

Finding a Better Stove: Cookstove Use in “Last Mile” Villages in Guatemala.

Deborah Hopkins

Policy Studies, Department of Interdisciplinary Arts and Sciences

University of Washington

Bothell, WA

Abstract

This project aims to explore cooking practice behaviors among indigenous Guatemalan women in select rural villages. Women across Guatemala place their health, and that of their children, at risk every time they prepare a meal for their families. Open fire cooking in unventilated spaces poses an immediate risk of exposure to burns, lower respiratory infections and chronic illnesses such as heart disease and stroke. In addition, as many as 70% of Guatemalan households use wood fuel, a rapidly diminishing resource, as a primary source of energy. This contributes to annual wood deficits and widespread deforestation. One possible solution is clean cooking through Improved cookstove (ICS) adoption. The Global Alliance for Clean Cookstoves suggests ICS is “the key to global development and climate goals” through its substantial impact on the United Nation’s Sustainable Development Goals. Despite recognition of the need for ICS adoption by the Guatemalan government, it remains an elusive goal particularly, in remote impoverished villages. The people living in “last mile” communities lack access to the most basic infrastructure to improve their livelihoods. This case study aims to characterize a baseline of cooking practices in six rural villages in the northeastern Guatemalan state of Izabal. Using a mixed methods approach, baseline data was collected through observations, interviews and secondary sources and combined with emerging data from cookstove intervention studies and research in culturally distinct definitions of health risks. This project will help inform future program development opportunities and provide recommendations for Improved cookstove adoption. The long-term goal is to support successful adoption of ICS in select villages to promote an expanded demand for ICS that overtime will lead to improved air quality, reduced wood fuel use and increased economic opportunities.

Chapter 1: Purpose of the Study

Introduction

Worldwide, three billion people cook over unventilated open fires in their home. The consequence is 4.3 million premature deaths each year that are attributed to exposure to indoor air pollution (World Health Organization, 2016b). In the developing world, health risks associated with open fire cooking fall disproportionately on women and girls, who do most of the cooking within their community (World Health Organization, 2016b). Furthermore, the rural communities' sole reliance on biomass fuels for energy in low to middle income countries intensifies the health risks for women. Guatemala for example has reported that 56% of its energy supply is provided by wood fuel (Perez Molina, O & Archila Dehesa, E, 2013), resulting in a huge demand and large annual wood deficits (Global Alliance for Clean Cookstoves, 2013). The Guatemalan government recognizes the need to reduce wood fuel use and has invested in cookstove education, as well as direct placement of stoves, to partially mitigate these negative outcomes (Guatemalan Ministry of Energy and Mines, 2013; Perez Molina, O & Archila Dehesa, E, 2013). The purpose of this study is to examine and report a baseline for clean cooking standards through the lens of current ICS availability among the extreme poor in rural Guatemala. These observations can be contrasted against other quality of life improvement data to form a clearer picture for program development.

Improved Cookstoves are not necessarily discrete stove types. Instead they represent a continuum of improvement, at one end is a three-stoned open fire and at the other is a solar or electric option. Everything in between is considered an improved cooking environment. This can be a stove with a smaller more efficient burning chamber or the addition of a chimney that removes smoke through the roof. It may also be a shift away from biomass fuels altogether to a cleaner burning alternative such as

Finding a Better Stove

propane. Even simple increases in the ventilation of a kitchen through half walls or windows can fall on the continuum of improvements.

There are triple benefits gained by communities that move towards more efficient and cleaner burning Improved Cook Stove (ICS) designs (Jeuland M & Pattanayak S, 2012). Most directly, reducing smoke exposure improves health and saves lives. The global burden of disease resulting from exposure to household air pollution continues to grow and now encompasses a wide array of disease categories. In addition to respiratory infections, there are now direct links between household air pollution and stroke, ischemic heart disease, COPD, cataracts and lung cancer (World Health Organization, 2016b). Growing evidence for the association of metabolic and developmental disorders due to chronic exposure to smoke adds more risks for those cooking without ICS (World Health Organization, 2016b). Secondly, ICS adoption can improve livelihoods for women and girls in each community, by increasing time for education, employment and income generating activities. Finally, the less wood burned the more stable forests become and the less overall impact on the climate and valuable ecosystems. Given the deforestation rates occurring across Guatemala, it is of global climate significance to preserve ecosystem services and biodiversity in this over harvested part of the country (Inter Press Service, 2012).

The impact of successful adoption of ICS in remote rural villages will most importantly and most directly affect health outcomes for a population that already battles poverty and isolation. But more broadly, ICS intervention can have impact on the United Nations Sustainable Development Goals (SDG). Ensuring healthy lives, promoting gender equality and building resilient infrastructure (Goals 3, 5, and 9) are part of the SDG high level political forum focus for 2017. Longer term, ICS adoption can have added benefits by ensuring access to modern energy, acting on climate change initiatives and protecting and preserving terrestrial ecosystems (Goals 7, 12, and 15). (“United Nations Sustainable Development Goals,” 2017) Given the alignment with current paradigms for development work, it is easy to see the value in devoting international efforts to support clean cooking strategies where they are most needed.

Finding a Better Stove

ICS program development in Guatemala, however, still faces many challenges and requires an understanding of the unique environment that exists in this country. For example, close to 60% of the Guatemalan population lives in poverty and 20% live in extreme poverty (Global Alliance for Clean Cookstoves, 2013; World Bank, 2014). Other challenges include a diversity of language that affects many indigenous Guatemalans. Guatemalans are governed by a Spanish speaking government even though more than 40% of the population communicates via 23 distinct languages. The lack of transportation infrastructure is another major impediment. More than half of the population lives in rural and in some cases increasingly isolated locations (World Health Organization, 2016a), that lack access to reliable transportation. Finally, there continues to be an ongoing struggle with corruption and decentralization, that makes coordination of services and programs inconsistent even when faced with natural disasters such as the increasing severity in annual storms (Piccard M et al., 2007). Providing services through a decentralized government with clear dependence on international NGOs, (Lawton, AM, 2015) has been a decades long struggle and continues to challenge the Guatemalan people.

Nonetheless, the Guatemalan government, collaborating with the international community, have defined a Country Action Plan to prioritize Improved Cook stove adoption (CAP4CCF). Rapid economic growth (World Bank, 2014), international pressures relating to energy needs, (Perez Molina, O & Archila Dehesa, E, 2013) economic value of natural resources, (Guatemalan Ministry of Energy and Mines, 2013) and climate change agreements, (Nino, 2016) have only added to the pressures for ICS. Using direct funding and education programs, CAP4CCF attempts to reach communities surviving at the poverty line (Global Alliance for Clean Cookstoves, 2014), but despite this, many households living below the poverty line still rely on open fire within the home. Government funded ICS replacement is simply out of reach for most rural communities. This is due to the current focus on development of supply chains, employer subsidies and microfinance loan structures better suited to employed households living in urban environments. Yet another example of the exclusion of rural indigenous villages from programs that might help break the cycle of poverty.

Research Problem

Isolated and impoverished rural villages in Guatemala are rarely visited by anyone other than inhabitants and visiting healthcare providers. This isolation can lead to a lack of transparency that makes program planning difficult. This study proposes to set a baseline that can be used by Government or Not for Profit driven programs to plan for cook stove provision within the context of extreme poverty and rural isolation. The Guatemala government, CAP4CCF, lists three strategic axes to define cookstove intervention points; enhance demand, strengthen supply, and foster an enabling environment(Global Alliance for Clean Cookstoves, 2014). To align with CAP4CCF, the research objectives listed for this study embraces these strategic axes, to set a baseline that will allow for preliminary recommendations for cookstove focused program development.

While there are large portions of the Guatemalan population living in poverty, this study evaluates remote indigenous communities living in conditions of extreme poverty. Extreme Poverty across the globe is defined by the World Bank as living on less than approximately \$2/day (Cohn, 2015; Ferreira, 2015). Those individuals living in extreme poverty in urban environments are beyond the scope of this research. This paper focuses on two representative municipalities, El Estor and Livingston within Department Izabal. These municipalities represent two distinct geographical regions; higher elevation mountainous villages or sea level “boat access only” river locations.

The goal is to understand the clean stove baseline and provide a framework that would support and enable successful ICS adoption. These six communities represent many others like them in the region. The hope is that this baseline can be applied to begin building an evidence base for the need to have village specific and culturally appropriate ICS programs. Fostering an enabling environment for ICS adoption in a few villages if successful, will help to spread similar programs through the larger region. This can be followed with empowering a peer to peer advocacy infrastructure and user based design strategy that will support better user adoption and create greater demand for ICS.

Conceptualized Study Objectives

***Research Objective #1.** Describe the current ICS environment in remote, rural, indigenous villages using community assessment tools.* Using direct observation of the cooking practices in several communities can help to (1) set a baseline for measuring future progress and (2) provide an evidence base for need of ICS adoption. This is critical to foster an environment that provides a broader understanding of the benefits of ICS interventions within each community. In addition, it expands the understanding that open fires, soot, smoke, and poor ventilation are measures for exposure to Household Air Pollution (HAP) which can help to promote advocacy and behavior change in cooking practices.

***Research Objective #2.** Identify any patterns in community assessment data that indicate receptivity to ICS adoption.* The potential receptivity to ICS adoption can be indirectly assessed based on the observation of other quality of life improvements made to improve health outcomes. Assessments of other prevention strategies in place, such as cement floors, steel roof replacement, latrines and water purification devices can provide insights into ability and prioritization of making health related changes.

***Recommendations.** Prepare individual recommendations for cookstove focused program development in each village as part of an individual case summary report.* Case summary reports can provide a starting point for the development of a framework for level of intervention within each village. Bringing together qualitative and quantitative data provides a thick description (Fitzpatrick, Sanders, & Worthen, 2011) of each individual environment that is appropriate for program decision making.

