

## Contribution of urban centers to environmental degradation: the case of wood energy consumption in the city of Guiglo

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**ABSTRACT:** The urban population is a major consumer of wood energy in all its forms in Côte d'Ivoire and particularly in the city of Guiglo. This consumption translates into the daily use of charcoal and firewood. Thus the city is perceived as a factor of environmental degradation through the domestic use of forest products such as wood for the needs of urban populations. This study proposes to evaluate the consumption of wood energy at the scale of the city of Guiglo in order to understand the involvement on the degradation of the environment. The methodological approach used was built consecutively around documentary research, a field survey consisting of direct observations, tracking and pointing of coal and charcoal sellers and semi-directive interviews with of the administration and the populations. Data processing and analysis have revealed that the city of Guiglo is a major source of wood energy consumption because of its easy and advantageous access for the population. A household consumes approximately 152 kg of wood energy per month, or 58,845.141 tons per year for the entire city.

**Keywords:** *Degradation, consumption, wood energy, households, Guiglo.*

### I. INTRODUCTION

The urban population increases every year in Africa and particularly in Côte d'Ivoire. It is estimated in 2021 at 15,428,957 people living in cities, i.e. 52.5% compared to 13,960,193 (47.5%) in rural areas (INS, 2021, p2). The energy most used by households for cooking and heating is wood extracted from forests. In 2010, about 2.7 billion people in developing countries depended mainly on biomass, including wood, charcoal, tree leaves, crop residues for cooking, of which nearly 60% of people living in urban areas in Sub-Saharan Africa (OECD/IEA, 2010, P251).

Charcoal is mainly used in urban and peri-urban areas, but its production is generally done by producers who use simple technologies with low yields (FAO, 2017, P2). Thus, the urban supply of wood energy is considered to be a major cause of degradation of forest cover and responsible for at least 7% of annual deforestation in the world (Chiduyamo & Gumbo, 2013). In most countries of sub-Saharan Africa, it is almost entirely taken from wood resources (FAO, 2017), less than 5% currently coming from dedicated plantations (Gazull, Gautier, 2015).

Admittedly, the regression of the forest in Côte d'Ivoire is due to agriculture, but urban growth and the overexploitation of forest resources for timber and charcoal/firewood are also causes, non negligible. The Ivorian population consumes on average for cooking needs, 69.6% of firewood and charcoal in 2019 and the transformation of wood into charcoal is 32.1% (Ministère du Pétrole, de l'Energie et des Energies Renouvelables, 2020, P12 and 20).

According to the Ministry of the Environment, Urban Sanitation and Sustainable Development of the Republic of Côte d'Ivoire, quoted by UNDP (2015), households consumed in 1996 on average about 2 kg of charcoal and 4, 6 kg of firewood per day, or 0.73 tons of charcoal per year. The use of firewood increases with the growth of the urban population and is a major cause of deforestation in the vicinity of urban centers (Ministère du plan et du Développement, 2010, p188). Furthermore, since the firewood and charcoal sectors are largely informal, it is very difficult to quantify the volumes of fuelwood taken. However, unsustainable forest harvesting can have negative impacts on forest ecosystems and the people who depend on them. Cities are often seen as consumption centers for forest products, which can increase pressures on surrounding forests.

The Cavally region, a coffee and cocoa growing area, is very threatened by the industrial exploitation of wood and promotes the mass sale of firewood and charcoal. Indeed, the Cavally region, whose capital is Guiglo, is an essentially agricultural region, which is part of the so-called "agricultural granaries" regions. In urban areas, 16,603

people work in agriculture, i.e. 32.53% of the agricultural population, compared to 31,432 people living in rural areas, i.e. 67.47% (Plan Stratégique de Développement 2023-2027, p69). The city of Guiglo, regional capital is the object of this study in order to analyze the effects of the consumption of firewood in all its forms on the degradation of the environment. This will involve determining the local consumption of firewood, the energy sources used in Guiglo and deducing the implications for the sustainable management of the forest environment.

