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Determinants of wood energy consumption by households in the Republic of the Congo: the case of district 1 Makélékélé

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Abstract:

The aim of this work is to identify the determinants of wood energy consumption. This studyuses data from the Laboratoire d'Economie et de Sociologie Rurales (LESR) and the Institut National de Recherche Forestière (IRF) obtained from a survey conducted in 2019 in two districts of Makélékélé. The logit model results appear to indicate that easy access to fuelwood, the level of education and the income of the head of household significantly influence the consumption of fuelwood. We suggest that policy makers implement policies to increaseincomes, reduce the price of cooking energy and economical woodfuel stoves, and establish urban and periurban woodfuel plantations.

Key words: wood energy, logit model

Classification JEL: Q4, C25, O55

1. Introduction

In developing countries, particularly in Africa, where energy demand is growing, woodfuel will become predominant in the coming decades as an energy source (FAO, 2010). However, as the exploitation and production of woodfuelare largely artisanal and concentrated in areas around large cities, its increasing use poses a problem for urban and semiurban forests, particularly in terms of their destruction or even disappearance (International Centre for Forestry (CIFOR), 2010). Moreover, in the current context of the fight against climate change, forest conservation is becoming a priority for the world's governments.

Theoretically, the determinants of wood energy consumption are based on two points of view. The first point of view links the determinants of wood energy to the level of a country's development. From this point of view, two theories can be distinguished: Kuznets' environmental curve theory (Foster and Rosenzweig, 2003) and the poverty-environment hypothesis (Wunder, 2001). According to these theories, the level of development, particularly when a country is poor, is conditioned on the use of wood energy as an energy source. The second view focuses only on household income and is based on the energy ladder theory (Leach, 1992). According to the latter, income is the main economic factor determining the choice of energy type and the amount of energy consumed by households (Leach, 1992). As a result, when income increases, households switch from traditional fuels to modern fuels (Leach, 1992; Ogwumike et al., 2014).

These two points of view show that there is a lack of theoretical consensus on the determinants of wood energy consumption. Nevertheless, empirical findings are almost the same, as some studies (Couture and al., 2009; Ouedraogo, 2006) show that income negatively relates to woodfuel consumption, while the study by Ogwumike et al. (2014) finds that income positively relates to woodfuel consumption.

As a result, the Congo is no exception to this problem. Indeed, with an annual population growth rate estimated at 3%, the Congolese population is estimated at 4 277 646 inhabitants (Census Général de la Population et de l'Habitation (RGPH), 2007), and the urbanization rate was 66.01% in 2007 (Koua, 2011); Thus, there is an increase in demand for wood energy in urban areas, i.e., 2992 hectares deforested to supply the cities of Brazzaville and 1582 hectares for Pointe-Noire (National Commission for the Reduction of Emissions due to Degradation and Deforestation, (CNREDD), 2014). This demand for wood energy is supported by the Pool and

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Kouilou forests located around these cities, which have deforestation rates of 2.75% and 0.58%, respectively (Ministry of Forest Economy and Sustainable Development, (MEFDD), 2014), although at the national level, this rate is low at approximately 0.77% (CNREDD, 2014). This deforestation could have important consequences for the environment, including forest degradation, as the majority of Congolese households, i.e., 84.8%,depend on wood energy (CNREDD, 2014).

In addition, at the national level, 40.9% of people livein poverty (World Bank, 2017). However, poor households use biofuels much more because of their affordability (Ogwumike and al, 2014). Given their low income, these households do not have sophisticated energy equipment such as gas cookers and electric cookers (Ogwumike and al., 2014). In the Congo, the majority of households are faced with energy poverty because other alternative energy sources are inaccessible or too expensive. Thus, the substitution of wood energy by gas is far from possible (Commission des Forêts d'Afrique Centrale, (COMIFAC), 2012). In terms of forest cover, approximately 65% of the national territory is occupied by forests (FAO, 2014). Under these conditions, low household incomes, particularly in rural areas, and the proximity and availability of wood fuel resources justify the use of deforestation (FAO, 2010). It is therefore wise to examine the determinants of woodfuel consumption in the Republic of the Congo, particularly in Makélékélé, which is one of the districts of Brazzaville.

