

Women's experiences with mixed use of wood and gas cookstoves and fuels in rural Lambayeque, Peru

Experiencias de mujeres en el uso mixto de combustibles para cocinar en una zona rural de Lambayeque, Perú

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ABSTRACT

Introduction: Despite program efforts to encourage use of clean cookstoves and fuels to mitigate climate change, many communities continue to use wood-fueled open fires. **Objectives:** Describe experiences of participants with mixed use of cooking and fuel technologies (e.g. open fires and chimney stoves using wood and liquefied petroleum gas (LPG) stoves) in rural Lambayeque, Peru in 2018. **Material and methods:** Fifteen participants were interviewed using a qualitative exploratory research design. Data was collected through semi-structured interviews and analyzed using thematic content analysis. **Results:** Four categories emerged: decisions about acquiring cooking fuels are primarily based on cost; plastic trash is used to light wood-burning stoves; decisions to use gas over wood are based on quick food cooking time; and benefits and health problems are recognized, but mixed use of fuels persist. **Conclusion:** Use of both traditional wood cookstoves and plastic trash to ignite fires were used frequently because both are free or cheap. The environmental impact of cutting down trees isn't considered important, but interviewees did notice detriments to their wellbeing. Although gas stoves are used and benefits were mentioned, use of traditional stoves persists. We recommend that policy makers in Peru begin to address barriers to full adoption of new clean cooking technologies and consider governmental subsidies to meet families' spending priorities.

Keywords: rural population; environmental health; biomass; liquefied petroleum gas; cookstoves (Source: DeCS-BIREME).

RESUMEN

Introducción: A pesar de los esfuerzos del programa para alentar el uso de estufas y combustibles limpios para mitigar el cambio climático, muchas comunidades continúan utilizando fuegos abiertos a leña. **Objetivo:** Describa las experiencias de los participantes con el uso mixto de la cocina y las tecnologías de combustible (por ejemplo, fuegos abiertos y estufas de chimenea que usan estufas de leña y gas licuado de petróleo (GLP)) en la zona rural de Lambayeque, Perú, en 2018. **Material y métodos:** Quince participantes fueron entrevistados utilizando un diseño de investigación exploratoria cualitativa. Los datos se recopilaron a través de

entrevistas semiestructuradas y se analizaron mediante análisis de contenido temático. **Resultados:** Surgieron cuatro categorías: las decisiones sobre la adquisición de combustibles para cocinar se basan principalmente en el costo; la basura plástica se usa para encender estufas de leña; las decisiones de usar gas sobre la madera se basan en el tiempo de cocción de comida rápida; y se reconocen los beneficios y los problemas de salud, pero persiste el uso mixto de combustibles. **Conclusión:** El uso de estufas de leña tradicionales y basura plástica para encender incendios se usaba con frecuencia porque ambos son gratuitos o baratos. El impacto ambiental de la tala de árboles no se considera importante, pero los entrevistados notaron daños en su bienestar. Aunque se usan estufas de gas y se mencionaron los beneficios, el uso de estufas tradicionales persiste. Recomendamos que los encargados de formular políticas en Perú comiencen a abordar las barreras para la adopción total de nuevas tecnologías de cocina limpia y consideren los subsidios

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gubernamentales para cumplir con las prioridades de gasto de las familias.

Palabras clave: población rural; salud ambiental; biomasa; gas licuado de petróleo; estufas (Source: *DeCS-BIREME*).

INTRODUCTION

Despite financial and technological progress, worldwide 3 billion people still live in impoverished rural areas, cooking and heating their homes with biomass fuel (wood, animal dung, agricultural residue and coal). Household air pollution causes 3.8 million premature deaths yearly primarily due to infant pneumonia, strokes, coronary heart disease, chronic obstructive pulmonary disease and lung cancer. In 2018, 50% of the deaths among children under the age of five years living in low income countries were due to pneumonia⁽¹⁾. The Global Alliance for Clean Cookstoves has the goal of reaching 100 million homes with cleaner and more efficient cooking methods by 2020 to mitigate climate change. Liquefied petroleum gas (LPG), ethanol and biogas offer greater potential benefits, not only for health, but also to meet climate and sustainable development objectives⁽²⁾. Nevertheless, introduced cookstoves need to be sustainable over time⁽³⁾. This points to the importance of national policies to encourage and support the transition to clean cookstoves and fuels.

