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Solar Technology Projects In El Salvador

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Introduction

The purpose of this project was to design, implement and introduce a solar cooking and related alternative technology pilot project into several rural, impoverished villages in southern El Salvador and in selected "barrios" (neighborhoods) of the urban capital city of San Salvador.

Registered dietitians and licensed nutritionists are in a unique position to introduce new cooking techniques and associated technologies applications in the developing world. The registered dietitian's expertise in food and nutrition serves as a natural conduit to tackling issues of malnutrition and other related diseases.

El Cuenco was established in 1997 to improve the lives of impoverished people in the developing world. El Cuenco is a United States-based non-profit organization [501(c)3]. The organization's current focus is in El Salvador, Central America. El Cuenco is co-managed by a master's-level, trained registered dietitian/public health nutritionist.

The organization focuses on five primary areas: nutrition, education, health, medical, and small economic development projects. These five areas form an integrated network that fosters community development. This evolving process permits the introduction of new methods and ideas into the community fabric.

History

In the early 1990s, I worked with the United States- based non-profit organization, CASEP (Central American Solar Energy Project), which was a "solar oven project," established by a nuclear physicist. My primary role as a nutritionist working in rural Honduras was to improve the diet of malnourished children and their families. The solar oven was an integral aspect of improving the diet. Women were invited to cooking and recipe workshops to learn how to prepare and cook nutrient-dense foods in solar ovens. Women interested were then selected through a detailed screening process to participate in solar oven construction projects. An

article featuring this work was published in JADA in 1995. **(Solar Energy Fuels Solutions to Hunger and Poverty in Central America, Peggy Lynn Gregson October 1995, Journal of the American Dietetic Association Vol. 95, Issue 10, Page 1102).**

In 1992, a trip to El Salvador was made to determine the possibility of introducing the solar oven project into impoverished villages. However, due to a protracted civil war, and continued unstable conditions, the solar oven project was aborted. However, since that time, I have worked in El Salvador, conducting nutrition screenings and emergency food aid projects to establish a presence in the country despite a fragile and often unstable government infrastructure. In 2009, a professional relationship was established between the University of El Salvador's Departments of Medicine, Nutrition, and Environmental Sciences and El Cuenco, a United States non-profit organization, to collaborate on projects that would improve the health and nutritional status of residents in impoverished villages. As a result of this collaboration, several projects have emerged, including, but not limited to: 1) improving water quality in coastline villages in collaboration with Engineers Without Borders, 2) improving the nutrient content of the diet, 3) collecting blood samples to assess nutrient status and measure lead concentrations, and, 4) introducing environmentally friendly fuel sources for cooking.

In 2007, Technical Sergeant Jeffrey Allen Barth of the United States Air Force Reserve, (Technical Sergeant Jeffrey Allen Barth earned a Bachelor's of Theology Degree from Bethany College in Minnesota. Additionally, he has received extensive technical and medical mission training from various educational institutes in the United States and abroad.), as a co-coordinator of El Cuenco, he introduced and presented basic diagrams and concepts on the topic of solar ovens to the faculty and students of the Department of Environmental Science, at the University of El Salvador. The presentation was well received, and resulted in a request for funding to implement a pilot project to construct solar ovens at the university. The goal of this pilot project was to collaborate with the Department of Nutrition to introduce the solar oven and to conduct solar oven cooking classes with women living in impoverished villages. If the pilot is successful, follow-up sessions and additional phases will be established to teach villagers: 1) how to build and maintain the solar ovens, and to use recipes modified for solar oven cooking, and, 2) how to improve the nutrient content of the diet with solar oven usage.

El Salvador

El Salvador is a country located in Central America that is bordered by the Pacific Ocean, Guatemala and Honduras. This Central American country measures about 21,040 square kilometers and is approximately the size of Massachusetts. The most current demographics of El Salvador published in 2000 by the Pan American Health Organization describe El Salvador as a nation affected by war and poverty: "...the population was estimated at about 6 million, 58% living in urban areas, and 50.7% male. It is a young population, with a mean age under 20 years." The types and severity of nutritional concerns include: "...chronic malnutrition of children under the age of 5 was 23.3%. The prevalence of anemia in mothers 15-49 years was 8.8%." **(PAHO, El Salvador, *Health Situation Analysis and Trends Summary*).**

A goal established by El Cuenco was to introduce solar ovens and cooking techniques to the country of El Salvador. As a health professional with prior training in basic solar cooking through the Central American Solar Energy Project (CASEP), and with applied solar oven technology experience in Honduras, Guatemala and Nicaragua, the opportunity to introduce a pilot project in El Salvador was considered possible especially with the support of University of El Salvador colleagues and, most importantly, if the communities and barrios were receptive to this program.

