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Energy Challenges and Strategies by Rural Communities in a Southern Philippine City

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Abstract

The United Nations' Sustainable Development Goal advocates affordable, reliable, sustainable, and modern energy for nations. Communities face distinct challenges in energy decisions due to cost, convenience, and income, requiring context-specific strategies. This paper documents the struggles and strategies in agricultural barangays in General Santos City, Philippines regarding household fuel choice. Data were collected through surveys, interviews, focus group discussions, and inspections, then analyzed using qualitative-descriptive statistics. San Jose and Sinawal were predominantly of the Blaan ethnic group, mainly in the low-income class, relying on farming. Modern and traditional energy sources were available. However, electricity was predominantly used only for lighting, entertainment, and communication. In contrast, conventional sources like wood and charcoal prevailed for heating and cooking. The limited use of modern energy sources, e.g., electricity and liquefied petroleum gas for cooking, is attributed to their high cost and potential hazards. Challenges such as availability, reliability, proximity, possible risks, and legal violations are commonly encountered when using conventional sources. Strategies including reliance on local provisions, cooperation in programs, legal compliance, resource-saving, and energy switching were practiced to address these challenges. Nevertheless, residents continue to face hardships, emphasizing the need for alternative heat sources or improved systems and programs to enhance accessibility within the community.

Keywords: *heat, renewable energy, energy use, energy consumption*

Introduction

Energy consumption is one of the most significant indicators of a country's economic development. It influences industrialization, urbanization, and technological advancement. The annual global energy consumption is estimated at 580 million terajoules, equivalent to approximately 13,865 million tons of oil ("Global Energy Consumption," 2023). Globally, energy consumption continues to grow, though it is slowing down, averaging 1-2% per year (Ritchie et al., 2020). Moreover, based on the Total Final Energy Consumption (TFEC) report, household energy consumption in the Philippines in 2018 ranked as the second most energy-intensive sector, accounting for a 27.5% share of the total energy consumption, following the transportation sector a 35.7% share (Department of Energy [DOE], 2020). Household energy consumption includes lighting, cooking, and heating using biomass, electricity, and petroleum as fuel.

Meanwhile, according to the World Health Organization (2022), around three billion people worldwide continue to cook simple meals with biomass like wood, animal dung, crop waste, and charcoal as fuel. The Philippines is not an exception. Based on a WHO-UNDP (World Health Organization – United Nations Development Programme) study, approximately 50–75% of the country's population has no access to modern energy services, of which 29.5% come from the rural sector (Morales, 2015). According to the Household Energy Consumption Survey 2011 (Philippine Statistics Authority [PSA], 2011) for 2004–2011, fuelwood remained the top fuel for cooking in the Philippines, with more than half of the households using it.

In the publication "Fuel for Life," the WHO highlighted the impact of using wood and other traditional fuels on the health and productivity of women (Rehfuess, 2006, pp. 12-18). Some of the most serious yet commonly neglected health problems are indoor air pollution and inefficient household energy practices, identified as significant obstacles to achieving the United Nations's Millennium Development Goals. If current trends continue, 25% of the world population will continue using unsafe and

inefficient cooking systems by 2030 (UN, 2023). For these reasons, the United Nations made it one of its Sustainable Development Goals to provide means for nations to ensure access to affordable, reliable, sustainable, and modern energy. Moreover, with cost and convenience as conflicting factors in choosing fuel, alternative low-cost and renewable sources are necessary.

Various factors influence household fuel choice, as explained within the framework of energy-switching or energy-stacking strategies. Energy-switching strategies dominate in urban areas, while energy stacking is more common in rural areas (Dacuycuy & Dacuycuy, 2018). In general, switching fuel sources (or shifting from one fuel source to another) for cooking is influenced mainly by the cost of fuel, household income, and the availability of new cooking fuel. In addition, convenience and the transfer of residences were cited as reasons for switching fuels (PSA, 2013). On the other hand, energy stacking behavior, characterized by multiple fuel uses or utilization of a combination of fuels, is usually influenced by fluctuations in prices, culture, and tradition and is practiced by keeping alternative sources as backups (Masera et al., 2008 as cited in Dacuycuy & Dacuycuy, 2018).

