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**Original Research Article**

# Determinants of the Behavior of Households in Ouagadougou Regarding the Choice of Cooking Energy

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**Abstract:** The Burkinabe energy context is characterized by a predominance of the use of biomass energies, the country's dependence on fossil fuels, low and inequitable access to modern energies and very low valorization of endogenous renewable energies. Households use these different types of energy for cooking, heating food and heating water. The choice of these energies depends on several criteria. The analysis of the characteristics which can influence this choice is based on the discrete choice model resulting from the hypothesis of utility maximization behavior of the economic agent. This analysis reveals that certain household characteristics including household size, high income and the level of education of the head of household have an effect on energy choice although it is weak. The environmental criterion has no effect on the choice of households and the observation is that the choice of households is mainly based on their desire for comfort. The environmental reason is rarely mentioned. Given the weakness of the vegetation cover in the country, it would be appropriate to intensify the supervision of the wood sector, to strengthen the actions already undertaken (reduction of wood consumption, promotion of energy alternatives, safeguarding and restoration of forests) and the capacities of the actors and finally placed great emphasis on the need to provide quality education to raise popular awareness of environmental issues.

**Keywords**: Energy, Household, Deforestation, Environmental impact.



## INTRODUCTION

Human existence involves the interaction of a wide range of interdependent activities, some of which involve energy resources and the production, transformation and use of energy. Energy consumption is an integral part of the growth process of any economy, whether developed or developing. The international environment has been characterized in recent years by a growing trend in energy demand, a scarcity of fossil energy sources, persistent instability in the main fossil energy production areas with the consequence of a continued rise in prices of these energies, feared climate change and continued environmental degradation. The recent rapid increase in demand for energy and especially for conventional primary energy can be explained in part or entirely by the continued progression of industrialization, per capita income and standard of living, as well as by the increase in number of inhabitants (United Nations. Economic Commission for Africa, 1975). Access to modern energy services has received increasing attention globally in recent years, partly due to its decisive importance for each of the three pillars – economic, social and environmental – of sustainable development this growing interest at the global level has been concretized by Sustainable Development Goal (SDG) number seven (7), which is to "Ensure

access for all to reliable, sustainable and modern energy services at an affordable cost. ". Access to energy is a necessary precondition for economic and social development, both for production activities and for the coverage of basic needs (cooking, lighting, communication, care and education). The share of biomass in the energy balance has been around 80% over the last five (05) years and firewood still remains the main source of energy ahead of charcoal and butane gas. Charcoal is generally used by city households, either exclusively with firewood, or in combination with conventional energies such as butane gas (Ministry of Energy, 2018). Burkina Faso faces increasing consumption of wood and charcoal and this use of wood is not without environmental consequences in a Sahelian country benefiting from only meager rainfall and already suffering from deforestation and degradation of its forests. Added to this is exposure to smoke from these polluting forms of cooking which pose health problems for populations. We are witnessing a widespread awareness of the problem of deforestation, global warming and its consequences on a social, economic and ecological level, among the authorities who are working to encourage the transition to cleaner fuels and cooking facilities. for the benefit of households. Faced with the increasingly growing demand for wood fuels, the Burkinabé State has carried out research actions to reduce the consumption of firewood. The policy proposed for this sector is based on rational and sustainable use of the resource, whether in terms of forest management and the use of improved stoves, but also the introduction of modern fuels such as butane gas and biogas. Thus the emphasis is placed on improved stoves. The "Improved stoves in Burkina Faso" (FAFASO) program, developed in 2005, with the help of German-Dutch cooperation, and considered representative of this intervention, worked on the popularization of improved stoves called "Roumdé" which consume less fuel and emitting less smoke and greenhouse gases. The FAFASO project involves around 75,000 improved stoves that have been manufactured and sold since 2007 (ILO, 2019).

Beyond FAFASO, there is also the National Biodigester Program of Burkina Faso (PNB-BF) which is a state structure having, since 2010, set up and coordinated the sector ensuring the promotion of the biodigester; this device which allows the production of biogas. The program covers the entire country with more than 8,500 biodigesters built and consists of supporting households in the production of biogas for domestic use (lighting and cooking) from livestock excrement (ILO, 2018). As for the butane gas sector, it constitutes the main fuel for households for access to modern fuels for thermal uses. As part of its policy of popularizing Liquefied Petroleum Gas (LPG), the government of Burkina has decided to provide support for consumption by means of a subsidy, knowing that the country does not have any notable source of fossil energy and imports all petroleum products (Uemoa, 2019). Since 2001, the State has implemented a policy to combat desertification by subsidizing household gas purchases by covering part of the sale price of LPG. However, the increase in population and its corollary pressure on resources (wood being the main source of domestic energy in Burkina Faso) and socio-economic development needs, in a context linked to climate change, leads to a reduction in biomass and forest plant cover with loss of biological diversity, loss of fertile soils and negative consequences on the environment. It should also be noted that this reduction in forest plant cover at the same time reduces the potential contribution of these forests to climate mitigation. These changes therefore require adaptation by the population and this is why energetic actions have been initiated, with firewood saving and fuel substitution programs launched following the great droughts of 1974 and 1984 and which were primarily aimed at combating deforestation. However, adaptations are made both collectively; yet it is necessary that they also be done individually, in particular with citizen participation. In view of all of the above, we can ask ourselves the following question: What are the determinants of the behavior of households in the city of Ouagadougou regarding the choice of energy for cooking? And more specifically: (i) How do households in the city of Ouagadougou react to the choice of cooking energy? (ii) What is the place of the question of environmental preservation in this process of choosing kitchen energy?

