CASE 1

The Fire Under the Shed: The Cornerstone Fuelling Our Plight

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> "*We must put in the measures now, so we can create a clean, healthy environment where health is no longer dependent only on drugs or vaccines, [where] we eat well, we breathe well, and we reduce pollutants in our agricultural products.*"
>
> Sherry Ayittey, Former Ghanaian Minister of Health

The international community, in 2010, undertook a global initiative to save lives and protect the environment from the effects of biomass fuels. The goal was to affect 100 million households by distributing clean cook stoves by 2020 (GACC, 2014). Partnerships were formed under the umbrella of the Global Alliance for Clean Cook stoves (GACC) in 2010. Organizations in the GACC include but are not limited to public-private partners, non-governmental organizations (NGOs), community-based organizations, and women's cooperatives (GACC, 2014).

AIR POLLUTION

Air pollution from biomass combustion is responsible for approximately 3.1 million deaths annually and 3.2% of the global burden of disease due to acute respiratory infections (ARI) (WHO, 2010). In sub-Saharan Africa (SSA), cooking with biomass fuel is widespread. Approximately 1.1 billion people rely on traditional cook stoves (GACC, 2011). Pollutants from these cook stoves lead to adverse health effects including ischaemic heart disease, chronic obstructive pulmonary disease (COPD), and pneumonia (WHO, 2015b).

Acute Lower Respiratory Infections (ALRI) include diseases such as pneumonia, acute bronchitis, bronchiolitis, influenza, and whooping cough. ALRI are among the leading causes of premature deaths in children under age five in developing countries (GAHP, 2012). ALRI are responsible for three times more deaths than malaria, HIV/AIDS, and measles combined (GACC, 2011). Hence, combating ALRI warrants the same attention given to combatting these diseases but the focus on ALRI has thus far been inadequate. In Ghana for instance, lower respiratory tract infections remain the leading cause of death in children under five (WHO, 2015a) though efforts have been made by the World Health Organization (WHO) and the Ministry of Health to mitigate the problem.

In May 2015, Akosua Agborson began her work as a research fellow at the Kintampo Health Research Centre (KHRC), Ghana. Akosua was a recent graduate who had earned her Master of Public Health degree in Canada and was returning to her native Ghana. During her interview for the position, she had told the KHRC director that the accomplishment of earning a Master's degree would not be complete without fulfilling her goal of helping fellow Ghanaians improve their health and quality of life. The KHRC is one of three research centres of the Ghana Health

Services within the Ministry of Health in Ghana. The Centre conducts research studies that influence health policies in the country. Located in Kintampo Municipality (North and South Districts) in the Brong Ahafo Region in the center of Ghana (see Exhibit 1), the KHRC is one of Africa's demographic surveillance systems for health. KHRC collaborates with several in-country and international institutions, including Navrongo Health Research Centre, the London School of Hygiene and Tropical Medicine (LSHTM), and Columbia University.

Akosua joined a team of KHRC researchers dedicated to reducing the burden of disease from biomass fuel known as the Ghana Randomized Air Pollution and Health Study (GRAPHS). GRAPHS conducted a number of research projects focused on measuring air pollution amongst individuals living in households. On arrival, Akosua consulted with researchers about issues of traditional cook stoves and possible solutions for the problem. Although the GRAPHS' core focus is on reducing air pollution in households, less focus has been placed on monitoring and intervention for those participating in industries with high levels of air pollution. The team was keen on expanding the research focus to include pollution from industrial activities.

The Millennium Development Goals (MDG) specified by the United Nations focused on empowerment of women, gender equality, reducing child mortality, and improving maternal health. The women who would become the focus of Akosua's study had achieved a measure of empowerment through their involvement in the gari industry, but it was this very industry that exposed them and their children to harmful pollutants. Speaking with the workers and gauging knowledge levels would provide a basis for KHRC to design effective interventions to improve the workers' health.

