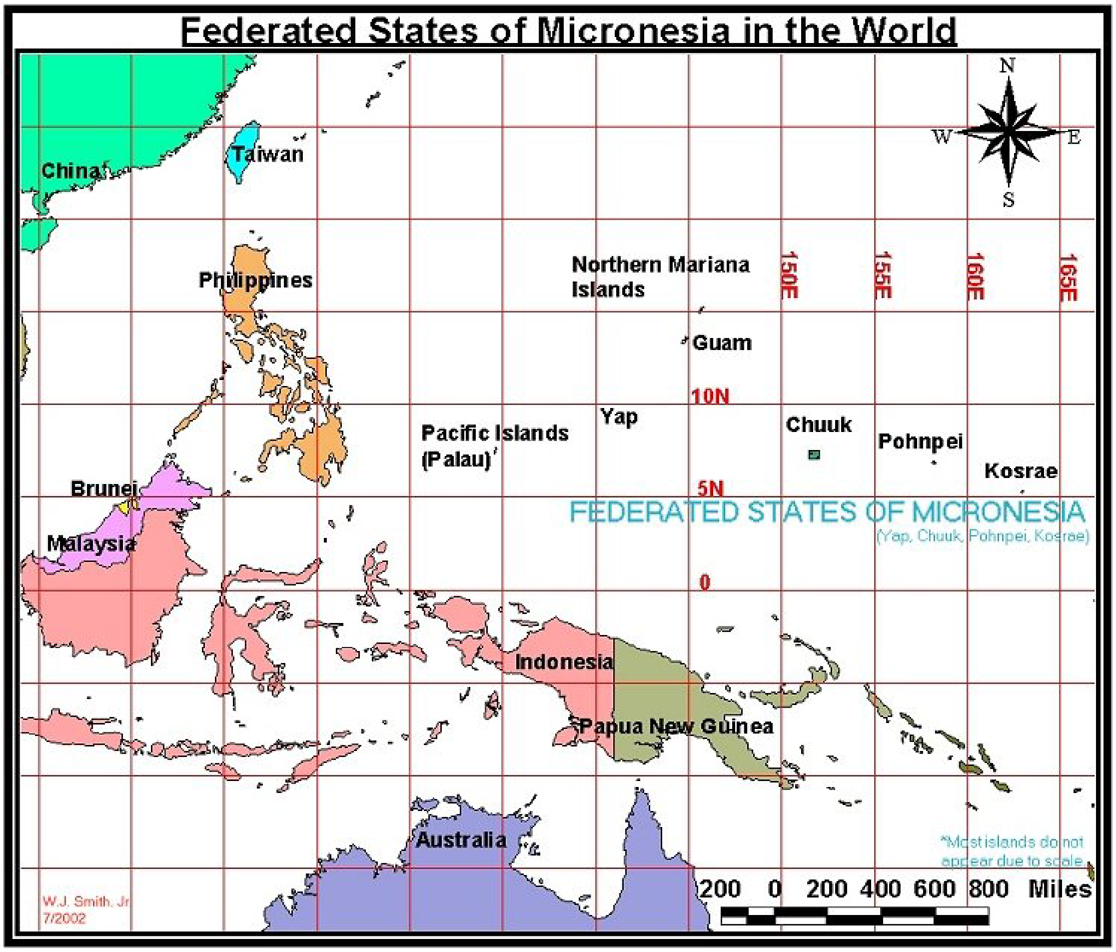

Figure 1. Location of Chuuk.