The opportunity for El Cuenco to move forward with the introduction of solar technology is now a reality as a partnership with the Directors of the Departments of Nutrition and of Environmental Health, under the direction of the medical school of the University of El Salvador, has been established. El Cuenco plans to create a pilot project to introduce solar technology and solar cooking to San Carlos Lempa and other impoverished villages in El Salvador. San Carlos Lempa is located in the southern region of El Salvador, in the Department of San Vicente near the Rio Lempa. San Carlos Lempa is a resettlement village formed during the war, when people fled their homes and sought a safer location. Unfortunately, the artesian wells in this region are contaminated by bacteria, parasites, and lead and the average temperature in southern El Salvador exceeds 90°F. Wood is the primary source of fuel used to cook food. Families gather this scarce resource, "**leña**" (firewood), frequently in San Carlos Lempa, and throughout El Salvador, resulting in deforestation and drastic climate changes. In the urban setting, such as in the capital city of San Salvador, mud slides are frequent due to the deforestation caused by wood gathering by the impoverished striving to survive. During the rainy season many city dwellers are forced to leave their shacks built on hillsides to avoid the devastation. In urban areas, potable water is expensive and may be delivered by a "**fuente**" (waterspout) that is located outdoors or delivered in a water truck. In San Salvador, the temperatures during the day can soar to higher than 80°F making the capital an ideal location to introduce solar cookers.

Rationale for Alternative Cooking Technologies

The deleterious effects of wood-smoke and other biomass fuel byproducts cannot be underestimated, when related to respiratory morbidity and mortality, especially in the developing world. According to Boman, et al, as related to wood-smoke emissions, "...there is clearly a background of a large number of organic and inorganic components that may be associated with adverse biological events. The potential health effects of by-products, such as volatile organic compounds, polycyclic aromatic hydrocarbons and fine particulate matter (PM), have been of particular concern ..." (**C. Boman, B. Forsberg, and T. Sandström. Shedding new light on wood smoke: a risk factor for respiratory health. Eur Respir J 2006 27:446-447**). In terms of the quantitative impact of these chemicals on human respiratory health, Solar Cooker's International, a United States-based non-governmental organization, summarizes the research as related to wood fires and respiratory health: "Indoor smoke from cooking fires results in childhood pneumonia which is responsible for greater than 4 million deaths per year." **(Solar Cookers International: Why Solar Cook?).**

Further studies as cited below underscore the urgency of replacing wood and other biomass fuels with alternative energy sources such as solar energy. The combined effects of chemical irritation to the respiratory mucosa, depressed immune responses, and resultant morbidity and mortality from toxins produced by wood-smoke illustrate the enormous public health burden that these cooking methods inflict in the developing world, including El Salvador.

In 2005 a report by Naeher, et al, specified that: "It appears clear from the toxicological studies that short-term inhalation of wood-smoke can compromise pulmonary immune defense mechanisms important for maintaining host resistance against pulmonary infections." The report later states the role of wood-smoke in: "...chronic obstructive lung disease and acute lower respiratory infections have been strongly associated with household exposures, leading to an estimate by the World Health Organization (WHO) of some 1.3 million premature deaths per year globally." Naeher's group also cites other studies that..."have also shown relationships with tuberculosis, cataracts, adverse birth outcomes and asthma." **(Naeher, L., et al., *Critical Review of the Health Effects of Woodsmoke*, Report Funded by the Air Health Effects Division, Health Canada, Ottawa, 2005. pp. 1-75).** Naeher's report and one by the Pan American Health Organization describes the reality with sobering statistics: "Acute respiratory disease constituted one of the leading causes of morbidity and mortality (in El Salvador). In 2000, the incidence rate [of acute respiratory disease] was 252 per 1000 people, affecting 52% of the population under the age of five. The incidence of pneumonia and bronchopneumonia (44.7 per 1000 population) affected 38.3% of children under the age of one." **(*PAHO, El Salvador Health Situation Analysis and Trends Summary*).**

