One Woman's Solar Cooking Experience in Micronesia

Submitted to Solar Cookers International by Lynn Bergeron on June 21, 2014
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Where

The Federated States of Micronesia (FSM) spans an east-west distance nearly as wide as the continental US and comprises four states, each consisting of many islands, together hardly the size of Rhode Island. The country lies southwest of Hawaii, north-northeast of Australia and east of the Philippines. My solar cooking experience was confined to the FSM state of Chuuk, on the small capital island of Weno, inside the Truk Lagoon, in a village named Nantaku, at approximately N 7° 27', E 151° 51'.

When

I was in Chuuk from July 2013 through May 2014. The solar cooking occurred from late August 2013 through mid-May 2014, roughly eight months.

Solar Cookers

I used two different solar cookers. Initially, I used the original *Haines Solar Cooker*, designed in 2013 by Roger Haines of San Diego, California, USA. This can be viewed at http://solarcooking.wikia.com/wiki/Haines_Solar_Cooker. I set up the cooker on a large, flat concrete roof offering the best insolation on the compound where I lived. SCI recommended this cooker because it is waterproof.

The second cooker, Jim La Joie's *All Season Solar Cooker*, arrived in February. See http://solarcooking.wikia.com/wiki/Jim_La_Joie. For a fair comparison, I used it in the same rooftop location.

I address the performance of both cookers later in the report. As an aside… both were a curiosity to many Chuukese unfamiliar with solar cooking.

Climate

The climate in the Truk Lagoon is only mildly friendly to solar cooking. FSM is in the tropics, but not a sun belt. When the sun shines, it's intense. However, it rains almost every day for some part of the day.

According to Wikipedia:

[hide]

Climate data for Chuuk Islands

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average high °C (°F)	30 (86)	30 (86)	30 (86)	31 (87)	31 (87)	31 (87)	31 (87)	31 (87)	31 (87)	31 (87)	31 (87)	30 (86)	30.7 (86.7)
Average low °C (°F)	25 (77)	25 (77)	25 (77)	25 (77)	25 (77)	24 (76)	24 (76)	24 (75)	24 (76)	24 (76)	24 (76)	25 (77)	24.5 (76.4)
Precipitation mm (in.)	226 (8.9)	170 (6.7)	224 (8.8)	312 (12.3)	363 (14.3)	300 (12)	348 (13.7)	353 (13.9)	320 (12.6)	345 (13.6)	287 (11.3)	307 (12.1)	3,555 (140.2)

Source: Weatherbase [3]

According to my observations:
I brought a digital thermometer to Chuuk. The *lowest* temperature I recorded during my entire stay was 79°F and the average high temps ran a degree or two higher than those shown above.

In April, I visited the NOAA weather station on Weno Island to see if they measure insolation. They do not. But they do measure cloud cover. Relevant to solar cooking on Weno, this information was most significant and explained/confirmed my experience of the limits of solar cooking there.

Because I was solar cooking, I became keenly sensitive to small changes in sunlight and weather conditions. Often in the evenings I asked my three housemates, "How would you describe the weather today?" The replies were "sunny, hot, and humid," yet the sun was obstructed much of the time by large, cumulus clouds and short rainsqualls. The overall perception gave a different picture than my moment-to-moment snapshots. Proximate to the equator, we had 12 hours of daylight. For nearly three quarters of my stay in Chuuk, daytime cloud cover exceeded 75%. There were indeed, no clear days.

Cloud cover during daylight hours

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
CLEAR	0	0	0	0	0	0	0	0	0	0	0	0
PARTLY CLOUDY	3	13	5	4	7	13	10	8	2	13	5	8
CLOUDY	27	18	26	26	24	17	21	23	26	18	25	10
Number of days	**30**	**31**	**31**	**30**	**31**	**30**	**31**	**31**	**28**	**31**	**30**	**18**

Note: May was a short cooking month. I left Chuuk May 21st.
Source: NOAA weather station, Weno, Chuuk, FSM

Clear = up to 25% cloud cover
Partly Cloudy = 25% up to 75% cloud cover
Cloudy = 75% up to 100% cloud cover

Current Cooking Methods

Though there are frequent outages, 2012 was the first year Weno had electric power round the clock. That is not to say every household has access to power, or can afford it. The cost of electricity on Weno at this writing is $0.56/kilowatt-hour – over seven times what I pay in the States. The generation plant uses diesel oil. Currently, less than 10% of Weno's power comes from alternative sources. Plans exist to increase that number. Still, at this point electric power is oil dependent and not sustainable.