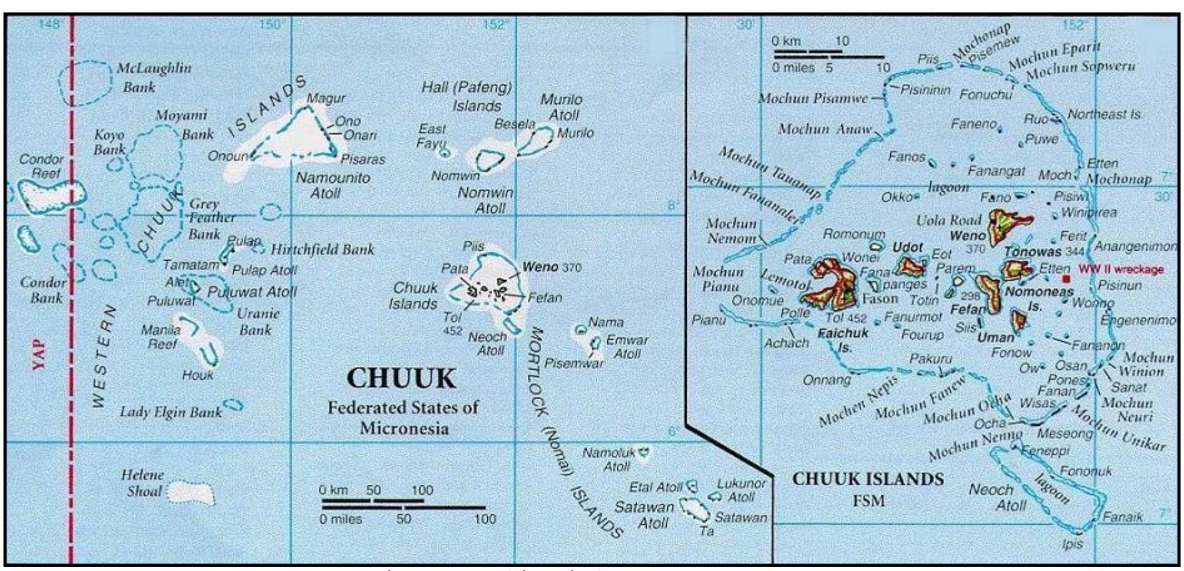

Figure 2. Chuuk State.