BIOMASS FUELS

The biomass fuels (wood, charcoal, and animal dung) that are used in traditional cook stoves generally do not undergo complete combustion. They emit smoke, other particulate matter, and gases that have adverse health effects (Kim, Jahan, & Kabir, 2011). In addition, biomass fuels cause reduced birth weight and stillbirths in pregnant women (WHO, 2011). The environmental effects are significant. Smoke from the burning of biomass fuels affects the ozone layer (Patrick, Murray, Sullivan, & Kimmell, 2015), destroys the natural flora, and leads to climate change (WHO, 2011).

Advances in technology have made clean cook stoves affordable and readily available in high-income countries. However, in developing countries, many individuals still use biomass cook stoves (3-stone, charcoal, wood, and others). In Ghana, use of biomass fuel is prevalent among households of low socioeconomic status (SES) (Chakraborty, Mondal, & Datta, 2014). Many cannot afford cook stoves with other fuel types such as liquified petroleum gas (LPG) or electricity. Women involved in commercial activities, such as food processing, face additional challenges in obtaining clean cook stoves due to the cost of the cook stoves and the price of the fuel (Zhou et al., 2011). In comparison, traditional cook stoves can be constructed using readily available materials, at a very low cost, allowing the women to maintain profits.

PROCESSED CASSAVA (MANIOC) (GARI)

Cassava (manioc) is the most common orphan crop grown in developing countries, and is the most common crop in sub-Saharan Africa (SSA) (Varshney et al., 2012). Cassava can grow in a variety of ecological zones, and is a staple in SSA, Asia, Latin America, and the Caribbean (Okogbenin et al., 2013). Cassava crops have contributed to food security in SSA due to the crops' resilience. When mature, the crops are harvested, peeled manually, and grated with a machine. The grated cassava is bagged in sacks, stacked, allowed to ferment, and pressed with a hydraulic press to extract the starchy water. After the extraction, the compressed grated

cassava is sifted and put in sunken metal sheets (pans) on the biomass fuel cook stove in portions and fried, stirring constantly until a consistent grainy textured product called gari (cassava grits) is produced. Ghana is among the top 10 producers of cassava in the world, with gari production being one of the easiest ways for individuals to earn money from cassava. Production of gari in rural communities represents close to 40% of the gari industry in Ghana (Angelucci, 2013). In fact, many pay a premium for gari that comes from rural communities in Ghana, based on the widespread belief that gari tastes better when prepared on a traditional stove.

Akosua and the GRAPHS team decided that a qualitative research study would be optimal. This would be the first attempt at conducting qualitative research with women involved in gari production. The goal of Akosua's research project was to assess awareness of the adverse effects of smoke on the health of the women whose commercial activities involve biomass fuel use.

The GRAPHS team selected Ntankro, a community in the Kintampo South District. The KHRC collaborates with Ntankro to undertake research on household air pollution. Gari processing is the most common industrial activity for women living in Ntankro, with approximately 90% of the community involved in gari processing. In the gari industry, there are full-time fryers and casual fryers. The casual fryers engage in gari frying on an as-needed basis. For instance, if individuals need immediate funds, they can decide to do the gari frying for three to four days. Full-time fryers work for five days a week and approximately 13 hours each day. Gari is processed in large quantities, and transported semi-weekly to other parts of Ghana, West Africa, and SSA countries. In Ntankro, approximately 75% of women are casual fryers and the remaining work full-time in the industry (Owusu-Agyei et al., 2012). The source of fuel for this activity is firewood, and essentially all rural households in the area cook with firewood.

Akosua reflected on her own personal relationship to gari. In recalling her childhood memories, she could close her eyes and conjure up the smell of gari being cooked on a traditional stove by her mother and grandmother. She could feel the warmth of gathering with family members, the safety of being in her household, and the joy of sharing food. Perhaps better than any non-Ghanaian could, Akosua understood first hand why the notion that being involved in the production of gari, a treasured food, could be difficult for the women to view as harmful. Also, Akosua would have to agree with the general consensus that gari cooked on a traditional stove tasted better than gari from a factory that was cooked on a modern stove. However, the health of these women, their children, and the community, was more important than the taste of the gari.

