



# **Influence of the Socio-Economic Profile of the Head of Household on Domestic Energy Use for Cooking in the City of Uíge, Angola**

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. Authors Monizi Mawunu, AETM, IJB, and NFEM participated in the data collection. Author MM designed the study, performed the statistical analysis, wrote the protocol and the first draft of the manuscript. Authors Masidivinga Landu managed the analyses of the study. Authors Monizi Mawunu, Masidivinga Landu, Mayi Mbemba, Mbumbu Luswamu, NKN, LN and FLL managed the literature searches. All authors read and approved the final manuscript.*

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## ABSTRACT

The city of Uíge, capital of the province of Uíge in northern Angola, presents a diversity of lifestyles, socio-economic levels and domestic energy sources for cooking. The present study aimed to identify the different domestic energy sources used in cooking operations in households in the city of Uíge, both in urban and peri-urban areas, as well as the reasons for their choice. By means of a semi-structured survey, 384 heads of households residing in three neighborhoods of the city of Uíge were interviewed, 96 (Kituma), 192 (Papelaço) and 96 (Popular No. 1). The majority of households in the city of Uíge are headed by men (75%), 77% in Papelaço; 78% in Popular No. 1; 69% in Kituma. 98% of the men are literate, the majority having attended junior or senior-high school (50%) and higher education (34%). Only 84% of female heads of household are literate, 30% have attended junior-high school and 22% adult education. In addition, the majority (55%) of households in the city of Uíge use Liquefied Petroleum Gas (LPG) for cooking. LPG is the main source of domestic energy for public servants (79%) and traders (66%) in the city of Uíge. Firewood is the main (54%) source of domestic energy used by small farmer households. But, 79% of households headed by university students cook mainly with LPG. In addition, 67% of heads of households with senior-high school and 41% with junior-high school use LPG as their main source of household energy. On the other hand, about 60% of illiterate people use wood as their main source of energy. In contrast, none of the head of households with higher education level use firewood to prepare food. Moreover 68% of the respondents' grill or roast with charcoal because it gives a better taste to the food and 25% of the respondents do so because of culinary or cultural habits. Charcoal is the main energy source (89%) for grilling and roasting. Households that cook with charcoal and firewood spend US\$ 59.63 per month compared to US\$ 13.24 for those who use LPG. Making modern commercial energy equipment available to all Angolan households would help low-income and poorly educated households to use the clean, modern energy they crave for cooking. Econometric studies should be conducted to estimate the correlation between household energy consumption and the number of inhabitants per household, for example.

*Keywords: Cooking energy; household profile; socio-economic level; Uíge city; Angola.*

## 1. INTRODUCTION

Most of the meals consumed by households, both locally and globally, are cooked, fried or grilled in gas or electric ovens, on braziers or even on firewood, using the various sources of domestic energy available and accessible physically or financially in the area where they live.

According to Mrs. Indira Gandhi, life and food are inseparable, like a hymn from the ancient wisdom books of India. Wisdom of India, the Upanishads, says that from food all creatures that live on earth are born, then they live on food and when they die, they return to food [1]. About 90% of staple foods for human consumption are cooked before they are eaten [2]. Furthermore, according to the World Health Organization (WHO) [3], energy used by the human population is a matter of vital importance as it is useful for various purposes such as cooking, heating and income generation, etc.

Furthermore, the WHO [3] emphasizes that energy is essential to meet the basic needs of

human daily life, to improve health, education and to increase the productivity of labour and capital.

On the other hand, more than three billion people in the world do not have access to modern energy sources (electricity, liquefied petroleum gas and kerosene) for cooking or heating. Poverty condemns almost half of the world's population to use traditional solid fuels such as biomass to meet their basic household energy needs for cooking [3,4]. According to the International Energy Agency (IEA) [5] and SCHURE et al. [6], more than 60% of the African population lives on less than two dollars a day and, so far, fuelwood accounts for 60-80% of cooking fuel consumption in sub-Saharan Africa, with, 93% of households in rural areas and 58% of households in urban areas using it as their main energy source.

According to the World Bank Group [7], more than 700 million Africans (82%) use solid fuels, such as wood, charcoal, dung, crop waste and coal, for their primary cooking needs - a number that will rise to 850-900 million by the end of the decade.

Only 11% of Africans use "clean" stoves that run on modern fuels, such as liquefied petroleum gas (LPG) (5%) and electric stoves (6%), as their primary cooking appliances. Paraffin, which is used by 7% of Africans, is unlikely to be considered a clean cooking solution in many cases, given the growing evidence of damage caused by typical paraffin stoves in Africa [7].

Angola has a lot of energy potential, second only to Nigeria as an oil producer in sub-Saharan Africa, with 1801 thousand barrels of crude oil produced per day [8], abundant water resources and immeasurable solar energy capacity, and also about 70-80% gas associated with oil combustion [9].