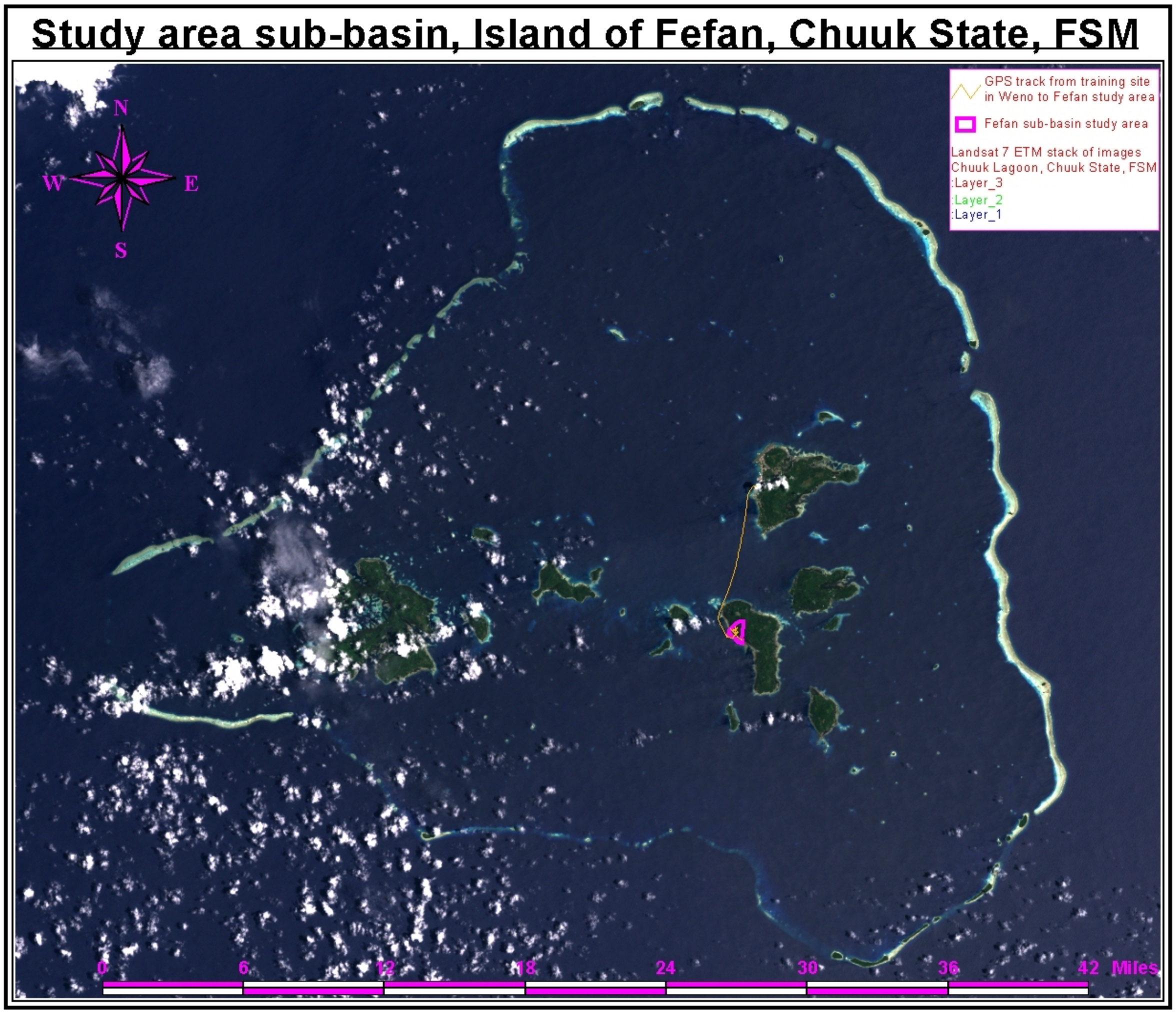

Figure 3. Chuuk Lagoon.