In rural areas of Peru, the predominance of cooking fuels are LPG (66%), wood (29%) and coal, natural gas and electricity (5%). Using biomass fuel leads to deforestation and emission of carbon dioxide (CO₂), one of the main contributors to atmospheric warming⁽⁴⁾. In other countries in Latin America, coal and wood are still used. In Paraguay, 21% of the urban population and 71% of the rural population use these fuels for cooking⁽⁵⁾. Wood is the second most commonly used cooking fuel in Ecuadorian homes, but it is far behind gas, which is used by 92% of households⁽⁶⁾. In the southern states of Mexico, between 25% and 55% of households depend on wood for cooking, which has consequences on the environment, development and health⁽⁷⁾.

In 2014, in Peru, 84,738 improved stoves were installed, and 491,817 LPG stove kits were delivered. Because traditional woodstoves take advantage of only 10 to 15% of the energy stored in wood, LPG stoves have led to significant improvement in the quality of life for families and has contributed to mitigation of climate change. However, families are using both LPG stoves and traditional wood stoves, which limits health and environmental benefits. There is a significant gap in research to understand the determinants of sustained exclusive use of clean fuels in poor rural communities⁽⁸⁾. In one study⁽⁹⁾, authors concluded that, although factors such as offering technologies that satisfy the needs of

the household and save fuel, user training and support, effective financing and a government that facilitates the action seem to be critical, none of the factors guaranteed success. On the other hand, the idea of saving fuel competes with the subjective perception that the women are able to save money on wood; in the consumer's mind, the improved stove may help the wood last longer⁽¹⁰⁾.

The population currently described in this study received a donation of a wood-fueled chimney stoves in 2008 from a local NGO (Centro ECO) and LPG stoves in 2011 from the Peruvian government. The LPG stove consisted of a two-burner stove, a table, a regulator and a 10-kilo LPG cylinder. In this study, we aim to describe women's experiences with mixed use of cooking fuels and stove technologies and reasons they returned to using the traditional wood-fueled open fire if they had received an improved woodstove or gas stove.

MATERIAL AND METHOD

This qualitative research study is descriptive and exploratory⁽¹¹⁾. The study elucidates the experiences of women with the mixed use of cooking fuels and stove technologies, with a focus on the social and cultural contexts. The convenience sample consisted of fifteen women from communities in the buffer zone of the Bosque de Pomac Historic Sanctuary, in the department of Lambayeque in Northern Peru.

All women were mothers and had three types of cookstoves (traditional open fire, wood-fueled chimney stove, and LPG stove). All completed secondary education and were an average of 50 years old. Most of the families worked in agriculture. They raised animals such as guinea pigs, ducks, turkeys, chickens, pigs, goats and sheep for wool. Some families worked in beekeeping.

Semi-structured interviews were used for data collection. Interview guides were developed by researchers and validated by three nursing experts in qualitative investigations and rural development programs. The Centro ECO is a non-governmental organization (NGO) that provided researchers with a list of recipients of stoves given before the coastal El Niño phenomenon in 2017. A convenience sample of interviewees who had three types of stoves were selected. The sample size was deemed sufficient when findings reached saturation. The interviews were held in homes from March to May 2018 using audio recording. Interviews averaged 25 minutes. After obtaining the interview, the participant was visited in her home a second time to verify the information obtained and to ensure it was in agreement with what was shared, or to complete missing information.

Interview text was processed through thematic content analysis, consisting of three stages: 1) pre-analysis and organizing the interview transcripts: dive into the reality expressed, review the information obtained, listen as many times as necessary to the recordings made during the interview in an attempt to relive the situation encountered and reflect on it to understand what was happening; 2) coding process: words, phrases or paragraphs were identified and coded with by grouping related meanings 3) categorization: resulting codes were grouped together by similarities creating categories. Categories were named based on segmentation of most significant passages that met the objectives of the study⁽¹²⁾.

Ethical considerations

All informed consent forms were read and then signed by the participants. Participant identities were protected using codes. The project was approved by the ethics committee of a private university in Lambayeque. Each participant responded freely and voluntarily to each of the questions⁽¹³⁾.