The objective of this work is to identify the determinants of wood energy consumption by households in the Republic of the Congo, particularly in Makélékélé. Specifically, the goal is to determine wood energy consumption in Makélékélé and identify the economic and noneconomic determinants of this consumption. The hypothesis put forward by this study is as follows: the consumption of fuelwood as a cooking fuel is determined by the income of the head of household, and this consumption follows an energy scale. This hypothesis is supported by energy scale theory and the work of Ouedraogo (2006). This theory states that low-income households use less clean energy (firewood and charcoal) and middle- and high-income households use cleaner energy (such as oil, electricity and liquefied petroleum gas).

2. State of wood energy consumption in Makélékélé

2.1. Use of wood energy by households

Graph 1 shows the wide use of wood energy by households, i.e., 97% against 3% who do not use wood energy. Achi-square test confirms the existence of very significant differences between these two groups of households (X^2=219.79; p= 0.0001). Theuse of wood energy is regular for some 51% and irregular or even occasional for others at 49% (the cooking of particular foods: saka-saka, beans, barbecue, etc.). However, charcoal remains the type of wood energy most used by households in the study area, at 58% (Graph 2). However, it is worth mentioning that 37% of households use both firewood and charcoal. Households using only firewood are rare, at 5%. The chi-square test confirms the existence of very significant differences between these groups of households (X^2=128.57; p=0.0001). In addition, 87% of households use a traditional fireplace. The use of wood energy by economically improved households is low, with only 13% of households claiming to use improved methods.

Figure 1: Distribution of households by use of wood fuel

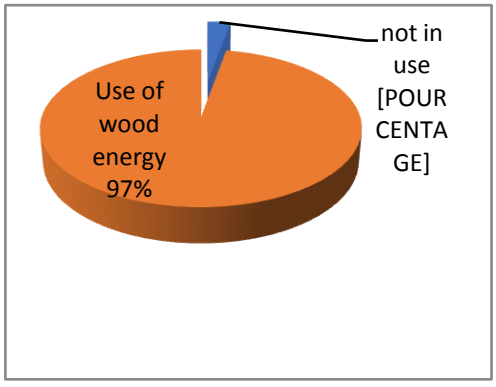
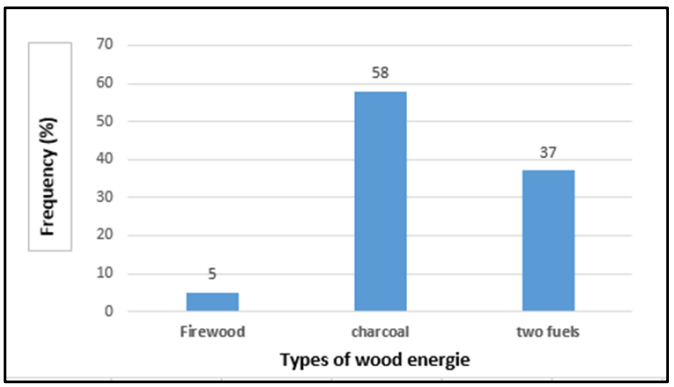