The remainder of this paper is structured into two (2) sections. We first present the materials and methods (1), then we address the results and the discussion (2) before concluding and seeing the policy implications.

## 1. MATERIALS AND METHODS

This section is devoted to the presentation of the study area (1.1), the choice of the model (1.2) and the definition of the variables (1.3).

### 1.1. Presentation of the Study Area

Our research took place in the city of Ouagadougou, the largest city in Burkina Faso in terms of population, with rapidly growing urbanization and demographics. This has an impact on natural resources and a high demand for energy. The choice was particularly made in the districts of Zaktouli, Karpala and Bonheur-ville for reasons of representativeness. Indeed, in these areas there are households with very variable socio-economic characteristics. The urban commune of Ouagadougou is characterized by a set of flat lands which slope

gently from South to North and by an absence of high points. No physical obstacle limits the sprawl of the city which expands with population growth and the occupation of the rural areas surrounding it. The city of Ouagadougou sits on shallow, nutrient-poor soils. The soils of the urban commune of Ouagadougou are leached tropical ferruginous types developed on sandy, sandy clay or clay materials. They are very rich in oxides and hydroxides of iron and manganese which gives them a reddish color. These soils are also characterized by their low potassium and phosphorus content and a fragile structure that is very sensitive to erosion.

The city benefits from the influence of the northern Sudanese climate due to its geographical location. It has two seasons: a rainy season which lasts from May to September and a dry season which lasts from October to April. The average rainfall is 740 mm with great inter-annual variability. The consequences of climate change observed in recent years have not spared the capital and the quantities of water falling experience significant variations from one year to the next, with a general downward trend. The downpours are often very violent, favoring runoff and flooding. The average temperature is 24.2°C with strong average diurnal thermal amplitudes which can exceed 13°C. The average relative humidity of the air is 49%. Two main types of winds blow over the city of Ouagadougou: dry harmattan winds and cool monsoon winds. Also, visibility is greatly reduced and this can be the cause of numerous traffic accidents. Overall, we note a progressive deterioration of climatic conditions which results in an increase in maximum temperatures, violent precipitation, reduction in river flow, reduction in the level of water tables, progressive degradation of the plant cover, etc. Added to this is the problem of flooding, a recurring phenomenon in recent years. We remember the torrential rain of September 1, 2009 which caused significant damage in the city of Ouagadougou and loss of human life. The high temperatures observed in recent years have impacted the city. There is an increase in illnesses, including hypertension and frequent dehydration, especially among newborns and the elderly.

The capital of Burkina Faso is located in the watershed of the Massili, a tributary of the Nakambé. It is crossed by four backwaters from South to North: the central backwater (or Paspanga) and the Zogona backwater developed into a canal, the Mooro Naaba backwater (or Kadiogo) of which only a section is built into a canal and that of Wemtenga (or Dassasgo); as well as secondary natural tributaries (marigos of Tampouy, Tanghin de Kossodo, Somgandé, Nioko I, Kossyam and Boulmiougou Dam). In addition, Ouagadougou has a total of 4 intra-urban dams, 3 of which contribute to the city's drinking water supply. The risks of flooding are enormous for the populations living near the backwaters and dams during heavy rains such as those recorded on September 1, 2009, the damage of which was enormous.

The vegetation is an anthropized shrub savannah. The main species encountered include Butyrospermun parkii, Parkia biglobosa, Lanea microcarpa, Kaya senegalensis Magifra indica, etc. Some protected areas, land reserves, Bangrewogo Park and green spaces were created under the aegis of the ministry responsible for the protection of the environment and the living environment.

In the 2019 census, there were 2,453,496 inhabitants in the city of Ouagadougou, made up of 1,203,811 men (49.06%) and 1,249,685 women (50.94%) (Insd, 2020). Since the 1960s, the population of Ouagadougou has continued to increase significantly, mainly due to the rural exodus that the country is experiencing. Capital of Burkina, it indeed constitutes an economic and administrative center of attraction in competition with Ouagadougou. We see that over each decade, the population has practically doubled. The growth of the "Ouagalese" population, both attributable to the demographic dynamism of the city, and to the rural exodus, has the immediate effect of an increasing sprawl of urban space with problems of equipment, housing and resulting sanitation. Today, the population of the city of Ouagadougou represents more than 12% of the total population of Burkina (Insd; 2021). The average density is 7,750 inhabitants/km2 compared to an average density of 59 inhabitants/km2 across the country.