Study Hypothesis

This study asserts that cookstove program development for rural indigenous communities living in extreme poverty requires a clear understanding of the starting baseline. It relies on the model that adoption of cookstoves is a complex behavior change that requires a contemplative and iterative approach. It demands an increase in the clarity of real world contextual conditions that include but are not limited to, need, ability, priority and cultural perspectives. The hypothesis is that a clear understanding of

Finding a Better Stove

a receptivity to other quality of life improvements and of the state of current cooking conditions will better define these contextual conditions for the benefit of future program development.

Overview of Study Methods:

Analyzing complex behavior change requires a mixed methods approach, as both quantitative and qualitative data must be taken into consideration when evaluating ICS program adoption (Stanistreet et al., 2015). Physical artifact observation, engagement with community members, observation of daily life, informal participant interviews, and participation in daily activities provided the basis for research data collected. Standards for Community based public health nursing were applied to perform all aspects of data collection (Hunt, 2009).

The first descriptions came from *Walking Surveys* performed in each community. Walking surveys are systematic observations based upon the five senses and they help to provide an overview of that community. When possible *Informant Interviews* were performed, where general questions regarding healthcare, daily life and cooking practices were asked. Visits to all villages were greater than 5+ hours and in one case included an overnight stay, thus allowing for extensive *Participant Observation* of daily life. Thick descriptions (Fitzpatrick et al., 2011) could be made as all visits contained a “pop-up” health care clinic, preparation and consumption of shared meals and active interaction with community members of all ages and both genders. Finally, village and home tours, allowed for detailed descriptions and accounting of important cooking tools and home improvements.

Chapter 2: Review of Literature

Overview

Guatemala Economic and Trade Policy Overview. Guatemala is a small Central American country of approximately 15 million people. As a colonized country, it has had a long history of dramatic civil conflict and violence that only recently came to an end with the signing of Peace Accords in 1996. While it is politically stable now, the government is in a state of transition due to recent citizen protest driven and United Nations backed removal of a sitting President in 2015 (Human Rights Watch, 2016). Guatemala's increasing value to the growing Central American economy and the North American continent, has focused the attention of world leaders on the steps this country takes as it enters a period of rapid population and economic growth (BBC News, 2016).

From a trade perspective, the country is in a prime position to take advantage of international routes between South Asia and the eastern seaboard of the United States. As an example of this influence, many internationally funded projects are in progress to widen highways across Guatemala for short interoceanic transport that avoids capacity limits at The Panama Canal (Valladares D, 2011). Guatemala is also rich in natural resources. It has wide agronomic appeal and nontraditional agricultural exports such as coffee continue to grow ("Poverty in Guatemala-Avivara Report," n.d.). Mineral and other natural resource mining, such as Nickel, are entering a period of rapid growth ("PRONICO, FAQ," Nickel ore extraction in Department Izabal). Taken together, all this suggests that the people of Guatemala have opportunities to reframe the environment within their country. But challenges remain in managing the environmental impacts, as well as the equitable distribution of benefits to the whole population.

One challenge to overcome is the decentralization in administrative roles of the government following the Peace Accords. This was meant to increase human rights protections, but the lack of clarity around these roles and responsibilities of the government, left many communities without services. In some cases this has managed to further cut off isolated indigenous communities (Piccard M et al., 2007).

Finding a Better Stove

Another challenge is Poverty. World Bank assessments of poverty following the Peace Accords between 2000-06 suggested a slight decrease in poverty (5%) across the country, but no corresponding change for those living in extreme poverty. Furthermore, the decrease was only observed in non-indigenous communities, whereas indigenous communities experienced a dramatic increase in extreme poverty (World Bank, 2009).

Overview of Extreme Poverty.

Since 2006, the World Bank has reported only increases in the poverty rate across the country despite the described potential for economic growth. A 2012 report cites that approximately 40% of Guatemalans live on \$1.50 USD per day, a number that has actually decreased 10 cents since 2003 (Welle, 2014). This falls below the international poverty line defined by the World Bank in 2015 and the 10-cent drop is concerning. A concrete economic picture of Guatemala's extreme poor is often hard to draw, because large portions of the population exist in informal economies or survive on remittances sent home from family members living outside the country (Sullivan, 2016). Despite the fact that current statistics are hard to find, there is a strong suggestion of a heightened inequality that is not buffered by the economic growth in the country.

In addition, recent public spending, as a portion of gross domestic product, has decreased due in a large part to an inability to collect taxes from unregistered personal and business incomes. This lack of government reinvestment exacerbates the increasing decay in infrastructure (Welle, 2014) and makes the extreme poverty cycle harder to break. Colonial history and ongoing wealth disparity have continued to reinforce a pattern of government and private land expropriation that pushes indigenous communities further and further from government provided resources ("Poverty in Guatemala-Avivara Report," n.d.). This results in scattered indigenous communities living in extremely impoverished conditions that are isolated from already declining government services.

Finding a Better Stove

Social indicators such as literacy rates, school enrollment rates, infant mortality rates, and rates of low birth weight, stunting and malnourishment all point to wide spread poverty (“Guatemala: An Assessment of Poverty,” 2016, “Poverty in Guatemala-Avivara Report,” n.d.). The results of this poverty are widely visible in the Northeastern portion of the country within Department Izabal. The steps often required to extricate oneself from poverty rely upon good health, growing literacy and access to education. In the rural indigenous Guatemalan communities, poverty appears to be firmly held in place. Cookstove interventions and cookstove factories may provide one facet in a multifaceted approach that can contribute to reversing these trends.

Overview of the Role of Energy and Environmental Policy in Cookstove Adoption. The importance of Guatemala’s energy policies cannot be overlooked, in both the growth of the country and for cookstove infrastructure. Through the Paris Climate Agreement, Guatemala has international responsibilities to develop green energy and adhere to international standards. These pressures are reflected in Guatemala’s 2013-27 Energy Policy, which focuses on increasing electrification across the country and reducing use of firewood in industry and residential settings. A projected Wood Use Plan also outlined in 2013, highlights the need for forest protection, sustainable forestry practices, and improved cookstove adoption (Guatemalan Ministry of Energy and Mines, 2013). Large regions of the country do not have access to electricity, specifically in remote areas of northeastern Guatemala such as Peten, Izabal and Alta Verapaz (Perez Molina, O & Archila Dehesa, E, 2013). As a result estimates suggest two million Guatemalans use wood fire to cook meals, placing a disproportionate demand for wood fuel across the country (Global Alliance for Clean Cookstoves, 2013). Wood makes up more than half of the energy budget and leads to wood deficits of more than 5 million tons per year (Global Alliance for Clean Cookstoves, 2013). Increasing the sustainability of wood as a commodity has also become a priority of the National Forestry Institute, known as INAB, which has launched incentive programs toward this end.

Finding a Better Stove

Deforestation and loss in biodiversity are externalities faced by the less developed regions in Northern Guatemala. In these regions, there are few governmental protections for the forests and these natural resources are rapidly being replaced by large plantations and cattle ranching (Inter Press Service, 2012). There is real concern that indigenous communities residing in mountainous and forested regions are being displaced and encounter erosion-related risks during severe weather. Storms such as Hurricanes Mitch in 1998, Stan in 2005, and Earl in 2016 had devastating impacts in these areas. The result was flooding and land slippage that were deadly and destructive in many remote communities (Piccard M et al., 2007). Even an excessive rainfall event in August 2015, reported in El Estor via National Coordination of Disaster Reduction (CONRED) was enough to create serious flooding events that destroyed homes, infrastructure and displaced communities (OCHA United Nations Office of Coordination of Humanitarian Affairs, 2015). As is often the case, rural agriculture-based communities bear the brunt of the impacts of deforestation and climate change (International Fund for Agricultural Development, n.d.), but are rarely given opportunities to participate in land use decisions.

The Maya Bioserve (MBR) in Peten, serves as an interesting case study for effective community driven forest land management within northern Guatemala (Barraclough & Ghimire, 2013). The bioserve was created in 1990 by legislative decree, to stem dramatic loss in forest cover and habitat disruption caused by decades of colonization and civil war (Hogdon, B, Hughell, D, Ramos, V, & McNab, R, 2015). While the MBR is a protected area, it remains under threat from both legal agricultural development as well as illegal cattle ranch-based money laundering operations, known as *narcoganaderia* and logging by Chinese organized crime (William Allen, 2012). International resources and research dollars have thus been focused on evaluating best strategies for addressing this land use problem.

Twenty years ago, the MBR was broken up into Core (CZ) and Multi-use (MUZ) zones to allow for different methods of resource management. The Core Zone is completely restricted to scientific research and tourism, whereas the Multi-Use Zone allows for low impact natural resource management practices that are driven by local residents. Recent study results evaluating these approaches have

Finding a Better Stove

indicated results are better when residents are empowered to sustainably manage the forest ecosystem rather than relying on strict protection. When deforestation rates were compared in the years between 2000-2013 Guatemala had a rate of 1.4%. The MBR Core Zone reported only 1%, but, the Multi-Use Zones reported deforestation rates of only 0.4%. When Forest Stewardship Council (FSC) oversight was overlaid on the MUZ rate, it dropped to almost 0 (Hogdon, B et al., 2015). This suggests that effective land use policy, especially one that provides education and a standardized structure conditioned upon empowerment of communities, is a more successful way to reduce deforestation in critical forested areas. One could envision introducing similar community driven policies around cookstoves and sustainable wood use.

Overview of The Role of Health Policy in Cookstove Adoption. Access to health care is a human right. Adequate health care also empowers individuals and communities to begin to break the cycle of poverty. For many of the rural poor in Guatemala the healthcare system is nonexistent due to two decades of decentralization of national health care programs (Lawton, AM, 2015). Building access to healthcare allows citizens to thrive, become better educated, and contribute capacities for growth to their communities. One way to improve health care outcomes without solely depending on healthcare systems is to increase community focus on prevention rather than treatment services alone. Transitioning away from open fire towards more efficient clean burning options in the home, follows a preventative modality in reducing both respiratory and non-communicable chronic diseases (NCDs).

