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Analysis of Factors Affecting Wood Energy Consumption in Urban Residences and Their Implication on Biodiversity Loss: Case of Cotonou, Benin

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Abstract

In Sub-Saharan Africa, wood fuels remain one of the most important sources of energy and income for habitants. The growing demand for this type of energy has strongly impacted the wood species in supply areas. The purpose of this study was to assess the risk of biodiversity loss (species degradation) due to wood energy consumption in Cotonou. The methodological approach included surveys using questionnaires with different categories of people such as consumers, transporters, and wood energy producers. Data was collected and processed using STATA v.13 software. The risk of biodiversity loss due to wood-energy consumption was evaluated using a scenario based on the risk ranking method in Tchaourou's commune. Results showed that four factors such as "City districts", "Wood Resistance (density)", "Wood origin (Provenance)" and "Household Size (Number of habitants)" were driving wood-energy demand in Cotonou. A total of 3924.03 tons of wood energy was transported from 17 communes to Cotonou. Djidja's commune was the most important (1200.01 tons), followed by Savè (586,814.6 tons) and Tchaourou (627,719.4 tons). In addition, among the 13 plant species frequently used by wood-energy producers in Tchaourou's commune, *Prosopis africana* and *Anogeissus leiocarpa* were mentioned with a high rate of extinction. The study concluded that the patterns of fuelwood production and consumption in Cotonou present a great danger to biodiversity in supply areas.

Keywords

Wood Energy Flow, Biodiversity Conservation, Urbanization

1. Introduction

Energy constitutes one of the most important aspects of human life. Today, meeting energy needs for people remains one of the major challenges in the context of population growth (Akouehou et al., 2010; Ayeki et al., 2018). Worldwide, more than 2.4 billion people (about one-third of the world's population) still rely on energy from biomass for cooking and heating (FAO & UNEP, 2020).

In developing countries, wood energy (fuelwood and charcoal) is the main source of energy for the majority of households. According to FAO (2017), it is estimated that half of the wood extracted from Africa's forests is used as fuelwood and more than 40 million people are engaged in commercial fuelwood and charcoal activities. The exploitation and production of this type of energy often led to important flows from rural areas to the surrounding urban cities (Akouehou et al., 2010; Serre-Duhem, 2007; Ogoudedji et al., 2007). Unfortunately, due to the growing demand in urban areas, wood energy consumption is not without consequences. It is generally related to an increased decline in forest resources and severe environmental problems including deforestation, land degradation, loss of biodiversity and climate change (Ayeki et al., 2018; Desta & Ambaye, 2020; Shaheen et al., 2016).

As the world becomes more urbanized, the consumption patterns of wood are increasing. To date, deforestation and forest degradation continue to take place at alarming rates, which contributes significantly to the ongoing loss of biodiversity (FAO & UNEP, 2020). Also, according to the Global Tree Search database website, more than 20,000 species of trees from the forests have been included in the IUCN Red List and over 8000 are assessed as globally threatened (Beech et al., 2017; Duarte et al., 2015). All this constitutes threats to the sustainability of biodiversity.

In Benin like in many countries in Sub-Saharan Africa, wood fuels were revealed as the major source of energy and income for habitants (Alem et al., 2010; Knight & Rosa, 2012). Most Urban households in this region, especially in Cotonou city heavily rely on traditional biomass (charcoal, firewood, and other wood-derived fuels like wood residues) for their cooking and heating needs (Akouehou et al., 2010). The growing demand for wood fuels in Cotonou has resulted in accelerated deforestation of forests because, local people have long time used specific tree species for fuel wood production (Desta & Ambaye, 2020; Mulenga et al., 2019; Orimoogunje & Asifat, 2015).

With the current projections of the Cotonou population (1,628,985 habitants in 2030) by the National Institute of Statistics and Economic Analysis (INSAE, 2016), the question becomes how to transition away from the current status quo means of meeting wood energy demand for Cotonou residents and conserve biodiversity. There is a need to have a better understanding of the relationship between wood energy flows (production, transportation, and consumption) and biodiversity loss (threatened to tree species) without underestimating the population growth factor. However, few studies focus on these metabolic relationships between cities and biodiversity loss in the ecosystems where products are from. The majority of these studies do not discuss what goes beyond urban boundaries (Ulgiati & Zucaro, 2019). Hence, there is a lack of understanding of the implication of wood energy consumption by urban households on biodiversity loss in supply areas.

The current research was designated to assess the risk of biodiversity loss (species degradation) due to wood energy consumption in Cotonou. Specifically, we propose to assess factors affecting wood energy consumption under socio-economic conditions in Cotonou; to identify the potential wood energy (charcoal, firewood) supply areas for the city and finally to evaluate the risk of biodiversity loss (fuels wood species degradation) due to wood energy demand in Cotonou.

2. Materials and Methods

2.1. Study Area

Cotonou is a large port city on the south coast of Benin, in West Africa. Located between 6˚21 North latitude and 2˚26 East longitude, it covers an area of 79 km^2. The city is bordered to the North by the Nokoué Lagoon, to the south by the Atlantic Ocean, to the East by the municipality of Sèmè-Kpodji and to the West by the municipality of Abomey-Calavi (**Figure 1**). It is composed of 13 districts and 144 city districts. Cotonou is a highly attractive pole of economic activity and employment, assuming a central role in the international activities of the country. The total population of the study area was estimated at 1.5 million people in 2020. The most dominant activities in Cotonou are trade, restaurant, and accommodation (40.5%), manufacturing industries (14.6%) and (24.7%) other services (INSAE, 2016).

