PalArch's Journal of Archaeology of Egypt / Egyptology

Assessing the Urban Resident Energy Consumption Pattern and Its Impact on Surrounding Environment: The case of Bule Hora Town, West Guji Zone, Oromia, Ethiopia

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Belay Daba, Teshome Deresse: Assessing the Urban Resident Energy Consumption Pattern and Its Impact on Surrounding Environment: The case of Bule Hora Town, West Guji Zone, Oromia, Ethiopia -- Palarch's Journal Of Archaeology Of Egypt/Egyptology 17(9). ISSN 1567-214x

Keywords: Consumption, Degraded, Energy, Environment, Urban Residents

ABSTRACT

This research was gave consideration on the pattern of urban resident energy utilization among the residents of Bule Hora Town. Energy has a crucial role in our daily life, agriculture, industry, and social services. Conversely, large energy utilization effect would bring climate change, environmental pollution, and problem of human health. The highest objectives of this paper were to evaluate the urban resident energy utilization pattern and its impact on the surrounding environment. 200 sample households have been selected from Bule Hora Town using both stratified and purposive sampling techniques and the field data were collected using the household survey. 78.5 % of the respondents confirmed the utilization of fuel wood and charcoal has been preferred by the urban residents rather than other sources of energy for heating and cooking. Multiple logistic regression analysis be situated charity to identify the variables that significantly upset the energy use of households and to check for correlations among the independent variables before running. The estimated forest area cover converted into the quantity of fuel wood was 102.29 ha per year. Totally in one year, 1087.122ha forests are degraded to provide cooking energy in the form of charcoal and firewood for Bule Hora Town households. The study showed that currently about 7439.392tones of CO2 equivalent is released into the atmosphere from Bule Hora Town household charcoal and firewood consumption annually and this had serious negative implications on the health and environment

1. Introduction

1.1 Background of the study

Energy has a decisive role in our daily life, agriculture, industry, and social services (IEA, 2007), and it is some of the greatest vital involvements for satisfying popular livings (Clancy, J., Skutsch, M., and Batchelor, S. 2003). Nevertheless, large energy feeding leads to a severe risk to climate alteration, environmental contamination, and human healthiness. Reducing releases develop an significant direction of ecological policy worldwide (IEA, 2010a). The development stage of the economic foundation of a country determines the type of energy sources the inhabitants consume. The level of energy consumption in the country have an impact on the welfare of the consumer (Reddy, 2000). Today there is a mounting argument that poverty reduction and development programs have to be reliant on universal admission to energy services that are reasonable and dependable good number (Reddy, 2000).

Plans additional propose 1.2 billion society determination motionless absence admission to electricity in 2030, 87% of them alive in country areas, and the amount of persons trusting on the old-style usage of biomass for cooking determination increase to 2.8 billion in 2030, 82% of them in country parts (IEA, 2010). The amount of the people depend on biomass is uppermost in Sub-Saharan Africa (SSA). In greatest nations in SSA, greater than 90% of the rural populace trusts on fuelwood and charcoal to encounter their energy necessities though ended partial altogether town family's trust on fuelwood, charcoal, or wood unused to encounter their cooking wants (IEA, 2006). Rise in quantity of people, upsurge in development, domestic energy is a significant subject for fewer industrialized countries as a whole and not as much of industrialized countries, such as Ethiopia, in specific.

According to the World Bank (2014), Ethiopia was categorized as a poor developing country with a GDP per capita of $ 550 and an average growth rate of 10.8% per year in 2003/04- 2013/14. World Bank (2011), the country's energy use per capita was about 16 Giga-joules (GJ) and the primary energy consumption was 1.3 Hexa joules (HJ). Electricity, produced almost entirely from hydropower, accounted for 1%. Fossil fuel burning accounts for 7% while traditional fuel (charcoal and fuelwood) accounts for the remaining 92% of energy production.

As World Bank (2013) stated, lone an assessed 12% of the Ethiopian people consumes admission to electricity. By nearly 85% of the Ethiopians alive in rural zones, here be situated important prejudice amid the influence supply of urban and rural people: only 2% of the rustic nonetheless 86% of the urban inhabitants has admission to electricity. The overcapacity of the system often disturbs the power supply of huge profitable and manufacturing clienteles. Here is essential aimed at considerable investments in the power organization.

1.2. Statement of the problem

The full dependence on biomass energy in Sub-Saharan Africa is owing to an insufficient current energy provisions and extensive insufficiency in the landmass. Although Sub-Saharan Africa styles active around 14% of the entire people unindustrialized nations, it balance sheet for nearly 40 percent of the populace deprived of energy right to use (UNDP and WHO, 2009). Certainly, the mainstream of public in Sub-Saharan Africa live under the insufficiency line, and they can't have enough money to pay for up-to-date energy bases for cooking purposes. By growing inhabitants and development completed time, town native energy feeding stands significant subject for unindustrialized nations in general, and not as good as developing nations, such as Ethiopia, in specific.

Rendering to OECD/IEA (2012), Ethiopia is one of the countries with the major inhabitants depend on the outdated usage of biomass aimed at cookery in 2010. As of 2010, around 96% of persons in the state be dependent on the outdated usage of biomass for cooking (OECD/IEA, 2012). The request for biomass fuels is rising at a degree of 6 % yearly (Lakew et al., 2011). The domestic segment remains important energy-consuming area in the country. Above 90% of biomass energy used up via homes, rustic and town alike (Gebrehiwot, 1997). Families, even in important towns of Ethiopia, incline toward upsurge the amount of fuels they custom by means of their profits increase trendy its place of totally substituting after the consumption of outdated fuels (such as wood) to current ones (such as kerosene and electricity) (Mekonnen and Kohlin, 2008). The energy strategy of the country enormously emphases on the delivery of current energy bases to realize a slow changeover since outdated to contemporary energy bases (Teka, 2006).