Figure 2: Proportion of households by type of wood energy used

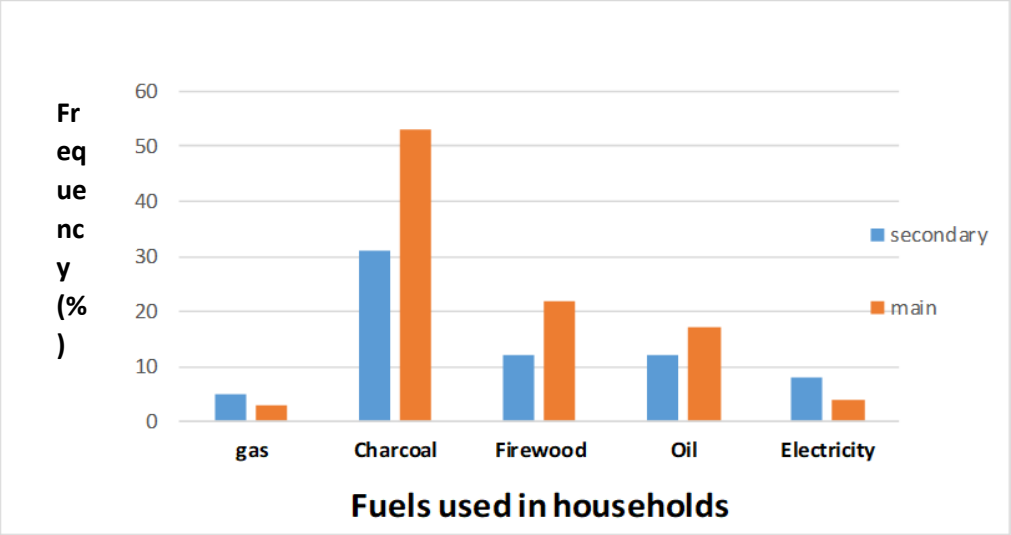


Source: Authors based on LESR and IRF survey data, 2019

2.2. Fuels taken into account in household budgets

A range of fuels, such as gas, charcoal, firewood, oil and electricity, are available for cooking food. The main fuel taken into account in a family budget remains gas, at 37% (Graph 4). Charcoal comes in second place at 31% but is the most used secondary fuel at 53%, followed by firewood at 12% as the main fuel and 22% as a secondary fuel and oil (12%). Electricity use is low, with very few households using it as a primary fuel (8%)oras a secondary fuel (4%). According to the chi-square test, the differences between consumer categories are very significant (X^2=501.03; p=0.0001). The presence of meters and problems with electricity load shedding are the two main reasons that hinder the use of electricity by households.

Figure 3 : Types of fuels included in household budgets



Source: Authors based on LESR and IRF survey data, 2019

Moreover, the choice of main/secondary fuel depends on several parameters, among which and according to the perception of the heads of households, we consider the cost of acquisition compared to that of other fuels (43%), accessibility (20%), and safety (18%). Despite high household incomes, some households opt for the use of fuelwood or oil stoves for security reasons. These consumers believe that gas is dangerous and presents enormous fire risks. Asurvey revealed that some households use wood energy only for the preparation of certain dishes (such as "saka-saka") and heating water. Taste preferences and culture also influence the choice of fuel.

3. Literature review

The literature reviewis divided into two parts: the theoretical review highlighting theories that explainwood energy consumption and the empirical review highlighting previous results on the subject.

3.1. Theoretical review

From a theoretical point of view, wood energy consumption can be explained by energy scale theory (Arnold and al., 2006), the poverty-environment hypothesis (Duraiappah, 1998; Wunder, 2001; Zwane, 2007; Baland and al., 2007) and the Kuznets environmental curve (EKC) (Foster and Rosenzweig, 2003).

Indeed, energy ladder theory gives a predominant place to economic factors such as income and is based on the hypothesis that the energy technology used by a household is a function of its status. Therefore, as incomes rise, households shift from traditional fuels to modern fuels and new cooking technology (Leach, 1992). Households desireto move up the energy ladder not only to achieve greater fuel efficiency and less exposure to direct pollution but also to show a change in their socioeconomic status (Biaou, 2011). Traditional fuels are used occasionally to compensate for the unavailability of the main energy source (Ouedraogo, 2006; Masera and al., 2000).

However, the poverty-environment hypothesis links poverty and the consumption of natural resources. This hypothesis assumes that the low standard of living of individuals negatively influences environmental resources; therefore, poor individuals are highly dependent on natural resources (Demurger and Fournier, 2010),

As is the consumption of wood energy as the main fuel for cooking. In the same vein, the EKC[4] shows that deforestation is a function of income and the relationship between these two variables forms an inverted U-curve. At the very beginning of the development process, when the level of income grows slowly, an increase in gross domestic product will accelerate the rate of deforestation to an inflection point. During this phase, deforestation is probably one of the causes of development, but as income increases, the rate of deforestation will decrease.

Applying this theory to the consumption of wood energy, it is necessary to assume that in the early stages of development (i.e., the poverty phase), households put pressure on the environment, particularly by deforestation, which can provide them with wood energy. However, when economic development is well established, these households are concerned about the environment. Thus, they implement environmental conservation policies. The effects of economic development and poverty reduction are not monotonous: rising living standards initially aggravate environmental problems (including the destruction of forest resources) and later improve them (Baland et al, 2007; Forest and Rosenzweig, 2003).