Based on a systematic search of local literature in Google Scholar and other search engines using relevant keywords like “Philippine energy,” it was found that there is limited literature on the energy consumption behavior of Filipinos, especially those belonging to rural communities who have less access to modern resources and technologies. Hence, the paper's main objective is to document the struggles encountered by residents in agricultural barangays in General Santos City, Philippines in finding reliable and efficient energy sources for household consumption, as well as their strategies for acquiring such resources. Specifically, it seeks to provide a demographic description of the rural communities under study, to understand how these communities gain access to electrical power, to document their ingenious means of providing heating, and to analyze their coping mechanisms in energy issues. The study's results will help in understanding the energy needs of marginal communities, addressing issues affecting such needs, and designing programs that will not only alleviate energy poverty but will also uplift the living conditions of the communities.

Materials and Methods

Research Design

This study employs a qualitative research design. Its primary objective is to explore household energy utilization within rural communities and their perspectives on renewable energy. The choice of a qualitative approach stems from the study's emphasis on descriptive analysis rather than hypothesis testing and parameter correlation.

Bavaresco, D'Oca, Ghisi, and Lamberts (2020) utilized a qualitative approach to evaluate the human dimension of energy consumption, engaging with diverse stakeholders. The research employed questionnaires and interviews to gain insights into stakeholders' perspectives and identify opportunities for optimizing energy utilization.

Study Participants

Countryside and rural communities were the target respondents in the study since they had the least access to energy sources. Out of the 26 barangays in General Santos City, Philippines two barangays were selected through convenience sampling. These were the agricultural barangays of Sinawal and San Jose. Upon the recommendations of the local officials, six (6) puroks were chosen as survey sites for Sinawal and six (6) puroks for San Jose. Enumerators randomly interviewed households until the target number of respondents (63 for Sinawal and 59 for San Jose) was reached. Table 1 shows the puroks surveyed and their corresponding percentage of the sampling universe.

Instrument and Interview Guides

Before conducting surveys and interviews, a questionnaire was initially prepared and pretested. It was developed based on the specific objectives of the entire extension project. It has five main parts, namely: (a) demographic profile of the respondent, (b) household energy sources and applications, (c) household waste management practices, (d) their perception of barangay-level waste management practices, and (e) their perception on renewable energy program. The specific contents were crafted based on the target results, actual community observations, and inputs from the residents and officials during the meetings and visits. The initial draft was pretested by running the survey on a small group and soliciting feedback from individuals outside the project. The final questionnaire for the household survey was based on the evaluation results. A modified version of the household questionnaire was used for the focus group discussions and key informant interviews.

Data Collection

Data were collected through a series of activities from 2017–2018, which involved conception meetings, household surveys, key informant interviews, focus group discussions, and ocular visits. Conception meetings were held with

Table 1

Distribution of Survey Respondents in Sinawal and San Jose

Sinawal		San Jose	
Purok	Percentage (%)	Purok	Percentage (%)
Bagong Silang	22.2	Lumbang	20.3
Malipayon	22.2	Shuttle	20.3
Cabuay	20.6	Sto. Niño	20.3
Raquenards-2	14.3	Purok 2	18.6
Raquenards-1	11.1	Purok 1	10.2
Bantilan	9.5	Bia-o	10.2
Total	100.0	Total	100.0

key local barangays in target rural communities, followed by project presentations during the council sessions. After that, house-to-house surveys were performed in Sinawal and San Jose. Non-probability sampling techniques, such as purposive and quota sampling, were followed when selecting the respondents. Selected local officials were also chosen to participate in the key informant interviews. These included the committee head or councilor for waste management, indigenous people, and education.

In another event, a stakeholders' forum was conducted. Representatives from different stakeholders participated in focus group discussions, including officials from the beneficiary barangays (Sinawal and San Jose), the City Environment and Natural Resources Office, the City Agriculturist Office, and a non-government organization. At the end of the event, a field tour was also conducted. After that, ocular visits to the communities were regularly conducted to validate the gathered information.

Data Analysis

Descriptive statistics was employed to analyze the data collected during the household surveys. SPSS (Statistical Package for the Social Sciences) and MS Excel were used to calculate percentages, minimum and maximum values, means, and standard deviations. The results were triangulated with the information gathered from the key informant interviews, focus group discussions, and ocular observations.

Ethical Considerations

Ethical considerations were implemented to ensure the safety and well-being of respondents participating in the activities, e.g., household surveys, key informant interviews, and focus group discussions. The following ethical considerations were implemented: (a) Participation was entirely voluntary; (b) Participants were informed about the study's objectives, along with details such as potential benefits, risks, and information about the funding agency, before the activities; (c) A consent form was included at the beginning of the questionnaire; (d) Enumerators and interviewers received training to explain and translate questions in the local language; and (e) Anonymity and confidentiality of the data were strictly maintained.