Analysis of the economic fabric of the city of Ouagadougou reveals the existence of a predominantly tertiary (commerce and services) and secondary (industries) productive base. Informal economic activity is an essential component of the economy of the city of Ouagadougou. Economic activity in the city is dominated by the tertiary sector made up of market services such as commerce and banks, bars, restaurants and hotels, transport and non-market services which mainly concern administration. Traditional commerce is strongly practiced and is located around markets, along the main thoroughfares, in neighborhoods in the form of points of sale. The secondary sector is mainly represented in the capital by industry and crafts. Several industrial activities are carried out in the industrial zones of Kossodo and Gounghin. Crafts are part of microenterprise and are important in the economy of the country and particularly of the commune of Ouagadougou. Crafts have two variants, namely service crafts and artistic crafts. In the city of

Ouagadougou, certain rural activities are still practiced. These include agriculture, livestock breeding, market gardening, forestry, etc. These activities are carried out by many people. Market gardening is developing for self-subsistence functions or supplying local markets. The practice of these different activities generates income.

### 1.2. Choice of Model

The modeling strategy used in this research is based on the discrete choice model resulting from the hypothesis of utility maximization behavior of the economic agent. In a choice decision process, the goal of the individual's decision is to find a best solution among possible alternatives to satisfy his or her objectives. We assume here that a household chooses between two cooking fuel alternatives: choosing "butane gas" fuel (or choosing a fuel other than wood) or choosing "wood". These two alternatives are indexed respectively with 1 and 0 according to the level of satisfaction (the utility provided by each). The dependent variable "type of cooking energy" (EnergyType) then takes the value 1 if alternative 1 provides more utility or the value 0 if alternative 0 has the greatest utility. If we assume that the consumer can compare the two alternatives, there exists a utility function U which mathematically expresses the consumer's preferences. However, the utilities are not known with certainty, so they are considered random variables. In this case, we decompose the random utility function of an alternative into two parts. The additive formulation of the random utility model (ARUM) gives the utilities of alternatives 0 and 1 as:

$U0 = V0 + Ɛ0$ (1), for the choice of fuel other than wood (B') and
$U1 = V1 + Ɛ1$ (2), for the choice of wood fuel (B).

Where V0 and V1 designate the deterministic or observable component of utilities and Ɛ0 and Ɛ1 designate the random component of utilities.

We cannot know exactly which alternative the household will choose during the decision process, but we can know the probability that it will choose the alternative. Still assuming that individuals select alternatives with the highest utility, the probability that the household selects alternative 1 will result in the utility of alternative 1 being greater than that of alternative 0, namely: U1 > U0; we then observe X = 1. Due to the presence of the random element of the utility function, this event is also random with:

$P[B=1] = P[U_1>U_0]$
$= P[V_1 + Ɛ_1 > V_0 + Ɛ_0]$
$=P[Ɛ_0 – Ɛ_1 < V_1 – V_0]$
$=F(V_1 – V_0)$
$= F(X'β)$ (3).
Where F (.) is the cumulative distribution function of error differences (Ɛ0 - Ɛ1) giving:
$P[B=1] = F(X'β)$ if $X'β= V1 – V0$ (4).

Determining the model specification concerns the specification of the random component. If we assume that the Ɛ0 and Ɛ1 are independently and identically distributed and that their difference follows a Gumbel distribution, we obtain the Multinomial Logit (MNL) model. We use the standard logistics distribution function given by:

$Λ(Ɛ0 - Ɛ1) = e(Ɛ0 - Ɛ1)/ (1 + e(Ɛ0 - Ɛ1))$ (5).
The derivative of this function gives the density:
$Λ'(Ɛ0 - Ɛ1) = e(Ɛ0 - Ɛ1)/ (1 + e(Ɛ0 - Ɛ1))$ (6)

This function is symmetric to zero. It is also a logistic random variable with zero mean and variance $π2/3 = 1:8142$. And the logit model is given by:
$P[-(Ɛ0 - Ɛ1) <X'β] = Λ(X'β)$ (7).

If we assume that Ɛ0 and Ɛ1 are not independent and that their difference (Ɛ0 - Ɛ1) follows a normal distribution with zero mean, still with alternative 1 chosen, we will obtain the probit formulation. In this case the probability is:

$P[B=1] = F(X'β) = Φ(X'β)$ (8).
Where Φ(.) is the distribution function of the normal standard.

Individuals, assumed to be rational, make cooking fuel choices based on observations such as environmental motive, income, sociodemographic characteristics of the head of household, etc., which make up the vector X' in the function equations of distribution.

### 1.3. Definition of Variables

Table 1 presents the definition of the variables retained and their expected signs.