Current population of the Bule Hora town is more than 67,297 according to the population record office of the Bule Hora town municipality administrative. The energy demand by the household is increasing but the supply is declining. The price of most biomass fuels gets high in which the majority could not afford to buy. Accordingly, this research is tried to incorporating the research break by observing at the vitality utilization level of families in Bule Hora town and its impacts on the Environment of the towns found in Southern Ethiopia.

2. Materials and Procedures

2. 1. Description of Study Area

This study would be done in Bule Hora Town, West Guji Zone of Oromia Regional State. The Town lies between 5026'-5052'N latitude and 37056'-38052'E longitude. Located on the paved of Addis Ababa Moyale highway and the Town far from Addis Ababa about 476 km to the Southern part of the country. The Bule Hora Woreda has 39 kebeles of which Bule Hora Town is one Woreda of the Zones (BHWAO, 2019).

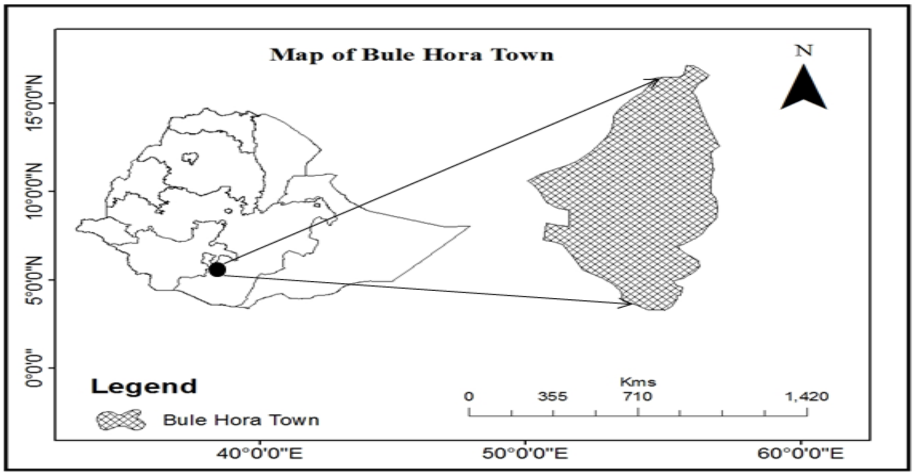

Figure: 2.1 *Map of Bule Hora Town* *Source: By Own, 2019*

2.2 Research Methods

2.2.1 Research Design

The research design for this paper would be applied as a sequential explanatory type of research design. Based on the nature of the inquiry, the research was employed both qualitative and quantitative research approaches. By applying quantitative principles, the researchers attempted to answer a research question that seeks to describe the existing situations to the patterns and determinants of household energy among households of Bule Hora Town and its implication on the surrounding environment.

Through a qualitative research approach, the researchers collected the opinion of respondents about patterns and determinant of household energy consumption as well as its implication on the Surrounding Environment.

For this study, the researchers have employed primary and secondary data sources. The research mainly depend on primary data obtained by quantitative and supported by a qualitative method of data collection through questionnaires, interviews, and personal observation. The secondary data was obtained from various sources such as books, journals, recorded materials, and published materials.

To conduct this study in a representative way and to increase its reliability and validity three-stage sampling procedures were developed for the identification of sample respondents from the total population (6,845 households). First, the three kebele was selected as it is from Bule Hora Town Administration. This is because the town has only three Kebeles (01, 02, and 03); so that the three Kebeles were taken purposively. Second, to select the sample households from the three Kebeles, stratified proportional sampling would be employed. The number of samples for each Kebele is determined based on their proportion to the size of the total population (households) in each Kebele from which the sample is drawn and also the researchers used purposive sampling in selecting the interviewees for interview. Third, to identify the number of household samples from each Kebele the researchers used systematic sampling (by using the Kth value system, "K=N/n") as their list was listed in the Kebele administration office.

Therefore, based on the above formula sample size was determined for this study. So that 200 sampled household was selected as a sample from the total population (from total households' 6,845). The table below indicates the summary of sample households from the three Kebeles based on their number of total households.

Table 2.1: *Sample Size of Respondents*

№	Sub Kebele	№ of Households	Sample Size	
			Number	%
1	Kebele 01	3177	93	46.5
2	Kebele 02	1866	54	27
3	Kebele 03	1802	53	26.5
	Total	6,845	200	100

Source: Own Survey, 2019

As it is indicated in the above table households from all Kebele have an equal chance to be selected in to sample. Therefore to give equal chance for selected household:

$$\text{n(stand for each Kebele sample size)} = \frac{\text{Total population (HH) in Kebele} * \text{Sample size}}{\text{Total population (HH) of the town}}$$

Total population= 6,845 (Kebele 01= 3177 household, Kebele 02= 1866 household and Kebele 03=1802 household)

Sample size= 200. So that,

$\text{Kebele } 01 = \frac{3,177*200}{6845}$ = 93 $\text{Kebele } 02 = \frac{1866*200}{6845}$ = 54 $\text{Kebele } 03 = \frac{1802*200}{6845}$ = 52

Totally, household respondents were selected as samples (the total sample size of the study research). This illustrated that all households in three Kebele have an equal chance to be included in the research and the researchers selected respondents from all Kebeles depend on the number of households that exist in each Kebele at the interval of 34th.