Although KHRC had previously been engaged with Ntankro, Akosua met three community leaders two weeks prior to the start of her research in order to gain entry into the community. In addition, she went to a government officer in the district, who is responsible for ensuring the community residents have good air quality and access to clean water that is safe from any other environmental pollutants.

After gaining entry into the community, Akosua introduced herself to the commercial gari processors. The women allowed Akosua to watch the gari processing from start to finish. She observed the five stages: cassava peeling, grating, extraction of the starch, sifting of the dough, and frying. For frying, the women had constructed traditional cook stoves in the middle of a shed. Three to four women occupied one such open shed covered by aluminum roofing sheets. The shed was poorly ventilated. The women stood continuously to stir the gari around the pan with wooden spatulas for approximately 13 hours. To further understand the harmful effects of

the smoke on these women, Akosua approached the gari processors in the community in order to ask questions.

Akosua learned through speaking with the women of Ntankro that commercial gari processors were concerned about two problems in addition to the smoke from the biomass fuel. These were the heat from the fire, and the improper waste disposal from the commercial activities (Adetifa & Samuel, 2012). Firstly, the heat from the fire often led to heat stress for the women. For example, normal body temperature is 37 degrees Celsius, but the surface of the gari frying cook stove is approximately 250 degrees Celsius as observed by Ikechukwu & Maduabum, et al. (2012). The temperature of the cook stoves increased the body temperature of gari processors.

Asabe, a 32-year-old gari processor with six years of experience, said: “When the smoke enters your eyes especially on your first day in the gari business, your eyes will be paining you in the night. You cannot sleep and your body will feel hot.”

Secondly, the gari processors had no means for proper disposal of the cassava peels and the eluates from the grated cassava leaked into the ground. The peels were left on the ground for days until livestock farmers collected them as feed. The peels release hydrogen cyanide (HCN), a toxic chemical, when being processed into gari. HCN has adverse effects on both the gari processors and the environment (Adenugba & John, 2014). Symptoms of HCN exposure include, but are not limited to, headache, weakness, chest pains, and cardiovascular diseases (Dhas, Chitra, Jayakumar, & Mary, 2011).

THE BURDEN OF TRADITIONAL COOK STOVES

During the course of the research, Akosua met with the government officer in the district. He detailed the strategies that had been put in place to enable gari processors to switch from traditional cook stoves to improved cook stoves. In collaboration with the Business Advisory Centre (BAC), the organization responsible for developing small scale businesses or commercial activities and improving the health of individuals involved in the commercial activities, Dr. Frimpong organised workshops for the women in order to teach them about the harms of traditional cook stoves.

According to Dr. Frimpong, the gari processors had insufficient funds to purchase LPGs on their own. To assist with purchasing improved stoves, the BAC linked gari processors to micro finance organizations such as the Brong Ahafo Catholic Cooperative for Social Development (BACCSOD) for loans. With the help of BAC, the gari processors formed cooperative business groups that were then able to open accounts at BACCSOD and access loans for the purchase of the LPGs. The BAC initiative had resulted in 25% of women in the industry purchasing clean cook stoves. Akosua focused her discussions on women who had not yet taken advantage of the BAC funds in order to get a good understanding of the barriers these women faced.

After Akosua’s meeting with Dr. Frimpong, she conducted two focus groups, the first group with 10 women and the second group with seven women. She also conducted in-depth interviews with six of the women to hear more about their experiences in gari processing. Through these interviews, she learned that purchasing the stoves was not the only financial barrier the women faced.

Matilda, a 50-year-old gari processor with 30 years of experience, said: “We use firewood because it produces greater heat compared to charcoal. We need heat and charcoal cannot produce that heat so most women prefer to use firewood. Besides, when we use charcoal, the

quantity and quality of the gari would be different. For instance, a bag of charcoal cannot even fry a half bag of gari. We could have used gas but we do not have money for it."