Paradoxically, the country ranks among the top twenty users of traditional fuels in the world [10]. In Angola's peri-urban areas, charcoal and firewood provide 50-75% of household energy [11]. According to the World Bank Group [7], in urban areas, LPG/LNG/Biogas is the main (59.5%) source of household energy in Angola.

This is followed by charcoal (25.2%), firewood (8.0%), paraffin (4.1%), electricity (1.7%), agricultural waste/straw (0.2%) and other types of energy (1.3%).

For cooking, Angolans often use a combination of two or three domestic energy sources to meet their basic needs. Household energy consumption for cooking operations varies according to the household income level of the head of household, the availability and cost of fuel, the level of education of the head, the price of household cooking equipment, the size of the household, cooking habits or cultural preferences and economic issues. This makes the choice of household energy sources a complex decision to make, as it would be influenced by the different factors mentioned above [11-13].

The present study aims to identify the factors that influence the choice of different domestic energy sources used in cooking operations by urban and peri-urban households in the city of Uíge.

## **2. MATERIALS AND METHODS**

### **2.1 Description of the Study Area and Selection of Respondents**

The city of Uíge has a quadrilateral shape, with a surface area of 2,500 km<sup>2</sup> that extends between parallels 5° 50 and 7° 20 of southern latitude,

and meridians 14° 50 and 17° 10 of eastern longitude.

The studies were conducted in the province of Uíge, which is located in the extreme north of Angola, bordered to the north by Kongo Central province of the Democratic Republic of Congo (DRC) and east by Kwango province of the DRC, to the south by the provinces of Malanje, Cuanza Norte and Bengo, and to the west by the province of Zaire. It has a population of over 600,000 inhabitants [14]. The town of Uíge is the capital of the province and municipality of the same name. Its population is mainly made up of Bantu from the Bakongo ethnolinguistic group. The town is home to three higher institutions (Kimpa Vita, Institut Supérieur des Sciences de l'Education and Institut Supérieur Polytechnique Privé de Uíge). Self-sufficiency agriculture is, apart from trade and the civil service, the main economic activity generating employment and income [15]. The municipality of Uíge belongs to Angola's agroecological zone 4, known in Portuguese as Zona agroecológica Caféicola Dembos Uíge.

According to the Köppen climate classification, the province has a tropical wet or dry or savannah climate Aw [16]. This so-called Guineo-Congolian rainforest climate is characterized by a rainy season [17]. The rain and the dry season which could be subclassified into a dry season between from mid-May to mid-September or October, called locally "Cacimbo in Kimbundu language" or Sivu also Mbangala in Kikongo language and a small dry season between the months of January and February (Kunde or Kuluta in Kikongo language). Also, the rainy season, lasting from 7 to 8 months depending on the years it is segmented into two Agricole sub-stations, sub-station A- that goes from mid-September or October to January (Masanza in Kikongo language), and Sub-station B- that goes from February or March to mid-May (Kitombo in Kikongo language) [18,19]. The study zone is characterized by a high complexity since elements of both formations are present. Edaphic conditions and the associated diverse topography strongly influence the formation of the distinctive vegetation mosaic patterns [20]. The hydrography of Uíge is one of the richest in Angola, composed of rivers, streams, lagoons and marshy areas. The relief consists of plains, hills and mountains. The economy of Uíge province is mainly based on subsistence agriculture, livestock, hunting and small trade [19].

Random sampling was used to conduct the research for this work. The data for this study were collected between June and December 2015. The choice of the study area was made after a pre-survey that confirmed the existence of different types of domestic energy used by households in the city of Uíge. Respondents were selected according to their availability. The method adopted for data collection is the socio-economic survey applied by Monizi et al. [21,22]. It consists firstly of drafting a questionnaire that allows for a better understanding of the different types and uses of household energy in the study area.

Also, data collection was carried out through direct observation in the field and individual interviews with heads of households or their wives.

## 2.2 Questionnaire

The survey questionnaire was divided into two sections: (1) data on the head of household (gender, education and main source of income); (2) the second is related to the household energy sources used for cooking (know the type of household energy equipment: electric stove, gas stove, kerosene stove, cooker, gas bottle, etc.). In addition, the survey was based on purposive sampling. Eligibility criteria were head of household, resident status in Uíge and availability for anthropological surveys. Direct observations and the semi-structured questionnaire were submitted orally to the different informants.

## 2.3 Socio-Economic Surveys

The survey interviewed 384 heads of households in the city of Uíge, of which 288 were men and 96 were women, ranging in age from 20 to over 63 years and with different levels of education. The individual anthropological interviews were conducted in Portuguese, the language spoken by the respondents.