2.2.2 Data Analysis Methods

The researchers employed descriptive statistics to examine data about the objectives of the study. In descriptive statistics such as frequency, and percentage would be employed to determine demographic characteristics of the household and discuss the results of the study. A different list of items would be used to collect the data about urban residents' energy consumption patterns as well as its impacts on the environment and analyzed descriptively using the responses from respondents. In addition, the data gained after the secondary source, and unstructured discussion would be examined qualitatively.

The researchers would be uses computer software of SPSS version 25.0 for analysis.

2.2.3 Variables

It is necessary to identify potential explanatory variables which can affect urban residents' energy consumption pattern.

The dependent variable for this study was urban residents' energy consumption patterns. This dual variable shows the result of the domestic to choose charcoal and firewood for cooking or electricity for cooking.

Factors that can affect the household energy choice in Bule Hora town are the independent variables for this study. Different literature examination state the influences household energy choice joined with personal Ethiopian arena familiarity directed the assortment of variables to be comprised cutting-edge the contemporary logistic regression model. An enormous works has emphasized reasons that disturb forms and stages of domestic vigor ingesting. The elements include:/ age of the domestic pate (Erlandsen & Nymoen, 2008; Lenzen, 2006), revenue, fuel fee, price of related utilizations, the chance cost for firewood collection (Lenzen, 2006; Hartmann & Sherbinin, 2001), side by side of urbanization, accessibility of fuel and connected uses, cultural preferences household extent (Lenzen, 2006; Hartmann & Sherbinin, 2001)] household category, tenancy type, engagement rank, amount of youngsters, and carriage proprietorship (Fuchs & Lorek, 2000) categorized the contributing factor of through energy choice by families into the following groups:

- Profitable effects (not reusable revenue, customer fees, payments arrangement, and accessibility of recognition).
- Socio-demographic effects (family mass and arrangement, oldness, behavioral influences, existence, approaches).
- Alive condition (per-capital, ground space, house type, house age, the standard of insulation).
- Knowledge (liveliness expertise of domestic uses)and
- Other influences: structure of homes– age and gender, maintained versus chartered, houses, and energy usage principles for original residences or employments, economic growth, technology, policy, and lifestyle.

2.3 Modeling Factors Influencing Household Cooking Energies Choice

Binary logistic regression be situated rummage-sale to limit the influences which disturb the choice (by homes) household energy consumption. The common logistic regression model balance is assumed by:

$$\text{Logit}(Y) = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \ldots + \beta_n X_n$$

Where: logity = $\ln\left(\frac{p}{1-p}\right)$ and p is the chance of the research event, α is the Y intercept, β_s are regression amounts, and X_s are an agreed predicators.

2.3.1 Scheming of GHGs Emissions from Energy Utilizations

Diverse outlines of energy utilizations lead to differences in greenhouse smoke releases. The emissions of greenhouse gases (GHG) in the form of CO_2-equivalent from the household energy consumption of all fuels can be determined by using the following model adopted from (IPCC, 2006) which stands grounded on the whole sum of fuel combusted. Avoidance release effects of diverse energy forms are shown below:

$$G_{ij} = \sum EiMiKi$$

Where G_{ij} is the total CO_2-equivalent emissions, element kg; Ei is the nonpayment CO_2-equivalent release factor of stove kind i, unit g/MJ; Mi is the whole firewood utilization of energy type i, element kg; Ki is the calorific charge of energy kind i, unit MJ/kg. Ei is from 2006 IPCC Strategies for National Hot house Gas Inventories and (Bhattacharya & Salam 2002); Ki is from (Barnes & O'Sullivan 2007; NMSA, 2001). According to the (IPCC, 2006), the 100-year worldwide heating capacities of methane (CH_4), nitrous oxide (N_2O) and carbon monoxide (CO) be situated 7.6, 300 and 1.9 times that of carbon dioxide, respectively.

2.3.2 Estimation of Forest Degraded

The average weighted of Charcoal and fuel wood consumed by the household was recorded during completion of the main questionnaire. These data were used to compute a weighted usual quantity of charcoal and fuel wood in kg. Clearly, charcoal production contributes to the deforestation of Ethiopia but it is problematic to calculate the level of deforestation and the involvement of charcoal making to degradation of forest. But, Van Asperen (2001) provides a useful formula: 50,000 tons of charcoal = 16,600 ha of forests = 26.7 million trees.

To change charcoal utilization into corresponding wet firewood and woodland zone modification, we will adapt the procedure and influences used by (Kammen et al., 2001). Based on this work the alteration issues for charcoal formed by means of the outdated kiln, it stayed originate 3% of the charcoal made is left-hand at the crushed kiln place as insignificant smithereens that cann't be packed. Bush biomass-to-charcoal alteration effectiveness, through humidity satisfied of 18%, for range desiccated wood and air-dried wood was 25% and 21% correspondingly. The next method is rummage-sale to analyze the wet wood mass aimed at air-dried wood.

Green wood (wet) = Air-dry weight/ (1-Moisture content).

This formula, for 1 kg of charcoal, interprets into:

Green wood (wet) = ((1/0.97)*(1/0.21))/ (1-0.18) = 5.9868.

This provides an issue of 1 kg of charcoal to around 6 kg of green wood. This influence be situated employed to change measure of fire wood utilized into wet wood corresponding and then to charcoal. The measure of charcoal corresponding was changed into predictable area protect by means of the influence agreed by Van Asperen (2001).