Matilda lived in Ntankro for 50 years. She claimed gas stoves were unaffordable. However, she could afford to purchase the stoves through BACCSOD. The BAC could assist her if she joined a gari processor group in the community. There were similar statements made by other gari processors in a group discussion.

Nana, a 40-year-old gari processor with five years of experience, said: "The work we do, if not the firewood, nothing can be used to fry the gari. Because if you look at the frying pan we use, it cannot be used on any other stove to fry gari. Therefore if we change the fuel, the frying pan has to also change."

Firewood and charcoal are the two fuel types mainly used in Ntankro. From discussions with Matilda and Nana, they seemed more knowledgeable about the firewood than LPG or electricity for gari processing. After speaking with the two women, Akosua went on to further inspect the traditional cook stove. She noticed the size of the pile of firewood that was stacked in the moulded space dedicated to burning wood inside of the stove. The gari processors used large pieces of firewood rather than chopping the logs into pieces because the smaller sized firewood burned too fast. The women typically fed three large logs of firewood into the burner instead of chopping the firewood to fit the space. They preferred to use the large logs because they could fry approximately four trays of gari and limit the number of times they went to fetch firewood. The smaller sized firewood, which burned faster, could only be used to fry one or two trays at a time (see Exhibit 2).

The women also believed the problem was the size of the pan, because they could not use the pan on a LPG stove. But Akosua had different opinions; the size of the pan or the stove was not the problem but it was the moulded space in the stove where the firewood was stacked. The pan was so small that the large logs could not fit under the pans. If the women were willing to chop the firewood into small pieces, the pan size would not be an issue. The women perceived firewood for the traditional cook stove to burn faster than fuel for clean cook stoves. Responses from the gari processors showed reluctance to move away from sources of fuel they were familiar with in order to use alternative fuels in the LPG cook stove. The women's decisions were driven by efficiency in producing gari. Moving to LPG stoves would increase their costs, lower productivity, and decrease profits.

Firewood is cost-effective for the women but it is also harmful to their health. Most gari processors opt for firewood because they cannot afford LPGs. Although BAC can assist the women with the LPGs, they would rather weigh the quantity and quality of gari from using firewood to the cost of LPGs. The same day, when Akosua was leaving the community, she saw women walking towards the community carrying stacks of firewood. She wondered about the distance the women travelled to fetch the firewood because some said 'good' firewood would determine the volume of smoke emitted. Akosua asked some gari processors to confirm if 'good' firewood can be used to control the smoke emitted.

One of the respondents**,** Asabe, suggested: "What you can do to control the amount of smoke is to use a good fire wood. If you do not get a good fire wood then there will be smoke by all means."

Asabe believed the quality of wood determined the amount of smoke emitted. So it was vital to spend time searching for 'good' firewood. Furthermore, the process of stacking the firewood in

the cook stoves was arduous to the women making the gari. Some gari processors – Rachael and Esi – had contrary views compared to those who assumed no alternative fuel could be used.

Rachael, a 20-year-old gari processor with four years of experience, said: “With the firewood, it is even difficult to set the fire. The firewoods are big. By the time you roll the firewood into the stove you will be tired. So if we would have the strength to use the gas stove, it will be easy for us.”

Esi, a 40-year-old gari processor with 20 years of experience, said: “If we use a gas stove there will be no smoke to disturb us, and we will be comfortable.”

Gari processing is laborious for the women. Akosua observed the gari production activities beginning in the early hours of the morning and ending in the late afternoon. Observing the women, Akosua saw how time consuming the entire process was; the time spent on fetching firewood, peeling and grating the cassava, extracting the starch, sifting the dough through a straw sieve, and finally frying the gari. Moreover, endless fetching of firewood for traditional cook stoves leads to depletion of the resources (Kuunibe, Issahaku, & Nkegbe, 2013). Even though the firewood is available at no cost to the women, depletion of the firewood has long-term consequences, impacting the sustainability of the community. Fetching the firewood also took time, and she wondered if the women could be convinced that alternative fuels have the benefit of saving them the time involved in fetching firewood.