**Table 1: Dictionary of variables**

| VARIABLES | DEFINITION | SIGNES ATTENDUS |
|---|---|---|
| MotifEnviron | Motif de préservation de l'environnement. Cette variable désigne le désir du ménage de préserver l'environnement à travers son choix d'énergie de cuisine. | + |
| Revenu | Revenu du ménage | + |

| VARIABLES | DEFINITION | SIGNES ATTENDUS |
|---|---|---|
| SexeCM, nivEtudCM | Caractéristiques sociodémographiques du chef de ménage. Les caractéristiques du ménage prises en compte sont relatives à la composition du ménage (le revenu, sa taille, le nombre de femmes et le nombre d'enfants). Les caractéristiques de la femme prises en compte sont le sexe, le niveau d'étude et l'activité principale (fonctionnaire, agriculture&élevage, commerce). | + |
| TailleMen | Nombre de personnes dans le ménage ou taille du ménage | + |
| NbreFemme | Nombre de femmes dans le ménage | + |
| ActivitéCM | Activité du chef de ménage | + |

**Source**: Author

The survey questionnaires administered to the different households served as a basis for collecting quantitative and qualitative information relating to the characteristics of households and their behavior in terms of kitchen energy consumption. The method used to sample our households was by quota. A sample of 150 households taken at random and distributed in three peripheral neighborhoods, at the rate of fifty (50) households per neighborhood. These are the districts of Zaktouli, Karpala and Bonheur Ville.

In this work, questionnaires were sent to households in order to characterize their socio-economic profiles and their behavior in terms of the choice of energy they consume, among other things. To immerse ourselves in the realities of our theme, this phase consisted of collecting data in the targeted neighborhoods. The questions focused both on the quantities consumed at the household level and on the determinants of household choice. The questionnaire was administered according to four main axes: general information about the household (neighborhood, number of people, age of the head of household, education, income, profession); energy consumption for cooking (type, frequency, quantities purchased according to season, price, place of purchase); consumption and non-consumption criteria; consumption patterns. Once the field phase was completed, our work was to analyze the various survey sheets using Microsoft Excel software and the econometric estimates were carried out with R software.

## 2. RESULTS AND DISCUSSION

This part consists of processing and analyzing the data collected from households. To obtain the results which were analyzed, we used Microsoft Excel and R software. This involves carrying out statistical analyzes on our data collected in the field in order to respond to our problem which is to identify the variables determining factors in the household cooking fuel choice process.

The hypothesis that we put forward above is that in the decision-making process of choosing cooking energy, the aim of the household decision is to find a better solution among the alternatives, "wood" and "gas". butane", to meet their objectives. Households are plural due to their socio-demographic profile (family composition, characteristics of the head, etc.) but also their economic-technical situation (income, type of housing) which define a capacity to act on its energy consumption. With the variables that we considered determining in this choice process, we will test and analyze the links between these variables and our variable of interest.

Descriptive statistics: This is a summary description of each of the variables in the model for better analysis.

**Table 2: Descriptive statistics of variables**

| Variables | | Moyenne | Ecart-type | Min | Max | Effectif | Fréquence |
|---|---|---|---|---|---|---|---|
| NbreFemme | | 1,08 | 0,75 | 0 | 5 | | |
| TailleMen | | 4,2 | 2,04 | 1 | 11 | | |
| MotifEnviron<br>-oui<br><br>-non | =1 si le choix d'énergie est motivé par la question environnementale<br>=1 si le choix d'énergie est motivé par une autre raison | | | | | 10<br><br>140 | 6,7<br><br>93,3 |
| TypEnergie<br>-bois<br>-gaz butane | =1 si le combustible utilisé est le bois<br>=1 si le combustible utilisé est autre | | | | | 37<br><br>113 | 24,7<br><br>75,3 |

| Variables | | Moyenne | Ecart-type | Min | Max | Effectif | Fréquence |
|---|---|---|---|---|---|---|---|
| Revenu<br>- [10000; 50000[<br>- [50000; 100000[<br>- [100000; 350000[ | =1 si le revenu du ménage est inférieur à 50000<br>=1 si le revenu du ménage est entre 50000 et 100000<br>=1 si le revenu du ménage est supérieur à 100000 | | | | | 47<br>67<br>36 | 31,3<br>44,7<br>24 |
| SexeCM<br>-homme<br>-femme | =1 si le chef de ménage est un homme<br>=1 si le chef de ménage est une femme | | | | | 131<br>19 | 87,3<br>12,7 |
| nivEtudCM<br>-primaire<br>-secondaire<br>-supérieur | =1 si le chef de ménage n'a pas d'éducation ou a le niveau primaire<br>=1 si le chef de ménage a le niveau secondaire<br>=1 si le chef de ménage a le niveau supérieur | | | | | 71<br>51<br>28 | 47.3<br>34.0<br>18.7 |
| ActivitéCM<br>-fonctionnaire<br>-commerçant<br>-agriculteur/éleveur<br>-autre | =1 si le chef de ménage est fonctionnaire<br>=1 si le chef de ménage est commerçant<br>=1 si le chef de ménage est agriculteur ou éleveur<br>=1 si le chef de ménage a une activité autre | | | | | 39<br>51<br>36<br>24 | 26<br>34<br>24<br>16 |