## II. METHODOLOGY

### 1. Presentation of the study area

The Municipality of Guiglo, located in the west of Côte d'Ivoire and 516 km from Abidjan, is the capital of the Cavally region. This region has four departments; namely Guiglo, Bolequin, Toulepleu and Tai. The Municipality of Guiglo covers an area of 1930 km<sup>2</sup> with a rapidly growing population estimated in 2021 at 134,936 inhabitants, including 77,552 inhabitants for the city of Guiglo. This very cosmopolitan population is dominated by the Gueré natives of the Zake-Blao canton with a strong presence of Yacouba, Wobê, Baoulé, Malinké, etc. foreigners and Burkinabe, Guinean, Malian natives who came either for trade or for agriculture. . The city is bounded to the north by the Tonkpi region, to the east by the Guemon region, to the south by the department of Taï and to the west by the departments of Bloléquin and Toulepleu (Fig. 1). Guiglo is considered one of the main gateways to the forest region of the country. The city of Guiglo is the crossroads of two (02) important axes linking Liberia (axis Guiglo - Bolequin - Toulepleu - Liberia and axis Guiglo - Taï - Liberia). The Municipality of Guiglo is abundantly watered by many rivers, the most important of which are the Nicla and the N'zo. The city is also home to a variety of commercial and industrial enterprises, particularly in the wood sectors (slurry and wood processing). The dense forest type vegetation in the surroundings, the presence of several nature reserves including that of the Tai National Park, the classified forest of Cavally, the classified forest of GoinDébé and Scio. This vegetation cover has been seriously degraded in recent years due to the intensification of agricultural activities and logging. In addition, food crops are widely practiced by urban populations. Thus, the presence of a dense forest cover, the heterogeneity of the habitat, the standard of living of the populations and the culture of the populations provide a framework conducive to the use of firewood by the populations.