Burning of biomass fuels in the developing world has been associated with a wide array of well-established respiratory complications. The primary cause is the release of air pollutants in smoke from burning in unventilated areas. The Environmental Protection Agency (EPA) of the United States lists carcinogens such as polycyclic aromatic hydrocarbons, benzene, formaldehyde and acrolein (US EPA, n.d.) as just some of the contaminants found in wood smoke. Strong correlations have been made between small particulate matter (Ghio, 2014) and carbon monoxide (Tuan, Venâncio, & Nascimento, 2015) levels found within wood burning households and the incidence of Acute Respiratory Infections

Finding a Better Stove

(ARI). Additional association of ARI with premature death and disability adjusted life years (DALYs), have made the clean cook stove initiatives a high priority for many world governments (Global Alliance for Clean Cookstoves, 2013).

While best understood in respiratory settings, there is growing evidence that smoke inhalation can lead to even greater burden of disease through correlations with Non-Communicable Diseases (NCDs). Data suggest incidence of NCDs such as infant mortality, low birth weight babies, and growth stunting (Mishra & Retherford, 2007; Wu, Hou, Ritz, & Chen, 2010; Wylie et al., 2014; Laurent et al., 2016; Laurent et al., 2014) as well as heart disease, stroke and diabetes increase for those that are exposed long term to these pollutants (Epstein, MB et al., 2013; To, T et al., 2015; Zhao, A et al., 2015). A thorough understanding of the growing associations of Household Air Pollution with negative health outcomes can influence not only the delivery of healthcare services but the weight placed on preventative measures.

Most preventative strategies for international aid, focus primarily on nutrition and water quality but view respiratory infections as well as non-communicable diseases through the lens of treating clinical symptoms rather than prevention. A growing number of international health and human rights organizations have acknowledged the risks and have added ICS adoption to necessary health prevention strategies. Reframing the provision of preventative healthcare services to include improved cookstoves on an equal footing with water purification and nutritional supplementation may have more impact. Combining all of these preventative approaches together may be most effective for improving health outcomes.

Overview of Incorporating Human Behavior Change in Evaluating Cookstove Adoption. Improved Cookstove adoption depends on behavior change. Understanding factors impacting behavior change increases the complexity over simply providing access. In the case of cleaner more efficient cookstoves, women must alter their traditions and practices, which is in turn influenced by a variety of diverse factors. This could include practical factors like access to fuel, funding for and knowledge of alternative stoves and understanding health risks. More importantly it includes more amorphous and difficult to measure

Finding a Better Stove

factors such as cultural cooking norms, spiritual relationships with fire, and warming of households. Stanistreet and colleagues investigated how using both qualitative assessments of stakeholder perspectives together with more traditional epidemiological methods may offer required insights into understanding human behavior change in the context of cookstove adoption. The authors argue, that behavior change research will benefit from further studies that couple diverse study design and integrate different qualitative and quantitative methods within data collection and data analysis phases of research (Stanistreet et al., 2015)

Regardless, the country of Guatemala has a responsibility to improve health prevention, energy, and land use policy with strategies that include cleaner cooking. This revolves around integrating indigenous Guatemalan communities into the design of stoves and stove delivery. International and local cookstove providers acknowledge that indigenous Guatemalans are the most likely to suffer from poverty, isolation and denial of healthcare or education services and that impedes cookstove adoption. For any cookstove intervention to be successful, these communities must be given a voice in the design and distribution of clean cooking strategies that fit their unique needs. New design approaches and education platforms may need to be quite distinct from the approaches have been taken over the past thirty years.

Importance must be placed on empowering the women who do the cooking, as well as community leaders, to communicate their distinct definitions of health priorities and further downstream their cooking design requirements. Examples of elegant approaches in understanding Native American and First Peoples priorities for health risks with special attention to “addressing the environmental health inequities and disparities faced by tribal communities” have been reported by researchers designing health policy relating to seafood consumption from contaminated environments (Donatuto, Satterfield, & Gregory, 2011; McOliver et al., 2015) . These reports can be used as models for how cookstove user adoption can be best supported through extensive interviews and community engaged research.

Chapter 3: Methodology

Study Setting

The study population was comprised of six communities; three remote rural villages in the mountains north of Lago Izabal in the El Estor municipality and three river villages located along the Rio Dulce just west of the Caribbean coast. Both municipalities were in Department Izabal. These villages were selected because of regular clinician visits to this region by a Seattle and Guatemala City based non-governmental organization, Guatemala Village Health. The personnel visiting the village include 26 volunteers from the United States and approximately 10 volunteers from Guatemala City. The team also included two Spanish to Q'eqchi' translators that served as health promoters in villages.

The mountain villages were accessible by dirt roads that linked El Estor to the agricultural properties, where many of the village members worked. Road conditions were weather dependent, but provided sufficient access for four-wheel drive vehicles. The river based villages that were visited for this study, existed in environments where no roads were observed. Villages were accessed using small gasoline powered motor boats.

The most recent census data from 2013, for Department Izabal reports a population of 434,378. Sixty three percent of the population lived in rural settings. There was an equal distribution of men to women 49.4%/50.6% reported. The median age of residents was calculated to be 18-year-old and the percentage reporting to be indigenous was approximately 27% (Ministerio de Economia, 2014). Participants in this study consisted of individuals living via subsistence farming or fishing practices in isolated regions. As mentioned access was restricted by either poor road conditions or a lack of roadways that limited residents to only boat access. Village observable data are outlined in Table I (see Appendix 2).

Study Design

The design was a cross-sectional case study as described by Yin. This was a descriptive study without intervention. Community health assessments consistent with public health nursing practices were applied to define community baselines of cookstove use and value in each village. Comprehensive community assessments were performed using four methods of collecting case study evidence (Yin, RK, 2014) in each village; physical artifact, direct observation, informant interviews and participant observation.

Data Collection Procedures

Physical Artifact. The main artifacts observed for this study are the stoves and cooking tools used in each village. Additional artifacts observed included water purification and sanitation tools as well as other energy and transportation tools, where available. Photographs, video and notetaking were used to record artifacts.

Direct Observation of the Environment. The first step in the community assessment observation were made by directly walking through each village and recording (Hunt, 2009). This began by using the five senses to gain an overview of how people lived in each community. It included aspects central to survival such as geography, accessibility, sense of safety, energy use, presence of smoke, water source, sanitation, and food sources. These also primarily allowed for visual confirmation of in home cooking environments. Secondly, it allowed for recording of other methods for health risk prevention strategies such as cement floors, water purification and steel rooves. Additional attributes observed in each village related more to the culture and identities of village members such as type of clothing for each gender and each age group, presence of art or music instruments, religion and school infrastructure.

Informant Interviews. Informal qualitative interviews were conducted in each village, where community resident guides who provided tours of the villages were interviewed. In some cases, the tours

Finding a Better Stove

were guided by authority figures within the village, or key informants. When available a representative of village leadership was asked questions regarding open fire, cookstove use, and wood availability.

Participant Observations. Two settings were used for the participant observations in each village. The first were in home tours and the second were as members of the community gathered for health care services. Common areas for cooking were in most cases located near the clinic setting, thus allowing for observation of the communal environment for cooking. This included such things as methods, gender of cooks, and creative additions to the cooking environment. Other community improvement measures that might be in place such as water purification devices were also reported.

Participants observed directly were asked and provided verbal consent to be photographed, video recorded, and provide tours of common areas and personal homes within each village. Individuals were selected based upon presence, willingness to participate, and proximity to clinic area or availability of tour guide within the village. When scheduling did not allow sufficient time to visit homes, observation of the outside of homes was recorded.

Walking surveys were done throughout each village visit. Depending on size of village and clinic demand on observer's time, these were performed throughout the day or night, spent at each village. Notes were hand written or typed into a mobile device. Double sided laminated survey cards with prepopulated metrics were used in an effort to tabulate consistent data among villages. Data were transcribed to notebooks after each visit. Interviews were performed with English-Spanish translators and hand written as recorded. Photographs and video of the interior of the homes, common areas and the area around each village were collected by multiple members of the visiting team and shared with author for this study.

Data Management

Following best practices for case study research design presented by Yin 2014, multiple sources of evidence were collected and a case study database was constructed in Microsoft Excel that contains

Finding a Better Stove

qualitative and quantitative source data that can be queried to maintain a chain of evidence for conclusions.

Ethical Considerations

A University of Washington human subjects review coordinator was consulted regarding these data and the methods used to collect and record. The study was not identified as human subjects research. An Human Subjects Research worksheet has been completed and is included in the case study database. In all cases, the participants are voluntary, not identified, and gave verbal consent for photographs. Based on worksheet and consultation, this study did not require IRB review.

Walking surveys were unobtrusive except for home tours. Home tours were requested only after the participants had been given the opportunity to participate in the clinic services. This prevented participants feeling that it was a requirement for receiving healthcare. In many cases the tours were provided by people that were not visiting the clinic that day. The tour moved to a new location, if homeowner did not wish to participate. All data were potentially subject to bias, as observers were not native to the region, did not have complete understanding of the community, and were not speaking the native language of Q'eqchi'.

Interviews were requested following clinic completion or with individuals not participating in clinic that day. As verbal reports, these interviews were subject to interviewer bias, potentially inaccurate reporting of facts due to the behavioral nature of the questions, and had potential for errors in translation. Verbal reports were transcribed in real time for three out of four collected. The interview in the village of Chinachoveilcoch was recorded as quickly as possible following completion.

Participant observations involved direct functional interaction with the community in multiple settings from, clinic preparation and function, to shared meal preparation and consumption. The risk of participant bias is also present given the language and cultural barriers. Full attention to observation may also be reduced given the participants dual role in clinic function.

Chapter 4: Results and Discussion

Data Analyses Strategy

These data result from a multiple case study approach and are reported here as cross case analysis of two research objectives. A composite scoring system was developed for both research questions and is described more fully below for each objective and in Appendix 2. Short individual case study summaries are also presented, chronologically, for each village visited. The case study summaries are in Appendix 3 and conclude with individual village specific recommendations for program development based on qualitative assessments and the quantitative composite score results. An accounting of village size, number and location of tours and number and location of informal interviews is included to provide context in Table 1 (Accounting of Village and Kitchen Visits), Appendix 2.