The surveys took place in three neighborhoods of the city of Uíge, namely: Popular No. 1 (rich or affluent neighborhood), Kituma (poor neighborhood) and Papelão (middle

neighborhood). The number of surveys conducted, as well as the margin of error for the calculation of the proportions for each neighborhood, with a confidence interval of 95%. The sample size was determined according to the population density of the three selected neighborhoods based on data from the National Institute of Statistics of Angola [23]. The sample size was calculated using the following formula:

$$n = \frac{(1.96)^2 * N}{(1.96)^2 + I^2 * (N - 1)}$$

Where

N = Population size and I = Margin of error

Table 1 shows the number of households interviewed in the three neighborhoods (Kituma, Papelão, Popular no. 1) of the study area.

## 2.4 Statistical Analysis

The socio-economic data in this study were analyzed using Statistical Package for Social Sciences (SPSS, Inc., Chicago, USA) version 25.0, Microsoft Excel 2013 and Origin 8.0.

## 3. RESULTS AND DISCUSSION

### 3.1 Socio-Economic Profile of Informants

Table 2 shows the socio-economic characteristics of the heads of households surveyed in the three neighborhoods of the city of Uíge.

#### 3.1.1 Gender

The results of this gender study reveal that households in the city of Uíge are predominantly (75%) headed by men in the three neighborhoods studied, 77% (Papelão), 78% (Popular No.1) and 70% (Kituma). On the other hand, only 25% of households are headed by women, of which 23% in Papelão, 22% in Popular No.1 and 31% in Kituma. The predominance of men as heads of households can be justified considering that throughout history, in various societies and particularly in traditional African society, men have occupied the role of household heads.

**Table 1. Representation of respondents by neighborhood**

Neighbourhoods	Frequency (%)	Sample size / Neighborhood
Kituma	25,00	96
Papelão	49,80	191
Popular No.1	25,20	97
Sample	100,00	384

**Table 2. Socio-economic characteristics of informants (%)**

Variables	Parameters (%)	Gender	
		Male	Female
Age range	18-30	27,02	8,62
	31-43	25,01	13,78
	44-53	25,42	36,21
	54-66	15,03	31,04
	> 66	7,52	10,35
Education level	Illiteracy	2,27	15,53
	Adult education	4,68	22,30
	Primary	8,68	11,95
	Junior-high school	29,72	30,03
	Senior-high school	20,57	5,01
Main activities	University	34,08	15,53
	Civil service	59,50	16,30
	Agriculture	15,50	41,40
	Trade	10,50	33,80
Residence areas	Other activities	14,50	8,50
	Popular No. 1	77,56	22,44
	Papelão	76,52	23,48
	Kituma	68,97	37,94

The results of this study corroborate with those of the national census conducted in Angola in 2014 by the National Institute of Statistics of Angola [23], which showed that the majority of household heads in Angola are men (62%), and barely 38% are women.

### 3.1.2 Age range

The results of this study on the age range (Table 2) show that, on average, female heads of household are older (49.50 years) than men (41.90 years).

Additionally, the data reveal that the majority (52%) of male heads of household in the city of Uíge are between 18-43 years old; 40% are between 44-66 years old and 8% are over 66 years old. On the other hand, the majority (67%) of female heads of household are 44-66 years old, 22% of women are aged 18-43 (young) and barely 10% are over 66 (old). From the above, the results reveal that there are more young men heads of household than women, which is why there are more elderly women than men; this may be related to the war which contributed to the death of many men in the decades of 70-90.

### 3.1.3 Education level

The results in Table 2 show that most (91%) of the heads of household can read and write, both for men and women.

Of the 98% of literate men, 34% have higher education, 30% have junior-high school (7-8 grades), 20.57% have senior-high school (10-12 grades), 9% have primary school and 5% have adult education. In contrast, only 2% of male heads of household are illiterate.

In relation to women, 84% of heads of household are literate; in which, 30% have attended junior-high school; 22% have attended adult education; 16% senior-higher school and 12% primary education. The results in Table 2 reveal that female heads of household have the highest illiteracy rate (16%) than men (2%). The results of this study corroborate with several studies which have reported that women have lower school attendance than men. According to the United Nations Educational, Scientific and Cultural Organization's Institute of Statistics

[24], worldwide, of the 757 million illiterate adults, two thirds (63%) are women and 37% are men. Furthermore, the National Institute of Statistics of Angola [23], reported that of the 34% of illiterate adults in Angola, two-thirds are women. This could be explained by the fact that Angola has experienced 30 years of civil wars which prevented many people from going to school. In addition, the local culture is that men go to school more than women because they are the future head of the household. Finally, the limited supply and availability of schools and study facilities (in the area of residence of these people) when combined with data on the average

age of the respondents, in addition to their own socio-economic and cultural condition may justify this observation.