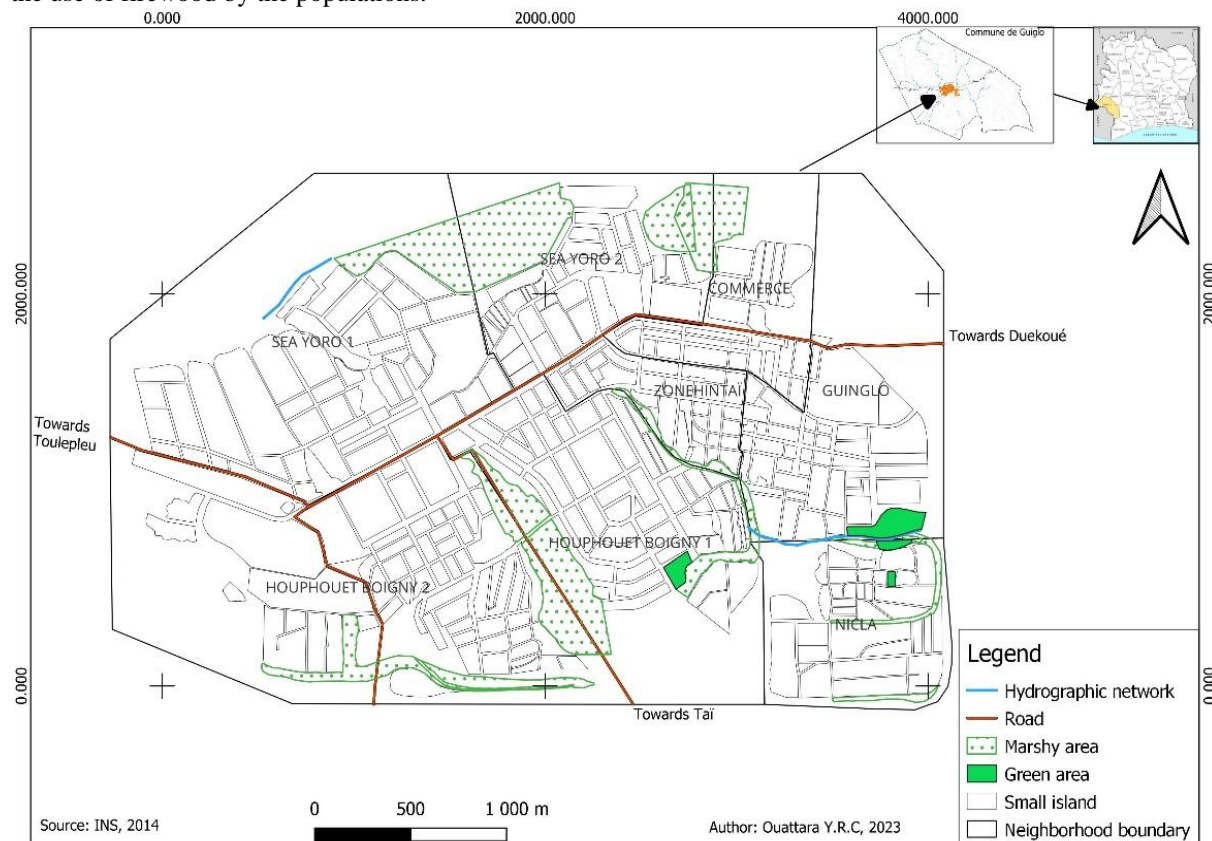


Figure 1: Location map of the study area

## 2. Data collection and processing methods

The methodology used to collect the data was based on the documentary review, the realization of semi-structured interviews and the administration of a questionnaire. The bibliographical review consisted of consulting various works (dissertations, thesis, report, etc.) on the internet, in the libraries of Felix HouphouëtBoigny University and at the library of the Institute of Tropical Geography. This data collection also extended to the Guiglo town hall, the National Institute of Statistics, the Water and Forest Department and the Forest Development Company (SODEFOR) Guiglo section. The sum of all this information made it possible to understand the mode of wood extraction, to estimate the quantity and frequency of use of firewood, to identify other sources of energy and the distribution circuit in households.

Semi-structured interviews were conducted with the Water and Forests services and SODEFOR management. These talks focused on the forest management systems and the strategies put in place by the authorities to combat the problems of forest harvesting. A questionnaire relating to the origin of the wood, the quantity of wood used and the type of stove used was administered to the respondents.

The statistical method used to determine the sample size in this study is the cluster sampling technique. Through this technique, the population was divided into several groups. Thus four (04) groups were formed, namely the group of restaurant owners, that of wood and charcoal traders, that of heads of households and the group of decentralized regional directors and civil servants. Thus, 24 restaurant owners and bakeries were randomly selected, 19 wood and charcoal traders were chosen, 49 heads of households and 11 public and private officials were surveyed. A total of 103 people were surveyed. A scale was used to weigh piles of wood and charcoal sold in detail in order to estimate the quantity of firewood and charcoal used by households.

## III. RESULTS

### 1. Characteristics of the households surveyed

The survey indicates that 92% of the households surveyed are women against 7.9% men. With regard to the level of education, households with no particular education are the most numerous with 57.4%. 19.8% have a primary level, those having reached secondary represent 16.8%, while households with a higher level have a proportion of 5.9%.

As for the size of the household, we note 62.4% having an average of 5 people, 33.6% of households have a size between 6 and 10 people and 4% of households have a size greater than 10 people.

Also, the survey reveals that 39.6% are natives against 60.4% non-natives.

The profile of firewood users is made up of housewives (46.53%), restaurant owners (23.76%), firewood traders (18.81%) and civil servants (10.96%).

### 2. Identification of cooking fuels in Guiglo

The people of the city of Guiglo use different types of fuels for cooking meals, including firewood, charcoal and butane gas (Photo 1, 2, 3).