The income of the household head, the standard of living of the household and the growth of a country can affect woodfuel consumption because, apart from economic reasons, some households are interested in using a combination of fuels because of cultural or social preferences, taste preferences, habit and the education level of the household head (Ogwumike and al., 2014; Nlom and Karimov., 2015; Farsi and al., 2007) but sometimes these households seek to enhance the security of the supply of cooking fuels (Ogwumike and al., 2014).

3.2. Empirical review

Several studies on the determinants of wood energy consumption or fuel choices for cooking have been carried out in developing countries and developed countries.

For example, in a study on Nigeria, Ogwumike and al. (2014), using a multinomial logit model, find that the educational level of the father and mother and per capita expenditure negatively and significantly influence woodfuel consumption, while household size and age positively influence woodfuel consumption. Furthermore, this study showsthat energy consumption for cooking in Nigeria does not follow the energy scale hypothesis but that of a fuel mix. Furthermore, in a study on the Abomey Calavi commune in Benin, Biaou (2011) uses a logit model to show that income, household size and education level are determinants of fuelwood consumption. Similarly, Couture et al. (2009), in France, find income to be a determinant using the multinomial logit model.

Furthermore, in a study onnorthern Cameroon, Nlom and Karimov (2015), using an ordered probit model, show that price, age, education of the household head, habits and type of housing significantly determine woodfuel consumption. Using aprobitmodel, Demurger and Fournier (2011) find the following determinants of woodfuel consumption in China: household income andwealth. Finally, Song and al. (2012),in a study based on four regions of the United States using the Tobit model, show that geographical location, the high price of other fuels (in rural areas) and income level (in urban areas) are determinants of woodfuel consumption.

This review shows that theories dealing with wood energy consumption are not based on the same factors; there is also controversy regarding the results of previous studies and various methodologies used for modeling the determinants of wood energy consumption. It is therefore imperative to model the determinants of woodfuel consumption in the Republic of the Congo using a approach different from that used by otherauthors dealing with the subject.

4. Methodology

4.1. Presentation of the database

This work uses primary data obtained from afield survey carried out by the members of LESR and IRF in 2019 on a sample of 244 households in district 1 Makélékélé with a population of nearly 74815 inhabitants, in particular the 101 districts with nearly 4666 inhabitants and 107 with nearly 19384 inhabitants. The choice of district is justified not only by the quality-cost-time constraint but also by the fact that a large quantity of wood energy consumed in Brazzaville is recorded by the MEFDD checkpoints located in the south of the city, notably the Djoué brigade post on the national road N°1 (MEFDD, 2018), which supplies the markets of Makélékélé. Furthermore, the choice of these two neighborhoods (101 and 107) was made by taking into account the quality-cost-time constraints, as well as the results of the theoretical review indicatingthat income is one of the primary determinants of wood energy consumption (Demurger and Fournier, 2010; Leach, 1992).

[4] The EKC, which is generally applied to explain deforestation (Foster and Rosenzweig, 2003), is used here to show how deforestation is a driver of wood energy consumption.

Consequently, the choice was made to survey a popular, well-known neighborhood that is likely to house many low-income households (Q.107) and one that is likely to have many middleand sometimes high-income households (Q.101). In Q.107, four (04) zones out of ten (10) were randomly selected, i.e., a sampling rate of 40%. However, in Ward 101, two (02) zones out of three (03) were surveyed, i.e., a sampling rate of 67%.

As far as sampling was concerned, the latter favored the random route or Itinerary method, and due to the small number of households in the district and neighborhood, the Swartz (1995) formula, which had been proposed to calculatethe sample size, could not be used. Thus, a survey was carried out for244 of the original 250 heads of household.

4.2. Presentation of the theoretical model and model for estimation purposes

The study of the determinants of wood energy consumption requires qualitative choice models because of the qualitative nature of the dependent variable. Authors such as Ogwumike et al.(2014); Ouedraogo (2006); Nlom and Karimov (2015); Couture et al.(2009); Biaou (2011) use either a multinomial logit model or an ordered or binary probit. Indeed, qualitative choice models are based on utility theory. The basic assumption of utility theory is that a rational consumer will always choose the most preferred product among all possible alternatives (Varian, 2010).