Numerical variables are described by means, standard deviations, minimums and maximums. The average number of people in households is 4 with a minimum of 1 person and a maximum of 11 people. In terms of the number of women, there is on average 1 woman in a household; a household may have no wife or have a maximum of 5. As for the number of children, it is 2 on average in a household, the minimum number of children is 0 and the maximum number of children is 8. As for the nominal variables, they are described by the numbers and the proportions. Of all available fuels, wood is used by 24.7% of households compared to 75.3% for the others. In this surveyed population, there are 31.3% of people with an income between 10,000 Fcfa and 49,999 Fcfa; 44.7% of them have an income between 50,000Fcfa and 99,999Fcfa and 24% have at least 100,000Fcfa. Also 87.3% of Burkinabe households are headed by men compared to 12.7% by women. As for the level of study, 47.3% of these heads of households have no education or have the primary level of study, 34% have the primary level and 18.7% have the higher level. Among heads of households, those who practice agriculture or livestock represent 24%, traders represent 34%, civil servants 26% and those who do other activities represent 16%.

Statistical tests: the chi-square test and the Fisher exact test: We wish to test the fact that the endogenous variable TypEnergie and each of the nominal explanatory variables (environmental motive, income, sex, activity and level of education of the head of household) are independent. The chi-square test and the Fisher test make it possible to check the absence of a statistical link between two variables. The hypothesis to be tested is the null hypothesis H0 (independence between variables) against hypothesis H1 (correlation between variables) and conceptually both tests have the same null hypothesis. Here, the aim is to test the null hypothesis H0 which is the independence between the choice of cooking fuel (TypEnergie) and: environmental motive, income of the head of household, sex of the head of household, activity of the head of household, education level of the head of household. Generally the null hypothesis H0 is rejected when the p-value or p-value ≤ 0.05 which means that the risk of being wrong is equal to 5%.

**Table 3: Contingency table**

| VARIABLES | | BOIS | GAZ BUTANE |
|---|---|---|---|
| SexeCM | Femme | 1 | 18 |
| | Homme | 36 | 95 |
| Revenu | [10000 ;50000[ | 23 | 24 |
| | [50000 ;100000[ | 13 | 54 |

| VARIABLES | | BOIS | GAZ BUTANE |
|---|---|---|---|
| | [100000; + [ | 1 | 35 |
| MotifEnviron | Oui | 0 | 10 |
| | Non | 37 | 103 |
| nivEtudCM | Primaire | 32 | 39 |
| | Secondaire | 5 | 46 |
| | Supérieur | 0 | 28 |
| ActivitéCM | Agriculteur/éleveur | 23 | 13 |
| | Commerçant | 10 | 41 |
| | Fonctionnaire | 1 | 38 |
| | Autres | 3 | 21 |

**Source**: Auteur

In our contingency table, we see that there are values less than 5. These data are not suitable for analysis using a chi-square test. We will carry out an analysis using Fisher's exact test.

The results are presented in Table 4.

**Table 4: Fisher statistics**

| Variables | P-value |
|---|---|
| MotifEnviron | 0,1205 |
| Revenu | 1.954e-06 |
| SexeCM | 0.0441 |
| nivEtudCM | 3.847e-08 |
| ActivitéCM | 3.091e-09 |

**Source**: Auteur

The results show that for the explanatory variables Income and the characteristic variables of the head of household (sex, levels of education and Activity) tested with the endogenous variable Type of Energy, the p values are less than 0.05 and even 0 .01 for the variables Income, levels of education and Activity of the head of household. As for testing the Environmental Pattern variable with the Energy Type variable, the results show a p-value of 0.1205. This value is greater than 0.05.

In view of the previous results, the variables which will constitute our model are: TypeEnergy, HeightMen, Income, SexCM, nivStudyCM, ActivityCM, Number of Women and Number of Children.

**Econometric Results**

The aim of our work is to measure the effect of the determinants on their choice of cooking fuel. Our variable of interest is TypEnergie (type of energy) and in our database we have two types of fuel: wood and butane gas. The criterion that we studied is the fact of choosing butane gas as fuel. The R software considers for each categorical variable a reference modality to which the other levels are compared. For our variable of interest, the "wood" modality was chosen as a reference and corresponds to the fact of not meeting the criterion studied, in our case to the fact of not choosing butane gas as fuel. As for the other variables, the reference modalities are: "[10000;50000[" for the "Income" variable; "Woman" for the variable "SexeCM"; "Primary" for the variable "nivEtudCM"; "Agri/livestock" for the "ActivityCM" variable.

**Model Estimation**

The model estimates are made following the probit and logit formulation. Table 5 illustrates the results of these estimations.