RESULTS

1. Money saving methods of acquiring cooking fuel and stoves.

Women in the study were provided with improved wood-fueled chimney stoves from Centro ECO in exchange for reforestation activities they participated in during 2008. Due to the El Niño flood phenomenon in 2017, the houses, with their chimney stoves, were destroyed. Women reverted to using traditional open fires since gathering wood is easier to obtain. Women who owned gas stoves, purchased or donated from the government, had trouble obtaining gas, saying, "Gas is very expensive and we don't have money." "I've had an improved woodstove, but the El Niño phenomenon of 2017 destroyed it. I haven't rebuilt it because I don't have money, so I use the traditional stove." (M2-M15) Only one participant was able to rebuild her improved woodstove: "My husband rebuilt my improved stove because it saves me on wood, because it was destroyed with all the rain." (M1)

Two participants use trees from their farm for fuel: "We don't buy wood, we have carob trees, cuncuno (*Vallesia glabra*) or lentil. A carob tree lasts half a year, and it contaminates the air less than the willow or sapote, so we use the wood since nature gives it to us and it is free." (M3, M8) Some participants say they do not spend money on wood because they collect it from the rivers, an hour walk from their homes: "We use the tree branches that are drying, or we go to the river to look for branches from the pájaro bobo shrub or *chope seco*, after lunch." (M2, M17) Some participants buy wood. They consider it cheaper than gas because it lasts them a little over 1 month and costs 18 United States dollars per load. "We go to the

river twice a week to look for chilco or we buy carob wood brought from Olmos. It costs 60 soles per load" (M5, M7, M10-15).

Although all participants had an LPG stove, they found it expensive and used it sparingly. Most participants received the stove as a gift from their children or as a donation from a government program. Some of them chose not to use their LPG stove because they spent more than 6.5 United States dollars a month on electricity for their televisions and refrigerators: "My son gave me a gas stove and he bought the gas cylinder (11.5 United States dollars). It lasts two months and I use it rarely so it doesn't get used up. I don't qualify for a gas voucher because the electricity bill is high, because of the television (we watch the news at night) and because of the refrigerator, that's why I use wood more to save money." (M1-M5) "I buy my gas in town and with the travel there and back it's more expensive (12 dollars). It lasts me two months and I am careful with it because sometimes there is no money to buy more. We still don't have the gas voucher." (M6-M15)

Participants say that in order to save money, instead of investing in constructing new chimney woodstoves damaged during El Niño, they have reverted to using traditional open fires, which typically consume more biomass. In this study, only three participants rebuilt their chimney woodstove. The rest would like to, but they didn't because of the extra expense, and stated that they were waiting for an institution to help with construction.

Use of LPG or wood depends on what types of foods are cooked, as well as cooking time. The participant who repaired her improved stove uses all three stoves: Traditional, improved and gas. She uses the traditional stove when cooking "large amounts of food, for example for a birthday", uses the improved stove every day, and uses the gas to heat up food.

2. Lighting wood-burning stoves with plastics

Participants burn plastic bags to light wood fires. Women stated: "To light my stove, I put the wood in and then I add trash or thin little sticks from the trees, and then I add plastic bags with the match and it makes the flame ignite." (M5, M8, M10) "I use matches, corncobs, corn husks, and plastic bags to light the fire. I used to use kerosene, but now there isn't any and if there is, it is expensive. (Kerosene) costs 10 soles per liter so we use petroleum, which costs 4 soles." (M2, M6, M11, M12) "I used to use plastics, but not anymore because it's harmful, that's what the nurses told me." (M1, M3) Two participants don't use plastic because they are aware of the danger from inhaling burning plastic. Most women were unaware of the risks of inhaling toxic gases from burning plastics.

3. Selection of fuels by food cooking time and use of gas to save time.

Food cooking time was an important factor in fuel selection. Therefore, “hard” to cook foods that require long cook times were prepared with traditional wood stoves. Gas was used to quickly heat food. Some participants said the LPG stove saves them time:

“I have an open fire and a gas stove, and I use both; I use the open fire stove to make beets, carrots, cassava, sweet potato and legumes so I don't use up the gas. I use the gas stove at breakfast and in the afternoon; I make my soup, my rice, my stewed fish, or in an emergency when it rains and the fire won't start.” (M4-M15) “I use the open fire when there is a birthday, or for the “chicha” (traditional corn drink), probably once a month. I use the gas to warm up the food, because lighting the wood fire takes some time, so it saves me time.” (M2)