### 3.1.4 Main sources of income by gender

In order to adequately meet basic needs, it is mandatory for the head of a household to have an income-generating activity, both individually and collectively. The results of this study (Table 2) show that the main source of income for men (60%) is civil service, while for women it is subsistence farming (41%). This can be explained by the fact that the majority of male heads of household have senior-high school or higher education, while most of women have a low level of education. Generally, people without qualifications take refuge in less productive and less remunerative jobs, namely agriculture, handicraft and petty trade. These findings corroborate with studies by the International Labour Office [25], which report that women are generally limited, resulting in a lower chance of finding a good job and expecting a higher income.

### 3.2 Main Domestic Energy Sources

Households in the city of Uíge use several domestic energy sources for cooking. Modern energy sources other than electricity (55% liquefied petroleum gas and 10% paraffin) represent the largest (65%) source of cooking energy used by households in Uíge.

In addition, 29% of respondents use traditional domestic energy for cooking, including 16% firewood and 10% charcoal. In addition, only 6% of the households surveyed cook with electricity. Consequently, households that use firewood as their main source of energy for cooking are mostly headed by women or farmers, or people with low levels of education. At the national level, [7], the main domestic energy sources used by urban households in Angola are LPG/LNG/Biogas (60%), charcoal (25%), firewood (8%) and Kerosene (4%). In contrast, the main domestic energy sources used in the Democratic Republic of Congo (DRC) are charcoal (52%), firewood (36%) and electricity (11%) [7]. The disparity of domestic energy sources for cooking in the two different countries can be explained by each country's domestic energy policies.

According to Schure et al. [6], the majority (95%) of the population of the city of Kisangani in the

DRC uses traditional energy, charcoal (72%) and firewood (23%) for cooking. Moreover, in Sahelian countries, fuelwood has the advantage of being accessible to poor and low-income populations, the majority of peri-urban households. It is also undoubtedly the cheapest and most affordable fuel for poor urban households. Charcoal can be purchased on a daily basis, and can be adapted to the often minimal and daily income conditions of poor families [26]. According to OECD/IEA [11], the poorest domestic energy consumers (farmers, illiterates, etc.) generally only seek to meet their most basic needs with biomass.

And the affordability of the equipment is as important as the affordability of the fuel that powers it. Energy poverty forces households with limited financial resources to resort to traditional energy sources that pollute the environment and human health. The eradication of poverty requires first and foremost the fight against polluting domestic energy.

#### 3.2.1 Main factors motivating the choice of energy sources

The choice for one or more domestic energy sources for cooking by urban households involves important decisions. Generally, this choice is related to the socio-economic profile of the head of household, the amount of food to be prepared and the type of utensils used. The main reasons for choosing domestic energy sources for cooking in households in the city of Uíge are: physical or financial accessibility (74%), comfort (10%), sustainability of fuels (8%), cleanliness (4%) and speed (3%).

#### 3.2.2 Combination of energy sources

The combination of different energy sources for cooking is a very common practice in households in the city of Uíge, regardless of the socio-economic level of the household heads. It was observed that even in households that use clean energy (liquefied petroleum gas and electricity) for cooking, the grilling of fish, chicken and meat is done with charcoal. This behavior was observed in the neighborhoods surveyed in the city of Uíge, from the wealthy neighborhood (Popular No. 1) to the poor neighborhood (Kituma).

Great part of the households (81%) surveyed in the city of Uíge use a combination of energy sources to cook their food regardless of the area

of residence. In the affluent neighborhood (Popular No. 1), the main (95%) energy combination used for cooking food is LPG with charcoal, while 5% use electricity, paraffin and charcoal.

Furthermore, the most frequent domestic energy combinations for cooking food in the intermediate neighborhood (Papelão) are LPG + charcoal (77%), while 23% of households combine electricity, charcoal and firewood for cooking. In Kituma (poor neighborhood), the main (71%) household energy combination used is paraffin, firewood, charcoal), while 29% of households cook with the combination of LPG and kerosene. From the data above, it is worth noting that, for cooking meals, households in the city of Uíge use one or more combinations of different energy sources adapted to their culinary needs, cultures and physical or financial energy constraints.

According to the World Bank Group [27], the price of fuel, desired comfort level, cooking preferences or practices, and the cooking equipment available (stoves, pans, etc.) on the market all play a role in determining how food is cooked. In addition, according to OECD/IEA [11], Angolans most often use a combination of two or three energy sources to meet their basic cooking energy needs.

**3.2.3 Household energy sources for grilling and roasting**

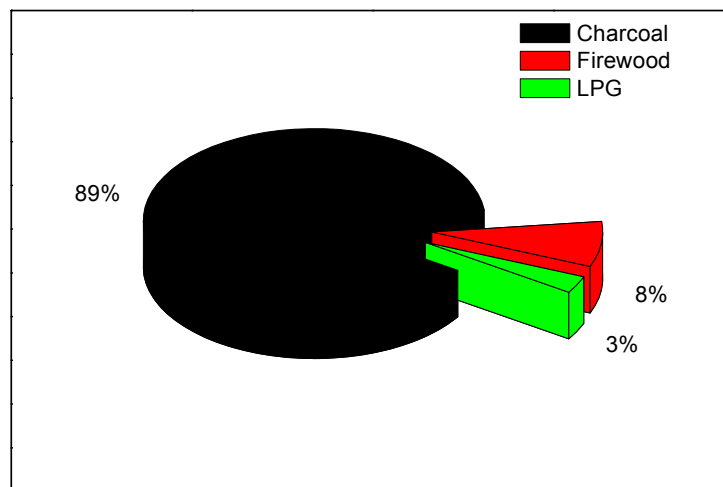
Fig. 1 shows the percentage distribution of households by main energy source used for grilling and roasting selected foods.