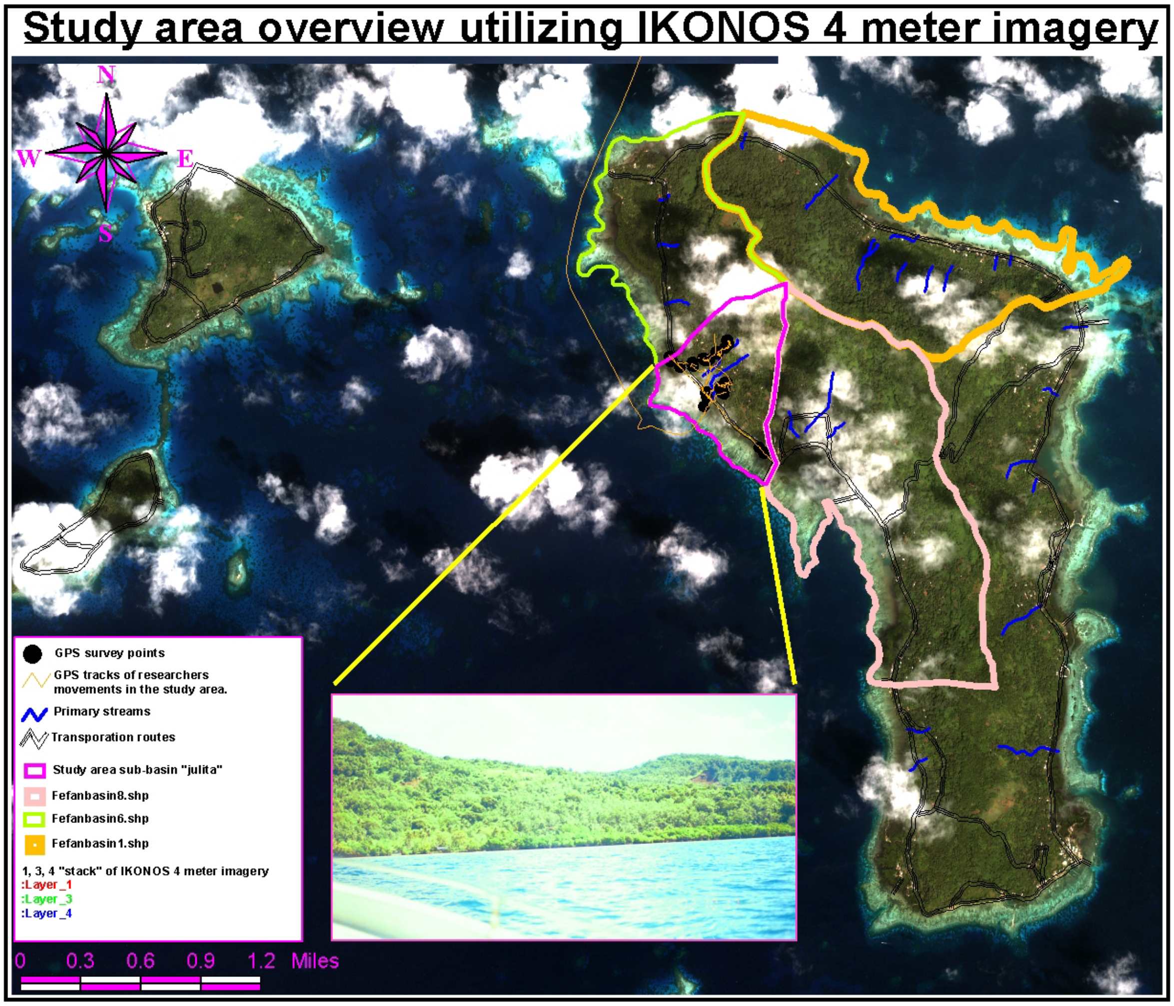

Figure 4. Study area on Fefan.

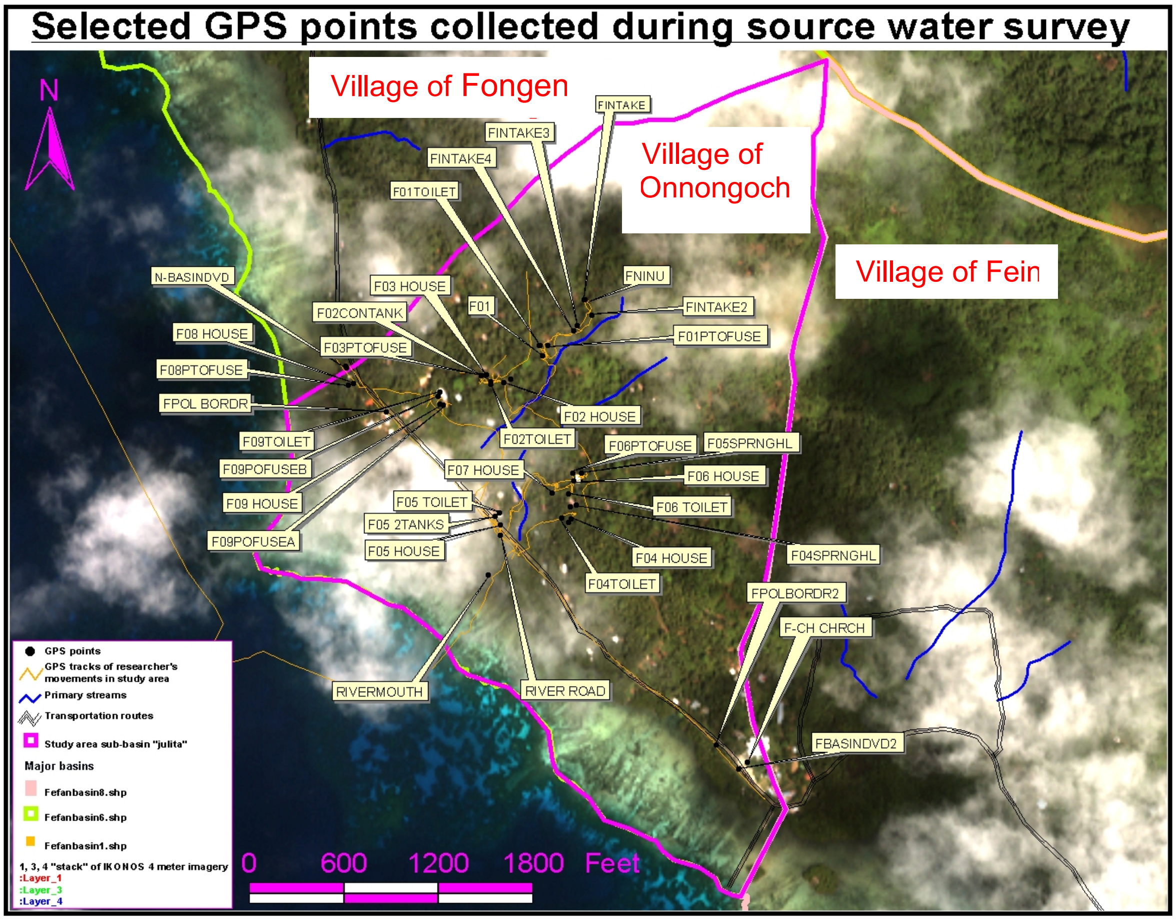

Figure 5. Source water survey of study area.