Results

Research Objective #1. Describe the current ICS environment in remote, rural, indigenous villages using community assessment tools. In the improved cookstove continuum illustrated in Figure 1 (Appendix 2) the villages in this study would be stalled at the first step in the process. The kitchens observed used one to two open fires raised on a platform as their primary stove and were reliant on biomass fuel. A composite scoring system was developed based on eleven parameters that evaluated physical artifacts, such as stoves and cookware, as well as direct observation of soot, smoke build up, cooking style, and wood foraging activities, listed in Table 2. Points between 0 and 1 were given for each parameter, such that an increasing total score represented an increased awareness of improved cookstove and sustainable wood fuel use. The study evaluated both home kitchen settings as well as common area kitchens associated with school or church.

In every village, the homes used open fire to cook indoors without chimneys. It was not apparent that there was access to either individual use of ICS or alternative fuel sources. Often a home would have two or more fires burning on one platform stove. The platform represents an improvement that increases

Finding a Better Stove

the safety of the cooking environment by preventing childhood burns but does nothing to alleviate exposure to Household Air Pollution (HAP). As a measure of the extent of household exposure to smoke, a visual assessment of soot was recorded. In all cases, home kitchens had soot on cooking tools. Most kitchens had soot and ash built up on floors, walls and in a few cases hanging as “soot icicles” from pieces of the thatched roof. Ventilation was another measure that related to household air pollution exposure. In half the kitchens, there was no ventilation observed for dispersal of smoke. The other half had a window or half wall that allowed for some ventilation of the cooking space. Most homes had a small supply of foraged wood collected locally. In the mountain villages, we observed women and children foraging for wood in the evening.

Cross case analysis of common area kitchens indicated that there is a growing awareness of the benefits of improving the cooking environments. In two of the four villages, there were donated ONIL improved cookstoves present, although it did not replace the platform stove in the kitchen. The use of open fire at the same time as ICS is referred to as “stove stacking” and is considered undesirable to the overall goal of improving cooking environments, as the health risks and less efficient biomass fuel use remain (Gordon & Hyman, 2012). While a chimney was present on the ONIL stoves, it was not appropriately vented out of the kitchen. This may explain why these stoves appeared not to be in use. Despite the lack of a chimney, there were four common area kitchens with ventilation provided by half walls or large windows. It is noted in these data, that women or girls prepared food in all cases that we observed, except when Guatemala Village Health staff prepared food.

Finally, informal interviews and qualitative observation of the general village areas suggested that awareness surrounding opportunities for improved cooking conditions is quite low. In three out of four of the villages where interviews were performed, it was reported that wood was not difficult to find and they were not concerned about wood deficits. In only one interview, was it expressed that individuals were aware of alternative stove options and that they would like to receive more donations of ICS (Table 4, Appendix 2).

Finding a Better Stove

Qualitative observations of the region indicated that palm, banana and rubber tree plantations dominated the landscape. This suggested that wood fuel may indeed become a threatened resource, as it is in other regions of Guatemala. Physicians in the clinic anecdotally reported that most children had chronic cough or asthma symptoms that were not attributable to a respiratory infection. This suggested that household air pollution could be the cause. Finally, an obvious smell of smoke permeated the region starting from early morning throughout the day. Taken together this describes a health and resource problem that is both poorly understood and poorly addressed in these vulnerable populations.

Research Objective #2. *Identify any patterns in community assessment data that indicated receptivity to ICS adoption.* Using a similar approach of observation and analyses this study also reported a composite score for quality of life improvements. The observations were focused on three distinct areas; improvements related to home and building structure, water and sanitation, and accessibility and transportation were grouped to develop a nine-parameter assessment (Table 3, Appendix 2). These data contained higher scores overall and a larger range than in data describing cookstoves. It is possible that this in part speaks to the long-term difficulties that cookstove intervention programs have faced relative to other program development such as water and sanitation. Other possible explanations for variability include village specific impacts from population size, geographical size, international exposure and financial stability.

Home and building structure assessments indicated that in five out of six villages there was evidence of a transition from dirt floors towards cement or wood flooring. This step improves sanitation and reduces health risks due to for example, parasitic infection. While none of the villages had access to a source of clean water, four out of six had some form of water purification strategy in place. The same four villages also had some access to electricity, albeit intermittent. Finally, one of the biggest hurdles to cookstove development programs is transportation and accessibility, and for this category there was significant variability among the villages. Despite each village having some access to healthcare, most

Finding a Better Stove

access in visited villages was provided by Guatemala Village Health, and only half the villages had any access to reliable transportation.

In all, three out of the six villages had a composite score above the mean, indicating the potential for receptivity and ability to make quality of life improvements in their villages. Interestingly, two of these higher scoring villages scored below the mean for cookstoves and wood use awareness. This suggested that ability to make changes may exist, but specific receptivity to cookstoves may be impeded. This provides an example for why further survey development and extensive interviews will be of value to better understand the impediment. A comprehensive grasp of the reasons that a home may have a refrigerator or a television and not a smoke free stove is required. Observation alone will not provide the relationships needed to add a better understanding of receptivity to behavior change. Further interaction within each individual village including bi-directional interview and survey analyses will help build the peer based communication required for stove use compliance.

Chapter 5: Conclusion

Without ICS the simple act of nurturing a family by cooking a meal directly exposes that family to smoke, a form of indoor air pollution, that can slow growth and development (Epstein, MB et al., 2013; Lertxundi, A et al., 2015) and increase individuals risk for respiratory infection and non-communicable diseases (To, T et al., 2015). While direct correlation of ICS placement with improved health outcomes has been a difficult hurdle, the indirect health benefits and immediate reduction in exposure to known pollutants and carcinogens is well documented.

Besides health, cookstove interventions offer two additional benefits because they burn less wood more efficiently. The first is the reduction of time spent foraging for wood, which most often falls to women and children in a village (Global Alliance for Clean Cookstoves, 2013). Women in a village already rise early in the morning to start and tend fires to cook meals throughout the day. Foraging for wood, that is becoming increasingly hard to find, takes away the time that remains. Reducing this lost time represents a substantial opportunity for capacity building in each village. Time gained could be used to support better education, increased literacy and income generation as well as expansion of income generating craft based skill sets.

The second benefit comes from protecting forests from over harvesting and thus deforestation. On a broad scale, reducing deforestation reduces carbon emissions that contribute to climate change (Kindermann et al., 2008). It also prevents habitat loss that leads to losses in biodiversity, an unmitigated global challenge. Less burning of wood fuel also decreases black carbon release, a significant and reversible contributor to climate change (Lefton R & Kelly C, 2014; Zimmer, C, 2013). In Guatemala, deforestation is also correlated with erosion, leading to shallow soil that is less able to retain water and is more easily carried away when heavy rains fall (Gorokhovich Y, Machado EA, Melgar L, & Ghahremani M, 2016). This puts rural communities at even greater risk for flooding and landslides. The many facets of reducing the use of wood burned only increases the value of making ICS available to all regions of Guatemala.

Finding a Better Stove

Using cross-case analyses there are three main findings. First, residents of the communities in remote regions of Department Izabal will benefit from improved cookstove education and program development. The current government and non-government organization (NGO) provided programs are not reaching these isolated locations. Secondly, the communities are not well informed on the health risks of wood burning in the home or the ongoing wood fuel deficits within the country. Therefore, targeting educational workshops to address health benefits of ICS may be one starting point. Including the benefits of increased efficiency and sustainable wood fuel use, will add necessary weight to the ICS impact. Finally, patterns in receptivity data suggest certain sanitation and water purification programs are more successful than are clean cooking programs. This is hopeful and yet also adds a new question to be addressed with future work. Why are cookstoves not adopted where there is evidence of adequate resources and a prioritization of healthier living?

This question leads to a discussion of the limitations of this study. There are significant language barriers throughout this study. English to Spanish to Q'eqchi' translation leaves much room for error in interpretation. In addition, the cultural biases that any researcher from North America brings to Central America and indigenous culture have impacts on the accuracy of observation. This points to a third limitation of this study which is the heavy reliance on direct observation as compared with interviews. This prevents the researcher from being able to answer the larger questions as to prioritization of improved cookstoves. Future work should include the use of a more community engaged research approach that involves detailed and iterative interviews, stove demonstrations and user based feedback. These approaches can provide a better understanding of the complexities of prioritizing ICS in limited resource settings.

Follow up from this baseline study should include a repetitive and iterative approach to communication between village residents and program development team. Funding for a two year three phased improved cookstove project is being sought based on the logic model proposed in Figure 2, Appendix 2. This approach requires that health care promoters learn from community members as to

Finding a Better Stove

their needs, wants and priorities for cleaner cooking strategies. An engaged community will be better able to provide a peer based infrastructure, that will help to build cookstove demand through avenues of trusted communication. The bidirectional nature of the communication will also provide feedback to cookstove manufacturers so they can make a truly user designed stove. The longstanding challenge of cookstove adoption is best addressed by providing a stove that residents will want to use more than the traditional open fires. In this way, the needs matching and empowered peer to peer infrastructure will help to sustain the adoption into the future and throughout the region.

APPENDICES

APPENDIX 2: Tables and Figures

Table 1: Accounting of Village and Kitchen Visits.

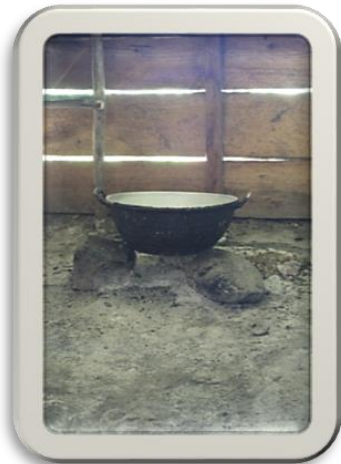
Village	Homes Toured	Common Areas Toured	Informal Interviews	Kitchens toured
China.	2	1	1	3
Marc.	2*	1	ND	1
Espa.	3 (2*)	1	ND	2
Ango.	1	1	1	2
Rio.	3	1	1	3
Brisa.	1	1	1	2
Total	12	6	4	13

* exterior/entryway only

Finding a Better Stove

Figure 1: Continuum of Improved Cookstoves.