PERCEPTIONS OF RESPONDENTS ON AIR POLLUTION

The activities of the gari processors in Ntankro resulted in air pollution from the use of biomass fuel (GAHP, 2012) and the pungent smell emitted from undisposed cassava peels when it rains (Okunade & Adekalu, 2013). On two occasions in the field, Akosua experienced the pungent smell following the rain. She spoke to the government officer about it. He said:

“The pollutants, the way they dispose of the waste is not proper. They said people take the cassava waste to feed their animals. I told them that, it’s not good because if people don’t come then the waste will just be there. I have asked them to get someone to clear it cause it can accumulate and lead to a big problem.”

The cook stoves used in the gari processing industry lead to negative health effects on those who use them for their commercial activities and would probably alter the ecological system of the environment (Jeuland & Pattanayak, 2012). Yet, gari processors were unaware of the effects the smoke has on the environment. Gari processors associated the polluted air to dust in the area, refuse dumps, nearby toilets, and not the smoke emitted from the cook stoves. They did not think the smoke from the industry was contributing to the air pollution. Of the 17 women Akosua spoke to, only four attributed air pollutants to the fuel wood. Rather, they linked the destruction of household structures and items, such as roofing sheets, to the smoke.

Matilda, a 50-year-old gari processor with 30 years of experience, said, “The smoke can darken the roofing sheets. It can destroy it. Also, the smoke can destroy the grasses that are used to roof some of the houses. When it enters your room, it can discolour all your clothes.”

Matilda had been in the business for 30 years but did not believe the smoke emitted from the cook stoves polluted the air. Akosua had only been going to Ntankro for a week but she was unsettled by the air quality. The air quality around households was similar to the gari processing areas. There was no difference in air quality because households were surrounded by gari

frying sheds. However, Afua, a 40-year-old gari processor with 20 years of experience, agreed. She understood, “Smoke can also pollute the air”.

She was aware the smoke from the fuel wood was affecting the air quality in the community. The disparity between some gari processors and community leaders surprised Akosua. Community leaders such as Dr. Frimpong were not the main recipients of the smoke but knew the difference between clean air and polluted air. The gari processors were the main recipients but did not consider the air to be polluted.

PERCEPTIONS OF RESPONDENTS ON THE HEALTH IMPACTS OF SMOKE INHALATION

With increasing age, exposure to biomass combustion conditions, such as lung cancer, asthma, cataracts, and tuberculosis may arise with increased atmospheric particulate matters and carbon monoxide (Alim et al., 2014). Akosua approached two gari processors under their shed – Adzoa and Yawo – and asked them for their opinions on the health effects associated with gari frying. But after greetings were exchanged, Akosua felt her eyes smarting. That could only be explained by the smoke emitted from the stove. If she could not endure the burning, she wondered what the women could be experiencing.

In Akosua’s discussions, Adzoa, a 34-year-old gari processor with five years of experience said, “When the smoke enters you as you fry the gari, you can get chest pains and a cough.”

Yawo, a 30-year-old gari processor with 10 years of experience said, “When you stand in the smoke for a long time, your heart will palpitate, and if you do not drink water it will feel like your heart is failing. Therefore, when the smoke enters you, you have to drink water to cool your heart.”

Similarly, the smoke from the firewood directly affects not only the gari processors but also their young children because they also stay by the cook stoves and are particularly susceptible to ALRI (Rodríguez-Martínez, Rodríguez, & Nino, 2015). During discussions with Adzoa and Yawo, Akosua observed young children sleeping or playing right next to the cook stoves. She pondered the effects of the smoke on the children. Fortunately, Adzoa, a 34-year-old gari processor with five years of experience, was willing to discuss this further with her, “It can give a child fever, diarrheal. Also, when the breast gets too warm and the child is breastfed with it, he or she can get fever or cough.”

Akosua asked Adzoa to explain further the relationship between the breast milk and the smoke. Adzoa was unable to explain further and refuted her statements about chest pains and fever. She claimed not to notice any differences in her health nor the childrens’. Thus, she continued taking the children to the gari frying shed. Due to Adzoa’s conflicting responses, Akosua spoke with other breast-feeding mothers who had expressed similar views. These women believed the chemical processes of the breast milk changed during gari frying.