3. Discussion and Result

3.1 Socio-Economic Features of Participant

In conducting this research, both male and female respondents were included. As is indicated in Table 3.1, from a total of 200 households, 116 (58 %) were male and 84 (42%) were females. These data show clearly that there was the participation of both sexes although the amount of male participants be situated well than of the female. As discussed in Table 3.1, 35 out of the total 200 respondents, the majority age group was between 20-30 which contains 40.5% (81 respondents) and the least age group from greater than 61 years which is only 2% (4 respondents).

Table3.1: *Age and Sex of Respondents*

Age of Respondents'	Sex of Respondents				Total	
	Male		Female		Frequency	%
	Frequency	%	Frequency	%		
20-30	43	21.5%	38	19%	81	40.5%
31-40	32	16%	25	12.5	57	28.5%
41-50	21	10.5	16	8%	37	18.5%
51-60	18	9%	3	1.5%	21	10.5%
>61	2	1%	2	1%	4	2%
Total	116	58%	84	42%	200	100%

Sources: Own Survey, 2019

As data in Figure 3.1 shows that, from the total respondents 82 (41%) were Government employees followed by merchants 63 (31.5%) and the least of them was from Private workers which are only 2 (1%). In other from the total sampled households, about 73 (36.5%) respondents' monthly incomes were more than 5000 birrs (the majority of them were government employee and followed by few merchants, as only a single respondent was from wage laborer, this indicates that the majority of the daily laborers gets low incomes), 43 (17.5%) respondents income range from 2001-5000, 35 (17.5%) of these 1001-2000 and the rest 49 (24.5% respondents income ranged from 500-1000 or below (the majority of them were from daily laborer and followed by pity trader/ merchants and farmers).

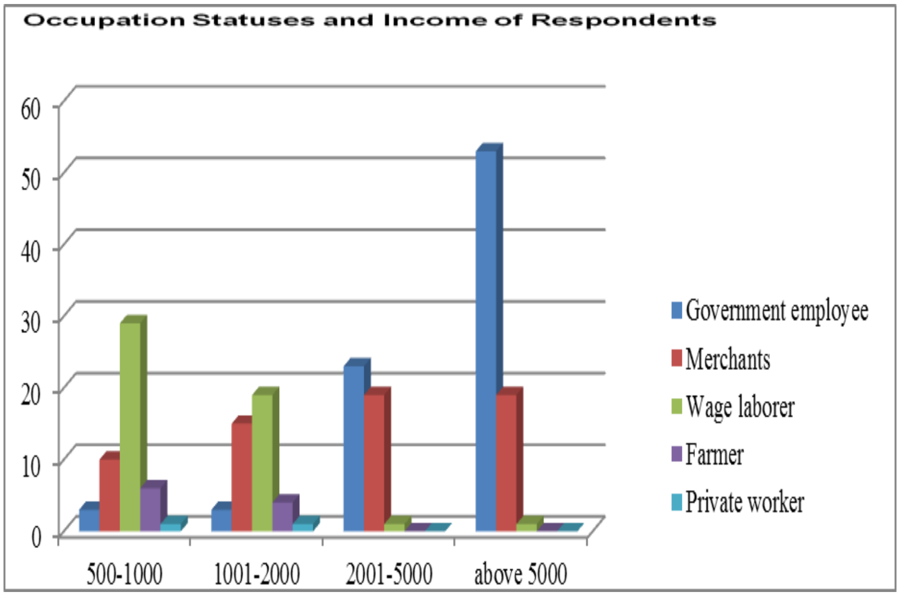

Figure 3.1: *Occupation Statuses and Income of Respondents Sources: Own Survey, 2019*

3.2 Bule Hora Town Energy Consumption Patterns for Cooking

Regarding the household energy consumption pattern in Bule Hora town shown in Figure 3.2, 33 (16.5.%) use electricity, 43(21.5%) use fuelwood, 121 (59 %) use charcoal for cooking wet, tea, coffee, and heating of water. Whereas 29(14.5%) use electricity, 166(83%) use fuelwood, 5(2.5%) use plant leaves, and fuelwood, for cooking Injera, and Bread. But based on the study, the key home cooking and light fuels originate in the research zone were: firewood, charcoal, electricity, and firewood and plant leaves. Firewood and charcoal be situated the foremost cooking fuels in the research region. The fuel select modeling be situated consequently accompanied aimed at these two fuels.