The results in Fig. 1 reveal that charcoal is by far the main (89%) source of household energy for grilling fish, fresh maize, plantains and tapioca or cassava (Kedi in Kikongo language). Charcoal is also used to roast chickens and meat. On the other hand, firewood (8%) and liquefied petroleum gas (3%) are the other domestic energy sources for grilling and roasting food in Uíge.

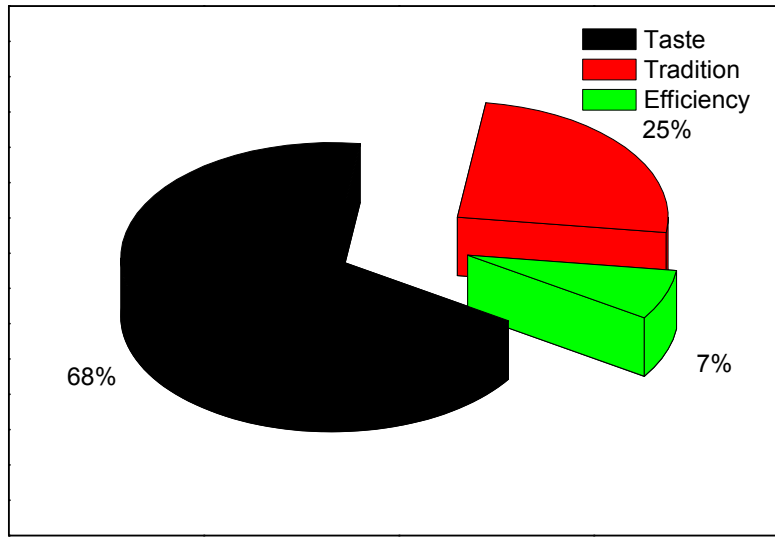
**3.2.3.1 Main reasons for grilling or roasting with charcoal**

Fig. 2 shows the main reasons why households in the Uíge city use charcoal for grilling or roasting fish, chicken, meat, maize, plantain or tapioca (Kedi in Kikongo language).

Fig. 2 shows the main reasons why households grill certain foods with charcoal. Irrespective of their area of residence and socio-economic profile, 68% of the heads of households interviewed said that they grill or roast with charcoal because it gives a better taste to the food, while 25% of the respondents do so out of respect for their tradition, custom and culture, i.e., their culinary or cultural habits and individual preferences. On the other hand, 7% of the respondents interviewed stated that they grill and roast on charcoal because of the speed and efficiency of this energy source. According to the IEA [5], in some cases, tradition determines the choice of energy source, regardless of its availability on the market or the income of consumers. For example, some wealthy families continue to buy charcoal for certain types of cooking, such as grilled fish. Finally, our results



**Fig. 1. Main energy sources used for grilling and roasting (%)**



**Fig. 2. Main reasons why households use charcoal for grilling or roasting food (%)**

show that the use of charcoal for grilling and roasting in the households of the city of Uíge will continue for a long time because users are motivated by tradition and culture. On the other hand, deforestation due to firewood collection and charcoal production for cooking is difficult to stop in this region.

### 3.2.3.2 Domestic energy sources for cooking at different events

In all societies of the world, there are happy or unhappy moments that bring families, friends, acquaintances, etc. together. In the town of Uíge, during ceremonies such as weddings, funerals, etc., the local custom or tradition is to offer a meal to the guests or comforters.

The results of this study show that traditional household energy (charcoal and firewood) is the most used (97.5%) during funerals, weddings, etc. There are several reasons for the use of these two fuels, firstly, the meals are cooked in the open air and secondly, large quantities of food are prepared to satisfy the guests or comforters which requires the use of large pots. The results of this study corroborate those of the World Bank [28] who reported that the use of firewood for cooking during traditional ceremonies is a very common practice in sub-Saharan Africa. For example, in Djibouti, during wedding and mourning celebrations or ceremonies, meals are prepared with firewood. According to FAO [1], wood is readily available and its use for cooking allows for rapid cooking.

### 3.2.3.3 Main people responsible and ways of acquiring household energy for cooking

Fig. 3 shows the household members responsible for purchasing or harvesting household energy for cooking.

