

## Title Page

# AN ANTHROPOLOGICAL ANALYSIS OF ADOPTION BARRIERS TO ISEC (INSULATED SOLAR ELECTRIC COOKER) IN INDIA

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## Annotated Bibliography

1. Criado-Perez, C. (2019). *Invisible Women: Data Bias in a World Designed for Men*. New York, NY: Abrams Press

This book chapter tries to explain why low emission or clean cookstoves are in the best interest of women but have such low adoption rates. This author may have bias because she uses language that is negative toward the NGO's and government agencies that have used the rhetoric of "women need more education in order to adopt cookstoves". The sources she used are all scientific articles, data from credible institutions like UNICEF, or books written about the clean cook stove industry and developmental efforts. She also interviewed an expert in the field. Scientists, NGOs, and governmental bodies have been trying to implement clean cooking technology for decades. The technology is efficient but women's opinions are not considered in the creation and design of clean cooking technology. The distributors of these technologies have blamed low adoption rates on the lack of education women have with the new technology without actually probing further into why. Studies that have asked for women's opinions on new technologies have found that adoption rates are low because of reasons like inability to multitask while cooking, lack of purchasing power in the home, and the technology simply does not fit into their lifestyle. This source is significant to my senior project because it indicates the need to study adoption barriers or adoption rates of clean cooking technologies. It also expresses the need to include the opinions of women who are using the technology, which is what my project would be analyzing. (244)

2. Otte, P. P. (2013). Solar cookers in developing countries- What is their key to success?. *Energy Policy, Volume 63*. 375-381

This paper attempts to provide a list of variables that influence the adoption of solar cooking technology in developing countries. The list is created by doing a literature review, watching interviews, and reviewing literature about the adoption of other solar technologies. The author breaks down the variables into six categories: environmental, economic, cultural, political, technical, and social. Those 6 categories are then broken down into subcategories of possible barriers to adoption. This paper claims there is a hierarchy to the variables. Solar cooking projects are usually on a time and budget constraint so the assumption that all of these variables would be met is not realistic. The most important factor is to understand the need for an alternative fuel in the area of dissemination. If there is no communal need for an alternative to the fuel that is already being used then the technology will not have a successful adoption. This article is relevant to my paper because the author expresses their opinion of the most important barrier to adoption of solar cooking technologies. A needs assessment needs to be distributed in the area of dissemination as well. If the cultural, social, and economic needs of the target group are not understood by disseminators the technology will not be successful. (213)

3. Puzzolo, E., Pope, D., Stanistreet, D., Rehfuess, E. A., & Bruce, N. G. (2016). Clean fuels for resource-poor settings: A systematic review of barriers and enablers to adoption and sustained use. *Environmental Research*, 146, 218-234. doi:10.1016/j.envres.2016.01.002

This paper outlines the barriers to adoption and sustained use of clean cooking fuels. The authors collected their sources from a literature review of case studies, dissertations, literature from NGO's and other organizations promoting clean cooking fuel, and consulted experts in the field. The author of this article breaks down the factors that lead to adoption of solar cookers and the factors that are barriers to adoption. In households that have high fuel consumption the solar cookers lack of need for fuel is a positive and could lead to adoption. Households have reported that they have saved time with the solar cookers because they do not spend time collecting fuel. Women in some studies reported less back ache from not having to bend over the solar cooker and tend to the meal being prepared. Solar cookers were adopted in more high income households than low income showing initial cost is a barrier to adoption. Stoves that were produced locally had higher adoption rates, presumably because they were less expensive to build. This source is significant to my senior project because we are studying adoption of solar cookers. The ISEC has the positive attributes like being solar, will help households with fuel consumption, and is locally produced. ISEC also has negative attributes like longer cook times and accommodation of daily schedules to cooking. (222)

4. Lankford, W. F., & Kammen, D. M. (1990). Cooking in the sunshine. *Nature*, 348(6300), 385–386. <https://doi.org/10.1038/348385a0>

This paper published in 1990 gives insight into a project introducing solar box ovens in Central America. This paper was written by a man attempting to implement solar cooking technology in Latin America. The author outlines the successes and failures of the project. He also gives advice to anyone who is trying to implement “appropriate technology” in the developing world. This author uses their own experiences to offer advice to others working in the field of implementing appropriate technology. The author found that when appropriate technology is introduced there needs to be local support for the technology. Also, the technology needs to be adapted to local needs. The author recalls that the original solar box cooker that was introduced is hardly ever used. The box cooker that was adapted by local women to the needs of the people it was serving is used frequently. The relationship the person implementing the technology has with the community is important as well. Instead of having a charitable, donation like relationship there needs to be a collaborative relationship. The author also found that women were instrumental in the success of the introduction of the solar box technology. This source is significant to my senior project because the article is giving insight into the aspects that help an appropriate technology succeed and what aspects make a project fail from someone who works in the field. This article is not a scientific study with a rigorous methodology but it is helpful since it is written by someone who has worked in the field.