TOOLS



Open fire on the ground

Enhanced efficiency burning chamber, Chimney, Increased Ventilation



ICS with alternative fuel source



IMPROVED COOKSTOVE (ICS) CONTINUUM

FUELS



Electric / Solar

Table 2: Composite Scoring System for Improved Cookstove and Sustainable Wood Use Evaluation.

<u>Homes</u>	china	score	marc	score	espa	score	ango	score	rio	score	brisas	score
Open fire used indoors (Y/N)**	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0
Fires in each cooking stove (ave.)	2.5				2		3		2		1	
Ventilation: chimney (Y/N)	N	0	N	0	N	0	N	0	N	0	N	0
Ventilation: window/half wall (Y/N)	Y	1	N*	0	Y	0.66	N	0	N	0	Y	1
Soot: present (Y/N)	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0
Thatch roof where cooking (Y/N)	Y	0.5	Y	0.5	Y	0.66	Y	0	Y	0	N	1
<u>Common Areas</u>												
Open fire used indoors (Y/N) **	Y	0.5	Y	0.5	Y	0	Y	0	Y	0	Y	0
# of open fires in each stove (#)	2				2		2		2		1	
ICS present (Y/N)	Y	1	Y	1	N	0	N	0	N	0	N	0
ICS used if present	Y		Y		NA		NA		NA		NA	
Ventilation: chimney (Y/N)	N	0	N	0	N	0	N	0	N	0	N	0
Ventilation: window/half wall (Y/N)	Y	1	Y	1	Y	1	Y	1	N	0	N	0
Thatch roof where cooking (Y/N)	N	1	N	1	N	1	N	1	Y	0	Y	0
Gender observed cooking (M/F)	F		GVH staff		F		F		GVH staff		GVH staff	
wood foraging observed (Y/N) ***	Y	0	Y	0	Y	0	Y	0	Y	0	Y	0
Total score		5		4		3.32		2		0		2

* ventilation assessed from outside, so suggestive but not definitive

**Open Fire only=1, ICS is present and used though not exclusively =0.5

***woodpiles, actual foraging or wood cutting observed

Finding a Better Stove

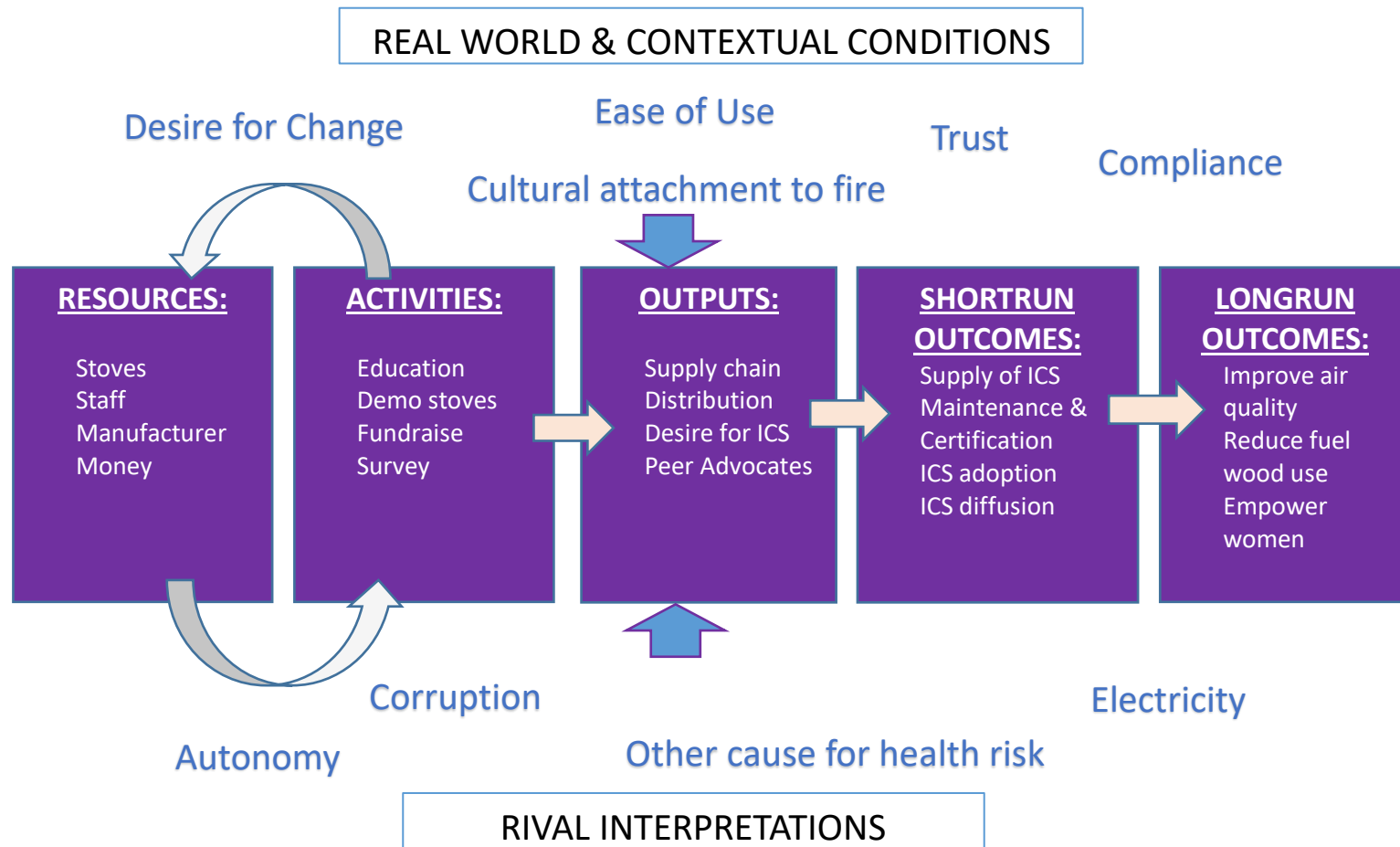
Table 3: Composite Scoring System for Quality of Life Improvements. *Access to healthcare scoring: poor (0.3)= no access, long distance, no transportation, likely GVH only; fair (0.6) = some access locally to physicians, some transportation; good (1.0)= onsite health outpost or health promoter, some access to local physicians, transportation*

<u>Description</u>	CHINA.	score	MARC.	score	ESP.	score	ANGO.	score	RIO.	score	BRISAS.	score
<u>Home/Building Improvement</u>												
cement/tile/wood floors (Y/N)	Y		Y		Y		Y		N		Y	
dirt floors (Y/N)	Y		Y		Y		N		Y		N	
total # cement floors obsv. out of buildings obsv.	6(9)	0.66	7(9)	0.78	11(12)	0.92	6(6)	1	0(6)	0	6(7)	0.85
steel roof (Y/N)	Y		Y		Y		Y		N		Y	
thatch roof (Y/N)	Y		Y		Y		Y		Y		Y	
total # steel roofs obsv. out of buildings obsv.	7(10)	0.7	7(14)	0.5	17(25)	0.68	6(7)	0.86	1(8)	0.13	3(7)	0.42
<u>Water/Sanitation Improvement</u>												
common use latrines (Y/N)	Y	1	Y	1	Y (toilet)	1	Y	1	N	0	Y (toilet)	1
clean water source	N	0	N	0	N	0	N	0	N	0	N	0
water purifiers (Y/N)	N	0	N	0	Y	1	Y	1	Y	1	Y	1
electricity (Y/N)	N	0	N	0	Y	1	N	1	Y	1	Y	1
litter (Y/N)	Y	0	N	1	N	1	Y	0	Y	0	N	1
<u>Accessibility Improvement</u>												
transportation (Y/N)	N	0	N	0	Y	1	Y	1	N	0	Y	1
access to healthcare	poor	0.3	poor	0.3	fair	0.6	good	1	poor	0.3	fair	0.6
Score		2.66		3.58		7.2		6.86		2.43		6.87

Table 4: Informal Interviews.

Village (aldea)	Interview subject	Tour of kitchen space	Notes	energy risk awareness and concern	ICS awareness
China.	Mayor	Yes (2 homes)	“wood is collected in an unsustainable way” “wood is harder to find” “he does worry that it will become harder to find” “he would definitely like more” (ICS) (answers noted and collected by me)	Aware and Concern	aware
Ango.	woman in toured home	Yes (1 home)	“Wood is not hard to find gestured to the mountain side”	Not aware and no concern	ND
Rio.	Pastor	Yes (2 homes)	“they had a good supply and it was easily collected plenty of wood from deadfall and were not concerned about running out” (answers noted and collected by me)	Not aware and no concern	ND
Brisas.	woman in toured home	Yes (1 home)	“ there was no difficulty finding wood” “ knew of no other fuel source” “had not heard of any other ICS”	Not aware and no concern	Not aware

Figure 2: Logic Model for ICS Program Development Strategies Adapted from Case Study Research Design and Methods.(Yin, RK, 2014)



Appendix 3: Individual Village Case Study Summaries.

Village Name: Chinachoveilcoch (china.)

Observation period: ~7 hrs

Resident population: Not Done

Patients served at clinic: 127; men, women and children

Setting: 2+ hour drive into Mountains within municipality, El Estor, in Department Izabal close to the Eastern Caribbean Coast

Language: Q'eqchi', and limited Spanish

Composite Score for awareness of ICS and wood use: 5, mean=2.72, median= 2.66

Composite Score for Quality of Life Improvements: 2.66, mean=4.8, median=6.8

Interviews: 1, mayor

Summary (500 words): Chinachoveilcoch was a remote village with few services available for its residents. The community clearly struggled financially, where most residents are paid for agricultural work at Fincas. The home sites were located on very steep hillsides in precarious positions relative to the common area. While food supply did not appear limited, food choice was limited to nixtamal tortillas and poultry or pork. A small tienda sold soda and candy. Energy was limited to foraged wood and no electricity was observed.