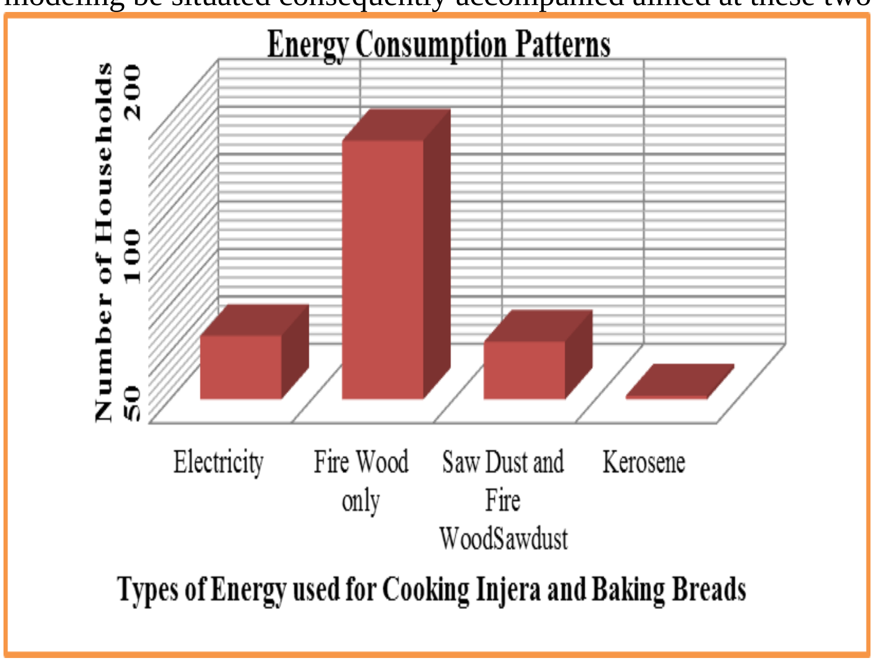

Figure3.2*: Energy Consumption Patterns Sources: Own Survey, 2019*

3.2.1Types of Cooking Stoves Used in Bule Hora Town

The consumption of different energy sources for the household function is not only depending on the fuel type but also the type of appliances used by a family. The low-income groups were employed traditional appliance at the function of low-efficiency level. Due to their quality and better efficiency of utilization better income households use more energy for varied household functions than the poor do.

As shown in Table 3.2, 155(77.5%),45(22.5%),47(67.5%),6 (2.475%) of the household use the traditional iron charcoal stove, improved charcoal stove, electric stove, kerosene stove respectively for cooking wet, tea, coffee, and heating of water. Out of 200 households, 147(73.5%), 53(26.5), and 100(29%) of the households use Open three-stone fire, Improved three-stone fire, and Electric stoves for cooking Injera and Bread respectively. According to Bess, 1995 Lakech charcoal stove 25% fuel saving than the metal charcoal stove. In addition to a single Lakech stove saves 0.125 charcoals per household per day. Therefore, the Bule Hora household mostly 147(73.5%) depends on traditional stove due to that they are consuming large amounts of forest.

Table3.2: *Types of Cooking Stoves*

Variables	Types of Stoves	Frequency	Percent
Cooking wet, tea, coffee and heating of Water	Traditional iron charcoal stove	155	77.5
	Improved Charcoal stove	45	22.5
	Electric stove	47	67.5
	Kerosene stove	6	2.475
Cooking Injera and bread	open three stone fire	147	73.5
	improved stoves	53	26.5
	Electric stoves	100	29

Sources: Own Survey, 2019

As the survey showed in Figure 3.3 the majority of households 130(65%) had no owned electric meter at their home level and 70(35%) had their own electric meter from their home.

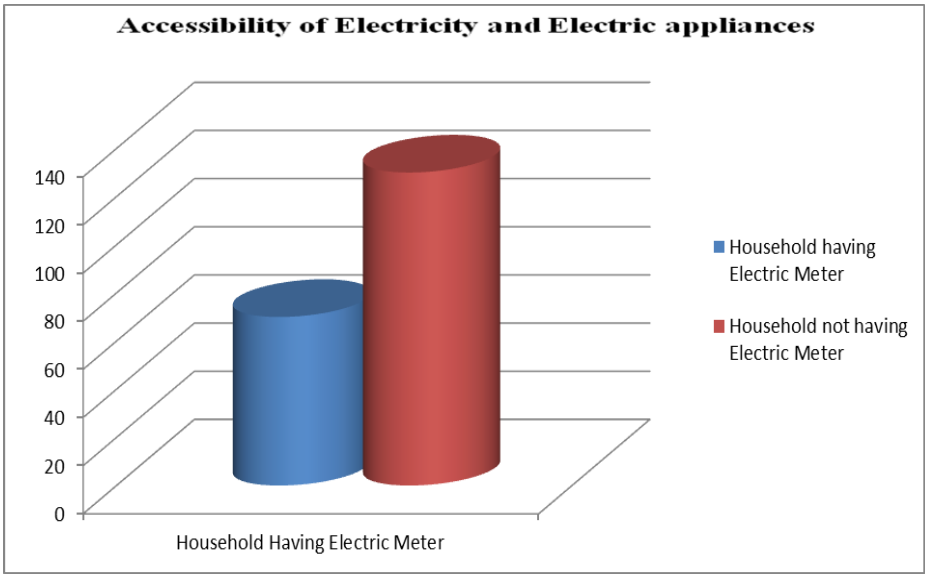

Figure 3.3: *Accessibility and Electric appliances for Households Sources: Own Survey, 2019*

According to the study as indicated in Table 4, the electric meter was accessible for 29 (14.5%) of the households. It was not easily accessible for 171(85.5%) of households. For the majority of them, it was difficult to get an electric meter for home. It is too costly to install the electric poles to have their own electric meter. The majority of the households don't possess electric appliances.

Again, 152(76%) of the households don't have electric appliances. Only 48(24%) of the households possess the appliances. Without electric appliances, it is impossible to use electric power for cooking purposes. According to the data from Table 3.3, 191(95.5%) the power of electricity was enough to use electricity for lighting and cooking.