The limitations of this article is that it is an opinion piece and provides insights from one person who works in the field. (279)

5. Pandey, S., & Yadama, G. (1992). Community Development Programs in Nepal: A Test of Diffusion of Innovation Theory. *Social Service Review*, 66(4), 582-597. from <http://www.jstor.org/stable/30012488>

This study seeks to find what might cause failure of adopting and diffusing a new technology in a community. This particular study is looking at villages in Nepal that had improved cookstoves (ICS) distributed 8 years prior to see if they are still in use, and if not why. The authors interviewed women (since they are the primary users of cooking technology) from 28 villages where the ICSs had been distributed. The authors obtained information from interviewing and observing women. The interview questions were then analyzed using LISREL software. The four factors the authors studied that influence adoption were: compatibility, relative advantage, knowledge, and complexity. Compatibility is defined as how well the new technology conforms to cooking practices and current cooking utensils. Compatibility showed to be the most impactful factor in adoption of the ICS. The study stated that if distributors of new technology want it to be successful the technology should reflect what is currently in the community. Relative advantage is defined as the perception of economic and health gains within the household by using the ICS. The amount of relative advantage the women perceived of the cookstove had a positive impact on the adoption. Knowledge means the understanding of how to clean, cook with, and maintain the cookstove. Complexity is defined as the difficulty of understanding a new technology. As long as a technology is perceived as advantageous to the user knowledge and complexity have little effect on adoption. This article is relevant to my senior project because it shows an in depth analysis of factors to adoption of improved cookstove technology. Critique of this article includes it only presents four factors to adoption when there are many. Other factors to adoption could have effect on the four that are being studied (294)

6. López-Martínez, O., & Cuanalo de la Cerda, H. E. (2020). Participatory action research in the design, construction and evaluation of improved cook stoves in a rural Yucatec Maya community. *Action Research*, 18(4), 490–509. <https://doi.org/10.1177/1476750317704047>

This paper's goal is to report on the process of using participatory action research in the designing and building process of an ICS with a small community in Yucatan, Mexico. This project took place over a 10 month time period with 3 of those months being "evaluation and follow-up". The first stage of the project was gaining trust of the community and gauging interest of participation in the ICS project. Once trust and interest were secured the authors started interviews individually then in smaller focus groups. The interviews were focused around what the community needed from the cookstove to cook local foods, what cookstove people were already using or preferred, and lastly what the main fuel source was for the community. During the designing and

construction of the ICS participants were asked for their recommendations on how to better adapt the technology to local needs. After two months of use the participants had positive feedback for the researchers. Users reported that the ICS saves wood, had less aggravation from smoke inside of their cooking spaces, and felt that the ICS was safer than a traditional cookstove. This paper is relevant to my senior project because it shows that local feedback and participation is a potential factor in adoption of a new technology. (212)

7. Timilsina, G. R., & Malla, S. (2021). Clean cooking: Why is adoption slow despite large health and environmental benefits? *Economics of Energy & Environmental Policy*, 10(1) doi:<http://dx.doi.org.ezproxy.lib.calpoly.edu/10.5547/2160-5890.9.1.gtim>

The purpose of this paper is to review the literature that gives empirical evidence on what factors affect adoption of clean cooking technology. The paper does not explain the methodology of the review; it only states that the authors reviewed the literature that had empirical evidence. The authors of the paper break down the lack of adoption of clean cooking technology into demand side facts and supply side facts. Supply side factors refer more to the lack of infrastructure around clean cooking technologies. The author specifically calls out electric cookstoves as having a potential supply side issue. The example they give is a house being financially capable of using electricity but not having the infrastructure to secure reliable electricity. Another supply side factor is the lack of customization a technology has to local circumstances. The authors reported that lack of knowledge of benefits was a major deterrent to improved cookstoves and more attention should be paid to spreading awareness. Economic issues like inability to afford the high upfront costs of clean cooking technology is noted in this paper as well. This paper is relevant to my senior project because it looks at the studies that used empirical data to determine what factors there are in adoption of clean cooking technology. (210)

8. Khandelwal, M. (2016). COOKING WITH FIREWOOD. In *Mapping Feminist Anthropology in the Twenty-First Century* (pp. 211-233). Rutgers University Press.