Results and Discussion

Demographic Profile of Participants

From Table 2, most survey respondents (80.95% on average) were women, particularly homemakers, since they stayed home and were responsible for household chores like cleaning and cooking. Respondents were primarily members of the ethnic group Blaan, comprising 65.10% of the respondents in Sinawal and 37.30% in San Jose. Other major ethnic groups in the areas were Cebuano and Ilonggo.

On ownership of the homestead, almost all the respondents declared that they owned the house. Only a few were living with a relative or renting a house. The average length of residency in the community was 23 years, with some living there since birth.

Table 3 shows that around 45.90% of the respondents had either reached or graduated from high school, and about 40.75% had reached or graduated from elementary school. Only a few percent were TESDA and college graduates.

For both barangays, the primary sources of income were farming and wages as laborers with a modal monthly income of 5,000.00 or less (Table 4). In a 2015 report, a family of five needed at least PhP 6,365 monthly to meet the family's basic food needs and at least PhP 9,140 on average monthly to meet basic and non-food needs (PSA, 2016). In a more recent report in 2018, the average annual

Table 2

Demographic Profile of the Respondents of the Household Survey

Barangay	Gender		Ethnicity			Homestead	
	Female	Male	Blaan	Cebuano	Others	Own House	Others
Sinawal (%)	87.30	12.70	65.10	28.60	6.30	84.10	15.90
San Jose (%)	74.60	25.40	37.30	37.30	25.40	83.10	16.90
Average	80.95	19.05	51.20	32.95	15.85	83.60	16.40

family income was pegged at PhP 113 thousand (the monthly equivalent of PhP 9.42 thousand), which is considered the lowest 10 percent income group (PSA, 2019). Thus, most households in the communities could barely provide for their food needs. Owing to the low average monthly income, most households keep non-food expenses to a minimum. Based on the 2018 Family Income and Expenditure Survey result, households in the bottom 30.00% income group spent around 58.20% of their total expenditures on food and 7.60% on water, electricity, gas, and other fuels (PSA, 2018).

For Alan, one of the respondents in the study, life in Sinawal was generally peaceful but challenging. Every time he fetched a container of water from a nearby source, he would have to pay an additional PhP12.00 for water transportation. For Les to cover the increasing price of their usual basic commodities like rice and fish, she had to adjust the allowance for her schooling children. Despite good leadership as perceived by the respondents, the insufficient number of paved roads in the barangays hindered easier access to many necessities, including water.

Access and Application of Electricity

Table 5 shows the distribution of households according to their type of electrical connections. As observed, only around half of the respondents in each barangay had personal access to electricity. In Sinawal, 34.90% had electrical connection tapped from their neighbor, in a system locally known as "series." In this system, the concerned family has to establish another branch circuit from their neighbor in a series connection; hence, the panelboard and electrical meter are found in another house. The occurrence of "series" electricity was higher in San Jose at 42.40%, resulting in a mean of 38.70% for the two barangays. At 12.70%, Sinawal had a higher percentage of households with no electricity, compared to San Jose at only 1.70%.

The results revealed that many barangay residents still needed a personal connection to electricity. Accordingly, the main reason for this was the high cost of installation. The expensive electrical wires, posts, meters, and panelboards were too much for a community where most families lay in the monthly income range below Php5,000 (58.7%

Table 3

Educational Profile of the Respondents

Education	Sinawal (%)	San Jose (%)	Average
Elementary School Level	20.60	22.00	21.30
Elementary School Graduate	27.00	11.90	19.45
High School Level	33.30	20.30	26.80
High School Graduate	11.10	27.10	19.10
College Level	3.20	10.20	6.70
College Graduate	4.80	1.70	3.25
TESDA Graduate	0.00	5.10	2.55
Alternative Learning System (ALS) Graduate	0.00	1.70	0.85
Total	100.00	100.00	100.00