2.2. Method of Data Collection and Analysis

To achieve the defined objectives, a bottom-up approach based on a field survey was used. In order to assess factors affecting wood energy consumption, a structured interview questionnaire with open and closed-ended questions at the household level was developed. The question appears in using the following design:

- Multiple-choice questions: respondents select one or more answers.
- Single-choice questions: Respondents select only one answer.
- Dichotomous Questions: Respondents choose between two options, such as “yes or no” or “true or false.”
- Ordinal sale questions: Respondents rank a list of options (in order of preference, importance, likelihood, etc.)
- Interval scale questions: Respondents rate their level of agreement or disagreement, typically on a scale of 1 to 5 or 1 to 7, using terms like “strongly

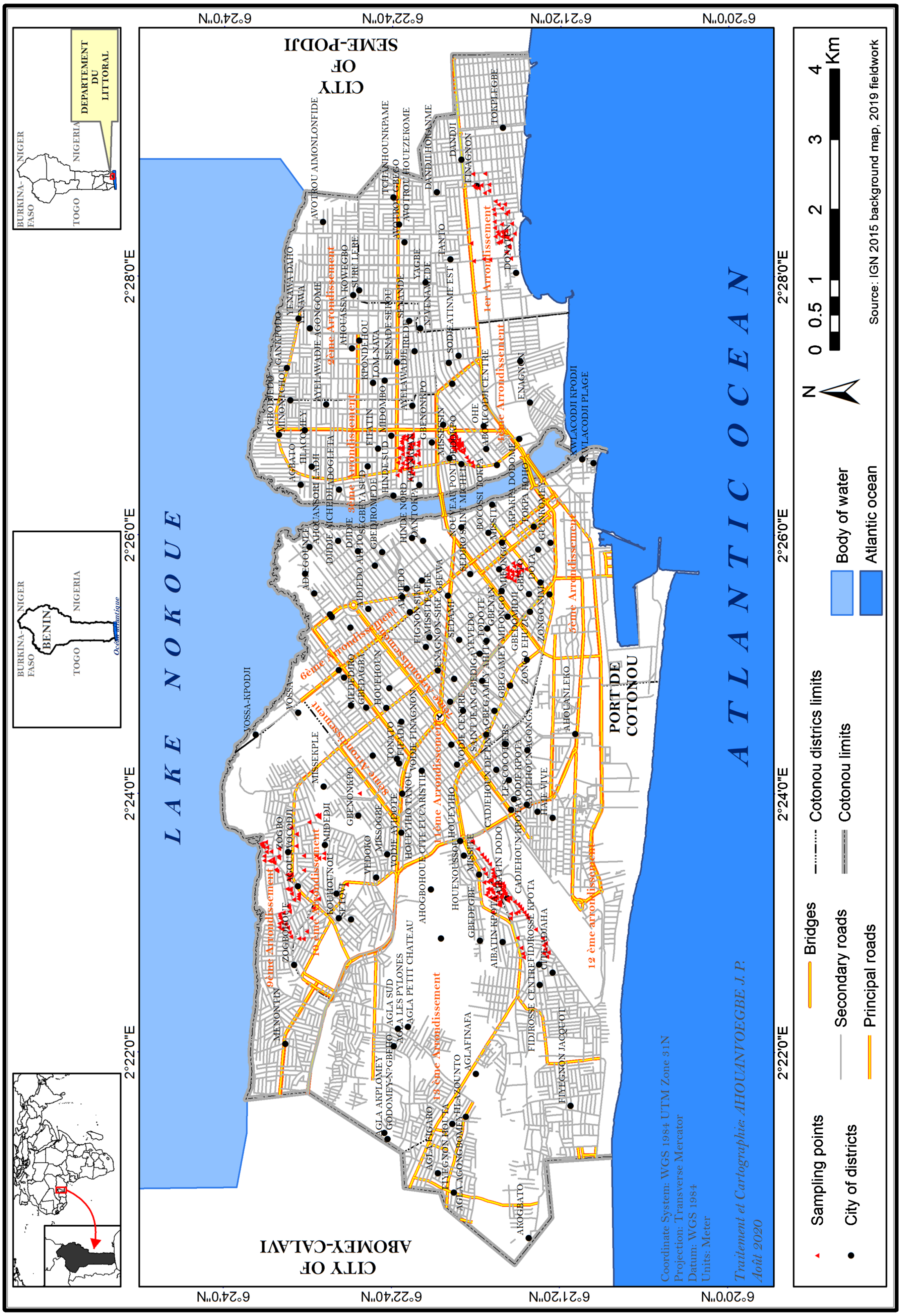

Figure 1. Map of Cotonou showing sampling points for household surveys.

agree," "neither agree nor disagree," etc.

- Attitude questions: Respondents provide free-form opinions about a topic.
- Recommendation questions: Respondents offer recommendations for specific interests.