The topic of this book chapter is to outline the difference in viewpoints on development from an engineers standpoint and a feminist anthropologists standpoint. This author is a feminist anthropologist. Some anthropologists have a history of criticism of development and development projects which could cause some bias in this book chapter. The author uses credible sources to help make her argument and back her points. The author describes how she was approached by an engineer pioneering a solar stove project in rural India that after one year has failed. The engineer asked, "Why are the women not using the stoves." The engineers main goal in bringing the technology to the area was to limit deforestation from biomass and air pollution within homes. The author asked if the engineer had gone with the women to collect firewood he replied no. When the engineer accompanied the women to get firewood his assumption of the task being arduous was wrong. The women enjoyed their time cutting firewood and made it into a communal activity. The women complained about their husbands and sang songs. This book chapter is significant to my senior project because it shows the assumptions development projects

make that could lead to the failure of their technology. This book chapter also explicitly shows how valuable social scientists are to development projects. (220)

9. Lewis, D. (2005). Anthropology and development: the uneasy relationship. In C. James G (Ed.), *A Handbook of Economic Anthropology* (pp. 472-486). Cheltenham, UK: Edward Elgar

This book chapter was written to give a history on anthropologies' relationship to the field of development. This author does not identify which category of relationship to development he belongs to but he is an anthropologist. This chapter was composed through a literature review. Lewis categorizes anthropologists' relationship to development as: antagonistic observers, reluctant participant, and engaged activist. Antagonistic observers are active critics of development projects. Antagonist observers are weary of the Post WWII "development" era being similar to that of colonialism. They write papers in opposition to development efforts. Reluctant participants are anthropologists who were in need of an income and the development sector could provide it. Lewis cites this migration of anthropologists to development after severe budget cutbacks in higher education. Lastly is the engaged activist. This type of anthropologist uses their cultural relativism and ethnographic skills to conduct research and advise development efforts. This source is significant to my senior project because it gives a synopsis of the relationship between anthropologists and development efforts. The author categorizes anthropologists' view of development into three categories. The author states that this is very much a generalization and anthropologies relationship with development is much more complex.

10. McEwan, C. (2001). Postcolonialism, feminism and development: intersections and dilemmas. *Progress in Development Studies*, 1(2), 93-111.

This research paper assesses topics like development and feminism through a postcolonialism lense. This author's methodology was a review of the current literature on postcolonialism, development, and feminism. Given the context of this paper postcolonialism is defined as eurocentric approaches and ideologies surrounding topics like development and feminism. The author first points out that the world "development" is ethnocentric and eurocentric indicating that any way of life that is not western is seen as "undeveloped". A postcolonial critique of the word "Third World" is eurocentric because it blends together so many different cultures, countries, etc that have different struggles and needs. Dismantling eurocentric ideologies in development also calls to allow people from these nations, communities, etc to speak on development issues. Having input from people in countries that receive aid will also dismantle the stereotype that these countries are passive, unable to help themselves, and reliant on the west to solve issues. This paper is relevant to my senior project because it explains the eurocentric and ethnocentric problems within development. A postcolonialism critique of feminism, development, and their intersectionality could lead to neglecting tangible poverty and feminist issues during discourse.

## Introduction

Three billion people use biomass or coal to cook around the world (WHO, 2018). Subsequently, four million people die each year from diseases attributed to inhalation of indoor air pollution (WHO, 2018). Inhaled indoor air pollution from biomass cooking is associated with around half of the pneumonia related deaths in children under the age of 5 years old, as well as stroke, heart disease, and lung cancer (WHO, 2018). Deforestation in the un-industrialized world along with climate change has the potential to make foraging for wood and biomass challenging for those who use it to cook. One way to combat this devastating issue is cleaner cooking technology that limits indoor air pollution and the use of biomass fuel. Clean cooking technologies are usually created by scientists in the West and are promoted by agencies like the WHO, UN, and other non governmental and governmental organizations. But to the surprise of these organizations, clean cooking technologies are not readily adopted in the Global South.

The introduction of Western technologies into the Global South is a topic of debate for anthropologists. Some anthropologists believe that the introduction of these technologies is a by-product of colonialism while others see no ethical qualm. There is a subsection of anthropologists who believe that the skills acquired through an anthropologists education make them uniquely qualified for this field. As the concern over limitations of biomass fuel and the dangers of indoor air pollution grow, organizations are attempting to understand why clean cooking technology is not more readily adopted in the global south. In this paper I focus on the potential adoption barriers to the ISEC (Insulated Solar Electric Cooker) in Kerala, India.

## **The Relationship Between Anthropology and Development**

Anthropology and the field of development have a complex and at times contentious past, present, and presumably future. A background in anthropology gives people a unique set of observational skills along with a skill that is useful for working with people: cultural relativism. On the flip side of cultural relativism is the skill of identifying when ethnocentrism is present. This toolbox of cultural relativism and observation leads some anthropologists to believe that they are uniquely set to work in the field of development where humans and culture are front and center. Other anthropologists believe it is going against the very nature to participate in such a field called “development” asking, “what exactly are you developing?” or “why does this person, place, thing need ‘developing’ in the first place?” In Lewis’s (2005) chapter in *A Handbook of Economic Anthropology* he categorizes anthropologists' relationship with development into three parties: antagonistic observer, reluctant participant, and engaged activist. Obviously this is a broad generalization that does not encapsulate the nuances in opinions of each person, but this generalization makes it easier to discuss the relationship between anthropology and development. In this section I will explain each category and some of the viewpoints in each.