Let us consider a sample of n rational individuals indexed i=1, 2..., n. For each individual, we will check whether they have consumedwood energy. Let W_i be the associated coded variable and Wi* be the latent variable representing the consumption of wood energy and therefore the probability that an individual will consume wood energy. $\forall$ i $\in$ [1, n], we have:

$$W_i = \begin{cases} 1 \text{ if } W_i^* > 0 \ (ndividual\ consumes\ wood\ energy) \\ 0 \text{ otherwise} \end{cases} \qquad (4)$$

Note:$W_i^* = \delta Z_i + \varepsilon_i$

Z_i : Vector of individual characteristics

δ: Vector of associated parameters

ε_i : The term error

Under these conditions, the logarithm of likelihood associated with sample n, denoted$I = (I_1, \dots, I_n)$can be written as follows:

$$(I, \delta) = \prod_1^n \left(F(\delta Z_i)^{I_i}\left(1 - F(\delta Z_i)\right)\right)^{1-I_i} \qquad (5)$$

Where F(.) designates the distribution function of the logistic law. Finally, the logit model to be estimated can thus be written as follows:

$$\mathbf{logw}\left[\mathbf{P}\left(\mathbf{wood\ energy} = \frac{\mathbf{1}}{\mathbf{Z}}\right)\right] = \mathbf{log}\left(\frac{\mathbf{P}\left(\mathbf{wood\ energy\ consumption} = \frac{\mathbf{1}}{\mathbf{Z}}\right)}{\mathbf{1} - \mathbf{P}\left(\mathbf{wood\ energy\ consumption} = \frac{\mathbf{1}}{\mathbf{Z}}\right)}\right) (\mathbf{6})$$

Before estimating the determinants of wood energy consumption, it is important to present, justify and describe the variables used inthe selected model.

Indeed, we chose as a dependent variable "**the regular use of wood energy by households**". This variable is a binary variable taking the value of 1 "if the individual regularly uses wood energy" and 0 "otherwise". In this work, we limit the studyto a single fuel, wood energy, unlike other authors who use the type of fuel consumed as a dependent variable (Biaou, 2011; Nkamleu and al., 2002).

In addition, we employed the following explanatory variables:

The monthly income of the head of the household captures the effect of income on the consumption of wood energy as cooking fuel. Indeed, the higher the income of the household, the less the household will use woodfuel as an energy source. This variable was also used by Nkamleu et al. (2002) and Ogwumike and al. (2014). Based on our assumption, this variable is expected to be significant and negative.

The level of education of the head of the household can play an important role in the choice of energy source. Indeed, the more educated the household head is, the more he or she will be able to make a reasonable choice of energy source. This variable was also used by Nlom and Karimov (2015).

However, as the variables presented are not the only ones that can influence wood energy consumption, it proved relevant to include the following control variables:

The gender of the head of the household shows gender differences in the use of wood energy as cooking fuel. This variable was used by Biaou (2011).

The age of the head of the household captures the effect of age on wood energy consumption. This variable can be a determining variable in the use of woodfuel, as the older the head of the household is, the less the individual will use woodfuel. This variable was also used by Biaou (2011) and Nlom and Karimov (2015).
Household size takes into account the number of people living in a household. Indeed, the weight borne by the income of the head of household can determine the consumption of wood energy as cooking fuel (Biaou, 2011).

Table 1: Descriptive statistics of the selected variables

Qualitative variables	Frequency	Percent
Level of education		
Without education	5	2.08
Primary	27	11.25
Secondary 1	48	20,00
Secondary 2	72	30.00
Superior	88	36.67
Sex		
Male	163	65.99
Female	84	34,01
Accessibility		
Yes	188	81.74
No	42	18,26
Regular use		
Yes	120	50.63
No	117	49.37
Quantitative variables	**Means**	**Standard deviation**
Income	1,786	1,851
Age	1,796	1,238
Household size	5,081	2,411

Source: Authors based on LESR and IRF survey data, 2019.

The above table shows that the majority of households using wood energy are managed by men, i.e., 65.99%, compared to 34.01% managed bywomen. With regard to educational attainment, the table shows that 36.67% of the individuals have higher education, 30% have upper secondary education, 20% have lower secondary education, 11.25% have primary education and 2.08% have no education at all. These descriptive statistics show that the majority (81.74%) of individuals have easy access to woodfuel, compared with 18.26% who have difficulty obtaining woodfuel. In addition, 50.63% use wood energy regularly, compared to 49.37% who use it occasionally. Finally, these statistics show that the average size of the households surveyed is 5 people, and the average between income and age groups is 1.78 and 1.79, respectively.