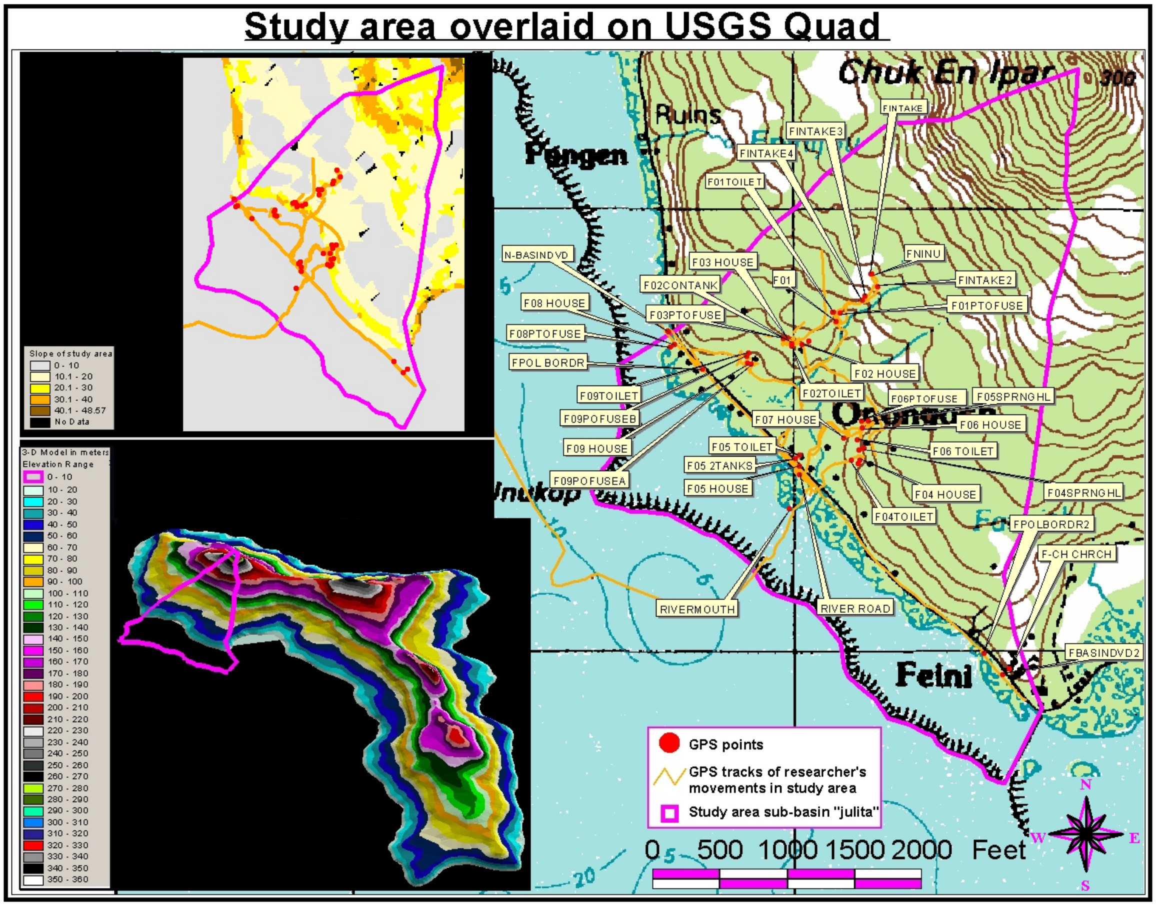

Figure 5. Study area slope and elevation.

Principal Findings and Significance

Full research and findings are found at the Micronesian Source Water Protection Coalition Web page at http://www.philippinefamily.net/fsmswpp.html. What follows are some of the findings and outputs of the research.

As is the case with EPA state guidelines for source water protection methodologies, the source water protection analysis was grounded in the process of:

1. Delineation;
2. Inventorying; and
3. Addressing susceptibility

This community outreach, combined with practicing with the GIS/GPS technology in the field, provided an output in terms of building capacity through improving Chuuk EPA skill-sets, as well as integrating staff knowledge with planning community outreach.