The data in Fig. 3 shows that women are the main (49%) responsible for the acquisition of cooking fuel in households in the Uíge city, followed by girls (22%), boys (17%) and fathers 7%. Finally, children occupy barely 5%.

As for the modes of acquiring domestic energy for cooking, the great majority (84%) of households acquire their energy for cooking financially, while 16% of households acquire it through physical accessibility - the collection of firewood. The collection or gathering of firewood is most accentuated for peasant households and/or those headed by illiterates, as they would be severely constrained by financial resources. Women and girls are mainly (99%) responsible for collecting or gathering firewood in poor households.

Women and girls are primarily responsible for collecting or gathering firewood in Songololo territory, Central Kongo province in DRC [29] and globally [3].

### 3.2.4 Responsible for cooking food

The results of this study on those responsible for cooking the food show that in households in the



town of Uíge, the great majority (93%) of meals are cooked by women and girls. In the case of funerals and weddings, all the meals (100%) are cooked by women.

It should be noted that in the African tradition and more particularly among the Bantu of the Kongo ethnolinguistic group (Bakongo), cooking is a cultural heritage of women and their daughters [22]. Female children are initiated into culinary tasks from their early childhood. It is said that a young girl who cannot cook is a disgrace to her family and especially to her mother. Moreover, in rural areas, the choice of a girl to marry depends largely on her cooking skills; in short, on her ability to run a household, especially the kitchen.

### 3.2.5 Average acquisition cost of the main cooking energy sources

The cost of energy for cooking depends on the market price and the cooking equipment. The results of this study show the estimated average costs of cooking with the different domestic energy sources per day and month.

On average, households that cook with charcoal and firewood spend USD 59.63 per month compared to only USD 13.24 for those using LPG. Translated per day, those using biomass (charcoal and firewood) spend an average of USD 1.99 per day while households that use LPG as their main source of energy for cooking spend only USD 0.44. From our results, it can be seen that households in Uíge who chose to cook with traditional energy spend about 4 times more money per day than those who use modern clean energy, LPG. Unfortunately, the great

majority of those using polluting traditional sources of energy are peasants and heads of households with little or no education and living in poor neighborhoods. Domestic energy for cooking in the city of Uíge is a major expense for poor households. The results of this study corroborate the studies of Barnes [30] who reported that for the same energy service (lighting or cooking), the poor pay several times more than others. On average, poor urban households spend about 20% of their income on cooking fuels, especially traditional fuels. According to the WHO [3], poor families tend to spend a higher proportion of their income on energy than wealthier households.

### 3.3 Relationship between Gender of Household Head and Main Source of Energy for Cooking

Fig. 4 shows the possible close relationship between the gender of the head of household and the main source of household energy for cooking.

Fig. 4. shows that overall, male-headed households use more modern energy (LPG and electricity) than female-headed households, 66% and 47% respectively. On the other hand, traditional energy (firewood and charcoal) is used more (38%) by female-headed households compared to 25% by male-headed households. This could be explained by the fact that, generally, female heads of households depend on agriculture as their main source of employment and have a low level of education, which prevents them from getting good jobs and are poorer than their male counterparts.

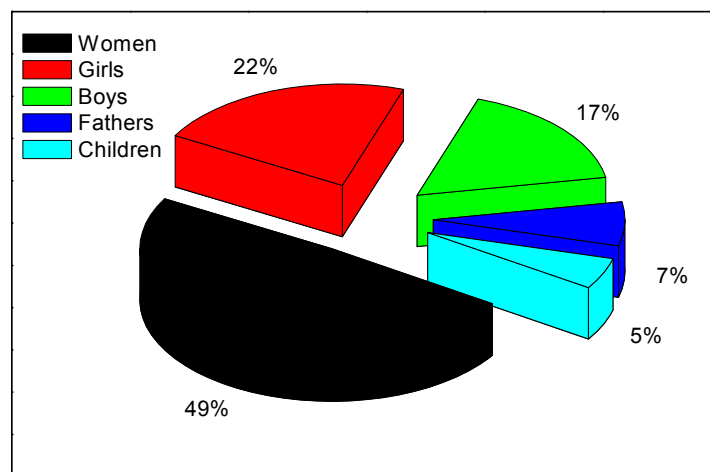


Fig. 3. Those responsible for acquiring energy for cooking (%)

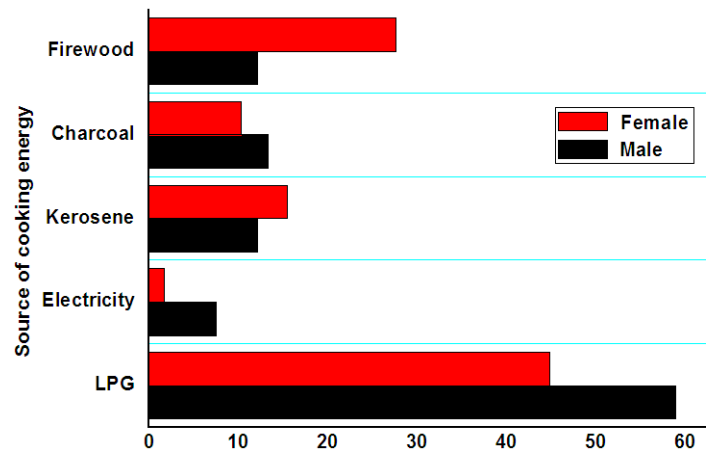


Fig. 4. Main source of household energy for cooking/gender (%)