### **Antagonistic Observer**

In my research I have found this category of anthropologists to be the loudest. I feel the viewpoint of the antagonistic observer is an anthropologist concerned with the ethnocentric and colonial roots of development. McEwan’s (2001) research paper, *Postcolonialism, Feminism and Development: Intersections and Dilemmas* falls into this category. McEwan (2001) uses a postcolonial lense to analyze development and especially the language used when addressing

concerns of developing nations. McEwan (2001) first points out that the word “development” is ethnocentric and eurocentric indicating that any way of life that is not western is seen as “undeveloped”. A word often used in reference to countries in development is Third World which is also eurocentric; it blends together so many different cultures, countries, etc that have different struggles and needs (McEwan, 2001).

### **Reluctant Participant**

Lewis (2005) defines the *Reluctant Participant* as a professional anthropologist faced with limited employment opportunities. The defunding of higher education and the growth of development studies as a discipline and profession has led some anthropologists to participate at various levels in the development field (Lewis, 2005). Lewis (2005) also cites a politicization of anthropology and the dependency theory as another contributing factor to reluctant participation.

Hoben (1982) explains that the participation of anthropologists in development work came after the United States aid program realized their technical solutions were not positively received by communities abroad. Anthropologists were then assigned to “fix” the problem of communities not accepting US aid technologies and were placed within the Community Development Department (Hoben, 1982).

### **Engaged Activist**

The *Engaged Activist* is someone who is involved in “applied anthropology” meaning “the use of anthropological methods and ideas in practical or policy contexts” (Lewis, 2005,

Engaged Activist). Engaged activists could run a gamut of roles in the development industry. From advocate to consultant, these engaged activists use their educational background to promote or analyze development plans and policies. Lewis (2005) cites two researchers who used their anthropological background to critically analyze an aquaculture program in Bangladesh and uncover cultural complexities of the local fishery industry.

### **The Field of Development and Reality**

Throughout this section I have identified the three broad categories in which anthropologists fall into in regards to development: *antagonistic observer*, *reluctant participant*, and *engaged activist*. Again, this is a broad generalization for the sake of discussion in this paper. Not all anthropologists stay in one category, fall into the categories above, or share all the same opinions of people they share a category with.

In my literature review I came across a book chapter in *Mapping Feminist Anthropology in the 21st Century* written by Khandelwal (2016) where she articulates the need for anthropologists to be on technological development teams.

Khandelwal (2016) had been approached by an engineer who had invented a solar cooking stove that was being deserted by the women of a rural Indian village where he introduced the technology. His email simply asked “how can we get these women who reside on the frontier of the Aravallis to adopt solar cookers and stop cutting firewood?” (Khandelwal, 2016, p. 213). He was completely baffled as to why these women would not use this invention when it would in his opinion drastically improve their livelihood (Khandelwal 2016).

First Khandelwal (2016) asked if the engineer had accompanied the women while they were harvesting wood for their cooking. The engineer said they had not, and then accompanied them upon request (Khandelwal, 2016) . This is what the engineer and his group of students found upon accompanying the women:

They were laughing, singing, trashing their husbands, and teasing the foreigners for their inability to lift seventy pounds of wood and navigate treacherous terrain in their fancy hiking boots as they themselves carried heavy loads across steep and rocky paths in long skirts and rubber flip flops. Harvesting wood is women's work; it is arduous, yes, but also creates community.....With these insights—wood is not solely a vault for carbon but is also a form of community and currency—the conversation became more interesting and began to feel like collaboration. ( Khandelwal, 2016, p. 213)

This simple probing of the engineer's assumptions about wood gathering helped him understand why these women may not have adopted his solar cookers. He assumed that this task was a negative experience for women, fuel collecting being the barrier to social progression for them. That may still be the case, but the women created community while doing this task.

It does not take much reading into the Anthropological critique of post WWII aid to become cynical about the field of aid and development. Khandelwal's (2016, p. 217) statement later on in the chapter brings the antagonist observer back into reality, “lest we be too absorbed in a passionate argument about neoliberalism to notice when the conference hotel falls into the ocean. ”.

## Solar Cookers and Adoption

### Overview

Perez, author of *Invisible Women* (2019) would say stagnation of clean cooking technology adoption is due to a lack of in-depth research on the needs of women. She points out that western NGOs and/or inventors of clean cooking technology have historically blamed lack of education for why the women do not adopt clean cookstoves (Perez, 2019). Perez (2019) notes multiple studies where lab technicians create technologically sound clean cookstoves, but don't take into account women's added workload when adopting these stoves, such as having to take extra time to cut wood in one cookstove design. After collecting data on what women need from their cookstoves, a 2015 study found a simple \$1 USD solution that reduced fuel emissions and worked for local women (Perez, 2019). One major adoption barrier seems to be the lack of data on how women cook, and the essentials of a cooking device for women in the developing world.