A total of 370 households were randomly selected and questioned out of 6 districts in Cotonou using the formula developed by Yamane (1967), Equation (1). The analysis was carried out with STATA v.13 software using descriptive statistics. Wood energy transporters met within the city were systematically questioned to identify the potential areas that supply the city.

$$n = \frac{N}{\left[1+\left(N \times e^2\right)\right]} = 370 \Big/ \left[1+\left(370 \times e^2\right)\right] \quad (1)$$

With n = sample size; N = total population; e = margin error at 5%

To evaluate the risk of biodiversity loss (wood species degradation) due to wood energy production, Tchaourou's commune was randomly selected. Wood energy's producers were interviewed. The taxonomic identification (scientific name of each plant as well as their family names) was carried out using the Analytical Flora of Benin (Akoegninou et al., 2006). The risk of biodiversity loss due to wood-energy production in deferent ecosystems was evaluated using the methodology developed by Tallis et al. (2013), but it was adjusted to fit the needs of this study. The method was based on using criteria for estimating the risks that are tailored to the life of species (**Table 1**). Two types of information were essential to evaluate the risk: exposure (E) and consequence (C) (Halpern et al., 2018; Samhouri & Levin, 2012). The exposure represents the degree to which a specific species of plant experiences stressors due to wood energy production, given the effectiveness of management practices and the consequence reflects the response to stressors (Arkema et al., 2014). The exposure and consequence were assigned a rank from 1 to 3 (low to high risk, with 0 = no score) and the Euclidean approach (**Figure 2**) was used to estimate risk R, Equation (2).

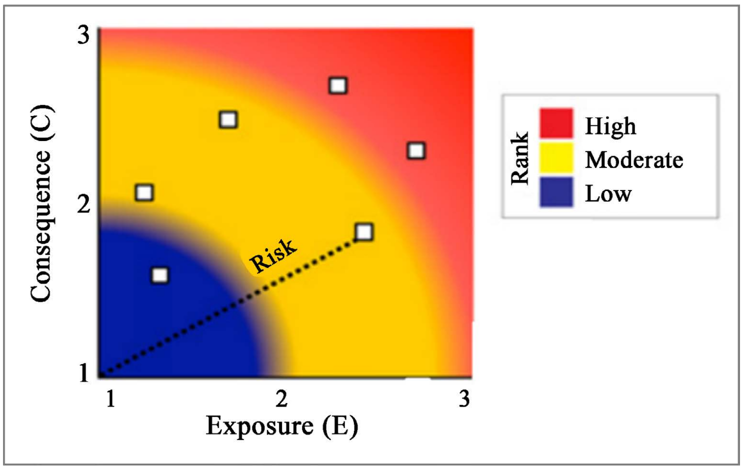

Figure 2. Conceptual diagram depicting how exposure and consequence criteria are combined to estimate risk using the Euclidean distance for species.

Table 1. Exposure and consequence scoring criteria for species risk (Tallis et al., 2013).

Criteria Intensity	Scores			
	0 No score	1 Low	2 Moderate	3 High
Exposure				
Population Reduction Rate	No score	30% - 50% population decline	50% - 70% population decline	≥80% - 90% population decline
Geographical range (Extent of Occurrence)	No score	>2000 km^2	>500 km^2	>10 km^2
Consequence criteria-sensitivity				
Extinction Probability	No score	At least 10% within the 50 years	At least 20% within the 25 years	At least 50% within the 10 years
Change in structure	No score	<20% loss in density)	20% - 50% loss in density	50% - 100% loss in density
Frequency of disturbance	No score	Daily to weekly	Several times a year	Less often
Consequence criteria resilience				
Natural mortality	No score	80% or higher mortality	20% - 50% mortality	<20% mortality
Recovery time	No score	Less than 1 year	1 - 10 years	More than 10 years

$$Rij = \sqrt{(E-1)^2 + (C-1)^2} \tag{2}$$

3. Results

3.1. Sociodemographic Characteristics of Respondents

Overall, 310 women (84%) and 60 men (16%) were surveyed across 6 city districts of Cotonou. As showed by the Figure 3, Zogbo district registered the highest responders for both women (104) and men (31). Among all the respondents, 65% were trader and only 3% were working in public sector officer (Figure 4).

3.2. Comparison of Wood-Energy Consumption by City Districts

Table 2 shows a comparison of wood-energy consumption by city districts in Cotonou. The average consumption of wood energy in the city is estimated at 2.40 kg/day which represents 0.33 kg/day for firewood and 2.07 kg/day for charcoal on average. However, the level of wood-energy consumption varies significantly across city districts as revealed by the ANOVA test (P-value < 0.05). For example, in the Missessin district, the average consumption of wood energy per day is 2.93 kg while it is less in the Aibatin I district (1.94 kg/day).

3.3. Factors Affecting Wood-Energy Consumption in Cotonou

3.3.1. Bivariate Analysis Using Socioeconomic and Demographic Variables

As presented in Table 3, the bivariate analysis conducted with STATA shows

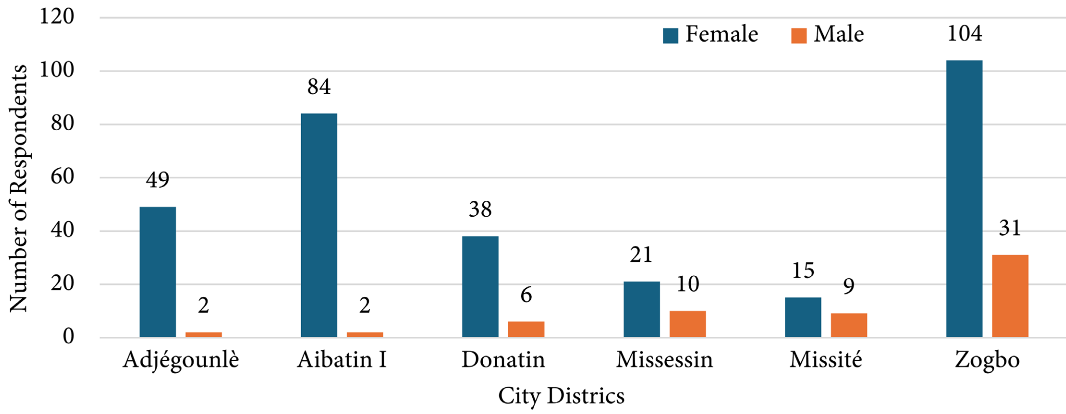

Figure 3. Responders by sex.