**Table 5: Estimation of probit and logit models**

| VARIABLES | | PROBIT | LOGIT |
|---|---|---|---|
| | Intercept | 2.129<br>0.035 * | 3.921<br>0.042 * |
| Revenu | [50000 ;100000[ / [10000; 50000[ | 0.589<br>0.086**.** | 1.001<br>0.101 |
| | [100000; + [ / [10000; 50000[ | 2.034<br>0.014 * | 3.708<br>0.017 * |
| TailleMen | | -1.098<br>0.024 * | -2.104<br>0.025 * |
| SexeCM | Homme / Femme | 0.025<br>0.974 | 0.385<br>0.792 |
| nivEtudCM | Secondaire / Primaire | 0.803<br>0.026 * | 1.50<br>0.022 * |
| | Supérieur / Primaire | 5.49<br>0.987 | 17.35<br>0.991 |

| VARIABLES | | PROBIT | LOGIT |
|---|---|---|---|
| ActivitéCM | Commerçant / Agriculteur/éleveur | 0.90<br>0.014 * | 1.583<br>0.016 * |
| | Fonctionnaire / Agriculteur/éleveur | 1.29<br>0.044 * | 2.854<br>0.038 * |
| | Autres / Agriculteur/éleveur | 0.415<br>0.435 | 0.641<br>0.493 |
| NbreFemme | | -0.251<br>0.375 | -0.409<br>0.407 |
| NbreEnfants | | 0.89<br>0.067. | 1.664<br>0.073. |
| AIC | | 108.66 | 107.36 |

**Source**: Auteur
**Significance codes**: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

After estimating the probit and logit models, the variables TailleMen (household size) and NbreFemme (number of women) have a negative effect on the choice of butane gas as a fuel by households. The other variables, i.e. income, number of children, gender, level of education and activity of the head of household have a positive effect on this choice.

Using the generated significance codes we can determine that of the model variables:

- **Probit model**: the results after estimations show that the variable SizeMen and the categories of variables Income [100000; + [, Secondary education level and Trader and Civil Servant activity are significant at 90%. As for the other variables, that is to say the variable number of children as well as the Income category [50000; 10000 [, sex of head of household, number of women, higher education levels, other activity, they are not significant.
  AIC = 108.66
- **Logit model**: for this model, the variables significant at 90% are the variable HeightMen and the categories of variables Income [100000; + [, secondary education level, trader and civil servant activity. The other variables, the variable number of children, sex of head of household, number of women, higher education levels, other activity are not significant.

The Akaike AIC information criterion allows models to be penalized based on the number of parameters. We then choose the model with the lowest AIC. According to the results, the appropriate model for our study is the logit model with an AIC = 107.36. The rest of the work consists of measuring the marginal effects of the model and presenting the order ratios.

**Marginal Effects**

The marginal effect is the effect of a modification at the margin of an economic variable. In this section, we have interpreted the impact of each explanatory variable taken individually on the probability of choosing butane gas. The table below shows the AME average marginal effects, standard error (SD), z-values, p-values.

**Table 6: Marginal effects**

| Variables | AME | SD | Z | P |
|---|---|---|---|---|
| Revenu-[50000 ;100000[ | 0,104 | 0,067 | 1,552 | 0,120 |
| Revenu-[100000 ; + [ | 0,280 | 0,068 | 4,118 | 0,000 |
| Taille du Ménage | -0,187 | 0,078 | -2,390 | 0,016 |
| Sexe du CM-Homme | 0,034 | 0,133 | 0,260 | 0,794 |
| Niveau Etude CM-Secondaire | 0,146 | 0,060 | 2,416 | 0,015 |
| Niveau Etude CM -Supérieur | 0,307 | 0,037 | 8,197 | 0,000 |
| Activité CM-Commerçant | 0,164 | 0,068 | 2,385 | 0,017 |
| Activité CM-Fonctionnaire | 0,257 | 0,090 | 2,839 | 0,004 |
| Activité CM-Autres | 0,070 | 0,104 | 0,674 | 0,50 |
| Nombre de Femmes | -0,036 | 0,043 | -0,835 | 0,403 |
| Nombre d'enfants | 0,147 | 0,079 | 1,860 | 0,062 |

**Source**: Auteur

Overall, the results show that household size and the number of women in the household have a negative impact on the probability that a household chooses to use butane gas. Thus the variation of a level of these variables leads to a variation in the opposite direction of probability. On the other hand,

variables such as income, number of children and characteristics of the head of household have a positive effect on this probability.

## 3.2. RESULTS ANALYSIS

In the previous section we highlighted the characteristics of households to explain the choice of households on their type of cooking energy. Some of our variables do indeed have an impact on the choice. During our survey, we were interested in the perception and opinions of the people we met on their energy consumption and on the environmental issue. We have noted certain points which are also important in their choice.