The assessment of village quality of life improvements was low. The composite score was 2.66 out of a total of 9, primarily because of its lack of sanitation improvements, transportation and access to healthcare. There was a single latrine for communal use and significant amount of litter surrounding the village. Despite this, school buildings had new steel roofs and cement floors were present or being added. Evidence of education platforms around sanitation were observed. An interview with the Mayor suggested that the political leadership recognized health risks and worried about future energy demands. Discussions with the GVH staff also suggested that the leadership in this village was notable, in that the mayor had undertaken some effort to initiate contact with GVH during a neighboring village clinic to seek

Finding a Better Stove

their help. The village indicated an awareness of better cooking practices. Though a composite score of 5 was low for a composite score it was well above the mean score for all the villages. This was primarily because most kitchens visited had reasonable ventilation, at least one home had sleeping areas completely separated from cooking area, and the common area had an Onil stove with chimney that had been recently installed and was used, although not exclusively.

Women in the village wore traditional Guatemalan clothing, woven skirts and simple light weight tank tops with flipflops. Men and children wore more traditional western clothing such as polos, t-shirts, jeans and boots. Most wore hats or carried umbrellas for sun protection and asked for sunglasses. While there was no evidence of artwork or music, many of the residents wore necklaces, earrings and watches. A completely enclosed church in the common area was not visited, but may have contained examples of village artwork, culture and music. There was a strong sense of community among the women, based on observation of cooking, childcare and respect for elders and the family bond.

My overview was that the awareness and desire to make change was high, resulting in attempts for ongoing enhancements, but that the financial constraints and rural isolation were also high. As such, I think this village provides an excellent opportunity for subsidized intervention. It is likely that program development opportunities will be well received but will require support financially and through distribution of stoves. As well, baseline measurements suggested improvements will be easily measured and evaluated. A cookstove intervention focused on increasing the voice of the village women would also likely to be successful due to the communal cooking observed and a sense of female empowerment already apparent.

Finding a Better Stove

Village Name: Marcajam (marc.)

Observation period: ~17hrs

Resident population: 350

Patients served at clinic: 70; 20% mostly women and children

Setting: 2 hr drive into Mountains within municipality, El Estor, in Department Izabal close to the Eastern Caribbean Coast

Language: Q'eqchi', and limited Spanish

Composite Score for awareness of ICS and wood use: 4, mean=2.72, median= 2.66

Composite Score for Quality of Life Improvements: 3.58, mean=4.8, median=6.8

Interviews: none

Summary (500 words): Marcajam was a remote village in the mountains approximately 2 hours by car from El Estor. The common area has seven total buildings, for school and community gatherings such as the clinic service visit. The building sites were several hundred feet below the road and a short walk from a river that served as the primary source of water. Residents generated income from growing corn and selling animals, but in the off season relied on employment at the local plantations, or Fincas. This suggested that the increased size and organization of this community has led to greater financial security. This was also suggested by observed tools like rain water catch basins and student artwork displayed on homes and in school buildings. Their food supply was not limited, but selection was limited to corn, pork and chicken.

Our team spent the night in this village and provided clinic services in the morning, so we had many hours to observe the environment. The evening was filled with loud wild animals, mosquitos, thunder and lightning, downpours and feral dog fights. There was indication of potential security risk in the barred windows on the school, barbed wire and broken glass barriers and a padlock on the school door. As early as four in the morning, smoke began to rise from the villager's homes and men began to

Finding a Better Stove

gather for the walk to the Finca. Some of these men were reported to be carrying weapons as well as their machetes required for agriculture work.

Women in the village wore traditional woven skirts and colorful huipil. They wore jewelry and carried woven bags to the clinic. The children wore more traditional western clothing except for older girls that dressed more like the adult women. Men and boys typically had boots or sturdy shoes and belts, whereas girls and women wore either flip flops or were barefoot. The girls and boys clearly separated into gender specific activities during play and throughout the day.

The assessment of village quality of life improvements was low at 3.58 out of a total of 9.2. Primarily because of its lack of water purification, transportation and access to healthcare. Despite this, all common area buildings had new steel roofs and cement floors, as did many homes. There was little evidence of common area litter and the three communal use latrines were well maintained. The village scored well on ICS because of better cooking practices, 4 points out of a total of 11. The common area kitchen was very well ventilated and contained an Onil stove with chimney that had been recently installed. GVH reported placing one additional smokeless stove in this village, although we did not observe it directly.

My overview was that the awareness and desire for improved cooking conditions in this village were high and that the increased financial security and community organization could provide a stable platform from which to propose an ICS intervention. However, the gender disparity was more clearly represented and approaching an empowered female voice for intervention might pose a challenge.

Finding a Better Stove

Village Name: Esperanza Tunico (esp.)

Observation period: ~8hrs

Resident population: 970

Patients served at clinic: 95; 10% mostly women and children

Setting: Plateau in municipality, El Estor, in Department Izabal close to the Eastern Caribbean Coast

Language: Q'eqchi', and Spanish

Composite Score for awareness of ICS and wood use: 3.32, mean=2.72, median= 2.66

Composite Score for Quality of Life Improvements: 7.2, mean=4.8, median=6.8

Interviews: none

Summary (500 words): Esperanza Tunico is a large and well-established village located on a plateau far from water, but with flat and stable building sites. The location was both close to the main city of El Estor and was easy to access on safe roads. This village had many examples of income generating opportunities for its residents. There were two well stocked tiendas with refrigeration, palm fronds were collected and stored as building materials, corn and mangoes were seen growing in home gardens and there were a few reported professional beekeepers. Most of the village reported the local Finca as the primary employer, but additional sources of income were available to some, and an average annual income for the village was reported at 3750Q (\$500USD).

The village had access to electricity although it was not used in many settings. For example, the church had a sound system with microphones and the clinic site had electric lights but nothing was in use during our visit. There were several fires in use, suggesting the primary source of energy is still wood. The food supply and selection was much greater than in the other two mountain villages. Both tiendas were stocked with bagged rice, bottles of oil and seasonings as well as a large selection of snack food and some over the counter medicine. Women, as in the other villages, wore traditional Guatemalan clothing, woven skirts and simple light weight tank tops with flipflops or bare feet. The men and children wore more traditional western clothing, such as polos, t-shirts, shorts, pants and boots.

Finding a Better Stove

Due to nutritional survey monitoring, our team had more time to observe and tour this village. The school building area was large and had many classrooms divided by grade. There was an accounting of student number and expenses reported on the wall. Artwork was present throughout the village as hand painted murals on many of the buildings. The church alter was decorated with flowers and colorful fabrics and there were many art projects displayed around school classrooms. The village had access to many tools not seen in previous villages, such as water filters, flush toilets, freezers, satellite dishes and motorcycles for transportation. The village also had at least one on-site health promoter trained by GVH. Given all this, the village scored very well for receptivity with a 7.2 - The highest score of any of the villages. It also scored well for ICS need with 3.32 out of 11. There were indications that improving cooking environments was a priority as most kitchens had adequate ventilation, raised platforms and reduced soot. While many quality of improvements were observed, all the kitchens we visited were still using open fire to cook meals and there were no examples of ICS observed.

My overview is that the financial stability, centralized location and demonstrated creativity around job creation suggest this might be an excellent site for a possible stove factory. Education and healthcare are clearly valued and an intervention would need less ICS stove subsidization and could benefit from more support for development of supply and distribution infrastructure.

Finding a Better Stove

Village Name: Los Angostura (ango.)

Observation period: ~5hrs

Resident population: 80

Patients served at clinic: 43; 50%, mostly women and children

Setting: On the bank of large tributary on Rio Dulce in municipality, Livingston, Department Izabal, close to the Eastern Caribbean Coast

Language: Q'eqchi', and Spanish

Composite Score for awareness of ICS and wood use: 2, mean=2.72, median= 2.66

Composite Score for Quality of Life Improvements: 6.86, mean=4.8, median=6.8

Interviews: 1, female resident

Summary (500 words): Los Angostura is a small village located directly on the bank of a large tributary of Rio Dulce. The home sites are somewhat insecure, either raised on stilts over mangroves or built into the steep hillsides. The common area of the village contained five buildings facing out towards the river and a long sturdy dock for boat access. The primary occupation for the residents was fishing, and a good supply of fishing nets and canoes was observed. The food supply was very diverse. Turkeys, geese, ducks, chicken and pigs ranged freely throughout the village. Corn, fresh vegetables and bananas were observed in the kitchen and a meal of chicken and tortillas was prepared for us. Litter around the property suggested sugary snacks are available, but a tienda was not observed.

The village had access to electricity, although as in other villages, examples of its use were infrequent. Wood was clearly the main source of energy. Large numbers of stumps throughout the village suggest foraging did not require much travel time and we observed residents cutting down a tree in the center of the village during our visit. We observed only two kitchens and one communal meal preparation. For the meal, women used two large open fires to provide heat for boiling water and a plancha style platform for making tortillas.

The women wore more traditional clothing of woven skirts and light weight tank tops but all the children had western style clothing including crocs as footwear. The home we visited had books,

Finding a Better Stove

drawings, photographs and certificates of education and was well stocked with tools, hammocks, mosquito nets and bedsheets. The school was not observed directly but the children stood out by comparison to other villages as precocious and curious about the laboratory and pharmacy procedures we performed. They gathered in large groups to watch blood collection and asked many questions.

The score of ICS need at 2 was low suggesting that baseline cooking practices needed improvement. While the common area cooking area was well ventilated, no improved Cookstoves were present. The home kitchen was more difficult to interpret. The stove was separate from the sleeping area but it was completely unventilated. In addition, a hammock was present, suggesting that someone likely slept in this room at times. The score for receptivity however was high, at 6.86, primarily due to the presence of wood or cement floors in every building, presence of water purifiers and access to boats for transportation. Finally, the village contained an onsite health outpost with a focus on women's reproductive health and family planning and an onsite health promoter. The only example of health services that we found in any village.