Akosua asked Nana, a 40-year-old gari processor with 5 years of experience, the reasons for taking the children along with them. She said: “Normally, the child is not that affected by the smoke because they stay here for a very short time, however the children sometimes experience a common sickness – fever and malaria.”

Nana seemed perplexed about the illnesses the children experienced because she made contradicting statements. She claimed gari processors experience a common sickness but both women maintained the children were not affected. From the responses, both women were less

knowledgeable on the harmful effects of the fuel wood. They did not know the causes of some of the symptoms but associated them with the heat from the cook stove.

Although some children were either sleeping or playing around the cook stoves, the gari processors did nothing to protect them from the smoke. They continued to take the children to the gari frying shed. This contradicted their assertions that the warm breast milk can cause fever, diarrheal, or cough. If they believed the children were susceptible to these three symptoms, Akosua thought they should stop taking the children with them.

Akosua pondered if a free day care centre would be beneficial to these women, because they expressed concerns of not having someone in the community to babysit. If the women could get attendants to take care of their children while they were at the gari processing site, their children would probably be less exposed to the fumes from the fuel wood. The women would only have to attend to the children to breastfeed. Conversely, one of the community leaders said:

“However, if the women carry their children with them nothing can be done. Mostly, they do that depending on their relationship with their husbands. Because it is a problem even if you go alone to fry the gari or you go with a child.”

The community leader suggested that husbands might not want the women to go alone to do the gari frying, but they might also not appreciate their children being exposed to the smoke. Akosua wondered what would result from communicating the harmful effects of commercial smoke exposure to the men in the community. In addition, some gari processors were pregnant and standing in close proximity to these cook stoves but were unaware of the harmful effects from the smoke on the foetus (Kelly et al., 2011). They continued working until a few days before delivery (see Exhibit 2).

In their defence, Araba, a 40-year-old gari processor with 10 years of experience said, “I think that if there are any effects, doctors are the right people to inform us because even if your child has any problem as a result of the smoke, you would not be able to tell unless a doctor complains to you. But we have never heard anything like that before.”

Araba was one of the gari processors who did not believe the smoke from the firewood could have an effect on the foetus. The gari processors valued and respected the doctor’s opinion so they would not stop gari frying when pregnant unless recommended by doctors. Akosua wondered if the power of the doctor’s opinion could be used to full effect. It seemed that if doctors informed the women about the harms to the foetus, they might discontinue the use of the cook stove until after delivery. Perhaps KHRC could involve the doctor in health promotion visits to Ntankro. There were others who disagreed with the views of these women. Some gari processors acknowledged health risks from using the cook stove. Adzoa was nine months pregnant and discontinued gari frying during her pregnancy.

The perceptions of gari processors differed on the health effects associated with the traditional cook stoves. There were gari processors who were aware of the health effects from inhaling the smoke while some others were unaware. The next phase of the GRAPHS team project was to measure the levels of smoke exposure among the women. Real time personal exposures were monitored at one-minute intervals over a 72-hour period on every woman using portable light weight Lascar EL-USB-CO devices (Lascar Electronics, n.d.). The Lascar monitors showed gari processors were exposed to high CO levels. For instance two gari processors – Asabe and Yawo – had mean CO of 12 in a 24-hour period. Asabe had a maximum minute-averaged CO level of 38.2, while Yawo had a maximum averaged CO level of 306**.** With such high levels, the

gari processors were at risk of various symptoms and ailments including but not limited to headaches, chest pain, muscle weakness, and cardiovascular diseases (ATSDR, 2012).

MEANS OF CONTROLLING ENVIRONMENTAL POLLUTION

Controlling pollution due to smoke from traditional cook stoves and improper disposal of cassava peels would not be an easy task. KHRC would need to work with community leaders to devise a plan. Perhaps they could construct a gari processing site a few kilometers from the community in addition to improving on the cook stoves. Although BAC and the government officer were in the process of improving the gari processing cook stoves in Ntankro, there was yet to be a solution for the waste disposal site in Ntankro.