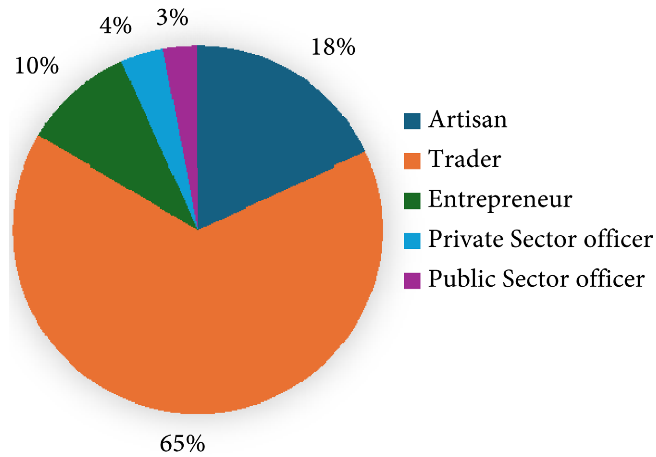

Figure 4. Responders by occupation.

Table 2. Comparison of wood-energy consumption by city districts.

City District	Frequency (N)	Mean (SD)	P-value*
Adjégounlè	46	2.04 (1.17)	
Aibatin I	84	1.94 (1.17)	
Donatin	43	1.97 (1.23)	
Missessin	42	2.93 (1.65)	<0.023
Missité	36	2.61 (1.06)	
Zogbo	119	2.78 (1.43)	
TOTAL	**370**	**2.40 (1.37)**	

SD: Standard Deviation, N= Frequency, P-value*: Probability of ANOVA test.

that variables such as City Districts, Household Size (Number of Habitant per house), Household Incomes, Wood Preferences (Charcoal or fuel wood), Wood Resistance (density) and Wood Origin (Provenance) were individually associated with the dependent variable named "Wood-energy Consumption" (p-value < 0.05).

Table 3. Bivariate analysis using socioeconomic and demographic variables.

Variables	N = 370				Prob > F
	Coef.	P > t	95% CI		
Sex					
Female	Ref				0.402
Male	−0.16	0.402	−0.5	0.2	
Religions					
Christianity	Ref				
Muslim	−0.08	0.702	−0.5	0.3	
No religion	−0.49	0.082	−1.0	0.1	0.372
Traditional	0.13	0.576	−0.3	0.6	
Other	0.08	0.686	−0.3	0.5	
City Districts					
Adjégoufnlè	Ref				
Aibatin I	−0.10	0.681	−0.6	0.4	
Donatin	−0.08	0.779	−0.6	0.5	<0.001
Missessin	0.89	0.002	0.3	1.4	
Missité	0.56	0.056	0.0	1.1	
Zogbo	0.74	0.001	0.3	1.2	
Occupation					
Artisan	Ref				
Trader	0.21	0.267	−0.2	0.6	
Entrepreneur	0.14	0.608	−0.4	0.7	0.001
Private Sector officer	−1.10	0.006	−1.9	−0.3	
Public Sector officer	−0.87	0.048	−1.7	0.0	
Age of Respondents					
20 - 29	Ref				
30 - 39	−0.07	0.742	−0.5	0.3	0.350
40 - 49	0.19	0.432	−0.3	0.7	
50 - Plus	0.38	0.32	−0.4	1.1	
Household Income					
No	Ref				0.027
Yes	−0.34	0.027	−0.6	0.0	
Household Size (Person/house)					
-	0.14	0.01	0.1	0.2	<0.001

Continued

Wood Preferences (charcoal or fuel wood)					
No	Ref				0.038
Yes	−0.80	0.038	−1.6	0.0	
Wood resistance (density)					
No	Ref				< 0.001
Yes	−1.01	0.001	−1.3	−0.7	
Prefer Gas					
No	Ref				0.647
Yes	0.22	0.647	−0.7	1.2	
Literacy					
No	Ref				0.460
Yes	−0.51	0.46	−1.9	0.8	
Availability of wood fuel					
No	Ref				0.247
Yes	0.61	0.247	−0.4	1.6	
Affordability of woof fuel					
No	Ref				0.555
Yes	−0.33	0.555	−1.4	0.8	
Wood origin (Provenance)					
No					< 0.001
Yes	1.21	0.001	0.9	1.5	
Cause health issues					
No	Ref				0.412
Yes	0.15	0.412	−0.2	0.5	

Compared to the respondents who live in the Adjégounlè district, the respondents living in the Missessin, Aibatin I and Zogbo districts reported higher levels of Energy use while those living in Missite and Donatin districts reported lower levels of Energy in comparison to the same reference group. Meanwhile, the correlation coefficients of Aibatin I, Donatin and Missite were not statistically significant (p-values > 0.05). Respondents living in the Zogbo and Missessin districts consumed almost a kilogram more of Energy (0.74 kg and 0.89 kg respectively) than those living in the Adjégounlè district.