Table 4

Economic Profile of the Respondents of the Household Survey

Barangay	Source of Income (%)			Monthly Income (PhP)		
	Farming	Laborer	Others	5000 or less	5001 - 10000	> 10000
Sinawal	44.40	19.00	36.60	58.70	28.60	12.70
San Jose	18.60	33.90	47.50	40.70	42.40	16.90
Average	31.50	26.45	42.05	49.70	35.50	14.80

for Sinawal and 40.7% for San Jose). The power cost pegged at a national average of PhP8.90 per kWh (based on 2017 data) was also difficult to maintain. The country's rates are among the highest in Southeast Asia, and the main reason is the continued lack of government subsidies (Rivera, 2017). Moreover, in the case of San Jose, land ownership issues and inappropriately planned electrical and road projects have hindered the installation of electricity in some puroks like Atbag, Bagong Silang, Data Salvan, Fataldao, Tanda, and Twok. Regarding the "series" type of connection, the biggest problem is the electricity owner's inconsistent high power cost per appliance.

Table 6 depicts how electricity is being utilized in each barangay. As can be seen, 100.00% of the respondents used electricity for lighting, followed by entertainment, which includes power for television and home radio sets, at an average of 86.70%. This finding indicates the love of Filipinos for entertainment, whether as music or TV shows and that despite being in a rural setting where satellite signals are weak, this need remains strong. At a mean of 77.90%, there was a high percentage of respondents utilizing electricity for communication, specifically mobile phones. Hence, the arms of modern technology have already reached these areas, as the need to communicate is very important. Other applications for electricity were cooking (24.30%); housekeeping, which includes washing machines (24.00%); food preservation, such as refrigerators (13.20%); education, which includes computers (7.10%); and comfort, such as air-conditioning units (7.10%).

Furthermore, it was also observed that those with access to electricity limit their electricity use for lighting, entertainment, and communication to minimize electrical consumption. Only those in a higher income range use electricity for comfort and convenience. Electricity usage varies across family income, with the more affluent households having the highest proportion of electricity users (Dacuycuy & Dacuycuy, 2018).

Heat Sources

Table 7 shows the distribution of sources of heat in each barangay. As observed, wood remained the most common heat source for both barangays (average of 89.2%), considering that trees and wooded plants were found everywhere. As fuel, the wood is fired into local versions of stoves (Figure 1) made from large stones, solid concrete, or metal grills. These stoves are placed in open areas outside the house or in some dirty kitchen known as “abuhan” (derived from the local term “abo” which means ash).

Figure 2 shows the different sources of wood fuel for the two barangays. Most people picked them up around their neighborhood or in the nearby woodlands. Since most families also grow fruit and wood trees in their backyards, these plants provide immediate fuel. Some bought wood fuels

Table 5

Access to Electricity in Sinawal and San Jose

Type of Connection	Sinawal (%)	San Jose (%)	Average
Own Installation	52.40	55.90	54.20
Tapped from Neighbor	34.90	42.40	38.70
No Access	12.70	1.70	7.20
Total	100.00	100.00	100.00

Table 6

Electrical Application of Sinawal and San Jose

Application	Sinawal (%)	San Jose (%)	Average
Light	100.00	100.00	100.00
Entertainment	85.50	87.90	86.70
Communication	78.20	77.60	77.90
Cooking	36.40	12.10	24.30
Housekeeping	25.50	22.40	24.00
Food preservation	7.30	19.00	13.20
Education	7.30	6.90	7.10
Comfort	7.30	6.90	7.10

from nearby "sari-sari" or retail stores. These are chopped wood tied into bundles of different sizes and prices.

At a mean of 54.3%, charcoal followed wood as the most prevalent heat source in the barangays (Table 7). Charcoal is manually produced using a method called pit-and-pile. In this technique, a pit is dug, wood material is stacked inside, and after initial ignition, the pit is covered with earth, which serves as a shield against oxygen and excessive heat loss. The pit method is the oldest carbonization system and is perhaps used to make more charcoal than any other method (Food and Agriculture Organization of the United Nations [FAO], 2018). From Figure 3, most of the barangay respondents bought charcoal from nearby stores. Only a few made their charcoal products.

Furthermore, only a small percentage of respondents (19.3%) used electricity for heating. Common electrical devices include rice cookers and water heaters. Lastly, a meager portion of the respondents (9.0%) used liquefied petroleum gas (LPG), which is a generic term for a mixture of ethane and butane that can exist in the liquid phase under low pressures at ambient temperatures (Falkiner, 2019).