One participant said she used the traditional stove because of the flavor of the food: *“I use wood to cook in my traditional stove. I prepare lunch (rice, stewed fish and soup) and the food tastes better. It allows me to save, especially on cooking legumes (lentils, round beans) because they are hard and the gas would be gone quickly.” (M3)*

Some used gas in a limited way, saying that LPG is “very expensive”. However, when they did use it, they felt that it saved time because they could perform other household tasks: *“When I have money I use the gas stove for breakfast, since my son goes to school, and to heat up dinner; it doesn't blacken the pots. With gas I can make progress on other things such as washing clothes or sweeping because I don't have to be stoking, because the wood gets used up.” (M5-M12)*

4. Benefits and health problems with the mixed use of fuels.

Although participants were aware of harmful effects of traditional cookstoves and see benefits to using LPG stoves, some continued to use wood. Participants acknowledged eye, head, musculoskeletal, and respiratory symptoms from using wood; *“With the wood-burning stove my eyes burn and my head and back hurt. When I was using my improved stove I felt well, because it had its chimney and the smoke went out up there.” (M3, M6, M10) “Using my gas stove, I feel even better because there isn't any smoke. On the other hand, with the wood stove I feel bad, because my eyes burn, I get a cold, my back hurts.” (M1, M2, M7) “When I use the gas stove my health is better, because there is no longer smoke and I am not hunched over.” (M8, M12)*

DISCUSSION

While participants acknowledged the benefits of the LPG stove, the tradition of using wood prevails. LPG is available to them, but they prioritized other expenses such as televisions, cellphones, and family celebrations. An important finding in this study was the increase in wood use and the traditional stove after improved stoves were implemented, as far back as

2008. Because the LPG stoves given to women were destroyed during the El Niño phenomenon in 2017, participants reverted to traditional stove use even though they had obtained LPG stoves through government social programs or as gifts from their children. Because families may not see the tangible, immediate benefits of clean cooking, educational campaigns that promote household spending on clean stoves and fuels for health benefits of family members should be undertaken.

Many rural homes in Peru used more than one type of fuel and stove for cooking, depending on the climate and geographical conditions, using wood and gas simultaneously⁽¹⁴⁾. Improved stoves have been implemented and continue to be used because of easy access to wood, the flavor of the food, and the decrease in smoke compared to the traditional stove. For these reasons, in other studies, participants repaired their improved stoves when they malfunctioned⁽¹⁵⁾. This was not our finding, which was performed a year after the floods from the coastal El Niño phenomenon (2017). In our study, in which the improved stoves were destroyed, only one participant repaired her chimney stove. Other participants reverted to using open fires. Perhaps if the present study had more time under observation, we would have seen an increase in repairs, or re-initiation of clean cookstoves. However, our findings point to a need for aid programs to provide stove aid to families who experience catastrophic losses during climate phenomena like El Niño, which may increase with increasing climate change.

A study in India⁽⁸⁾ found that in rural areas people continue to use traditional cooking technologies. In the Peruvian Andes⁽¹⁶⁾, wood is the fuel used the most for cooking and is used exclusively in 40% of homes, with only 5% use LPG exclusively. Over 50% of homes use both fuels. In a study in Cajamarca, Cuzco and La Libertad in Peru, authors found that rural families continue to use the traditional stove because they do not like the flavor of food cooked on LPG. They also believed that they cannot cook traditional dishes on LPG stoves, are worried about safety when using LPG, or are concerned about cost of, and limited access to, LPG⁽¹⁷⁾. In our study, only one participant said she used wood for the flavor of the food. The majority of women in our study used wood to save money.

Despite having LPG stoves, our participants stated that fuel is very expensive and they only use these stoves for short cooking events, such as heating food or preparing foods that cook easily and quickly. According to Troncoso⁽¹⁸⁾, in rural areas people do not switch from one cooking technology to another, or from one fuel to another quickly. New stoves are used in conjunction with traditional stoves. This helps families meet their financial needs and make cooking decisions based on weather conditions. Wood has secondary uses such as

heating homes in cooler regions and driving away insects with wood smoke⁽¹⁹⁾. In one study performed in Guatemala⁽¹⁰⁾, authors found that among users of mixed fuels for cooking, 70% say they still use wood to save money, but most of the women would use LPG if they had the financial resources. This illustrates the need to provide subsidized LPG fuel to low-income households, and to ensure that it is accessible for rural households.