Photo1: Bag of stored charcoal for sale



Photo 2: Firewood



Photo 3: Butane gas B6

Shooting: Ouattara Y. R., december 2022

In order to better perceive the frequency of use of the different energy sources, a specific analysis of each component of the user population was made. Namely: restaurant owners and bakers, charcoal and firewood traders and heads of households (Table 1).

**Table 1: Nature of fuels and frequency of use by the population**

| Type of fuels                    | Frequency of use by populations |                                     |
|----------------------------------|---------------------------------|-------------------------------------|
|                                  | Restaurant owners and bakers    | Households including civil servants |
| Firewood only                    | 46%                             | 43%                                 |
| Charcoal only                    | 0%                              | 0%                                  |
| Butane gas only                  | 0%                              | 14%                                 |
| Charcoal + Firewood              | 33%                             | 27%                                 |
| Charcoal + Butane Gas            | 17%                             | 14%                                 |
| Firewood + Butane gas            | 0%                              | 0%                                  |
| Charcoal + Firewood + Butane gas | 4%                              | 2%                                  |

**Source :** Our surveys, December 2022

L'analyse du tableau 1 montre que les ménages utilisent le bois de chauffe pour la cuisson à 43% et le gaz butane à 14%. L'utilisation du charbon de bois est toujours associée soit au bois de chauffe (27 %) ou au gaz butane(14%).

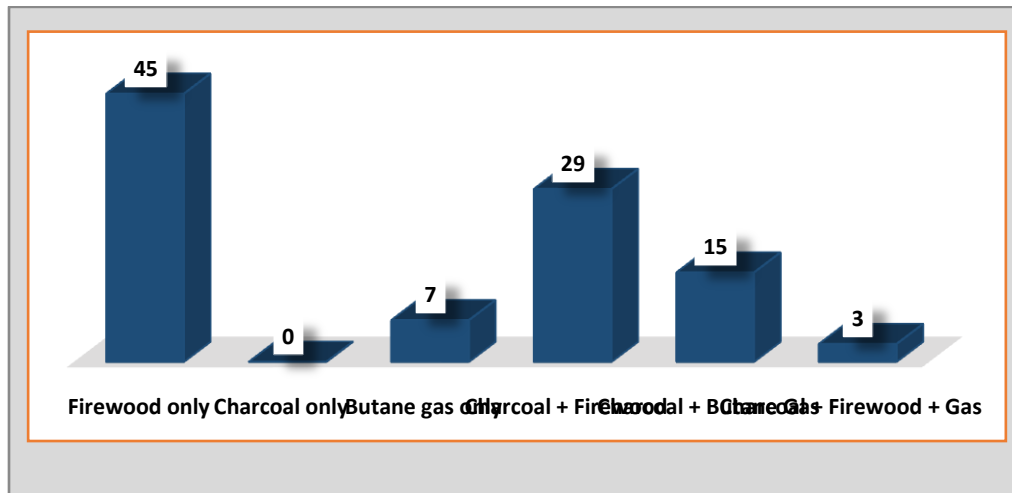
S'agissant des restaurateurs et boulangers, le bois de chauffe est également le plus employé (46%) en utilisation unique ou associé pour certains avec le gaz (4%) et le charbon de bois (33%).

Il ressort aussi de cette analyse que certaines populations n'utilisent pas le bois de chauffe. Elles ont opté pour la combinaison du charbon de bois et le gaz pour la cuisson des mets (17% restaurateurs et 14% ménages). The analysis of Table 1 shows that households use firewood for cooking at 43% and butane gas at 14%. The use of charcoal is always associated with either firewood (27%) or butane gas (14%).

With regard to restaurant owners and bakers, firewood is also the most used (46%) in single use or associated for some with gas (4%) and charcoal (33%).

It also emerges from this analysis that some populations do not use firewood. They opted for the combination of charcoal and gas for cooking meals (17% restaurant owners and 14% households).