Otte's (2013) paper, *Solar Cookers in Developing Countries- What is their Key to Success?* Provides a literature review of solar cooker adoption barriers, Otte also consulted professionals in the field to figure out why solar stoves have not been adopted more. Otte (2013) states that little research has been done in the field of adoption. Most of the studies are centered around technical improvements rather than cultural studies (Otte, 2013). Otte (2013) breaks down adoption barriers into six different categories: economic, social, cultural, environmental, political, and technical that are further broken down into subcategories. The fact that adoption barriers have to be broken down into six different categories for the sake of simplicity shows the complexity of this issue.

Another literature review done in 2016 suggests that the initial cost of a solar cooker is also an important adoption barrier (Puzzolo et al., 2016). Since solar cookers traditionally have a high initial cost, wealthier families are more inclined to adopt the technology while poorer families do not have the capital to overcome this barrier (Puzzolo et al., 2016). The health benefits that include reduced air pollution, and some reports of fewer backaches from picking up wood are positives for adoption of solar cookers (Puzzolo et al., 2016). Although some solar stove users reported having to change their cooking habits to accommodate the cookers, and solar cookers traditionally are able to only cook slow-cooking foods, these negative aspects of solar cooking could lead to non adoption (Puzzolo et al., 2016).

Timilsina and Malla (2021) stated that cultural factors can lead to non adoption of clean cookstoves in general. They cited multiple studies that showed that even when households have the income and access to clean cookstoves these houses chose not to use them because they preferred the traditional methods of cooking with firewood (Timilsina & Malla 2021).

### **Implementation of Clean Cooking Projects**

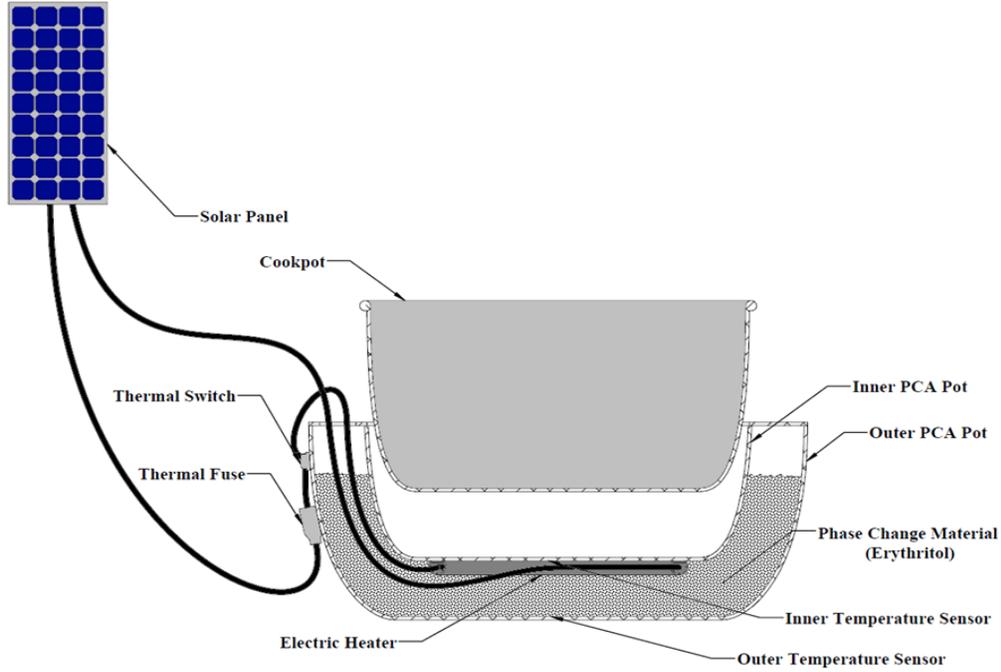
A recent study was published on a Participatory Action Research (PAR) project in Yaxcaba, Mexico where researchers and community participants designed a clean cookstove together (López-Martínez & Cuanalo de la Cerda, 2020). Yaxcaba, Mexico was chosen because of its past association with development and research efforts (López-Martínez & Cuanalo de la Cerda, 2020). This study had several phases that lasted over a ten month period: introduction to community, self diagnosis, design, construction, and evaluation and follow up (López-Martínez & Cuanalo de la Cerda, 2020). During the introduction to the community phase, researchers participated in community wide events, and engaged with their key informants to gain the trust