Struggles and Strategies in Obtaining Energy

Among the sources of heat cited, electricity would be the most convenient to use, especially in areas with increasing agricultural and commercial production. Large multinational companies growing tropical fruits like banana and pineapple recently took root in Sinawal and San Jose, offering tremendous job opportunities for many locales. These jobs include laborers for planting, field maintenance and harvesting, machine operators, guards, and office clerks. Electrical devices would be a handy means for preparing their meals, mainly since agricultural production operates at hours earlier than commonly practiced in urban areas. However, as earlier discussed, only a few households had access to electricity. Those with private connections or a "series" connection with their neighbor would instead utilize power for more basic and practical uses like lighting.

Wood was the preferred heat source as the source materials were found throughout the barangays. However, gathering wood is a big struggle for many households as the material is heavy. Since the fathers were mostly on the farm or at work, the women and children shouldered the burden of looking around for wood fuel. If they

Table 7

Source of Heat in Sinawal and San Jose

Heat Source	Sinawal (%)	San Jose (%)	Average
Wood	93.7	84.6	89.2
Charcoal	47.6	61.0	54.3
Electricity	31.7	6.8	19.3
Liquefied Petroleum Gas (LPG)	9.5	8.5	9.0

Figure 1

Local makeshift stoves: three large stones to hold the pot (left), and the "abuhan" or dirty kitchen (right)

were not available in their yards or neighbors, they would be forced to search in the hillsides and wooded areas (Figure 4). On top of the hardship of cutting down tree branches and carrying the wood back into their homes long distances, they also faced the perils of climbing steep roads, walking amidst tall grasses, and encountering dangerous animals. These struggles are even intensified during monsoon seasons when wood becomes soaked in rain, rendering it hard to ignite and unusable as fuel.

In the case of a public elementary school in San Jose, wood fuel is an essential daily need as the school administrators need it for their feeding program. Daily, the school feeds at least 200 kids classified as "severely wasted" or too thin or small for their age (WHO, 2018). In the country, malnutrition among children is very rampant as caused by interrelated factors related to health, physical, social, and economic nature. Despite abundant food supply and distribution, the subsequent inadequate intake of food and nutrients leads to malnutrition (FAO, 2010). Other reported causes are poor care practices, lack of access to health services, and unsanitary conditions (UNICEF, 2018).

To realize the school's feeding program, the teachers, students, and the surrounding community worked hand in hand, especially in coming up with the required quantity of wood fuel (Figure 5). Usually, the kids were asked to bring in wood, which they got from their homes; in worst

Figure 2

Sources of wood fuel in Sinawal and San Jose

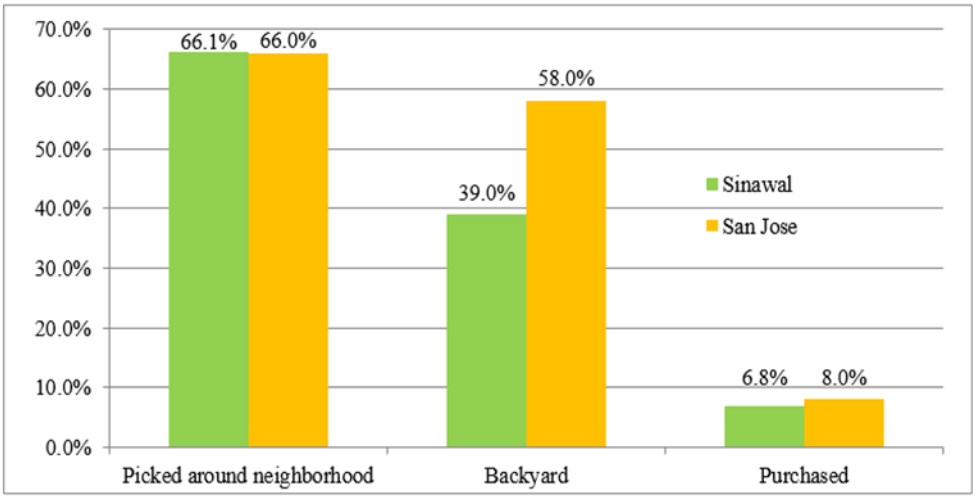
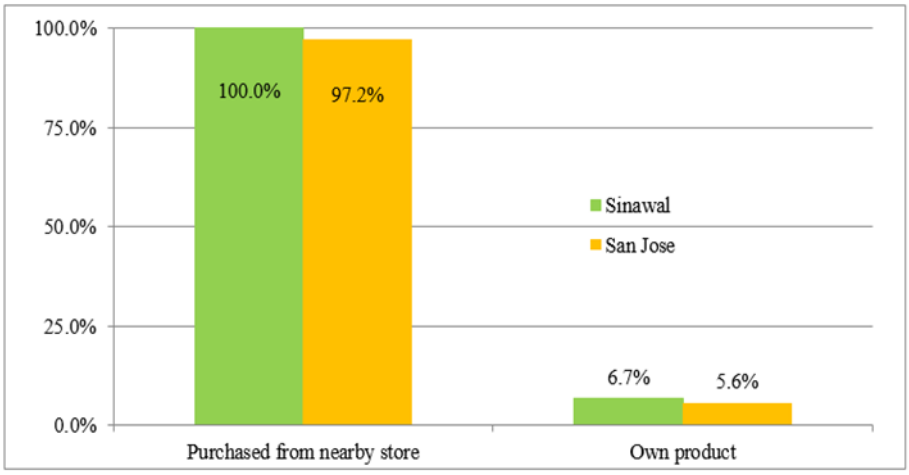