5. Analysis of the determinants of wood energy consumption

5.1. Validation of the model and presentation of the results

To validate the model, two tests are employed: the likelihood test and the Wald test. Indeed, it appears from Table 3 below that the maximum likelihood value is large in terms of absolute value (-101.901). This leads to the conclusion that the data are compatible with the model. For Wald's chi 2, the associated probability is less than 5%, which means that all the explanatory variables are related to the dependent variable. Finally, for each variable, the associated Wald's test shows the extent to which each explanatory variable is significantly related to the dependent variable. This leads to the conclusion that the results of this model can be analyzed, interpreted and discussed.

Table 2: Results of the logit model estimation of the determinants of wood energy consumption

Variables	Marginal effects	Standard deviation
Household size	0,024	0,018
Income	-0,057***	0,016
Age	0,046	0,027
Sex		
Female	Ref	Ref
Male	0,026	0,064
Level of education	-0,097***	0,027
Accessibility		
Yes	0,44***	0,106
No	Ref	Ref

Nombre of observations = 198
Wald chi2 (6) =41.99
Prob > chi2=0.0000
Pseudo R^2= 0.2573
Log pseudolikelihood=-101.90176

Source: Authors based on LESR and IRF survey data, 2019.
Note: ***, **, and * indicatestatistically significance at the 1%, 5% and 10% thresholds.
The results of this table show that the income bracket and level of education of the head of the household negatively determine the consumption of woodfuel, whereas the accessibility of woodfuel positively influences itsconsumption. All these results are significant at the 1% threshold.

Indeed, the marginal effects recorded in this table show that an increase of one unit of income reduces the probability of consuming wood energy as an energy source by 0.057 times on average. This result is similar to those obtained by Ouedraogo (2006) and Demurger and Fournier (2011). Similarly, an increase in educational attainment reduces the probability of using fuelwood as an energy source by 0.097 times on average. This result is consistent with Ouedraogo (2006) and Nlom and Karimov (2015). On the other hand, for the variable accessibility to woodfuel, we note that individuals with easy access to woodfuel have a 0.44% probability of using woodfuel compared to individuals without access to woodfuel. This result is consistent with thoseobtained by Nkamleu and al. (2002); Song and al. (2012).

In light of these results, we can see that the hypothesis put forward is verified, and the income of the head of household determines the consumption of wood energy. In addition, the level of education of the head of household and easy access to fuelwood are also determinants.

5.2. Interpretation and discussion of the results

The results obtained for the Republic of the Congo can be interpreted in two ways. First, distance increases the supply of wood energy. Second, human capital and wealth lead to the use of alternative sources of energy.

Distance increases the supply of wood energy

Indeed, distance favors the supply of wood energy due to the abundance of forest cover in the country, the presence of several points of sale for wood energy in the city and the weak protection of periurban forests or forest galleries located around Brazzaville.

Regarding forest cover, Congo has a large heritage forest, and more than 65% of the national territory is covered by forests: 65% is equivalent to 22,471,271 hectares, and the Pool's forest galleries, which supply the city of Brazzaville, cover an area of 753,121.9 hectares, which is more than enough to cover the demand for wood energy by city dwellers, provided that production is carried out in a sustainable manner. However, this is done in a small-scale manner and causes considerable loss (CNREDD, 2014), which is likely to lead to degradation, particularly of periurban forests.

In 2014, the demand for charcoal, which is the most consumed form of wood energy (Graph 2) and the most destructive to forests, was estimated at 115,444 tons or 13,581.65 hectares of deforested forests (CNREDD, 2014). Makélékélé accounts for nearly 31.04% of Brazzaville's demand. Indeed, 1 hectare of forest must be

destroyed to obtain 8.5 tons of charcoal, whereas 1 hectare can produce 68 tons of fuelwood (CNREDD, 2014). In addition, in the area surveyed, there are several points of sale for wood energy, which provides easy access to fuelwood for households not far from the sales points.