of the community (López-Martínez & Cuanalo de la Cerda, 2020). Self diagnosis consisted of tiers of interviews with interested parties (López-Martínez & Cuanalo de la Cerda, 2020). The first tier was individual interviews and second tier was a focus-group discussion that was structured from the answers of the individual interviews (López-Martínez & Cuanalo de la Cerda, 2020). The findings from the interviews were classified into three terms: needs, preferences and expectation, and resources (López-Martínez & Cuanalo de la Cerda, 2020). Resources in this case meant: what type of fuel people use in their stoves, how they attain this fuel, and what sort of materials are used to construct their stoves (López-Martínez & Cuanalo de la Cerda, 2020). The design stage occurred over a two month period where facilitators held workshops showing examples of other clean cookstoves in Mexico and surrounding regions, and asked participants how to adjust already existing cookstoves to fit the needs of the community (López-Martínez & Cuanalo de la Cerda, 2020). After the design period, two clean cookstoves were built in households who were in need the most and who had support in the building process (López-Martínez & Cuanalo de la Cerda, 2020). After two months of use facilitators conducted follow up interviews to see how the participants were using their clean cookstoves. Participants gave positive feedback that included: 1. Cookstoves allowed them to cook all the food they desired. 2. It saved wood, 3. Had less smoke irritation inside the home, and 4. Felt the clean cook stove was safer for their children (López-Martínez & Cuanalo de la Cerda, 2020).

## **ISEC and India**

Dr. Pete Schwartz and Cal Poly students have designed a solar electric cooker, ISEC (Insulated Solar Electric Cooker), to help limit the use of biomass fuel and indoor air pollution in the developing world. This design is unique because it does not require an inverter and includes a phase change material (PCM) that can store heat within the cooker so users can cook after the sun goes down. The ISEC is also heavily insulated, allowing it to cook off of a lower wattage solar panel and making the technology more accessible. The design of an ISEC is simple, a solar panel is connected to a heating element (resistive heater). This heating element is submerged in the PCM within a double walled container. Finally, a cookpot is placed inside of the double walled container containing the PCM (see *Figure 1*).

The ISEC is a cheaper alternative to other solar electric cookers with an initial cost of \$45 USD. Prices vary slightly from country to country depending on the cost of materials. Dr. Schwartz uses collaborative methods like an open source manual and forum to teach collaborators how to build ISECs by hand with local materials. Currently the ISEC is being built by collaborators in: Ghana, Togo, Sierra Leone, South Africa, Jamaica, and India (see *Figure 2*).



**Figure 1.** *ISEC Model*

*Note.* This is a diagram of the ISEC (Insulated Solar Electric Cooker) explaining the design of the technology cited in Osei et al. (in press).



**Figure 2.** *Collaborating ISEC Countries*

*Note.* A map highlighting all of the countries that ISEC is currently being built by collaborators created by mapchart.net.

### **Kerala, India**

This report is focusing on the collaborating country India. The collaborator is currently building and disseminating ISECs in Parappanangadi, Kerala, India. They came into contact with Pete Schwartz after seeing his Facebook page dedicated to ISEC and watching his subsequent YouTube videos explaining ISEC design.

Kerala is a southwestern state in India (see *Figure 3*). According to the census data the population is 33,406,061 (Census Organization of India, 2011). Kerala means “land of the coconuts” in Malayalam, with “kera” meaning coconut tree and “alam” meaning land (El Khoury, 2015). Kerala has been described as, “having achieved some of the highest indicators of social development in the industrializing world...” (El Khoury, 2015, p. 241). This descriptor is not surprising with Kerala having the highest literacy in the country, 94%, and the infant mortality rate of 5.69 (Census Organization of India 2011).



Created with mapchart.net

**Figure 3.** *Kerala, India*

*Note.* The highlighted state is Kerala created by mapchart.net.

## Methodology

### Cooking Methods and ISEC Cooking Survey

This study revolves around a cooking methods survey that was distributed in Parappanangadi, Kerala, India by the collaborator. The surveys were administered in multiple ways. All participants filled out a consent form before answering this survey. Covid 19 was a barrier to getting the surveys filled out in person. Most of the surveys were administered orally, and then the answers were written down, but some of the participants printed and returned their surveys to the practitioner. The surveys were translated into Malayalam, the language the collaborator requested.

The survey was modeled after the focus group discussion outline in the paper *eCook Zambia Focus Group Discussions Summary Report* I found through the MECS (Modern Energy Cooking Services) website (Leary et al., 2019). MECS is a British NGO that funds solar cooking and development projects across the world. The Leary et al. (2019) discussion outline was created to understand FGD (focus group discussion) participants current cooking practices and desired cooking practices. The discussion outline was a great skeleton for the preliminary survey because I wanted to find out what participants' current cooking practices are and their desired cooking practices.

The Cooking Methods Questionnaire survey consists of ten questions with Likert scale, fill in, and multiple choice answers. These questions referenced current cooking practices by asking how much time participants spend cooking each meal, naming the four foods they cook most often, and their current fuel choice. The participants' were then asked about their satisfaction of their current cooking appliances, specifically asking what they like and dislike

about their current appliance. We measured their desire to change their cooking appliance by asking what their desired fuel and features of a cooking appliance are, if any circumstances have forced them to change their cooking appliances, and if they have a desire to change.