### 3.2.1. MODEL DISCUSSION

To analyze the process of household cooking energy choice, we used household characteristic variables to constitute our model. The Fisher exact test made it possible to highlight the statistical link between the choice of energy and some of these variables. Indeed, the null hypothesis of independence of the variable 'Type of Energy' and the explanatory variables 'Income', 'Sex', 'levels of study' and 'Activity' is rejected. The endogenous variable Type of Energy has a strong statistical link with explanatory variables Income and the characteristic variables of the head of household (sex, levels of study and Activity) with a confidence interval of 95% for the variable Sex of head of household and 99% for the others. As for testing the Environmental Pattern variable with the Energy Type variable, the result is not statistically significant. Thus the Environmental Pattern variable does not have a strong statistical link with the endogenous Energy Type variable. In households, the question of preserving the environment does not constitute a criterion which strongly influences the choice of cooking fuel. Of the 150 households surveyed, only 10 (or 6.7%) say they choose their cooking fuel for environmental reasons. The significance of our categorical variables is difficult to determine. After estimation, certain levels of the same variable are significant while others are not. This does not make it possible to determine and interpret the real effect of the variable itself on household choice. For the variable Household size, a numerical variable and also significant at 90%, the effect on the choice of butane gas is negative. This could be explained by the fact that in our societies place is given to the extended family. In this case, the cooked meals are in large quantities and require a large amount of energy for cooking. The use of butane gas becomes difficult given the size of the kitchen accessories and the duration of use. Wood is therefore adapting to this situation. However, nowadays the trend is towards the nuclear family, especially in urban areas. The approach with the characteristics of the household did not make it possible to highlight the factors which determine the choice of households on their cooking energy. When the head of the household has a secondary level of education, the probability that this household will adopt butane gas increases 14.69% compared to a household whose head has a primary level. As for the Activity variable, compared to households with a farmer/breeder head of household, the probabilities of using butane gas increase by 16.41% and 25.72% respectively for a household with a trader and civil servant head. Also when the number of people in the household increases by one unit, the probability of using butane gas decreases by 18.70%. These results might be different if we had a larger sample covering more diverse household characteristics.

In the writings mentioned above, what mainly influenced the choice of households on the form of energy to use is the economic reason. Indeed, according to our results, the probability that households with an income in class [100000; + [use butane gas increases by 28.07% compared to households with an income [10,000; 50000[. The affordable purchasing cost of wood has made it the main source of energy for low-income households despite the efforts of the State and NGOs to make modern forms of energy and consumption techniques accessible. Clean and environmentally friendly. However, household energy consumption does not depend only on their socio-economic characteristics, even less on concern for environmental preservation. Their behaviors are structured by the social norm of comfort. In addition to the budgetary question, there is also a concern for domestic practices (frequencies of use). In fact, households give several reasons which motivate their choice and the one cited by the majority of them, around 60%, is the simplicity or speed of using their cooking energy. The observation is that households classified in this category all use butane gas for cooking. They believe that this form of energy is not only fast and economical; we save precious time compared to wood energy. He is clean ; because it does not dirty the pots. This confirms the household preferences mentioned in the CILSS study which we discussed above. The budgetary reason comes in second place with 24.3% of households for whom the energy they use has financial advantages because it is less expensive. The majority of these households use wood for cooking. We were interested in the monthly household energy budget and depending on either the number of butane gas bottles or the daily cost of wood, we estimated a monthly household cost. For our sample, the average expenditure on cooking energy is 4793 CFA francs. Another category of households raises a question of accessibility to the form of energy they use. They represent 6% of households and use energy that is more accessible to them. Most of them, using butane gas, find this form of energy easier to find than wood. The environmental issue was raised by certain

households, i.e. 6.7% of households surveyed. According to them, to meet the needs of households, excessive cutting of wood which results in deforestation is the main reason why they use butane gas. In view of the environmental problems, notably deforestation, which arise, we initially considered the environmental motive as a variable that could influence the choice of households regarding their form of cooking energy. However, it turned out to be irrelevant because it did not have a strong enough statistical link to the variable defining the choice of energy. Domestic practices on the choice of energy mainly refer to two elements which are comfort (simplicity and/or speed) and cost of energy.

## CONCLUSION AND ECONOMIC POLICY IMPLICATIONS

The domestic energy demand of the households surveyed mainly concerns wood and butane gas with an increasingly pronounced preference for butane gas. The energy choice is influenced by certain criteria of the socio-economic conditions of the heads of households, the size of the households and the level of income influence but in a minimal way. Wood energy remains a major source of domestic energy on a national scale and the development of policies and strategies aimed at securing both the wood resource and the supply of populations remains a key issue. However, butane gas is becoming more and more part of the habits of city dwellers. It is the primary source of energy for the majority of households surveyed. But the country is characterized by a strong deficiency in energy resources and is dependent on the outside, a more marked penetration is not desirable, because it would induce economic pressure on the balance of payments and financial pressure for the State in terms of volume. Subsidy or for the household in terms of high purchase price if the subsidy were to disappear.