The main reason participants in our study used wood was availability compared to LPG. Access to fuels like LPG does not eliminate the use of wood. Since study participants live in a dry forest ecosystem, they use the branches of the trees in the area (carob, huarango, *Prosopis pallida*, sapote), pruning them and then cutting them down. Just like in the Caicedo study⁽⁶⁾, the consumption of wood by Ecuadorian households is not only a cultural problem, but actually involves other factors, mainly associated with poverty and living conditions. Families justify wood use because it is cheap and available to homes located in native forests. Wood continues to be used for activities that require a large amount of energy and for cooking traditional foods such as beans⁽⁴⁾. Participants used wood for large meals, to boil traditional drinks like chicha, when the ingredients are difficult to cook, and for celebrations like birthdays, declaring that they save money on fuel. In this study, families continue to use wood, collecting free wood from their property. Some purchase wood. Educational campaigns that emphasize the effects of deforestation on climate change, including water supply and habitat protection should be encouraged.

The combined use of gas stoves and wood stoves was common in our study. In Peru, gas costs more than collected wood, therefore, gas is used for small tasks (like heating water or heating food). Participants used wood for "hard foods". This is a new finding and might be used to educate homes about using LPG at a low boil, covering pots when cooking and pre-soaking legumes to conserve fuel. An encouraging finding in this study was that all the participants used a gas stove, but because of their limited financial resources, they used it only for certain occasions, such as making breakfast quickly, heating up food or preparing foods that cook easily. To ensure an appropriate transition to gas stoves, strategies that ensure adoption and sustained use need to be reassessed. In our study, most rural families did not have the government vouchers for subsidized fuel, making the cost of gas high for the families at \$10.48. Accessibility is limited, including fuel transportation to homes. According to Ramírez⁽²⁰⁾, the distance from home to fuel distributors is a major challenge for rural households, since transporting the fuel requires more physical effort, time and cost. By contrast, in Paraguay⁽⁵⁾, authors found that wood use led to more time collecting wood (average of 2.49 hours a week) and preparing and cooking food (average of 4.25 hours more per week than households using LPG). The trade-

off between time and cost spent procuring wood fuel versus the time and cost procuring LPG fuel should be evaluated in future studies.

Burning biomass creates carbon dioxide and incomplete combustion of wood by-products that are dangerous to health and cause a large number of conditions, including eye, nose and throat irritation, headaches, nausea and dizziness, and respiratory problems, such that exposure to pollutants emitted by open fires can have adverse health effects^(21, 22, 23). Participants in our study shared their experiences with health benefits. They described health problems, including eye, respiratory and muscular pain from bending over the traditional stove. However, due to limited financial resources, they continued to use wood as their main fuel, even if they were bothered by the woodsmoke. They recognized that the location of the stove inside a closed kitchen meant that smoke was trapped inside the home, causing respiratory and eye conditions. However, exposure to burning wood was compounded by burning agricultural residue and plastic trash to help ignite the fire.

Some countries in Latin America have found it easier to transition to clean fuels and technologies. In Paraguay (5), electricity for cooking may be a feasible alternative to biomass, due to hydroelectric resources (99%). That would not be feasible for rural areas of Peru. Potentially, piped natural gas appears to be an emerging viable alternative for Peru.

As found in other studies, we found persistent mixed use of wood and LPG fuel, even after homes had adopted LPG stoves. In order to ensure sustained, consistent use of clean fuels, government policies should place greater importance on creating incentives and subsidies to homes that wish to, or have, adopted clean cookstoves but are unable to maintain their use. In our study, the El Niño flood in 2017 caused catastrophic conditions that were not met with commensurate aid to poor families. While families have proven resilient, conducting financially profitable activities such as beekeeping, raising sheep and forestation activities in the Bosque Seco, they are harvesting their own trees for wood fuel. Future studies should explore spending priorities with rural families who make decision about household purchases, often spending on modern technologies (e.g. televisions, laptop computers, mobile phones)⁽²⁴⁾ instead of purchasing or repairing clean cookstoves.

Conflict of interests: authors declared no conflict of interest.

Financing: self-financing

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Peer Review

Received: 29/04/2020
Accepted: 30/06/2020