The types of GIS outputs have already been discussed, and will not be repeated here. However, it is important to note that an important output was supporting the capacity to create environmental health outreach materials and deliver them to the public. We used GIS/GPS to create basin-based water quality education that explained how to reduce vulnerability to waterborne disease. Included on posters and brochures posted publicly and shared with schools were local examples pollutants and also water collection, treatment, storage and delivery technology, and a guide as to how to use that technology, as well as for what purposes, to mitigate vulnerability to waterborne disease. The image files are too large to include here, so please see the posters and brochures we created that are downloadable at the MSWPC Web site. These outputs were delivered to the public vis-à-vis several community outreach efforts at schools and in the study area community.

Outreach is quite important, because our study discovered that villagers were vulnerable due to (not including complementary and vital hygienic reasons):

1. Drinking untreated stream water;
2. Not fixing broken rooftop catchments;
3. Not boiling water for drinking;
4. Boiling or using rooftop water for drinking, but not for brushing teeth, other food preparation (i.e. preparing taro or sashimi), or cooking that does not involve boiling; and
5. Poor basin management practices such as suspending pig cages above streams, dumping generators along streams for flood control, locating human waste near sources, etc. (on Weno many buried transformers were also just uphill of food and perhaps water). It is worth noting that "basin management" in an environment where regulation is weak *must* be participatory, and in Chuuk it must incorporated hygiene education.

Staff learned to integrate their GIS/GPS products with their outreach materials and short mock technical reports. Thus, both verbal and written communication skills for utilizing GIS/GPS were fostered, while practical Chuuk issues were examined.

Integrating spatial analysis skills at a state management scale, while at the same time studying source water vulnerability at a village scale, allowed the trainees to consistently focus their skill-building on the relevant local experiences of people they wish to assist.

During our studies it was discovered that rooftop catchments were not as numerous in the study area as anticipated, and were in need of maintenance through a local management team. Perhaps a church-based group would be a good idea, as people are turning back to dug-out springs and stream water that is at times untreated. In addition, the cholera scare of the 1980s is still remembered. However, we discovered that the environmental health message regarding when to boil water or use rooftop catchment water, and how to protect sources in the landscape from coming into contact with point and non-point sources of pollution is woefully inadequate.

From our research it has become clear that, rather than focus on centralized and high tech approaches to providing safe water only in areas where the relatively wealthy can afford to pay for "treated" water, a participatory and low tech and low cost approach should be adopted. It appears best to focus on basin-based source water protection education regarding how and where to dump hazardous materials, locate human waste in relation to sources of water, and allow for vegetative buffers and elevated surfaces around sources such as dugout springs for partial filtration. In addition, villagers need village scale education regarding for what purposes they should boil water, and this should be combined with hygiene education (a future hygiene study like this source water research would be helpful!). This education should be integrated formally through the school system to facilitate a semblance of fair or sustainable distribution of the knowledge in the long-term. Again, another idea worth exploring would be the use of church-based groups to maintain broken rooftop catchments. Lastly, their may be other less-wealthy world technologies that would better transfer to Chuuk than expensive and high tech ones. For example, the National Academies of Science have proven in no uncertain terms that wrapping saris (a garment worn in India) in a certain way around water collection vessels has the proven ability to strain out relatively large pathogenic microorganisms and prevent cholera. Such materials could also carry important environmental health messages.

The integration of basic basin management education for source water protection that uses local examples, understanding of how and for what purposes to boil water or utilize rooftop catchment water, and adopting hygienic practices, together, hold the most promise for reducing vulnerability to waterborne disease across rural basins in Chuuk. The role of environmental education in this endeavor is not simply as a support to technology, but is actually the most important factor in the sustainability of mitigating waterborne disease in the area. Without doubt, such environmental education can be well supported through adoption of GIS/GPS tools by environmental managers. The Micronesian Source Water Protection Coalition has started Chuuk down this path, though a longer term partnership is vital to keep momentum moving forward.

Environmental health and basin-based source water protection education, as well as honing of low tech approaches are often not as glamorous endeavors as installing high technology, and they are not normally profitable. This may be a reason this approach is often ignored globally given the present paradigm of the commodification of water, and generally, academic researchers have trouble garnering grants for such projects because they do not represent "cutting-edge science." However, we are convinced that our research demonstrates that such approaches represent the primary way to equitably help most Chuukese avoid waterborne disease, protect the very young, old, and immunocompromised, and allow Chuukese to live longer and healthier lives. This type of approach to improving access to safe water deserves sustained support from within and outside the Chuukese community, and the lessons learned here likely hold relevance in many other parts of the less-wealthy realm.