In sum, the more male a household head is, the more his household will use modern energy to cook its food. On the contrary, the more female the head of household is, the more likely her household will use traditional energy sources such as firewood and charcoal.

### 3.4 Relationship between the Level of Education of the Head of Household and the Main Source of Cooking Energy

Fig. 5 shows the relationship between the level of education of the head of household and the main source of cooking fuel.

The results in Fig. 6 show that the great majority (90%) of heads of households with university education use modern commercial energy, including Liquefied Petroleum Gas (79%) and electricity (10%). Furthermore, 67% of the heads of households had humanities education; 41% had secondary education; 14% had adult literacy school and 14% had primary school. On the other hand, barely 8% of illiterate heads of household use modern domestic energy for cooking.

It should be noted that 20% of illiterate households and 25% of households whose heads have senior-high school use charcoal as a second source of household energy for cooking.

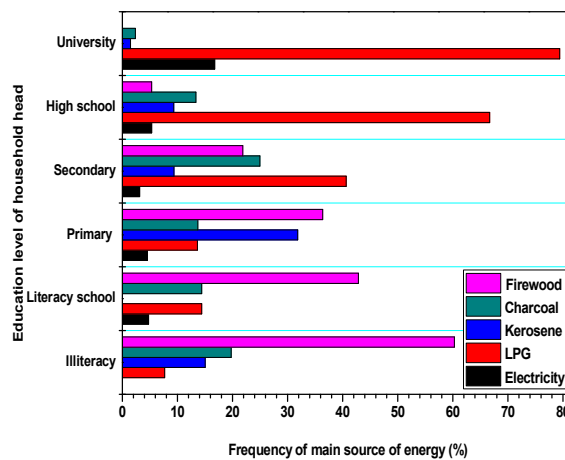


Fig. 5. Relationship between level of education and main source of energy for cooking (%)

The results of this study also reveal that kerosene and electricity are modern domestic energy sources that are not widely used by households in Uíge (Fig. 6).

From data above, it can be noted that the higher the level of education of the head of household, the less his or her household uses traditional energy (firewood and charcoal) as the main source of domestic energy for cooking. Moreover, the lower the level of education of the head of household, the more likely his or her household is to use a polluting source of traditional energy.

Among the households that use wood, about 60% are headed by illiterates; 43% have attended adult literacy school; 36% have attended primary school; 22% have attended junior-high school and 5% have senior-high school. In contrast, none of the headed households with higher education use firewood to prepare food.

### 3.5 Relationship between the Main Source of Income of the Household Head and the Main Source of Cooking Energy

The use of household energy for cooking would be strongly related to the main source of income of the household head.

Fig. 6 shows the possible relationship between the different sources of cooking energy

and the main source of income of the household head.

The results in Fig. 6 show that the great majority (91%) of households headed by civil servant use modern energy, 79% (Liquefied Petroleum Gas) and 12% (electricity) for cooking, compared to 20% of households headed by small farmers. Furthermore, 66% of merchant households use modern energy, compared to 38% of those who carry out other independent activities (handicraft, mechanics, metalwork, etc.). In addition, the majority (54%) of farmer-headed households use firewood as their main source of household energy for cooking food, compared to none of the households headed by public servants. The above observations could be explained by the fact that subsistence farming in the region [18] is a low-income activity, mainly for self-consumption. Despite their good will, small farmer households are forced to cook with firewood as their main source of cooking energy because they are poor. Findings from OECD/IEA [11] report that the higher the income, the more likely a household is to use cleaner, more efficient fuels. Even when households have the economic capacity to purchase cleaner fuels, they may choose not to use them if their price is much higher than that of firewood. The poorest consumers of household cooking energy are usually only interested in meeting their most basic needs: heating, cooking, and choosing their energy sources from among the various forms of biomass.