## Results

A total of eight surveys were completed and analyzed for this project. Table 1 displays the results of the question, “Name the 4 foods you cook most often.” Rice is the most common food cooked among participants with every participant reporting rice (n=8) as one of their four most common foods cooked. The second most common food cooked is curry (n=7) then dosa and fish (n=4). Dosa is described as, “large, thin, savory crepes typical of South India” (Krishna & Krishna, 2019, p.113). Roti is an indian flatbread, in my favorite indian cookbook it is used in pizza and wraps (Krishna & Krishna, 2019). Papad is described as, “thin, crisp crackers made of lentils, designed for munching alongside any and all indian stews.” (Krishna & Krishna, 2019, p.34). Upma is a southern indian breakfast made with cream of wheat and various spices (Amit, 2020). Idli is, “a soft and fluffy steamed cake made of fermented rice & lentil batter” (Swasthi, 2020).

**Table 1.** *Foods Cooked Most Often*

Question	Food	n=
Name the 4 foods you cook most often	Rice	8
	Curry	7
	Dosa	4
	Fish	4
	Veggies (counts stir fried veggies)	3
	Chicken	2
	Chapati/Roti	2
	Papad	1
	Upma	1

*Note.* n= is the number of participants with that answer in the survey.

We asked participants how many hours they spend cooking each meal. The mean amount of hours spent cooking are: breakfast=1.50, lunch= 2.69, and dinner= 1.49.

Participants were asked how they cook the four most common foods. Table 2 displays the findings. Boiling and frying (n=8) were cooking methods used by all participants. More than half stated they used the simmer and boil (n=5) method as well.

**Table 2.** *Cooking Method*

Question	Cooking method	n=
How do you cook these foods?	Boil	8
	Frying (this counts shallow & deep frying)	8
	Simmer and Boil	5
	Steaming	1

*Note.* Simmer and boil is its own form of cooking, separate from the act of just simmering or just boiling

We also asked participants the fuel type their current cooking appliance uses. The results are displayed in Table 3.

**Table 3.** *Fuel Type*

Question	Fuel	n=
What fuel do you use with your cooking appliance(s)?	LPG	7
	Wood	5
	Gas	1
	Electricity	1

Participants were asked if they had ever cooked with electricity. More participants answered yes (n=5) than no (n=3). The following question asked participants what their experience has been cooking with electricity. Easy was the highest report experience (n=4), followed by fast (n=3), and user friendly (n=1).

Participants were asked to rate their satisfaction with their cooking appliance on a likert scale (1 very unsatisfied - 5 very satisfied). The mean answer is 4.24, the highest answer being five and lowest being three. We also asked participants if they have a desire to change the way they cook using a likert scale as well (1 no desire to change - 5 desire to change). The mean for this question is 2.33, the highest answer being 4 and the lowest being 1.

Participants were asked to list what they like about their current cooking appliance. Time management was the highest rated answer (n=3), taste of the food (n=1), utensils not damaged (n=1), and no smoke and soot (n=1) were also listed. Participants were also asked what they did not like about their current cooking appliance. Participants' answers are: nil (n=2), did not like cooking on their wood stove (n=2), price hike regarding fuel (n=2), and smoke (n=2).

We asked if there have been any circumstances that have made participants change the way they cook. The results are displayed in Table 4. Fuel shortage is the highest recorded answer (n=6).

**Table 4. Circumstance Undergone that Led to a Change in Cooking Appliances**

Question	Circumstance	n=
Have any circumstances occurred that have made you change the way you cook?(Ex: fuel shortages for a certain appliance, fuel is too expensive, changes in weather patterns)	Fuel shortage	6
	Price hike	4
	Change in weather	1

“What would be the barriers to you changing your cooking appliance? (Time, cost, etc)” is a question included in this survey. The results are displayed in Table 5. Time is the highest recorded answer (n=4). Utensils seemed to be a barrier (n=1) for a participant and a participant noted there is “no specific reason” (n=1) they would want to change their appliance.

**Table 5.** *Barriers to Changing Cooking Appliances*

Question	Barrier	n=
What would be the barriers to you changing your cooking appliance? (Time, cost, etc.)	Time	4
	Cost	2
	Type of utensil used	1
	No specific reason	1

Participants were asked what their most desirable features in a cooking appliance are. Results are displayed in Table 6. The highest recorded answer is the ability to multitask (n=5).

**Table 6.** *Desirable Feature in a Cooking Appliance*

Question	Desirable feature	n=
What are the desirable features of your ideal cooking appliance?(Ex: Ability to multitask, Portability, Safety within the household, Easy to maintain)	Multitasking	5
	Easy maintenance	4
	Safety	4
	Portability	1

Participants were asked what fuel their ideal cooking appliance would use. Gas was the highest recorded answer (n=5), wood (n=1), and smokeless fuel (n=1) were both recorded as well.