Concerning respondents' occupations, Traders and Entrepreneurs had higher levels of wood-energy consumption compared to Artisans while those working in Private and Public Sectors had lower levels of consumption. Nevertheless, only the correlation coefficients of those working in the Private and Public Sectors were statistically significant (p-value = 0.006 and 0.048 respectively). Respondents who were Traders and entrepreneurs consumed about half a kilogram more of wood energy (0.21 kg and 0.14 kg respectively) than those working in the Private and Public Sectors.

As shown by the results, the correlation coefficients of the variable Household Size and Household incomes were also statistically significant (p-value < 0.001). When the size of the household increases by one individual, the level of wood energy consumption increases by 0.14 kg per day. Furthermore, respondents who mentioned that wood energy consumption depended on Household Incomes consumed 0.34 kg less than those who did not mention (coef: −0.34; p-value = 0.027). However, respondents who used it because of its origin (Provenance) consumed 1.21 kg more compared to those who did not mention it (p-value < 0.001)

3.3.2. Multivariate Analysis of Variables that Were Individually Associated with the Dependent Variable

Table 4 shows the Multivariate analysis of variables that were individually associated with the dependent variable. After adjustment to other factors in linear regression, only variables such as "City districts", " Wood Resistance (density)", "Wood origin (Provenance)" and " Household Size (Number of Habitants)" were correlated with the level of wood-energy consumption. On the other hand, variables such as "Occupation" and "Household Incomes' and "Wood Preferences (charcoal or fuel wood)" were no longer significant.

Regarding the association between city districts and wood-energy consumption, only the correlation coefficients of Missessin and Zogbo districts remained significant. Although the coefficients have decreased slightly for both localities, they are still positive. Indeed, respondents from the Missessin and Zogbo districts use respectively 0.89 and 0.74 kilograms of wood energy more than respondents from the Adjégounlè district. The adjusted R-square of the regression model was 0.3516, indicating that 35.16% of the variation of the level of wood energy consumption in Cotonou can be explained by "City districts", "Wood Resistance (density)", "Wood origin (Provenance)" and "Household Size". The remaining 64% were not explained in the multivariate model.

3.4. Main Wood-Energy Supply Areas for Cotonou City

As Cotonou is a wood-energy exporting city, the majority of the wood-energy comes from all over the country (see Table 5). As a result, producers exerted enormous pressure on classified forests. Figure 5 presents the Sankey diagram of wood-energy flows for Cotonou. A total of 17 communes have been reported as wood-energy supply areas for Cotonou.

About 3924.03 tons of wood energy (96.79% of charcoal and 3.21% of firewood) were transported to Cotonou. The amount of wood energy exported from

Table 4. Multivariate analysis of variables that were individually associated with the dependent variable.

Variables	N = 370				LRT P-values
	Crude Coef. (CI)	Wald P-value*	Adjusted Coef. (CI)	Wald P-value**	
City Districts					
Adjégounlè			Ref		
Aibatin I	−0.10 (−0.6; 0.4)	0.681	−0.04 (−0.5; 0.4)	0.879	
Donatin	−0.08 (−0.6; 0.5)	0.779	−0.40 (−0.9; 0.1)	0.096	
Missessin	0.89 (0.3; 1.4)	0.002	0.58 (−0.1; 1.1)	0.023	<0.001
Missité	0.56 (0.0; 1.1)	0.056	0.35 (−0.2; 0.9)	0.181	
Zogbo	0.74 (0.3; 1.2)	0.001	0.60 (0.2; 1.0)	0.004	
Occupation					
Artisan			Ref		
Trader	0.21 (−0.2; 0.6)	0.267	0.05 (−0.4; 0.3)	0.769	
Entrepreneur	0.14 (−0.4; 0.7)	0.608	0.20 (−0.3; 0.7)	0.395	0.2536
Private Sector officer	−1.10 (−1.9; −0.3)	0.006	−0.42 (−1.1; 0.3)	0.218	
Public Sector officer	−0.87 (−1.7; 0.1)	0.048	−0.53 (−1.3; 0.2)	0.162	
Household Income					
No			Ref		
Yes	−0.34 (−0.6; 0.1)	0.027	−0.26 (−0.5; 0.0)	0.069	0.0633
Wood Preferences (charcoal or fuel wood)					
No			Ref		
Yes	−0.80 (−1.6; 0.1)	0.038	−0.55 (−1.1; 0.1)	0.129	0.1211
Wood Resistance (density)					
No			Ref		
Yes	−1.01 (−1.3; −0.7)	<0.001	−0.65 (−0.9; −0.4)	<0.001	<0.001
Wood origin (Provenance)					
No			Ref		
Yes	1.21 (0.9; 1.5)	<0.001	0.98 (0.7; 1.3)	<0.001	0.001

Continued

Household Size (Person/house)					
-	0.14 (0.1; 0.2)	<0.001	0.17 (0.1; 0.2)	<0.001	<0.001
Intercept					
	–	–	1.60 (1.01; 2.20)	<0.001	-

LRT p-values: Likelihood Ratio test p-values; Wald P-value*: P-value Bivariate analysis; Wald P-value**: P-value Multivariate analysis; Crude Coef. (CI): Coefficient for Bivariate analysis; Adjusted Coef. (CI): Coefficient for Multivariate analysis.