Figure 3

Sources of charcoal in Sinawal and San Jose



cases, they would take a chip from their wooden fences and dilapidated fixtures to develop the requirement. Daisy, one of the teachers in the school, shared that the students often complained about it, saying, "Ma'am wala man gani mi kahoy sa balay, magdala pa mi" [Ma'am, we do not even have wood fuel at home, and yet we have to bring some]. If worse comes to worst, she would have to ask her pupils to bring animal manure for fuel since cattle dung is abundant in the locality.

Unfortunately, the soot and smoke emitted from the wood fuel also bring in health issues, as observed by the respondents. Inhaling fine particles from smoke can cause respiratory and cardiovascular diseases (Seaton et al., 1995). Cooking with solid fuels is a major source of one of the world's biggest killers – household air pollution (Sibiya et al., 2017). Health improvement outcomes are likely when clean cooking programs focus on fundamentally clean fuels, such as LPG, electricity, biogas, or ethanol (Rosenthal et al., 2018). Good health is crucial as household livelihoods rely on the health of family members. Being ill because of inhaling indoor smoke or having to care for sick children reduces earnings and leads to additional expenses for health care and medication. Broken bones, backache, and snake bites endured during fuel collection add to the problem (Rehfuess, 2006).

Next to wood, charcoal was the most common fuel for cooking in Sinawal and San Jose. Proximity to the source, transportation of wood material for charcoaling, and unavailability of usable wood during rainfall periods were also prevalent concerns in the area. The most pressing issue was charcoal production, which poses several environmental problems. Locally, the City Ordinance #12 series of 2008 has set and imposed

Figure 4

Typical rural community: dilapidated houses (left) and rolls of woods and grassland (right)

guidelines for the green charcoal process as mandated by Republic Act 9003, otherwise known as the "Ecological Solid Waste Management Act of 2000". According to local officials, only multiplier trees can be used for charcoal production. These trees, such as ipil-ipil (Leucaena leucocephala), typically grow fast, quickly regenerate branches, and have broad foliage (Lukehurst & Bywater, 2015). Due to restrictions on cutting and trimming trees, charcoal-making activities had also declined in the barangays.

Like wood, charcoal emits soot and smoke when burned, which are health and environmental hazards (Zhang, 2012). Moreover, charcoal has the added disadvantage of being tender and brittle. When improperly handled, charcoal easily crumbles, resulting in shards and fines that are no longer serviceable as fuel materials. These bits and pieces are obliviously disposed of, causing more hazards. It further implies that a substantial number of resources have also been wasted.

Meanwhile, the people of Sinawal and San Jose do not commonly use liquefied petroleum gas, mainly because of the cost. In addition to the high cost of tank and gas, refilling or replacing an empty tank is cumbersome as stores offering such service are not readily accessible. Locals also have anxieties about potential explosions caused by gas leaks.

The most serious issue about the heat source mentioned earlier is the cost of acquiring them. Table 8 shows the estimated weekly expenses incurred for purchasing wood or charcoal or for refilling/replacement LPG. These estimates were provided by the respondents who were using such heat sources. LPG was very expensive at an average cost of PhP779.67, transportation costs included. This amount is 7.24 times greater than wood (PhP45.82) and 17.0 times greater than charcoal (PhP107.73). Though the latter are both biomass materials, they are still purchased from nearby stores during rainy seasons or when households run out of stock.