Wood fuels, including coconut husks and shells are readily available in rural areas on Weno. I observed small groups of men gathering large pieces of wood and women/girls gathering kindling material alone or in pairs. As households able to afford it switch to electric cooking, the wood fuel freed up seems to balance the loss of forested land consumed for housing, roads, and utilities.

I observed households cooking exclusively with wood fires. I also observed households cooking exclusively with electric hot plates and rice cookers. Some households cooking exclusively with wood fires have electricity. It's difficult to say whether they continue to cook with wood because of the high cost of electric or they're clinging to the age-old way of doing things. Some households cooking with wood can no longer get sufficient supply within their own lands and seek opportunities to gather wood from other landowners. That means they need a truck to haul it. Yet I would not say procuring wood fuel is a problem. Unemployment is high. Many men have many hours available to gather wood. There always seems to be at least one truck up and running in large clans. And, trees grow *fast*.

Foods and Food Preparation

Since white rice became available in large quantities, most Chuukese switched to rice as a staple. It's not cheap, but it is a convenience food. They don't have to work one tenth as hard to procure and prepare rice as they do for taro root, tapioca (cassava) root, or breadfruit. Of course it's far less nutrient rich and contributes to the extremely high occurrence of diabetes in Chuuk. At least half of every meal is white rice. Though I preferred not to encourage white rice, preparing it in a solar cooker is a step in the right direction. Because the average Weno household is nine people, it would take two or three solar cookers to cook enough rice for the household for a day because it would all have to be started in the morning, in hopes of sufficient sunshine. They couldn't cook a batch in the morning and another in the afternoon – at least on most days.

For the sake of testing foods the locals eat, I occasionally cooked white rice. I combined it with other foods that have short cooking times, such as small reef fish (gutted and scaled) and

some kind of greens – native bele leaves, or a wild green locally called "spinach," or a leafy cabbage from my garden. I'd eat the fish and greens and give away the rice.

I experimented with traditional staple foods. Taro root and tapioca root are denser than say, an Idaho potato. I venture to say twice as dense. Chuukese women cut these roots into large chunks (2-3 cubic inches) and boil them a couple hours over a wood fire or on a hotplate if they have electricity. I chopped roots into small chunks (1/2" cubed) or even shredded them to reduce solar cooking time. I was cooking for only one. Given the large quantities of food they prepare, I think Chuukese women may resist added food prep labor required for solar cooking these foods. Even though it reduces the need for gathering kindling and building fires, the greater part of wood gathering is done by men, making it more difficult for women to give it due consideration as part of food preparation.

I had shipped myself organic quinoa, brown rice, and chia seeds. I always kept onions on hand. I grew basil. I brought curry powder. My quick, throw-together solar meal was chopped onions, chia seeds, basil or curry, and quinoa or brown rice. I sometimes added a little coconut milk after cooking.

I did not attempt to cook chicken, in whole or parts. There was no local poultry available, and the expensive frozen chicken was factory raised. Breadfruit, well… I never learned to like it and stopped cooking it early on. Cooking bananas I did like, but they didn't like me so those also dropped from my repertoire after a couple months.

Cooker Performance and Preferences

Let me first set the stage: I did not do a lot of solar cooking – two meals a week, maximum. With the exception of Christmas break, I was away from home for the greater part of the day 5-6 days a week, teaching and working for a non-government organization. The weather was ever changing. On the many mornings it was raining or the sky was completely overcast, I did not put out food to cook before leaving for school. Being away, I was unable to take advantage of repositioning the cookers to maximize heat gain. I simply set them facing due south and/or angled for the mid-day sun. Sundays I was at home and when the weather cooperated, those were the most successful solar cooking days. Though the concrete roof offered the best solar exposure, we were surrounded on three sides by jungle trees that cast early morning and late afternoon shadows, shortening the arc of available sunlight.

Haines Cooker

Through the cooperation of Roger Haines and SCI, the Haines Cooker arrived just a couple days prior to my departure for FSM. It folds and rolls up small enough to fit a carry-on bag. I used this cooker through mid-January. It came with a black enamel roasting pot with a solid

lid and two polycarbonate sleeves. Simple, easy set up. A nylon cord tied to a rock at each end anchored it (as shown on the website cited above) and spring clamps secured the sides where the bottom meets the back (the clips shown did not stand up to the wind). I set the cooker, rocks and all on a salvaged scrap of plywood (roughly 3 ft. square), making it easier to rotate toward the sun. I also used appropriately shaped rocks to tilt up the front-bottom and support the back. It lived on the flat, concrete roof day and night, surviving high winds, heavy rains, and tussling puppies tumbling on to it – a good test of its durability.