My overview is that education and healthcare are clearly valued in this village. While it was small, the onsite health promoter and outpost likely provided services to people from the surrounding area providing an excellent opportunity for diffusion of new programs. An ICS intervention at Los Angostura would be well received and could potentially introduce ICS options to more people.

Finding a Better Stove

Village Name: Rio Blanco (rio.)

Observation period: ~6hrs

Resident population: 80

Patients served at clinic: 59; >50%, mostly women and children

Setting: On the bank of small tributary on Rio Dulce in municipality, Livingston, Department Izabal, close to the Eastern Caribbean Coast

Language:

Composite Score for awareness of ICS and wood use: 0, mean=2.72, median= 2.66

Composite Score for Quality of Life Improvements: 2.43, mean=4.8, median=6.8

Interviews: 1, pastor

Summary (500 words): Rio Blanco was both small and extremely isolated. The common area of the village was located approximately a quarter of a mile from the banks of a small tributary and about a 40 minute boat ride from Rio Dulce. The home sites were spread around open flat areas adjacent to large cornfields on both sides of the river. A new bridge had been built recently to allow better access between home sites. The river represented the primary source of income generation via fishing and was also their primary water source. Water carrying containers were found in most buildings, suggesting water hauling was required almost everywhere. This village was the most impoverished of the villages that we visited. Food supply did appear to be limited as the incidence of malnutrition was high among the children visiting the clinic. We observed corn stores, fish, crabs and other shellfish as well as breadfruit trees. There was a substantial amount of litter in the village suggesting sugary snacks were also available.

Foraged wood was the primary source for energy in this village although electricity was available in common areas and unlike other villages it was in use and offered for our use in the clinic. When asked the villagers seemed unconcerned about wood supplies. Of the kitchens observed all used platform open fire stoves in unventilated spaces and there was no evidence of ICS. Women were observed preparing a meal in a windowless thatch communal kitchen. All cooking areas had large soot buildup on tools as well as walls and roofs, resulting in soot icicles hanging from palm thatch.

Finding a Better Stove

Women wore traditional skirts and light weight tank tops but few had shoes of any kind and this was also true of the young girls. The homes we visited had evidence of art work and personal musical instruments such as a marimba and a guitar. The church building was well decorated, had a sound system, marimba and keyboard. We did not observe a school building in the common area and were told it was a short walk to a different part of the village to attend school.

Based on the ICS needs assessment, this village received a composite score of 0, meaning it had the lowest baseline of clean cooking awareness and sustainable wood use practices. It also scored well below the mean on quality of life improvements. This was due to very low numbers of homes with any improvements in flooring or roofing. There was a single very poorly maintained latrine for the entire village and a tremendous amount of litter around the village common areas. Villagers reported that boat taxis to Livingston area were available for 50Q, but the village has no boat dock and no boats. It was a one hour walk to the nearest village that owned a boat. Most villagers had cell phones and despite isolation were connected beyond their remote location.

My overview is that this village would best be served by clean cooking education programs before cookstove intervention is proposed. An awareness of cooking in well ventilated kitchens would go a long way to improving their current baseline cooking environment while more clearly emergent health concerns can be addressed. With increased health awareness, this village would over time become a good site for intervention, but the obvious gender disparity observed may pose a problem for empowering women's voices in this community.

Finding a Better Stove

Village Name: Brisas de Golfete (brisas.)

Observation period ~5hrs

Resident population: 3-500

Patients served at clinic: 65; men, women and children

Setting: Bank of large tributary on Rio Dulce in municipality, Livingston, in Department Izabal close to the Eastern Caribbean Coast

Language: Q'eqchi', and Spanish

Composite Score for awareness of ICS and wood use: 2, mean=2.72, median= 2.66

Composite Score for Quality of Life Improvements: 6.87, mean=4.8, median=6.8

Interviews: 1, female resident

Summary (500 words): Brisas de Golfete was a large village of over 300 residents, a short 10 min walk on a boardwalk through mangroves from the large cement boat dock that served as the entry point for the village. The common areas and home sites were built on flat sturdy plateaus surrounding wetlands that extended through the dense foliage. This village was a short 15 min walk to local health clinic and boat service was available once per day at 8:00 am. Access to water was reported to be the overarching concern for this village by those interviewed. Wells served most needs during the rainy season, but they dry up during the dry season, and water hauling was then required.

This village did appear to be financially more stable, and there was a greater diversity of religion and perhaps income levels. The society was more heterogeneous than in other settings in that not every family attended the same church. Some were catholic, some Spanish speaking evangelical, and others Q'eqchi speaking evangelical. This may be a result of greater interaction with other Rio Dulce communities, clear evidence of additional international organization presence, or the relative wealth of this village. The primary source of work was animal work for private landowners in the area, as well as fishing and raising of animals for sale within the village. The women wore traditional clothing but the styles were more mixed than in other villages. This was the only village where we saw adult women

Finding a Better Stove

wearing western style clothing, but also huipils and woven skirts. The men and children wore western clothes and all had shoes, some even lace up sneakers and soccer cleats.

Unlike any other village visited, the homes and common areas had access to electricity that was in use. Despite this, the primary fuel for cooking was still wood and smoke was rising from many of the outside of homes with thatched roofs. In the common area, it was not clear that they had cooking areas for general use. A meal was prepared for us, but the space used did not seem like a kitchen that was used regularly. It was poorly ventilated and a fire burned on the ground. We observed one other home kitchen that was separate from living space. It had a raised platform for cooking and a makeshift cement block constructed burning chamber, perhaps to increase burning efficiency. It was well ventilated, with little soot build up and it did not appear that anyone also slept in this kitchen area.

The ICS needs assessment composite score of 2, is below the mean for villages visited even though this was one of the wealthiest villages we visited. It had good access to health, education and sanitation resources. There was extensive artwork on the buildings as murals and in the classrooms. We observed home refrigeration and even a flat screen television playing cartoons for children, but no evidence of ICS. The composite score for quality of life improvements was above the mean at 6.9. This village provided an interesting example for further interviews, as it had resources and educational platforms but potentially had either no knowledge or no interest in making an investment in ICS.

My overview for this village is that because of the resources, accessibility and more diverse population of this village it would be an excellent place for a cookstove intervention. Women seemed very interested in talking with us about what improvements to water quality they would like to see, and I think this would make a solid platform for peer to peer advocacy programs. However, I think education and outreach might be critical to understand why with their financial resources they have televisions but not stoves. It would also require interviewers to seek access to the many distinct peer groups that exist in the community.

References

- Barraclough, S., & Ghimire, K. (2013). *Agricultural Expansion and Tropical Deforestation: International Trade, Poverty and Land Use*. Routledge.
- BBC News. (2016). Jimmy Morales inaugurated as new Guatemala president. Retrieved May 29, 2016, from <http://www.bbc.com/news/world-latin-america-35320332>
- Cohn, J. (2015). This Is What It's Like To Live On \$2 A Day. *Huffington Post*. Retrieved from http://www.huffingtonpost.com/entry/2-dollars-a-day-extreme-poverty_us_55e79208e4b0aec9f356019c
- Donatuto, J., Satterfield, T. A., & Gregory, R. (2011). Poisoning the body to nourish the soul: Prioritising health risks and impacts in a Native American community. *Health, Risk and Society*, 13(2), 103–127.
- Epstein, MB, Bates, MN, Arora, NK, Balakrishnan, K, Jack, DW, & Smith, KR. (2013). Household fuels, low birth weight, and neonatal death in India: The separate impacts of biomass, kerosene, and coal. *International Journal of Hygiene and Environmental Health*, 216, 523–32.
- Ferreira, F. (2015). The international poverty line has just been raised to \$1.90 a day, but global poverty is basically unchanged. How is that even possible? [Text]. Retrieved June 4, 2017, from <https://blogs.worldbank.org/developmenttalk/international-poverty-line-has-just-been-raised-190-day-global-poverty-basically-unchanged-how-even>
- Fitzpatrick, J., Sanders, J., & Worthen, B. (2011). *Program Evaluation* (4th ed.). Pearson Education.
- Ghio, A. J. (2014). Particle exposures and infections. *Infection*, 42(3), 459–467.
<https://doi.org/10.1007/s15010-014-0592-6>
- Global Alliance for Clean Cookstoves. (2013). *Guatemala Cookstoves and Fuels Market Assessment Sector Mapping*. Energía Sin Fronteras Fundación Solar Universidad Politécnica de Madrid.
Retrieved from http://cleancookstoves.org/resources_files/guatemala-market-assessment-1.pdf

Finding a Better Stove

Global Alliance for Clean Cookstoves. (2014). *Guatemala Country Action Plan for Clean Cookstoves And Fuels* (Action Plan). Retrieved from http://cleancookstoves.org/resources_files/guatemala-country-action-plan.pdf

Gordon, J., & Hyman, J. (2012). The Stoves Are Also Stacked: Evaluating the Energy Ladder, Cookstove Swap-Out Programs, and Social Adoption Preferences in the Cookstove Literature. *Journal of Environmental Investing*, 3(1). Retrieved from <http://www.thejei.com/wp-content/uploads/2015/01/154-515-1-PB.pdf>

Gorokhovich Y, Machado EA, Melgar L, & Ghahremani M. (2016). Improving landslide hazard and risk mapping in Guatemala using terrain aspect. *Natural Hazards*, 81, 869--86.