From the results, the energy portfolio of households for cooking in these communities is described by energy-switching and energy-stacking strategies. The households in both barangays utilize combinations of energy sources for cooking. For cooking, fuelwood was most used by more than half of households in the country (54% of the total households in 2011 and 55%in 2004) (PSA, 2013). Most households use wood fuel as a primary or secondary fuel source. Most households exclusively use traditional fuel (wood and charcoal), while those who use modern fuel (LPG and electricity) combine it with conventional fuel.

The energy choices of households in urban and rural areas have different patterns. Several factors influence energy choices. Energy choices can be explained using a conceptual framework for the analysis of household decision behavior based upon three layers of factors: (1) the household external biophysical environment, (2) the household external political and institutional-economic decision context, and (3) the household internal opportunity set (van der Kroon et al., 2013).

In the case of San Jose and Sinawal, the energy choice was mainly influenced by the cost and availability of the fuel. According to Hosier and Dowd (1987), as cited in Dacuycuy and Dacuycuy (2018), the energy-switching strategy is

Figure 5

Feeding program facility of a public elementary school in San Jose: feeding center (left) and the kitchen area with a large concrete stove (right)

conceptualized by the energy ladder model, which assumes that households behave as neoclassical consumers so that their demand for cleaner and safer energy sources increases with income. The strong reliance of the households on wood fuel is primarily influenced by the cost of the other sources of energy and the average monthly income of the households. Households that used LPG and electricity as the source of fuel for cooking were those in the higher income bracket.

Lastly, the energy consumption behavior of the community can be explained with the multifuel model, which argues that: a) the irregular and variable income flows of households (derived from agricultural work or informal selling of goods) prohibit the regular consumption of modern energy, b) the supply of modern fuels is erratic and the reliability of supply channels low, hence households must have one or two fuels that can be used as backups if their primary fuels are temporarily unavailable, and c) the fluctuations of commercial energy prices might make the preferred fuel temporarily unaffordable (van der Kroon et al., 2013).

Conclusion

Access to electricity remains a pressing issue that must be addressed in General Santos City, Philippines, specifically in the rural communities of barangay Sinawal and San Jose. Only half of the respondents had private electrical installations, while the remaining half had none or were connected in "series" with their neighbors. Only a small percentage used electricity as a heat source because wood and charcoal were preferred due to the availability of source materials. However, due to problems brought about by the occasional rains, the grassy and sloping terrain in the areas, their potential environmental and health hazards, and the restrictions set by local laws, these fuels are becoming more unattractive and discouraging, especially to women and children who bore the burden of searching for them. Liquefied petroleum gas would have been a more convenient alternative if not for its high cost and explosive nature. Therefore, there is a need to design a program or system to make such heat sources more available to rural communities; otherwise, key people should look for more strategies to ease the difficulties encountered in acquiring the present fuels.

Recommendations

Based on the respondents' sentiments and actual observations, installing more electrical lines would have eased the struggles of the residents in the rural communities. Due to high installation costs, a more friendly means of repayment, such as on a staggered basis, may be implemented to encourage a more personal electrical connection. Installing community-level solar-powered lighting or wind-powered water pumps in the nearby rivers and water sources could also help ease some of their day-to-day burdens and address some needs. More extensive rural energy education and training programs may be conducted, particularly on renewable sources, since these are abundant in the areas. Since many of the residents have yet to attain higher levels of education, existing programs and future initiatives should be packaged in more comprehensible and doable ways for the locales. Since these issues are complex and involve several physical, social, political, and economic considerations, frequent dialogues among officials and between officials and residents could pave the way for a clearer understanding of pressing needs and actions that need to be undertaken.

Author's Contribution

GPP served as the project leader and primary author of this research paper. As study

Table 8

Estimated Fuel Cost (PhP) per Replacement/week in Sinawal and San Jose

Energy Source	Barangay	Min	Max	Average	Grand Average
LPG	Sinawal	496.00	1,000.00	779.33	779.67
	San Jose	500.00	1,000.00	780.00	
Wood	Sinawal	10.00	500.00	54.96	45.82
	San Jose	10.00	75.00	36.67	
Charcoal	Sinawal	20.00	400.00	117.96	107.73
	San Jose	10.00	400.00	97.50	

leaders in the project, MOS assisted in conducting the research and writing the full paper, while VAH helped in the actual fieldwork and interviews.

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