Overall, about 93% of the population use wood either directly (raw) or in charcoal and even combined with butane gas. Butane gas is used very little by households (7%) (graph 2).



**Graph 2: summary of the frequency of use of energy sources in Guiglo**

Source: 2022 survey

Analysis of the graph reveals that 45% of respondents use only wood and 29% use both charcoal and firewood and only 07% of respondents use butane gas. As for charcoal, it comes in additives to the first two. Through this analysis, we see that the fuel most used is firewood and its derivatives such as charcoal. Charcoal is always combined with other energy sources. This confirms the permanent use of wood in urban areas and particularly in Guiglo.

**2. Consumption of firewood has an impact on the environment**

An assessment of the wood consumed by households and restaurants and bakers was carried out in order to analyze their impact on environmental degradation. The estimate of the wood is made on the basis of the consumption per month by each group. More specifically for households that take wood from retailers, a scale (photo 4) was used to weigh piles of firewood and charcoal in relation to the number of piles consumed per month.

**Table 2: Quantity of wood used per month**

| Surveyed Population          | Number     | Quantity of wood (kg) consumed per month | Quantity of charcoal (kg) consumed per month |
|------------------------------|------------|------------------------------------------|----------------------------------------------|
| Household                    | 58         | 10440                                    | 2,250                                        |
| Restaurant owners and bakers | 24         | 54000                                    | 3600                                         |
| Wood and charcoal traders    | 19         | 16920                                    | 48 sacs de 50 kg (2400 kg)                   |
| <b>Total</b>                 | <b>101</b> | <b>81360</b>                             | <b>6002</b>                                  |

Source: 2022 survey

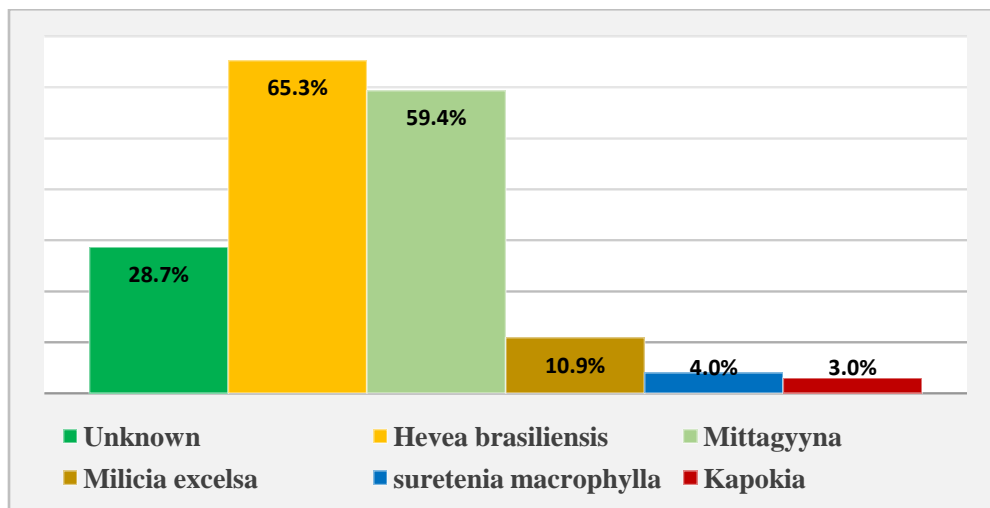
Analysis of the table shows that the 101 people surveyed consume a total of 81,360 tons of firewood and about 6,002 tons of charcoal per month, i.e. respectively 976.32 tons and 72,027 tons per year. We also note that approximately 17 tons of firewood are sold in the town of Guiglo and that the economic activity sector of food, in particular catering (photo 5) and bakery are major users of firewood.