On the school days I used the Haines Cooker, I came home to a fully cooked dish only once - a white rice dish with chopped onions and shredded carrots. Seems that with rainsqualls, I not only lost the sun, but wind and rain cooled the pot and I lost residual heat that may have finished the cooking. I did have a couple Sunday successes with foods requiring short cooking times, but none with longer cooking grains or local root staples. I always had to finish off quinoa, brown rice, taro or tapioca on the hot plate.

By the time the All Season Cooker arrived in February, the Haines Cooker was wearing out. The foil was flaking off the plastic bubble material it sandwiched. Molds were growing in it and on it. I retired it but kept it until shortly before I returned to the States. I left the Haines Cooker, two sleeves and one pot in the hands of Chuuk's Chief of Staff, Robert who, several years earlier implemented some of the first solar projects on other islands in the Truk Lagoon. When I returned to the States, I sent him enough bubble pack insulation to make two more Haines Cookers using the old one as a pattern. Robert's plan is to work with fishermen on his home island. He thinks they might set up a cooker on the beach when they head out in their fishing boats, and return later in the day to a cooked meal. I suggested he recess the cooker in the sand a bit, for protection and stability. The portability of the Haines Cooker will be an advantage.

All Season Cooker

This cooker arrived on the eve of three weeks of heavy rainfall and could not be put into use until the first of March. March had more favorable weather, allowing me to step up the frequency of solar cooking. Jim La Joie also sent me the same pot that came with the Haines Cooker, two 4-quart Pyrex bowls, a simple iron trivet, large oven roasting bags and a simple wire frame to hold the roasting bags away from the cooking pot.

The All Season Cooker can be precisely focused at any given time using its attached sundial-like device, or I could use the device to set the position/angle of the cooker for the best hours ahead. On cooking Sundays, I fine-tuned the cooker each hour. On cooking school days I set it for the mid-day hours. In our jungle location I could not take advantage of this cooker's ability to catch the sun's earliest rays. Large mango and breadfruit trees blocked early morning sun.

I kept this cooker in the house, setting it out on the scrap plywood base on cooking days. Sans rock anchors and supports, it was easy to pick up and carry inside. I tried the black enamel pot in the following configurations (worst to best performance):

1. Pot set on trivet with Pyrex bowl for lid
2. Pot with lid set on trivet
3. Pot with lid set in polycarbonate sleeve (same configuration used with Haines Cooker)
4. Pot with lid inside roasting bag, set on trivet
5. The bowl bubble - pot w/lid encased by two Pyrex bowls, one inverted over the other. The bowl bubble intuitively seemed like the best configuration. It was the last one I tried because the second bowl arrived at a later date, under separate cover.

Given the role glazing plays in any solar application, it's no surprise the last two configurations yielded the best results. On partly cloudy Sundays, when I was present to make adjustments, the All Season Cooker was able to finish cooking dishes requiring higher heat/longer cooking times. I have a definite preference for the bowl bubble over roasting bags. I found the bags and wire frame clumsy to use; checking food during cooking was more difficult. Drawbacks to the bowl bubble are: 1) Pyrex bowls (or other suitable brands) were not readily available on Weno. 2) The bowls are breakable and costly to ship.

I left the All Seasons Cooker in the hands of my Chuukese host family, who are able to afford a refrigerator. When my host "Mom" Shereen cooks, she almost always cooks extra so she doesn't need to cook as often. Shereen latched on the solar cooker as a means of re-heating leftovers – "cooking" not required.

Conclusions

In my opinion, the greatest impediment to the spread of solar cooking on Weno is the uncertainty on any given day the cooking process will complete. One cannot plan on food being ready by a certain time. Even maximizing performance through cooker selection, appropriate glazing, and best attendance throughout the day, forever fickle weather always begs the question, "When will my food be ready? Am I going to have to build a fire (or use the hotplate) anyway to finish the cooking?"

That is not to say there's no place for solar cookers. FSM may indeed have many different microclimates where solar cooking is more successful than in Nantaku. It may also be the case that weather during my stay was exceptional. In the long run, how will climate change affect solar cooking in Micronesia? Certainly, experimentation should continue if opportunity presents.