In Burkina Faso, in view of previous studies and ours, the question of preserving the environment through the use of clean energy and consumption techniques remains a concern for public authorities. It is therefore important to secure the satisfaction of domestic energy needs through a much more thorough policy of awareness at household level and a diversification of energies and to favor which are produced locally. Contributing to the sustainable management of existing woody resources through appropriate techniques (improved stoves, charcoal instead of household firewood, etc.) and increasing the development of forest plantations while making the sectors more viable, are objectives that States and environmental organizations should consider as priorities. The climate emergency undoubtedly requires reducing the use of fossil fuels as much as possible and strengthening the promotion of clean and efficient cooking sectors (improved quality biomass stove, LPG, fuels from agricultural residues, etc.) which promote use of improved stoves or liquefied petroleum gas (LPG). Systems and equipment must improve in performance

Technical. This requires significant investment and it is important to appeal to the contribution of the private sector. It is within this framework that the Wood Energy Sahel project falls, which aims to increase the rate of equipment and use of clean and efficient cooking stoves (CPE) by supporting stakeholders in the sector to facilitate access. to Clean and Efficient Cooking (CPE) solutions for the populations of the main urban centers, notably Ouagadougou and Bobo-Dioulasso.

Achieving the objectives of policies and strategies requires multi-sectoral commitment, effective implementation of decentralization regarding the management of forest resources in their territory and above all taking into consideration the perceptions, expectations and behaviors of consumers in terms of energy. There are environmental risks that can be associated with all forms of energy used by households. It is important to rethink society's form of consumption; the choice of energies will also depend on society's choice to perpetuate a mode of consumption with plundering of the planet's resources or to have sober consumption with a new, more sustainable energy model.

Most households surveyed use butane gas for cooking. This could be explained by the policy of hydrocarbon subsidies by the State in order to make this form of energy more accessible. If for the State it is a question of confronting the degradation of the natural environment by reducing significant quantities of wood energy, this does not constitute an important element for households in general, at least in our study site. The knowledge of the respondents on the environmental impacts of logging is of capital importance. It appears from our study that only 46.7% of the households surveyed have knowledge of the environmental impacts linked to unrestrained logging. The observation is that these informed households constitute less than half of the total households surveyed. Among these households are both wood users and those using butane gas, respectively 41.25% and 58.75%. They alluded to desertification and deforestation as a consequence of the strong pressure on forest resources. These households received information through awareness channels such as television and also in daily life. From an environmental point of view, information is extremely important. Although at the level of the form of cooking energy the trend is towards the use of butane gas, the fact remains that many people do

not have information on the environmental problems and that the pressures that a household can exert on the environment are diverse and are very little linked to its "environmental consciousness". In fact, butane gas is not within the reach of all households and we are seeing the increase in hydrocarbons despite the efforts of the State. This aspect has been noted by some households who fear that a time will come when they will no longer be able to obtain butane gas. There is a wish at certain levels to be able to change the form of cooking energy. 14% of households expressed this but especially at the level of households using wood and according to them the ideal would be to switch to butane gas. But at this level again the motivations are other than that of preserving the environment. They are those advanced above. Information and awareness can be a way to significantly reduce household impacts on the environment. Awareness is necessary to initiate a change in mentality. The aim is to raise public awareness of the interdependence of living beings and their environment, and of the impact of human activities on ecosystems. It is important to implement activities with the objective of expanding environmental knowledge, including relationships with human development and the impact of climate change on livelihoods. The actions undertaken by structures or institutions for the development of technologies and sectors such as those of biofuels and especially solar energy (solar cookers) must be popularized in order to bring to the attention of populations the opportunities for which they could opt. It is also about better understanding and monitoring consumers, their behavior, their consumption trends, their price sensitivities and their expectations: effective methods exist to do this, inspired by those used in marketing and gradually adapted to African realities. They must make it possible to design and adapt energy policies and strategies, as well as commercial strategies for the dissemination of alternative stoves and fuels, taking into account consumer logic as closely as possible. The analysis of the characteristics of households, considered as variables that can explain their choice of households on the cooking energy they use, shows that there are certain characteristics which have a significant effect on the choice of households. Indeed, the statistical test of our explanatory variables, taken individually, with our variable of interest revealed strong statistical links between these variables. It is on this basis that we constituted our discrete choice model. But if we consider the significance of the variables, the analysis of the logit model, more appropriate in our case, shows that the effects of the Household Size variable and the levels of the Income variables [100000; + [, secondary education level, trader and civil servant activity are quite minimal on the choice of energy. As for the other variables, the variable number of children, sex of head of household, number of women, income level [50000;100000[, higher education levels, other activity, there is no effect detected. With a view to preserving the environment by protecting forest resources, the Burkinabe authorities have focused on promoting butane gas in households. In order to secure the satisfaction of domestic energy needs, it is necessary to support the structures which work to develop, implement and evaluate adequate energy options through the popularization of the results with and above all the involvement of the municipal authorities who are closer to the populations.

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