**Photo 4 : Scale used for weighing Photo 5 : Use of wood by a restorer in Guiglo city**

Shooting: Ouattara Y. R., december 2022

A household uses an average of 152 kg of wood per month and 0.375 kg of charcoal over the same period. The survey showed that the entire population uses firewood as the main source of energy. With reference to the last census of 2021, the size of the total household in the city of Guiglo is estimated at 26,987. On this basis, the total consumption of firewood and charcoal by the population is respectively 4,102, 024 tons and 60.721 tons per month. Per year, the two types of consumption are estimated at 49,952.288 tons of wood taken from the forests surrounding the town of Guiglo. The most used firewood is rubber wood (65.3%), then that of acacia (59.4%), then hiroko wood (10.9%) and finally come respectively the mahogany wood (4%) and cheese (3%). However, 28.7% of the wood used is declared from unknown sources (Graph 3).



**Graph 3: Quality of firewood used by households in Guiglo**

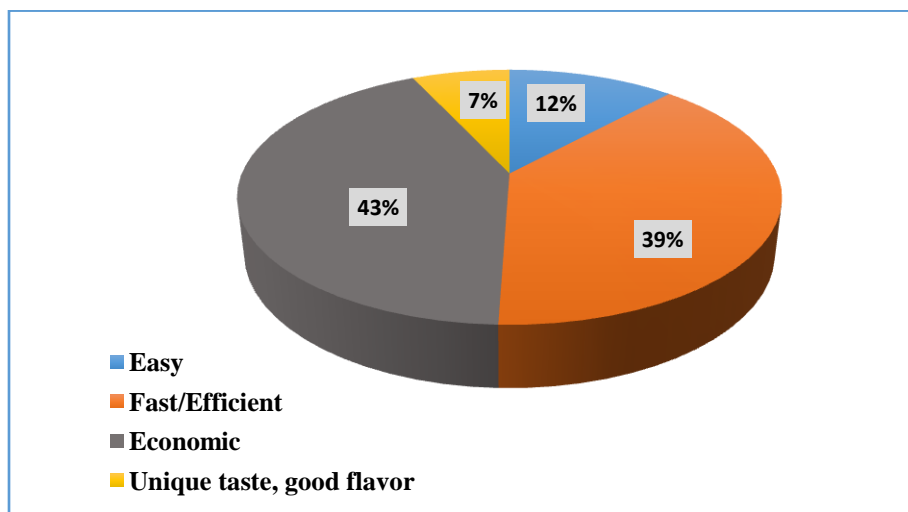
Source :2022 survey

### 3. The reasons for choosing firewood as the main fuel

The use of firewood as the main source of energy for cooking by households is explained by the following reasons:

- Easy to access, because available throughout the municipal territory at all times, no risk of breakage;

- Economical in terms of cost (table 3): Firewood can be obtained at a relatively low cost compared to other sources of energy for cooking.
- Unique Taste: Firewood can add a unique and natural flavor to cooked food. Firewood can provide a stable temperature for cooking, which is ideal for foods that require slow, even cooking.
- Fast and efficient cooking of food.



Graph 4 : shows the expression of households.

When analyzing the graph, one of the main reasons for using firewood is the cost, i.e. the economic factor (43%), it is less expensive than coal and butane gas . Then follows the notion of cooking speed (39%), then the ease of its use and finally the preservation of the flavors of the dishes (7%).

This preference for wood is also linked to the use of several hearthstones, in particular for restaurants (photo 6). The study also compared the costs of purchasing firewood, charcoal and gas (Table 3)



Photo 6 :Use of several wood-burning fireplaces in a restaurant

| Source d'énergie | Quantité    | Prix en FCFA |
|------------------|-------------|--------------|
| Butane gas       | B6 (Faitou) | 5000         |
| Firewood         | 180 kg      | 2000         |
| Charcoal         | 2kg         | 3000         |

Source : 2022 survey

Shooting: Ouattara Y. R, December 2022

The wood is sold by individuals consisting of landowners who cut in their plantation, street vendors using a tricycle, tractor, bicycle that take samples from forests or buy with loggers and retailers that buy either with landowners or street vendors. But, some take dead wood taken directly from plantations.