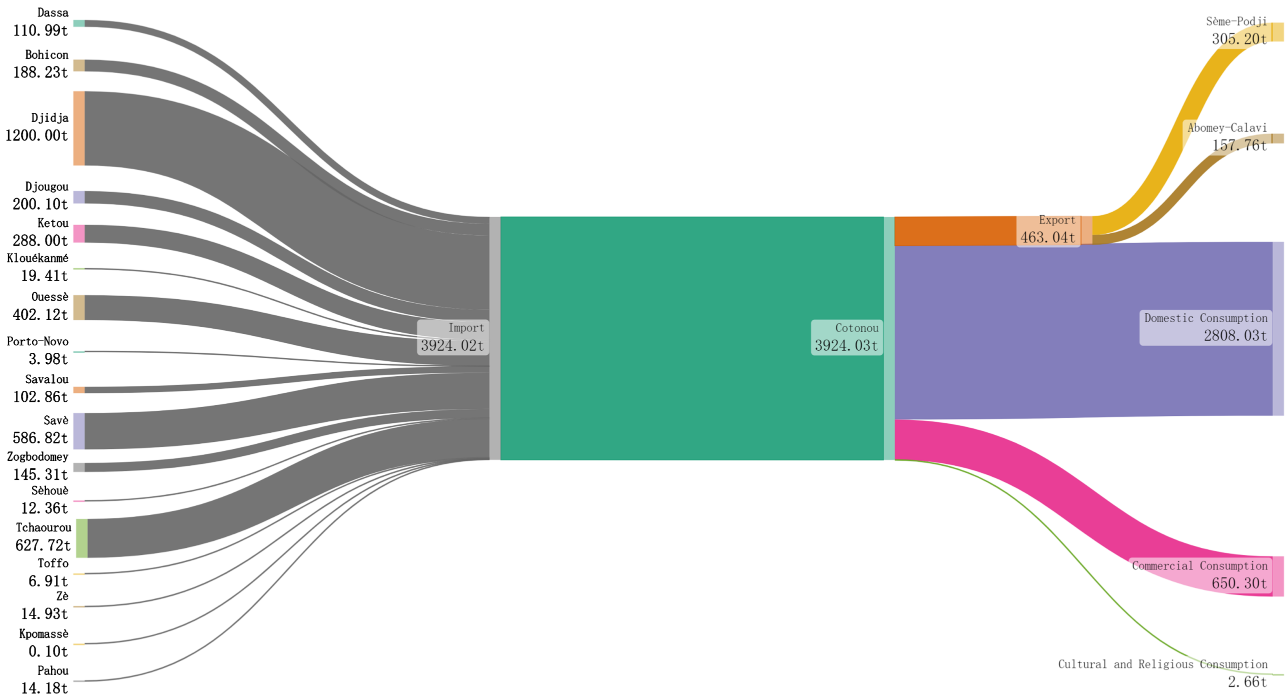

Figure 5. Sankey Diagram showing the wood-energy flows of Cotonou City.

Cotonou (463.04 tons) is mainly destined for nearby towns such as Sèmè-podji (305.2 tons) and Abomey-Calavi (157.76 tons). The remainder is used mainly for domestic (2808.03 tons) and commercial purposes (650.3 tonnes). Exporting wood energy is not insignificant compared to importing it into the city. Indeed, there is a strong connection between Djidja and Cotonou. The municipality of Djidja is the most important city which served Cotonou in wood energy (1200.01 tons), followed by Savè (586,814.6 tons) and Tchaourou (627,719.4 tons). About 46.89% of wood energy comes from the North and Centre of the country, especially from communes such as Djoudou, Tchaourou, Ouèssè, Savè, Savalou and Dassa (Figure 6).

3.5. Wood Energy Production and Its Effect on the Plant Species

Different plant species are involved in wood energy production. To produce

Table 5. Main wood energy supply areas and quantities loaded in direction of Cotonou.

Name of the supply area	Frequency (N)	Quantity of Charcoal (kg)	Quantity of firewood (kg)	Total of wood-energy (kg)	Percentage by supply area (%)
Bohicon	5	184,101	4124.9	188,225.9	5.21
Dassa	3	109,536	1453.5	110,989.5	3.13
Djidja	23	1,200,011.1	-	1,200,011.1	23.96
Djougou	3	200,100	-	200,100	3.13
Ketou	7	281,575.6	6428	288,003.6	7.29
Klouékanmé	3	-	19,408	19,408	3.13
Kpomassè	1	-	90.2	90.2	1.04
Ouessè	9	395,620.5	6503.1	402,123.6	9.38
Pahou	1	-	14,175	14,175	1.04
Porto-Novo	3	-	3975	3975	3.13
Savalou	2	102,855	-	102,855	2.08
Savè	16	552,124.1	34,690	586,814.6	16.67
Sèhouè	1	-	12,360	12,360	1.04
Tchaourou	12	627,719.4	-	627,719.4	12.5
Toffo	1	-	6912	6912	1.04
Zè	2	-	14,928	14,928	2.08
Zogbodomey	4	144,484.6	822	145,306.6	4.17
Total	96	3,798,127.3	125,869.7	3,923,997.2	100

Table 6. List of plants used to make firewood or charcoal in Tchaourou municipality.