Ntankro has a local government established pursuant to Act 462, Local Government Act, 1993 (Government of Ghana, 1993). Parts of Section 10(3) of Act 462 include references to environmental pollution but not in regards to local by-laws. The Act fosters development of industries, mobilization of resources, and supports economic activities at district levels but makes no reference to community levels of air pollution. Without local by-laws, there would be no legal means of controlling pollution in the community.

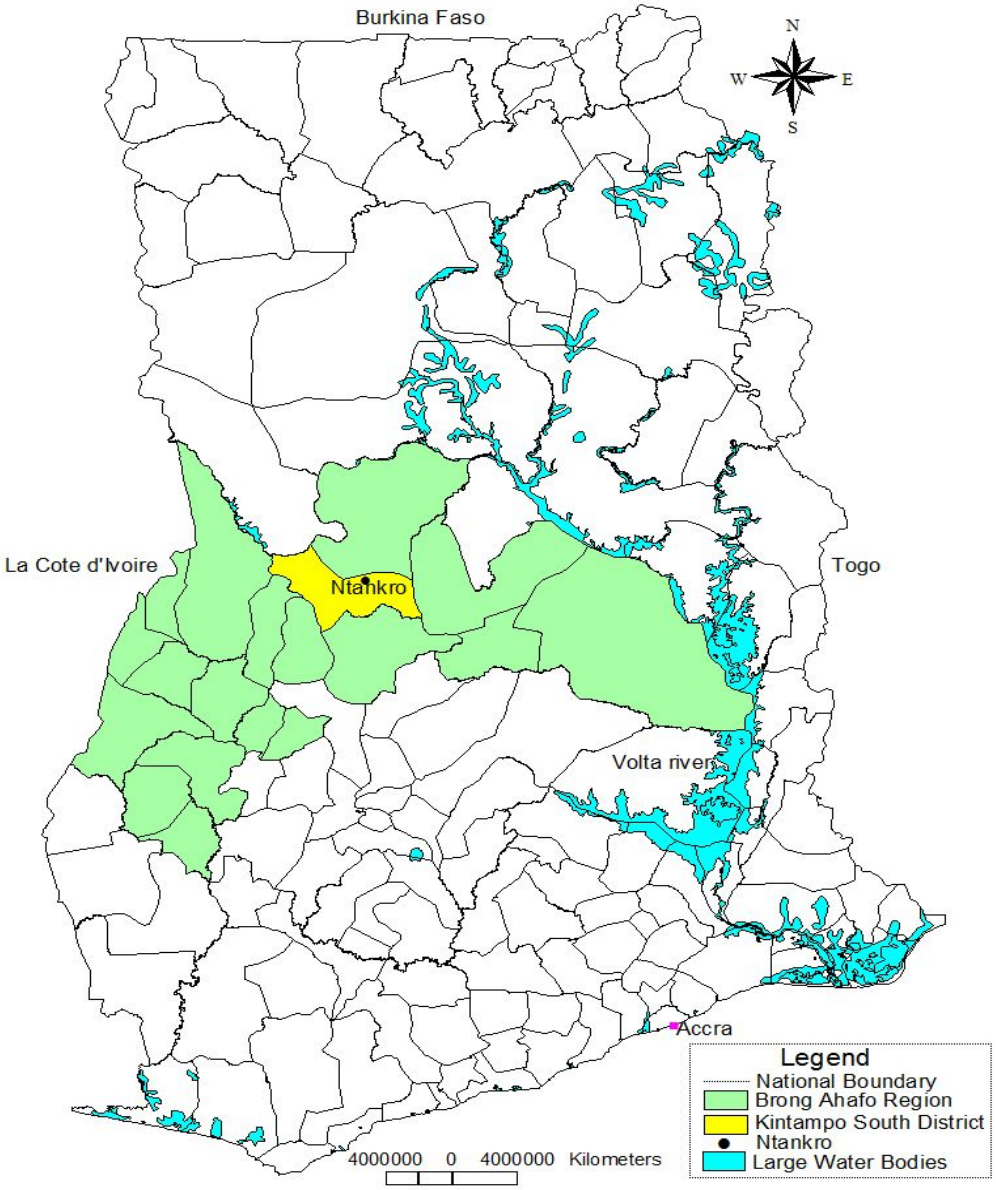
UNRESOLVED ISSUES

Some gari processors in Ntankro expressed a desire for LPG cook stoves while others were opposed to LPGs. The gari processors are the users of the cook stoves. Akosua wondered whether or not the community leaders and other stakeholders at the government and international level considered the women's needs before redesigning the cook stoves. If the women could be included in the process, then they could contribute to the design and performance of the improved cook stoves. Perhaps the KHRC could facilitate a process whereby the women could take ownership over the design of improved stoves.

But are the gari processors aware of the pollutants emitted by the cook stoves and the health effects of inhaling these pollutants? Without awareness, it is clear that the women would not be motivated to improve the stoves and reduce emissions. How could the impact on the profitability of the gari industry be addressed? What could Akosua and the GRAPHS team do to educate the women? What support can community leaders provide for women in the gari industry? Could the gari processors be motivated to work collectively to implement solutions? For example, could gari processors pool resources and assign babysitter roles to reduce exposure of children during working hours?

The gari frying process is fundamental to this industry but little has been done to help those involved. The BAC and the government leaders have implemented workshops to inform women about means of controlling pollution from the gari industry and constructed a cook stove with a chimney but the interventions have thus far been inadequate**.** For many years, traditional cook stoves in the gari industry have been putting the health of individuals and communities at risk. Yet, gari is a major source of food security. Could intervention from the government cause the benefits of the improved cook stoves to outweigh the familiarity and profit potential associated with the traditional stoves?