Table 3.3: *Accessibility, Appliances and Power of Electric at Bule Hora Town*

Variables	**Characteristics**	**Frequency**	**Percent**
Accessibility of Electric meter	Accessible	29	14.5
	Not Easily Accessible	171	85.5
Total		**200**	**100.0**
Household having Electric Appliance	Household having Electric Appliance	48	24
	Household not having Electric Appliance	152	76.0
Total		**200**	**100.0**
Power of the	Weak	9	4.5

Electricity			
	Enough	191	95.5
Total		200	100

Sources: Own Survey, 2019

3.3 Determinants of Household Energy Choice Pattern

The fuel choice modeling was conducted for charcoal, electricity, and fire fuels for household choice. Multiple binary logistic regression examination be situated approved available to discovery available variables that significantly affected the choice of household cooking fuels in the research place. Since fuel-wood, charcoal, and electricity were the foremost bases of vigor for cooking and because biomass fuel consumptions harm social and environmental aspects, the analysis was conducted separately for each one of the fuels. The applicant variables identified and the regression outcomes stand accessible popular Tables 3.3 besides 3.4 correspondingly.

The descriptive results suggested while urban households in Bule Hora Town displayed approximately propensity in the direction of fuel converting in reply to alterations in socio-economic rank, this reply is not conventional advancing. Given the complexity of fuel choices in Bule Hora Town, a binary logistics model was used to classify causes of a home's fuel optimal. In the analysis for households using fuel wood as a basis of energy aimed at cooking the independent variables such as:/ household monthly income, residence ownership of dwelling house, types of dwelling ownership house, and households having own electric meter were those variables significantly influencing the use of fire-wood as an energy source.

Table3.4: *Factors Affecting Household Fuel Wood Choice for Cooking*

Variable	B	S.E.	Wald	Sig.	Exp(B)	95% C.I. for EXP(B)	
						Lower	Upper
Family Monthly Revenue	-0.21	.0815	3.196	0.005	0.318	.223	.441
Ownership of Dwelling House	0.365	0.15	3.0414	.0063	1.0302	0.5726	1.8526
Household not having Own Electric Meter	0.595	0.15	7.735	0.000	1.6541	0.9068	3.0166
Types of Dwelling House	0.499	0.214	2.6658	0.009	1.356	0.5756	3.1985

Sources: Own Survey, 2019

3.3.1 Household Monthly Income

As data of Table3.4, the income of the household was positively significant (AOR=0.2868 p = 0.000) and again strongly affected the high-quality of charcoal as a source of energy for cooking. This is because the income of the household significantly affects the type of energy convertor used in the household. Households who had higher monthly income levels have a larger likelihood of purchasing electric energy converters and the likelihood of using charcoal is less. Therefore, household standing too effects household energy choice levels. Evidence has been shown by Gebreegziabher (2010) in Ethiopia, modern ranges performance a title role as "status symbols" and buying those stands apparent as similar through advanced communal position. The result thus supported that of other recent studies. Farsi et al. (2006); Mekonnen & Köhlin (2008) showed that several influences like income, price, and education of the household head were originate to remain significant in defining household fuel optimal in urban households of India and major cities of Ethiopia. This review also argued with Barnes et al. (2010) that revealed growing incomes in conjunction with other socio-economic factors are seen as determining factors for the household's fuel switch and choice toward cleaner energy sources.

3.3.2 Residence Ownership of Dwelling House

According to Table3.4, Households with owned residence dwelling house most likely prefer firewood to electricity for cooking Injera and Bread (AOR =1.0302, p= 0.00634). Non-home owners possibly limited not to have own electric meter that in turn limits the households to use firewood as the energy basis intended for cooking Injera in addition Bread; this may be due to a fact that those households use electric energy even for lighting from neighboring households. Ownership of a dwelling house tends to variation in having the electric meter to use sound energy source. This is inlined with a study done by Degnet (2007) in Jimma town that found that non-homeowners would be restricted to depend on additional on outdated fuels than owners do. This implies that unless the households possess their own residence home, it would be difficult to use sustainable energy sources.

3.3.3 Types of Dwelling Ownership House of Households

Based on Table3.4 data, mainly the household level of living were essentially imitated in the housing circumstances which remain revealed by:/ substantial used for ground, tops, walls, if the household is electrified or not, and current sanitation – water and/or sewerage arrangement (Abeyasekera, 2002). This study revealed that households with traditional dwelling houses prefer firewood to electricity for cooking fuel choice for Injera and Bread (AOR =1.3565, p =0.0926). The housing circumstances show that Bule Hora town homes by poor housing circumstances as specified above would utilize more firewood in favorite for power. The low living values variables (roof, floor, and wall) decrease per capital kindling utilization, then rise the chance of overwhelming fuelwood for cooking. This is predictable because homes with houses with thatched roofs, soil floor, and soil walls possess little wealth hence low income to afford electric stoves. Given this, it is predictable that their per capita fuelwood utilization determination be rising with the rise in their wealth because fuelwood is a normal good in this case. But this study shows that the probability of using firewood increases with a decrease in the quality of dwelling ownership houses of households. As values of active for a specific household recover utilization of fuelwood drops and vice versa. Similarly, Dereje D. (2013) in his paper of domestic energy favorites aimed at cooking in urban originate that as values of living better the use of firewood weakened.

3.4 Factors Affecting Household Cooking Fuel Choice for Charcoal

Table3.5 shows that, factors affecting a considerable amount of homes that in standard could afford a current, domestic, and suitable power sustained to trust completely or partly on charcoal. This stretches a diverse viewpoint on energy choice. In general, the usage of charcoal by means of key category of cooking energy relation to extra foundations, secretarial intended for 80.98% of the entire Bule Hora town families. This fixes not appropriate simply with the old-style energy ranking model. In the analysis for households using charcoal as a foundation of energy for cooking the independent variables such as Sure outdated cooking methods that give respectable sensitivity or texture to the food, monthly income of households, and not having own electric meter.