N°	Local names	Scientific names	Species family
1	Akajutin (f)	*Anacardium occidentale*	Anacardiaceae
2	Hihlon (f), Ayin(y)	*Anogeissus leiocarpa*	Combretaceae
3	Kininutin (f), Yaro (n)	*Azadirachta indica*	Meliaceae
4	Ajasi kake (f), Atakpa (y)	*Burkea africana*	Fabaceae
5	Zatin (f), Iya (n)	*Daniellia oliveri*	Fabaceae
6	Kpakpa lolo (f)	*Isoberlinia doka*	Fabaceae
7	Caïlcédrat (f) Aganwo (n)	*Khaya senegalensis*	Meliaceae
8	Amangatin (f), Mangoro (n)	*Mangifera indica*	Anacardiaceae
9	Kpanumon (f)	*Piliostigma thonningii*	Fabaceae
10	Kakè (f), Kakakanyi (y)	*Prosopis africana*	Fabaceae
11	Gbèngètin/Kosso (f)	*Pterocarpus eurinaceus*	Fabaceae
12	Teck (f), Ikpatomu (y)	*Teetona grandis*	Lamiaceae
13	Wugo (f), Karité	*Vitellaria paradoxa*	Sapotaceae

Type of Language for local name: y = yoruba, n = nago, f = fon.

quality charcoal, trees are selected according to their hardness. The survey carried out in Tchaourou enabled us to identify 13 different plant species, as well as their local names in Table 6. The most important families are Fabaceae (6 species), Anacardiaceae (2 species), Meliaceae (2 species), and the other less important families are represented by only one species.

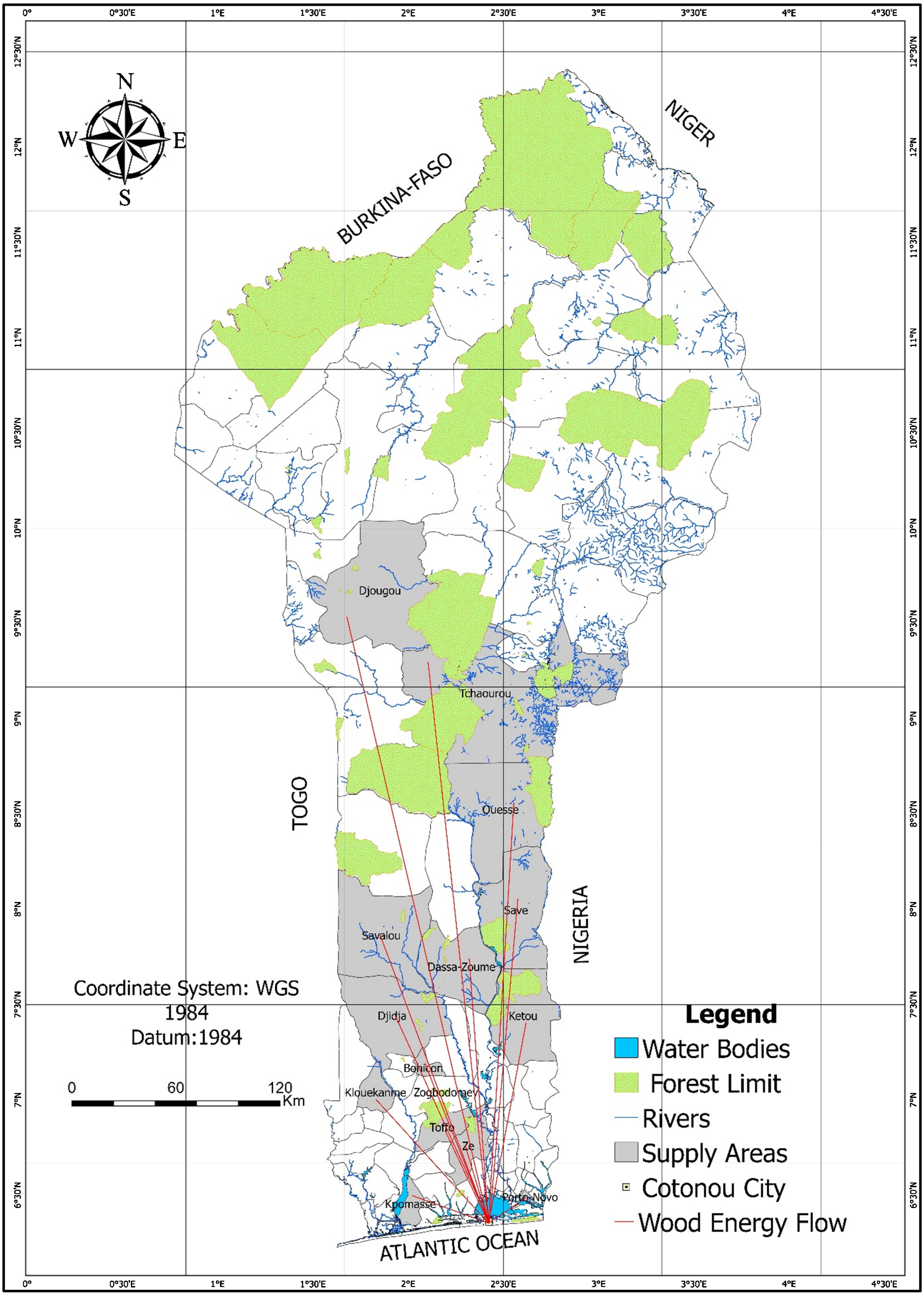

Figure 6. Wood-energy supply areas in the direction of Cotonou.

Figure 7 presents the Exposure Risk of the above species based on pre-established criteria. Among those species, some are mentioned with a high rate of extinction because of their ability to make good charcoal or fuel wood. Examples include *Prosopis africana* and *Anogeissus leiocarpa.*

According to the inhabitants of the Tchaourou region, charcoal making, and wood collection have followed the progressive degradation of crop performance (impoverishment of soil and proliferation of weeds) and have thus provided additional income for the farmers. The wood collection is carried out on fallow land of 7 to 30 years. Generally, trees like *Anogeissus leiocarpa* and *Prosopis africana*, fully grow at a slow rate and take several years (up to 20 - 25 years) to harvest.