In 2008, the World Health Organization (WHO) conducted a meta-analysis to determine the risks of respiratory disease related to unprocessed solid fuels, and concluded that: "that reduction of household Indoor Air Pollution (IAP) from solid fuel use through switching to other fuels, improving combustion and ventilation, and possibly other measures, would make an important contribution to prevention of pneumonia morbidity and mortality." **(Bulletin of the World Health Organization, vol. 86 no. 5 Geneva May 2008. *Indoor air pollution from unprocessed solid fuel use and pneumonia risk in children aged under five years: a systematic review and meta-analysis*).**

Gastrointestinal diseases, as related to the consumption of contaminated water, contribute to morbidity and mortality in the developing world, especially in the pediatric population in El Salvador.; According to the Centers for Disease Control (CDC), in Latin America: "The public health significance of the microbiological quality of water and disinfection deficiency is exemplified by ... the prevailing high incidenc ... of amoebic and bacillary dysenteries." **(CDC, *Safe Water System Publications* – *Low cost safe water for the world: a practical interim solution,* Reif, F., et. al., pp 1-13).**

This summary of the investigative literature provides a potent rationale for the introduction of alternative fuel sources in the developing world. To address these preventable causes of morbidity and mortality, a Three-Phase Solar Oven and Solar Technologies Pilot Program was

initiated in El Salvador, in the community of San Carlos Lempa and nearby villages, in January of 2011.

The Role of Community: Introducing Alternative Technologies

An article published in the *Science* section of the **New York Times**, reveals the key to the acceptance of solar energy alternatives in Central America, "The scientists attribute the success to a change in approach, from a well-intentioned donation of technology to collaboration with residents." **(New York Times, *Science*, *Scientists Design Solar Oven to Dampen Use of Firewood*, December 11, 1990).**

The role of the community cannot be over-emphasized when introducing new practices. The Latin culture is community-oriented, and the El Salvadoran culture is no exception. The community model of engaging the residents to determine their needs and desires to resolve community issues will be used. This model of community –based participation has been successful in other oven projects in Central America. CASEP offers advice to those desiring to implement alternative technologies: Sometimes this advice mitigates situations such as those described here: "What was wrong with the way I have been cooking all these years?" is a quote from Nicaraguan women who were given the solar oven without any participation in the project. In a follow-up to determine usage, they indicated "…very soon the ovens were collecting dust." **(Ibid.)**

As women, children, and men gather firewood to cook their beans and corn, the desolate landscape and dusty roads, current flooding and prior hurricanes of El Salvador attest to the damage this practice inflicts not only on physical health, but on environmental health, as well. Historically, in illiterate populations in the developing world, including El Salvador, the customs and beliefs of a culture are shared through the practice of oral tradition and demonstration. Many people in El Salvador practice the rich oral tradition of passing down important skills to their young. The famous tortilla is a flat and round corn product that young girls learn to make and master by observing and practicing with their mothers. Therefore, the introduction of a new practice, in this case solar technology, would include a model of best-practice that encompasses a live demonstration of cooking with the sun, followed with a celebration meal of solar cooked foods.

Benefits of Solar Technologies and Cooking

According to **Solar Cookers International**, the benefits of solar cooking include, but are not limited to:

- Preservation of nutritional quality
- Moderate cooking temperatures in simple solar cookers help preserve nutrients
- Reduction in cooking costs
- Solar food business opportunities, like restaurants and bakeries.
- A smoke –free cooking environment

- Lower risk of burns (Solar cookers are fire-free)
- Reallocation of time (e.g., reduced time required to collect wood for fuel, reduced time in dangerous areas)
- With good sunlight, solar cookers can be used to cook food or to pasteurize water during emergencies when other fuels and power sources may not be available
- The ability to preserve (can) foods, such as tomatoes and fruits, to heat water for household chores, to sanitize dishes and utensils, etc.