According to Table3.5, households not having their electric meter highly prefer charcoal to electricity than households having their electric meter (AOR = 0.987 (p =0.000976). This shows that admission to electricity has a positive then important effect on charcoal utilization through the coefficient suggesting that being linked to electricity decreases charcoal utilization. Households who did not have their electric meter impeded from using the electric services as they demanded and limited to less efficient fuel sources like charcoal to fill their energy needs for cooking wet, tea, coffee, and heating of water. Not having their electric meter possibly limited the households to use charcoal as an energy source; this may be because households cannot use electric energy for cooking by using an electric meter of the neighboring households, as households those who have not electric meter complained during data collection.

Table3.5: *Factors affecting household Charcoal choice for Cooking*

	B	S.E.	Wald	Sig.	Exp(B)	95% C.I. for EXP(B)	
						Lesser	Greater
Monthly income	0.2585	0.06585	7.5614	0.000	0.2868	0.2204	.374
Household not having own electric meter	0.3439	0.112682	4.5532	0.000975	0.987	0.623	1.5512
Taste of coffee, tea and Wet cooked by charcoal	0.54	0.11805	10.1195	0.000	1.467	0.915	2.363

Sources: Own Survey, 2019

3.5 Impacts of Household Energy Consumption on Environmental
3.5.1 Forest Degraded and Environmental Degradation

Inefficient and unsustainable fuel choice for cooking has thoughtful inferences on the situation, such as land degradation and global warming. As Table3.6, firewood takes up to almost 67.40% for cooking Injera, and charcoal takes up 83.5% for making Wet, tea, coffee, and heating water in Bule Hora Town. These biomass fuels are collected from forests of "Bada Magada" located in Bule Hora and Dugda Dawa Woreda, West Guji Zone, and 485km southwest of Addis Ababa and forms the parts of the southeast highlands of Ethiopia. So, it can be easily concluded that,/ the household energy consumption of the Bule Hora Town is one of the major contributors to deforestation in the nearby forests. Household energy utilization in the research site clearly shows heavy dependency of households on biomass energy for household cooking. According to ORSSPIP (2002), therefore, sources of household energy in the study area have been contributing to the deforestation of the nearby forests and woodlands.

According to the analysis of the study, 252.175 Kg of charcoal was consumed on average per household per year. Per capital Charcoal consumption was 910.488 kg per year. The mean annual firewood consumption per household of this study area is 356.95 kg. Per capita, firewood consumption was 693.9kg per year. Charcoal consumption per household per year was higher than the average utilization of urban households in Zambia, which according to (Mulenga, 2002) is about 490.8kg and lower than Ogbomoso households in Nigeria, which according to (Ajao A.O 2011) is about 556.8kg.

Table3.6: *Fuel Wood Consumed and Forest Degraded*

Type of Fuel	Amount of Fuel consumed per HH per year (Kg)	Green Wood(Wet)(tones)	Forest degraded per household per year(ha)	Annual forest degraded per year per the town(ha)
Fire wood	346.95	0.3561	0.0195	176.634
Charcoal	252.175	-		910.488
Total				1087.122

Sources: Own Survey, 2019

Furthermore, like in other developing countries in Ethiopia (Zenebe, 2007), this practice encourages tremendous environmental deprivation, such as deforestation, soil erosion, and desertification, and some other health impact and social impacts, for example time and a trip to get firewood in the study area. The data from the zonal office clearly shows that fuelwood stocks are relatively plentiful but are being harvested well above their sustainable yield in Bule Hora. Fuelwood is becoming scarce in many parts of the area. This may be attributed to the ever-increasing deforestation in West Guji Zone in general (ORSSPIP 2002). Therefore, currently, inefficient household energy use in Bule Hora town puts great pressure on the resources and environments.

3.5.2 Green House Gas Emissions from Household Energy Consumption

Based on Table 3.7, fire-wood, charcoal, and kerosene were commonly used by Bule Hora households for cooking. According to the given model, the amount of greenhouse gas emitted by each household was quantitatively explained and presented in Table 3.7.

The research result tells that the average household size in the study area was 5-6, and the population of the study area is 27,820 and the number of households is 6,845. The population is high because colleges and universities are found in the study area. 80.98% of households use charcoal, 67.40% use firewood; 15.06% plant leaves and fuelwood for cooking, and 0.985% use only plant leaves for cooking Injera and Bread. About 166(83%) use fuelwood, about 34(17) % use electricity, and about 5(2.5%) households use plant leaves and fuelwood, for cooking Injera and Bread. As the analysis month imitated characteristic monthly utilization of charcoal, the annual consumption of charcoal by Bule Hora town family unit in one year was 2742.44tons. According to Van Asperen's (2001) conversion ratio of 50,000 tons of charcoal equivalent to 16,600 hectares of forest, about 910.488ha of living and standing forests are removed annually to fill the energy need of the households found in Bule Hora town from charcoal alone. The entire annual firewood utilization in the extent is estimated to be 3177.56 tonnes. According to, Cunningham MA (2003) the tree moisture content is 18%. The total annual wet wood converted to firewood in the area was estimated to be 1870.87 tonnes. The amount of firewood corresponding changed into appraised area cover using the factor given by Cunningham MA (2003) was 102.29 hectors. Totally, in one year 1087.122ha forests were degraded to provide cooking energy in the form of charcoal, firewood for Bule Hora town households.