## Conclusion and Discussion

In this section I am going to discuss the results of the surveys and compare the results to the adoption barriers talked about earlier in the paper. Perez (2019) states that a major adoption barrier is the lack of data on the needs of the participants. The *Cooking Methods* survey takes inventories on what the participants need and want out of a cooking technology. Lopez-Martinez and Cuanalo de la Cerda (2020) also took time to interview their participants asking questions similar to the ones asked of the participants.

Initial cost of a solar cooker is also a studied adoption barrier (Puzzolo et al, 2016). The ISEC uses local materials for manufacturing and has the potential to make the cooking technology cheaper than other alternatives. Lopez-Martinez and Cuanalo de la Cerda (2020) had success in their PAR research by building their clean cookstove using local materials as well.

Frying was a cooking method reported by all participants. This is a positive sign since previous tests with the ISEC have shown that it can successfully fry foods. More participants had experience cooking with electricity which is a positive sign for adoption as well. Time management was the highest recorded answer, the ISEC has the ability to multitask which is another positive sign. Participants stated they did not like: cooking with their wood stove, price inflation regarding fuel, and smoke about their current cooking device. ISEC was created to combat the use of biomass fuel and smoke in the home. Fuel shortage was the highest reported answer for participants changing the way they cook, this could also be a positive for ISEC since the fuel source is the sun.

Satisfaction with current cooking appliances and willingness to change are worrisome for the adoption of ISEC. Satisfaction with current cooking appliances is 4.24 and desire to change is 2.33 which shows that there is very little initial desire to change and a high satisfaction with

current cooking appliances. This is an interesting average considering participants said they do not enjoy: cooking with their wood stove, price inflation regarding fuel, and smoke about their current cooking device. There needs to be more questioning into why participants like their current cookstoves but also have elements that they do not like. This could be a result of a lack of explanation as to what the ISEC can do and how it works. This could also mean people simply do not wish to change their appliance. This is something the ISEC team will have to consider moving forward.

Time was reported as the main reason participants are resistant to change cooking methods, this is also worrisome because previous observations have shown that the ISEC takes longer to cook than a traditional cooking method. Gas was also the highest recorded answer for desired fuel of a cooking appliance, this could lead to resistance of electricity as a fuel source.

This study only has eight participants which means it cannot be applied to the success or adoption barriers to Kerala at large. In the survey results there are some contradictions talked about above. This uncovers a need for further questioning and understanding of the willingness to change cooking appliances by participants or if there is a lack of education about the ISEC technology. Surveys like this will be extremely helpful for every country ISEC is collaborating with since it identified some key understandings. There are considerable barriers identified in the adoption of ISEC in Kerala, India identified above that need further probing and questioning.

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## **APPENDIX**

### 1. Cooking Method Questionnaire

## Cooking Method Questionnaire

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1. How much time is spent cooking each day?

Meal time (lunch, dinner, etc.)	Time spent cooking

2. Name the 4 foods you cook most often. How do you cook those foods?

Food/Dish	Method of Cooking (ex: boiling, frying, etc.)

3. What fuel do you use with your cooking appliances?

Cooking Appliance	Fuel

4. How much money do you spend per week on fuel?

Fuel Type	Amount per Week Spent

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5. How much time do you spend per week getting fuel?

Fuel Type	Time per Week Spent

6. Do you have experience cooking with electricity?

Yes	No
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a. If so, what was your experience?

7. How satisfied are you with your options of cooking appliances?

<b>1 - not at all satisfied</b>	<b>2 – somewhat dissatisfied</b>	<b>3 - neutral</b>	<b>4 – somewhat satisfied</b>	<b>5 - very satisfied</b>
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a. What do you NOT like about your current cooking appliances?

b. What do you like the most about your current cooking appliances?

8. Have any circumstances occurred that have made you change the way you cook?  
(Ex: fuel shortages for a certain appliance, fuel is too expensive, changes in weather patterns)

9. Do you have a desire to change the way you cook?

<b>1 – no desire to change</b>	<b>2 – hesitant to change</b>	<b>3 - neutral</b>	<b>4 – some desire to change</b>	<b>5 – very strong desire to change</b>
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a. What would be the barriers to you changing your cooking appliance? (Time, cost, etc.)

10. What are the desirable features of your ideal cooking appliance?

(Ex: Ability to multitask, Portability, Safety within the household, Easy to maintain)

a. What fuel would your ideal cooking appliance use?

- € Electricity
- € Wood
- € Gas
- € Other (specify)

10. How likely would you be to take out a loan to buy your own Insulated Solar Electric Cooker for \$100?

<b>1 - not at all likely</b>	<b>2 - less likely</b>	<b>3 - neutral</b>	<b>4 - probably likely</b>	<b>5 - very likely</b>
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