Human capital and wealth positively affect energy substitution

In the Republic of the Congo, human capital and wealth lead to energy substitution for several reasons: an increase in the level of education, knowledge of the harmful effects of wood energy combustion on health and pollution and GDP per capita**.**

With regard to the level of education, it can be noted that over the last three years, the level of education has increased from 65.3% in 2005 to 84.5% in 2011 (National Strategy for Sustainable Development (SND), 2014). This increase in the level of education may be accompanied by a change in mentality regarding the type of fuel used forcooking (Ouedraogo, 2006). In fact, an educated individual has sufficient knowledge about the harmful effects of using wood energy on health and environmental degradation.

Concerning health, high or regular consumption of wood energy exposes consumers to the fumes emitted when burning firewood (Baland and al., 2007; Couture and al., 2009). These fumes contain carbon monoxide, which is harmful to health (Taty and al. 2015). Therefore, an educated household will not use wood energy as a source of energy.Moreover, these households know that woodfuel is a source of forest degradation and environmental pollution. Consequently, they will be concerned about the preservation of heritage forests.

However, Biaou (2011) contests this result by arguing that anincrease in the level of education leads to a reduction in the consumption of firewood and an increase in the consumption of charcoal. He explains this by stating that the more educated an individual is, the more he or she is interested in modern fuels, such ascharcoal, which has qualities close to gas and is cheaper than other modern fuels and thus the most widely used.

In terms of GDP per capita, Congo is a country in the intermediate development bracket, at the same level as Cameroon. However, there is a difference in GDP per capita. Indeed, GDP per capita is improving in both the Congo and Cameroon; it has increased from 1147.2435 in 2010 to 1407.4034 in 2014 in Cameroon and from 2953.18 in 2010 to 3147.072 in 2014 in the Congo (BM, 2015). These improvements in living standards are expected to be accompanied by changes in cooking habits in terms ofthe use of modern fuels.

In addition, the Congo has a range of cooking fuel that is expensive to access. However, as incomes improve, it is likely that households will reintegrate electricity into their cooking fuel mix. The same is true for LPG, of which kg is sold at 450 FCFA (Taty and al, 2015), with slight variations in purchase prices at the depots depending on the distribution company and the availability of the product. The gradual improvement in income leads to the use of a combination of fuels for cooking energy or even the substitution of woodfuel with modern energy sources. This change will help the Congo achieve Sustainable Development Goal 7 (SD Goal 7), which stipulates access to clean and affordable energy for all.

However, poor or low-income households will continue to put pressure on natural resources by, for example, increasingly their use ofbiofuels for cooking. Increased income improves housing structures and the environment, making the use of wood energy incompatible and leading to the adoption of modern fuels. Thus, as incomes increase, households use woodfuel less and switch to more modern (gas or electricity) and more expensive fuels (Ouedraogo, 2006; Demurger and Fournier, 2010; Biaou, 2011; Song and al., 2012; Nkamleu and al., 2002 and Couture and al., 2009).

However, some authors, such as Ogwumike and al. (2014), oppose this result. Indeed, Ogwumike and al. (2014) find that income has no influence on the use of woodfuel since some households with relatively high incomes use woodfuel or a combination of fuels (gas and woodfuel, electricity and woodfuel, woodfuel and oil)to ensure the security of the fuel supply, or just out of habit, for culinary or security reasons.

6. Conclusion and implications for economic policies

The production of wood energy is one of the causes of the degradation of urban and periurban forests. To prevent this problem, the aim of our study was to identify the determinants of wood energy consumption by households. Using survey data from 244 households, a logit model was constructed; the results highlight the significant determinants of woodfuel consumption: income and education level have a negative influence, and easy access to this resource has a positive influence. In view of these results, the hypothesis formulated in the framework of this work is supported. In addition, these results have two important implications. First, distance affects the supply of wood energy. Second, human capital and individual wealth lead to energy substitution.

From the point of view of the implications foreconomic policies, these results suggest that the fight against the degradation of urban and periurban forests requires public decision-makers to put in place policies to improve incomes and reduce the price of cooking energy, economical woodfuel stoves and urban and periurban woodfuel plantations.

Furthermore, this study did not take into account all the parameters that could influence wood energy consumption throughout the Republic of the Congo. It is therefore advisable to extend this study by taking into account other factors and broadening the scope of the study, particularly by consideringlarge urban centers that have few or almost no woodfuel forests, to better understand the problem of the degradation of periurban forests linked to wood energy consumption.

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