In the impoverished communities of El Salvador, the ability to preserve nutritional quality to prevent malnutrition, to reduce respiratory infections, and to pasteurize water to prevent gastrointestinal diseases, combined with the urgent need to find an alternative fuel source is essential if the cycle of poverty and illness is to be broken. Therefore, the introduction of solar technology and its associated benefits can provide improved health, and possibly, an improved economic status.

Introducing the Solar Cooker and Solar Cooking Techniques

Dr. Ruth Dow, a registered dietitian who volunteers in developing countries, recently donated copies of "**Como Hacer Y Usar Una Cocina Solar**" (How to Make and Use a "Solar Cooker") to the University of El Salvador's Departments of Nutrition and Environmental Sciences. These booklets contain "blueprints" for various models of solar cookers. These inexpensive designs created from local materials will be used to introduce solar cooking into the communities. These models will be presented to people in the community and modified as needed in the Solar Oven Pilot Project using the "***taller***" method. "**Tallers**" are workshops favored by Central Americans as a community process that permits residents to participate in the exchange of information and ideas. In Phase I of the project, several models of the solar cookers will be displayed and demonstrated to introduce the concept of solar cooking and its benefits. Selected residents will solar cook foods such as beans, rice, chicken, and vegetables using a solar cooker to determine if the food quality is acceptable. Residents will be offered food samples, and recipes will be shared with the community to further determine interest and acceptability on a wider scale. Organizers of the taller will solicit feedback from the residents, and if positive for learning more about solar ovens and cooking, additional workshops and demonstrations will be offered in churches, schools, and community centers. The success of these presentations will lead to Phase Two of the project, in which a workshop will be organized to teach residents how to build a basic solar cooker. During Phase Two, community residents will be invited to participate in the construction of a basic solar cooker for home use. New recipes will be shared and foods will be prepared to be eaten together in a "***Fiesta Del Sol***". The Catholic Church is an important component of the Latin culture, and, the practice of involving the church in behavioral change will be initiated. The popular "Latina fiesta" for celebrating life will include an invitation to the local priest to bless the meal and the solar cookers as the participants prepare to take them home.

Solar Cookers International and CASEP offer more sophisticated solar oven designs that will be introduced in Phase Three of the pilot project if community interest is sustained. These ovens

are built from durable materials, usually are more expensive, and have added features such as a table with wheels that can be built in community solar oven workshops. These projects demand a committed community response to achieve and maintain success. Therefore, Phase One and Two of the project are essential to evaluate the interest and desire of the community to progress toward adopting solar energy as a new fuel source for cooking food and for purifying water.

Water Pasteurization Indication (WAPI)

The water along the coast of El Salvador is contaminated with lead, parasites and harmful bacteria according to preliminary tests conducted by the Departments of Environmental Health at the University of El Salvador and the University of North Carolina at Chapel Hill. These data were presented to a North Carolina chapter of Engineers Without Borders, a non-governmental organization collaborating with El Cuenco, to improve the water quality of villages located near the coastline. Water pilot projects are expected to be initiated this winter, in San Carlos Lempa. Water contamination is of primary concern, as the residents suffer from gastrointestinal diseases and parasitic diseases. Water can be treated by pasteurization to kill microbes and to provide a source of potable water. Pasteurization is accomplished by heating water to 149°F for a short period of time. At this temperature, worms, protozoa cysts (Giardia, Cryptosporidium, Entamoeba), bacteria (V. cholera, E. coli, Shingella, Salmonella typhi), and Rotavirus are destroyed. Solar Cookers International produces a **Water Pasteurization Indicator** (WAPI), which is an instrument that indicates when water has been pasteurized by solar energy, gas, or wood. The purchase of indicators will permit the residents participating in the pilot projects to determine when water is safe to drink. This concept will be introduced, demonstrated and taught in workshops during Phases One and Two.

Conclusion

In conclusion, the registered dietitian is positioned to tackle complex world health problems at the community level. The registered dietitian can assess public health and medical issues in impoverished communities and can implement projects that enhance health and reduce microbial organisms that contribute to high rates of morbidity and mortality. Community and cross-cultural training guides the registered dietitian to implement projects that embrace each unique dynamic that exists when working in diverse environments. This project, to improve the environmental health of residents of El Salvador, will impact nutritional well-being through improved food quality and increased access to potable water. In turn, a healthier population can attend school and work to improve their economic status.