**Photo 7: Rolls of wood sold at 1000 FCFA**      **Photo 8 : Piles of wood sold à 500FCFA**

Shooting : Ouattara Y. R, décembre 2022

#### **4. What management to reduce environmental degradation by the city of Guiglo?**

In the city of Guiglo, almost all households use wood and charcoal as their main sources of domestic energy. One of the main consequences of these practices is the progressive degradation of the environment. How to contribute to the sustainable supply of timber and wood energy? The study options are:

- Sensitize communities to reforestation with species used as firewood;
- Promote the use of improved stoves, in order to allow rational use of wood energy;
- Sensitize urban populations to the use of butane gas;
- Make butane gas accessible to the population.

#### **IV. DISCUSSION**

With regard to the results of this study, it should be noted that the city contributes to a degradation of its environment, because it constitutes a center of significant consumption (58129.844 t/year) of wood-energy including coal. The nature of the firewood consists of 73.3% forest products (acacia, hiroko, cheese) and homegrown trees (rubber and mahogany) representing 69.3%. Indeed, for a household of five people, the monthly consumption is equivalent to 152 kg of fuelwood, or 1 kg per person per day. As for coal, monthly consumption is equal to 0.375 kg of coal per household. About 93% of the population use wood as fuel either directly (firewood) or as charcoal. This result is close to that of the study by the Ministère de l'environnement et de la protection de la nature au Bénin (2007, P.5) which indicates that the average consumption of firewood is estimated at 0.63 kg per inhabitant per urban day. As for butane gas, it is less used by the populations in Guiglo (7%). The results of this study confirm those obtained by G.F. M. BAKOUEUILA et al. (2020, p. 15248). However, these authors note a wood energy use rate of 50% in urban areas. On the other hand, the rate of use of butane gas remains high, at 39%. In Senegal, in the city of Diouloulou, the average daily consumption is 0.4 kg per person (FALL Aïdara C. A. Lamine, DIEME Alassane, SANE Yancouba, 2021, P100). In addition, note that the city of Guiglo is a secondary city which has an agricultural vocation, which could justify the significant use of wood energy in the city. In Guiglo, the food economic activity sector (bakery, catering, etc.) is a major user of firewood. Indeed, in Benin, the average daily consumption of firewood in catering units is estimated at 15.3 kg, while that in processing units is 25.2 kg (Ministry of the Environment and the Protection of nature in Benin (2007, P.6).

One of the main reasons for using firewood is the cost (2000 FCFA/month); it is less expensive than coal (3000 FCFA/month) and butane gas (5000 FCFA/month). This result corroborates that of Gérard Madon (2017, p.207) who indicates that firewood is the cheapest fuel, within reach of the poorest. It can be purchased on a day-to-day basis, adapting to the income conditions of actors in the informal sector. Thus, wood appears to be the fuel best suited to the different strata of society. However, appropriate measures must be taken to allow on the one hand the preservation of the environment and on the other hand by preserving the habits of the populations. This is why Gérard Madon (2017, P.217.) mentions in his study that wood is a low-carbon energy for sustainable development when the conditions for its long-term renewal are adequately ensured.



## V. CONCLUSION

The contribution of the city of Guiglo to environmental degradation is quite significant. This is somewhat dependent on the low level of development of the city and its status as a secondary city. Apart from agriculture, which is the main occupation of the populations, the economy is based on informal activities. This status of the populations keeps them in the habits of the rural populations with regard to the daily use of firewood for cooking. Given the attachment of the populations to the use of firewood and in view of the cost of butane gas which seems high and less accessible for households, we recommend that local authorities initiate at their level community plots dedicated to reforestation and initiate awareness campaigns for the use of improved artisanal stoves accessible to all.

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