The estimates were based on several expectations: that all trees are felled mainly for charcoal and firewood fabrication, and that completely plantations stand of even concentration. In truth, vegetation may be situated selectively gathered for charcoal and firewood manufacture departure irregular plantation shield. Moreover, charcoal and firewood may possibly also be manufactured as of plantation unoccupied for additional determinations. In spite of these possible worries with the estimation, it is indistinct that the influence of charcoal and firewood feeding toward forestry deprivation be present important. Bule Hora Town is the center town of West Guji Zone with a large population size therefore; the contribution of the households of Bule Hora town toward environmental deterioration is much. Unless and otherwise regulated or shifted to cleaner energy sources, household energy consumption particularly from traditional energy sources such as firewood and charcoal is contributing to ongoing deforestation as a deriving factor.

Table 3.7: *Greenhouse Gas Emitted from Bule Hora Town per Household*

Type of Fuel	Amount of Fuel per HH per year (Kg)	Type of stoves	Calorific Value(MJ/Kg)	Emitted gCO2-e MJ[1]usefulenergy	Annual Emitted CO_2equivalent(tones) per capital	Annual Emitted CO_2 equivalent (tones) per the town
Fire wood	3510.04	Open TSF	16	53.512	0.6146	4402.468
	311.29	Improved TSF	16	36.048	0.3658	1480.03
Charcoal	275.707	Traditional charcoal Stove	30	8.1463	0.16097	1169.024
	213.83	Improved Charcoal Stove	30	8.146	0.1073	387.87
Kerosene	4.146L	Wick kerosene		170.58536	0.0014634	0.39024
Total						7439.778

Sources: Own Survey, 2019

The foodstuffs of imperfect combustion emitted from the charcoal and firewood cooking stoves segment the greater percentage of energy-related releases in standings of entire GWP (in CO2 equals) encompassing 31% completed a 100 years-time edge(IPCC, 2006). The study showed that currently about 7439.77824 tons of CO2 equivalent is released into the atmosphere from Bule Hora town household charcoal, and firewood consumption in one year. The largest emission rate of CO2 equivalent was from the household's firewood consumption with 5882.498 tones, followed by charcoal consumption. This implies that the inefficient three-stone fires were contributed to not only the higher consumption of biomass fuels but also the emission of GHGs. The reason for this outcome is that fuel woods burned in minor measure burning devices do not sufficiently combination through air, thus they give off many products of incomplete combustion (Kammen et al., 2001; Smith et al., 2000). Also, charcoal stoves were highly contributing to the emission of GHGs and health-damaging pollutants. The secretion of contaminants after the process of biomass fuels hinge on on the amounts of the fuels used up. Likewise, TSFs existence minor and simple devices cause much higher pollution per kg of biomass fuel used associated to other energy strategies. Evidence from studies assumed that great numbers of CO_2 are released after the ranges (IPCC, 2006; WHO, 2006). Due to the amplified inhabitants progress and recurrent disintegration of woodlands, the biomass firewood sequence in developing countries is unmaintainable (Smith et al., 2000) which clues to an amplified gathering of fuel wood on or after community forests and resultant deforestation.

4. Conclusions

Household energy consumption in Bule Hora town primarily depended on charcoal and firewood for cooking and heating, which is unsustainable due to environmental effects and energy supply constraints. Based on the study, the key domestic cooking and igniting energies originate in the paper area are: firewood, charcoal, kerosene, electricity. Firewood and charcoal stand the principal cooking fuels in the study zone. The possible uses of fuel types found in the study area were as shadows: firewood (cooking and heating of water), charcoal (cooking, making coffee, tea, and heating of water), kerosene (cooking, making tea, coffee, and heating water), and electricity (lighting and cooking). Overall, the majority of households use firewood 33 (16.5. %), 121 (59 %) use charcoal for cooking wet, tea, coffee, and heating of water. Only 21.5%of the family circle in the revision part usage energy for cooking. Kerosene is only used by 2.5 % of households for cooking. These practices polluted both indoor and outdoor environments as well as degraded the environment.

The review has revealed that here is a statistically important favorite of the families for fuelwood and charcoal as sources of energy. The outcomes recommended that statistically important factors distressing household fuel special are: income of household, residence ownership, having own electric meter, types of dwelling ownership house, and behavioral and cultural characteristics of households. More emphasis could be given to the forces that drive charcoal and firewood choices of the household for a better understanding of its implication.

About 910.488ha of living and standing forests are removed annually to fill the energy need of the households found in Bule Hora town from charcoal alone. The estimated forest area cover converted into the quantity of fuelwood was102.29 ha per year. Totally in one year, 1087.122ha forests are degraded to provide cooking energy in the form of charcoal, firewood, and sawdust for Bule Hora town households.

The study showed that currently about 7439.392tones of CO2 equivalent is released into the atmosphere from Bule Hora town household charcoal, sawdust, and firewood consumption annually.

It is doubtful consequently that the afforestation program in the study area has had a important influence on dipping heaviness on natural forests. Therefore, more concentrated hard work must be focused on the way to improving the maintainable organization of the expected plantations, nonetheless this doesn't indicate whatever that bush establishing doings would be disregarded. Naturally talking, the harm of usual plantations cannot be unpaid by plantation forests since they take diverse standards in standings of biodiversity besides ecology purposes.

Acknowledgements

We want express our appreciation to Bule Hora Municipality administration, experts and respondents for sharing their valuable experiences, material as well as cooperation to conduct the study.

Conflict of Interest

The author declared no conflict of Interest.

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