Guatemala: An Assessment of Poverty. (2016). Retrieved May 30, 2017, from <http://go.worldbank.org/37PY9S2I50>

Guatemalan Ministry of Energy and Mines. (2013). National Strategic Plan for Sustainable Use of Wood. Retrieved from <http://www.mem.gob.gt/wp-content/uploads/2015/07/NATIONAL-STRATEGIC-PLAN-FOR-SUSTAINABLE-USE-OF-WOOD.pdf>

Hogdon, B, Hughell, D, Ramos, V, & McNab, R. (2015). *Deforestation Trends in the Maya Biosphere Reserve, Guatemala (2000 - 2013)*. Retrieved from <http://www.rainforest-alliance.org/impact-studies/deforestation-trends-maya-biosphere-reserve>

Human Rights Watch. (2016). Guatemala: Otto Perez resignation. Retrieved May 29, 2016, from <https://www.hrw.org/world-report/2016/country-chapters/guatemala>

Hunt, R. (2009). *Introduction to Community-based Nursing*. Lippincott Williams & Wilkins.

Inter Press Service. (2012). Deforestation Wreaks Havoc in Guatemala's Caribbean Region | Inter Press Service. Retrieved October 24, 2016, from <http://www.ipsnews.net/2012/12/deforestation-wreaks-havoc-in-guatemalas-caribbean-region-2/>

Finding a Better Stove

- International Fund for Agricultural Development. (n.d.). *Climate change: building the resilience of poor rural communities* (pp. 1–8). IFAD. Retrieved from <https://www.ifad.org/documents/10180/37cb3c45-560a-495f-b3fc-d454d45139ed>
- Jeuland M, & Pattanayak S. (2012). Benefits and Costs of Improved Cookstoves: Assessing the Implications of Variability in Health, Forest and Climate Impacts. *PLOS One*, 7(2).
- Kindermann, G., Obersteiner, M., Sohngen, B., Sathaye, J., Andrasko, K., Rametsteiner, E., ... Beach, R. (2008). Global cost estimates of reducing carbon emissions through avoided deforestation. *Proceedings of the National Academy of Sciences*, 105(30), 10302–10307. <https://doi.org/10.1073/pnas.0710616105>
- Laurent, O., Hu, J., Li, L., Cockburn, M., Escobedo, L., Kleeman, M. J., & Wu, J. (2014). Sources and contents of air pollution affecting term low birth weight in Los Angeles County, California, 2001–2008. *Environmental Research*, 134, 488–495. <https://doi.org/10.1016/j.envres.2014.05.003>
- Laurent, O., Hu, J., Li, L., Kleeman, M. J., Bartell, S. M., Cockburn, M., ... Wu, J. (2016). Low birth weight and air pollution in California: Which sources and components drive the risk? *Environment International*, 92–93, 471–477. <https://doi.org/10.1016/j.envint.2016.04.034>
- Lawton, AM. (2015). The Right to Health in Indigenous Guatemala: Prevailing Historical Structures in the Context of Health Care. *Health and Human Rights Journal*. Retrieved from <http://www.hhrjournal.org/2015/08/the-right-to-health-in-indigenous-guatemala-prevailing-historical-structures-in-the-context-of-health-care/>
- Lefton R, & Kelly C. (2014). *Saving the Arctic: The urgent need to cut black carbon emissions and slow climate change*. Center for American Progress. Retrieved from <https://cdn.americanprogress.org/wp-content/uploads/2014/08/BlackCarbonArctic-report.pdf>
- Lertxundi, A, Baccini, M, Lertxundi, N, Fano, E, Aranbarri, A, Martinez, MD, ... Ibarluzea, J. (2015). Exposure to fine particle matter, nitrogen dioxide and benzene during pregnancy and cognitive

Finding a Better Stove

and psychomotor developments in children at 15 months of age. *Environment International*, 80, 33–40.

McOliver, C. A., Camper, A. K., Doyle, J. T., Eggers, M. J., Ford, T. E., Lila, M. A., ... Donatuto, J. (2015). Community-Based Research as a Mechanism to Reduce Environmental Health Disparities in American Indian and Alaska Native Communities. *Int.J. Environ. Res. Public Health*, 12, 4076–4100.

Ministerio de Economia. (2014). *Caracterizacion departmental Izabal 2013*. Guatemala. Retrieved from <https://www.ine.gob.gt/sistema/uploads/2015/07/20/vG9kX3R5yw1mgIzMnUsKX4n7RFnu2ICF.pdf>

Mishra, V., & Retherford, R. D. (2007). Does biofuel smoke contribute to anaemia and stunting in early childhood? *International Journal of Epidemiology*, 36(1), 117–129.
<https://doi.org/10.1093/ije/dyl234>

Nino, F. S. (2016). List of Parties that signed the Paris Agreement on 22 April. Retrieved October 26, 2016, from <http://www.un.org/sustainabledevelopment/blog/2016/04/parisagreementsingatures/>

OCHA United Nations Office of Coordination of Humanitarian Affairs. (2015). *Latin America and Caribbean Weekly Note On Emergencies, REDLAC* (weekly note No. volume 416) (p. 2). United Nations. Retrieved from http://reliefweb.int/sites/reliefweb.int/files/resources/LAC-Report-Weekly_Note_On_Emergencies-ROLAC-ENG-20150810-MR-16845.pdf

Perez Molina, O, & Archila Dehesa, E. (2013). *Guatemala Energy Policy 2013-2027 Energy for Development*. Retrieved from <http://petnac.mem.gob.gt/wp-content/uploads/2014/07/6.-Energy-Policy-2013-2027.pdf>

Finding a Better Stove

Piccard M, Fisher D, Soberanis M, Venegas R, Cruz J, & The Guatemalan Red Cross Society. (2007). *Legal Issues from the International Response to Tropical Storm Stan in Guatemala* (Case Study).

Retrieved from <http://www.ifrc.org/PageFiles/93716/guatemala-cs.pdf>

Poverty in Guatemala-Avivara Report. (n.d.). Retrieved May 30, 2017, from

<http://www.avivara.org/aboutguatemala/povertyinguatemala.html>

PRONICO, FAQ. *Nickel ore extraction in Department Izabal*. Retrieved May 30, 2017, from

<http://www.pronico.com.gt/en/faq.html>

Stanistreet, D., Hyseni, L., Bashin, M., Sadumah, I., Pope, D., Sage, M., & Bruce, N. (2015). The Role of Mixed Methods in Improved Cookstove Research. *Journal of Health Communication*, 20(sup1),

84–93. <https://doi.org/10.1080/10810730.2014.999896>

Sullivan, Z. (2016). Guatemala: The indigenous population too poor to stay. *Aljazeera*. Retrieved from

<http://www.aljazeera.com/indepth/features/2016/03/guatemala-indigenous-population-poor-stay-160310120053955.html>

To, T, Zhu, J, Villeneuve, P, Simatovic, J, Feldman, L, Gao, C, ... Miller, AB. (2015). Chronic disease

prevalence in women and air pollution — A 30-year longitudinal cohort study. *Environment International*, 80, 26–32.

Tuan, T. S., Venâncio, T. S., & Nascimento, L. F. C. (2015). Air pollutants and hospitalization due to

pneumonia among children. An ecological time series study. *São Paulo Medical Journal = Revista Paulista De Medicina*, 133(5), 408–413. <https://doi.org/10.1590/1516-3180.2014.00122601>

United Nations Sustainable Development Goals. (2017). Retrieved April 28, 2017, from

<https://sustainabledevelopment.un.org/hlpf>

US EPA, O. (n.d.). Wood Smoke and Your Health [Overviews and Factsheets]. Retrieved June 8, 2016,

from <https://www.epa.gov/burnwise/wood-smoke-and-your-health>

Finding a Better Stove

- Valladares D. (2011). Guatemala: Future Interoceanic Corridor Will Rival Panama Canal | Inter Press Service. Retrieved October 24, 2016, from <http://www.ipsnews.net/2011/06/guatemala-future-interoceanic-corridor-will-rival-panama-canal/>
- Welle, D. (2014). Guatemala's poor getting poorer. *DW.COM*. Retrieved from <http://p.dw.com/p/1DBEv>
- William Allen. (2012). In the Land of the Maya, A Battle for a Vital Forest. Retrieved June 8, 2016, from http://e360.yale.edu/feature/in_the_land_of_the_maya_a_battle_for_a_vital_forest/2580/
- World Bank. (2009). *Guatemala Poverty Assessment Good Performance at Low Levels*. Retrieved from <http://documents.worldbank.org/curated/en/803331468254934801/pdf/439200ESW0GT0P1IC0Disclosed07171091.pdf>
- World Bank. (2014). Guatemala Overview. Retrieved October 26, 2016, from <http://www.worldbank.org/en/country/guatemala/overview>
- World Health Organization. (2016a). Guatemala: WHO statistical profile. Retrieved July 6, 2016, from http://www.who.int/nmh/countries/gtm_en.pdf?ua=1
- World Health Organization. (2016b). *WHO | Household air pollution and health (Fact Sheet No. 292)*. Retrieved from <http://www.who.int/mediacentre/factsheets/fs292/en/>
- Wu, J., Hou, H., Ritz, B., & Chen, Y. (2010). Exposure to polycyclic aromatic hydrocarbons and missed abortion in early pregnancy in a Chinese population. *The Science of the Total Environment*, 408(11), 2312–2318. <https://doi.org/10.1016/j.scitotenv.2010.02.028>
- Wylie, B. J., Coull, B. A., Hamer, D. H., Singh, M. P., Jack, D., Yeboah-Antwi, K., ... MacLeod, W. B. (2014). Impact of biomass fuels on pregnancy outcomes in central East India. *Environmental Health: A Global Access Science Source*, 13(1), 1. <https://doi.org/10.1186/1476-069X-13-1>
- Yin, RK. (2014). *Case Study Research Design and Methods (fifth)*. SAGE Publications.

Finding a Better Stove

Zhao,A, Chen,R, Wang, C, Zhao, Z, Yang,C, Lu, J, ... Kan,H. (2015). Associations between size-fractionated particulate air pollution and blood pressure in a panel of type II diabetes mellitus patients.

Environmental International, 80, 19–25.

Zimmer, Carl. (2013, January 7). Black Carbon and Warming: It's Worse than We Thought by Carl

Zimmer: Yale Environment 360. Retrieved April 19, 2016, from

http://e360.yale.edu/feature/carl_zimmer_black_carbon_and_global_warming_worse_than_thought/2611/