EXHIBIT 1
Map of Ghana Showing Ntankro



Source: Kintampo Health Research Centre, 2015.

EXHIBIT 2
Pregnant Woman Using Cook Stove

Source: Captured by author.

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INSTRUCTOR GUIDANCE

The Fire Under the Shed: The Cornerstone Fuelling Our Plight

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BACKGROUND

In Ghana, smoke from biomass fuel cook stoves leads to acute lower respiratory infections (ALRI) in children under five. Akosua Agborson, a research fellow, had the opportunity to work with the Ghana Randomized Air Pollution and Health Study (GRAPHS) team at the Kintampo Health Research Centre to address this public health issue. The GRAPHS team is responsible for reducing air pollution and improving cook stoves for households in Ghana. Akosua decided to support the GRAPHS team by doing a case research study on gari processing involving biomass fuel. She focused on gari processors because Ghana is the sixth largest producer of gari (cassava grits) in the world. Akosua and the GRAPHS team interviewed gari processors, community leaders, and the district government officer in order to understand the levels of knowledge about health risks and the perceptions of air pollution attributable to biomass fuel used in the gari processing industry.

OBJECTIVES

1. To illustrate the challenges of overcoming a lack of health knowledge among vulnerable people.
2. To identify the optimal strategy for promoting health and motivating change.
3. To develop a plan for health promotion that is informed by an understanding of the context.
4. To navigate the complexities of industry and innovation in formulating public health strategy.

DISCUSSION QUESTIONS

1. What is the willingness of gari processors to adopt clean cook stoves?
2. What strategies can improve gari processors' knowledge base on the health risks from smoke inhalation?
3. What strategies can be implemented to reduce harm from exposure to pollutants in the short-term?
4. What is the optimal approach to designing improved cook stoves for use in the gari processing industry?
5. How can the cost of improved cook stoves be subsidized to minimize the financial impact on the women?
6. How beneficial would an alternative source of fuel be to the gari industry?

KEYWORDS

Air pollution; biomass fuel; cook stoves; cassava; manioc; gari; gari processing industry; health knowledge; health promotion; Ghana.