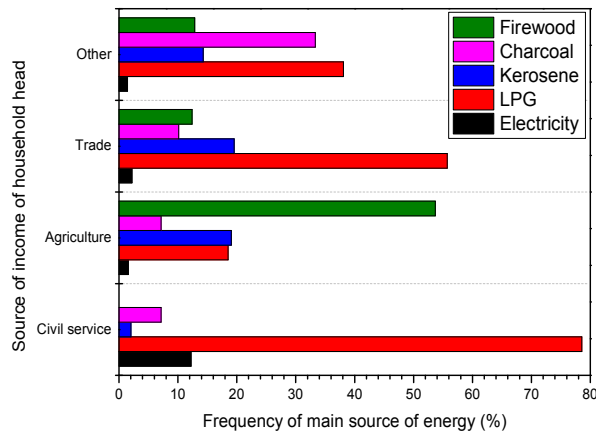


Fig. 6. Relationship between the main source of income of the household head and the main source of energy (%)

In short, access to modern domestic energy sources for cooking is taxed by the unaffordable prices of cooking equipment such as electric stoves, gas stoves, gas bottles, etc. The creation of subsidy policies for such equipment by the Angolan government could relieve poor households and contribute to the reduction of the number of users of firewood as the main source of domestic energy, and in turn reduce the pressure on ecosystems for firewood collection and charcoal production.

### 3.2.6 Relationship between area of residence of households and main source of energy for cooking

The results of this study based on the relationship between area of residence and main source of energy for cooking show that the vast majority (98%) of the households surveyed in the affluent or rich neighborhood (Popular No. 1) cook with LPG or electricity as their main source of household energy.

However, no household in this neighborhood cooks with firewood. Additionally, 56% of households residing in Papelão (intermediate neighborhood) cook with LPG and electricity and 33% with biomass (coal and firewood). The remaining 11% of households use paraffin as their main source of energy for cooking. Finally, the majority (48%) of households in Kituma (a poor, peri-urban neighborhood) cook with biomass (charcoal and firewood) and 36% use LPG or electricity for cooking. Only 16% of households in poor and intermediate neighborhoods cook with kerosene.

The above observations can be explained on the basis of the level of education and the main source of income of heads of households. In Popular no. 1, most households are headed by public servants with senior-high school or higher levels of education, which allows them to hold a well-paid position and easily pay their bills for modern cooking energy. Furthermore, heads of households living in the poor district depend greatly on agriculture as their main source of income and have mostly low levels of education which forces them to choose cheaper but more harmful domestic energy sources.

## 4. CONCLUSION AND PERSPECTIVES

The aims of this study was to identify the factors that influence the use of different domestic energy sources used for cooking operations by

households in the Popular No. 1, Papelão and Kituma neighborhoods of the city of Uíge, as well as to diagnose the reasons that motivate in their choice.

The results of this research show that:

- The majority of households in the city of Uíge are headed by men: 77% in the Papelão neighborhood; 78% in the Popular No. 1 neighborhood and 69% in the Kituma neighborhood.
- The majority of the men have junior and senior-high school (50%), while (34%) have higher education.
- The majority (30%) of female heads of household had junior-high school, while 22% had adult education.
- LPG is the main (55%) source of household energy in Uíge, while 16% use firewood and 10% use charcoal.
- The great majority (79%) of households headed by public servant's cook with LPG and 66% of merchant households and 38% of those engaged in other activities (handicraft, mechanics, masonry etc.) cook with LPG.
- Firewood is the main (54%) source of domestic energy for cooking in farmer-headed households.
- Heads of households with higher education cook mainly (79%) with modern commercial energy, including LPG. Also, 67% of the heads of households with senior-high school and 41% with junior-high school cook mainly with LPG.
- About 60% of households headed by illiterates cook with firewood; 43% have attended adult education; 36% have attended primary school; 22% have attended junior-high school and 5% have senior-high school. In contrast, none of the head of households with higher education level use firewood to prepare food.
- The main (89%) source of household energy for grilling and roasting is charcoal.
- 68% of the households grill or roast with charcoal because it gives a better taste to the food, while 25% of the respondents do so out of respect to their tradition, custom and culture (culinary or cultural habits and individual preferences).
- The average cost on domestic energy expenditure of households in Uíge who cook mainly with biomass (charcoal and firewood) is four times higher (US\$ 59.63) than those who cook with LPG as the main domestic energy source, i.e., US\$ 13.24.

Better education of women especially female heads of households, would contribute to the reduction of physical effort and time spent by women in acquiring domestic energy for cooking of food; decrease the use of polluting domestic energy and the pressure on forest ecosystems, increase the family income of poor households and improve their human well-being.

Moreover, good and inclusive socio-economic policies are developed within the overall framework of a national energy poverty reduction strategy. This strategy will also allow for the equitable distribution of the country's wealth regardless of where people live, the socio-economic level of the Angolan population, and also the high pressure on forest ecosystems. Making modern commercial energy equipment accessible to all Angolan households would help low-income and poorly-educated, small farmer households to use the clean, modern energy they crave for cooking. The creation of a support bank loan for the acquisition of modern cooking equipment for low-income families is a way of restoring their human dignity and sparing them from some of the diseases caused by smoke. Econometric studies should be carried out to estimate the level of correlation between variables such as cooking energy consumption and the number of inhabitants per household.

## DISCLAIMER

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## CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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