The most commonly used process to make charcoal in Tchaourou is the grindstone, which is the least expensive and made from local products. The piles of greenwood to be charred are placed on the ground and covered with leaves and straw (see Figure 8). In the center, a combustion cone is made from small piles of dry wood. The whole is covered with sand. Vents are provided to control the carbonization which takes place in three phases: dehydration, carbonization, and cooling. Monitoring is constant to prevent air from entering.

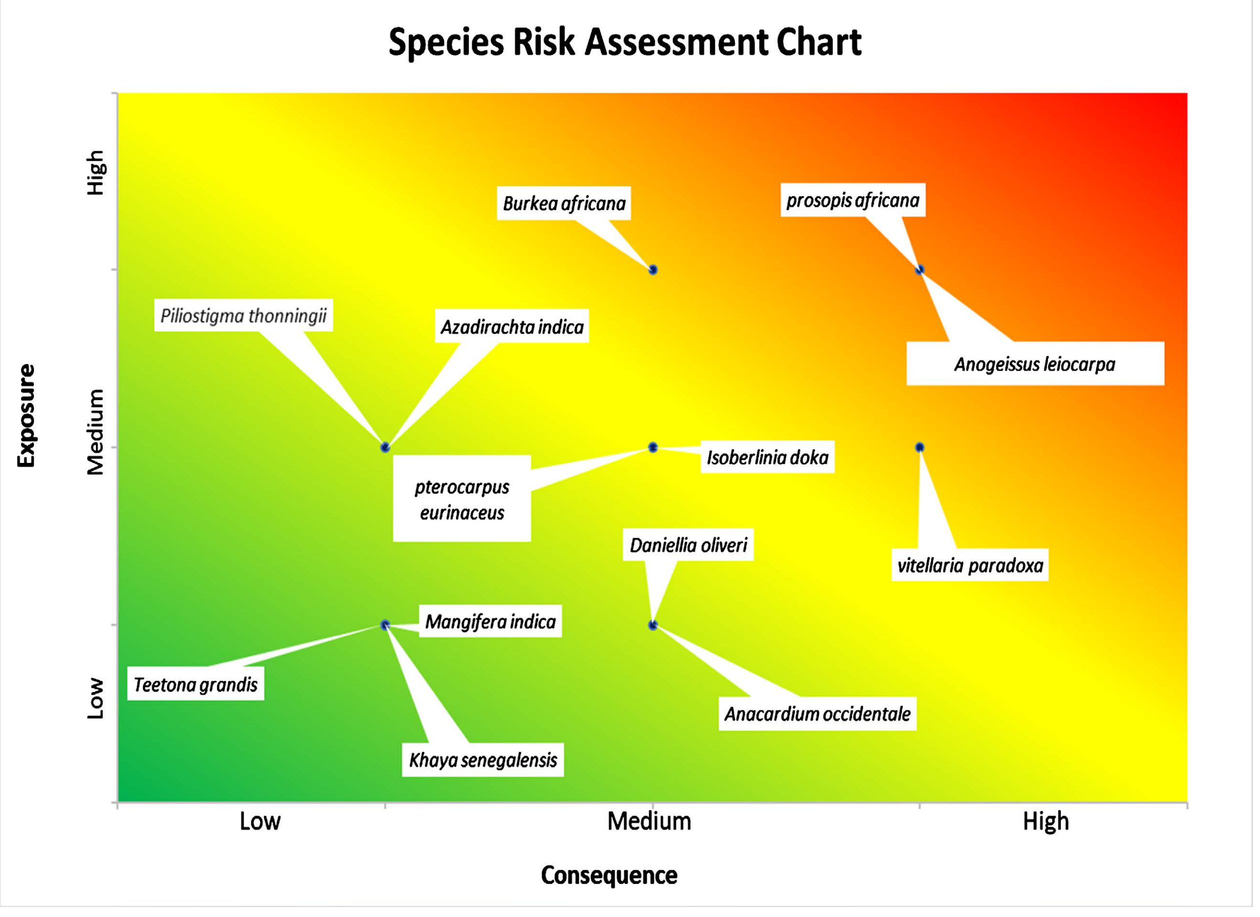

Figure 7. Plant Risk Assessment due to wood-energy production.

Figure 8. Charcoal carbonization using woods in the Tchaourou region

4. Conclusion

In summary, wood-energy consumption in Cotonou is estimated at 2.40 kg/day, and charcoal represents the most wood-energy used (86.25%). The study identified factors affecting wood energy consumption. These factors are "City districts", "Wood Resistance (density)", "Wood origin (Provenance)" and "Household Size (Number of habitants)". The analysis of these factors reveals that when the household increases by one individual, the level of wood energy increases by 0.14 kg per day. Cotonou is mainly served by 17 municipalities located from the south up to the central zone of the country. The consumption of wood energy in Cotonou implies the strong pressure on certain plant species such as *Prosopis africana*, *Anogeissus leiocarpa*, *Burkea Africana* and *Vitellaria paradoxa* which are vulnerable or even critically endangered in Tchaourou region for example. As it stands, the present study contributed to identifying the main supply areas of wood energy in the direction of Cotonou and also the major wood species threatened by such activity in Tchaourou's commune. Because of time limitations and financial means, the study could not explore more regions. Future research may explore all areas that supply Cotonou with wood energy and develop an exhaustive list of plant species in order to appreciate the impact of biodiversity loss.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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