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AN ASSESSMENT OF HOUSEHOLD ENERGY TYPES, SOURCES, USES AND ITS IMPLICATION ON SUSTAINABLE FOREST MANAGEMENT, IN THE BUEA MUNICIPALITY OF THE SOUTH WEST REGION OF CAMEROON

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ABSTRACT

The study focused on the assessment of household energy types, sources, uses and their implications on sustainable forest management in the Buea Municipality of the South West Region of Cameroon**.** The study was carried out in the months of May- September 2005 and November-April 2006. The study made use of the random sampling technique for the administration of questionnaires. Along side the administration of the questionnaire, some selected Participatory rural Appraisal (PRA) tools were employed. Results revealed that, Fuel wood (FW), Kerosene (K), Sawdust (SD), Cooking gas (CG), Charcoal (CH), Rubber (RB), Electricity (EL), were the main energy types/sources identified in the Buea Municipality. Saw dust and Fuel wood were found to be the most frequently consumed energy type/source in the Buea Municipality with a resultant effect on deforestation. On an aggregate weighting, the area was found to consume a total of about 253m^3 of FW, 744Litres of K, 14602Kg of SD, 6360Litres of CG, 20625Kg of CH, 3861g of RB, and 40,299KW of EL in a month. Monthly total household expenditure on the various energy types/sources for the study area was evaluated at about 10496640 FRS CFA (US$ 20993). The quantity supplied and consumed of the identified energy types/sources were observed to be adversely affected by income levels of consumers, market prices for these energy types/sources, seasons and the disappearing forest.

KEYWORDS: Energy, Types, Sources, Household, Consumption.

INTRODUCTION

The running of any given economic sector (industrial, domestic) is powered by various forms of energy that can be sourced from renewable and non-renewable sources (FAO 1999). The domestic sector of some developing countries, like Cameroon, depends on the renewable or traditional energy sources for various activities (heating, cooking, brewing, lighting and local craft

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production) and supplemented by the non-renewable sources (FAO, 1990).

These traditional sources of energy are facing a steady rise in pressure on them from the increasing population (Ibrahim, 1998, Kang, 2005).

The World Bank, as early as 1981, estimated that about 5-15% of the energy from petroleum products at the turn of the century might be substituted by energy from renewable sources. Ayodele (1998) and Zhang *et al*. (2005) observed that about 70% of the population of Africa live in rural areas, with a majority of this population depending on the forest and, to a lesser extent, on crop residue for their daily domestic energy needs. From this backdrop, forest size, tree species quality and quantity is on a decrease making it difficult for the forest to provide the needed natural environmental functions.

In view of the steady decline in the value of forest goods and services in the Congo Basin, the Cameroonian rural and urban households have developed a wide range of traditional and semi modern strategies in the domestic energy sector. The developed strategies are intended to help them cope with the problems of the retreating forest, loss of preferred tree species for fuel wood and their inability to pay for the increasing non-renewable fuel prices. The driving force is not unconnected to their inability to survive with less than a Dollar income a day.

A household in the Cameroonian context considers all persons, living under the same roof and feeding from the same pot (a common feeding arrangement), (Bassam 2004). Households are however, subjected to varying factors, which include: population size, income, and feeding habit. These ultimately influence's the household income expenditure patterns and domestic energy demands (Kantai 2002).

Buea Municipality, which harbours a cross section of these rural and urban Cameroonian households, who treasure and use local indigenous knowledge, gives an opportunity to study and assess the types and sources of domestic energy and alternatives in the area.

OBJECTIVES

The general objectives of the study were to assess the types, sources and uses of domestic energy consumed in the Buea Municipality and its impact on sustainable forest management.

Specific Objective

- Identify the types, sources and use patterns of domestic energy used in the Buea Municipality,
- Identify major factors that influence the use, consumption, and production of each energy type and source as well as its impact on sustainable forest management,
- Evaluate aggregate household income spent on each energy type and source.

MATERIALS AND METHODOLOGY

Study Area

Buea Municipality is located at about 1000m above Sea level at the base of Mount Cameroon. It lies between latitudes 4^0 12'N and longitudes 9^0 12' E and has a total surface area of 870 km^2, with a population of about 110,000 inhabitants living in urban and rural settlements. (Buea Rural Council, 2004, Neba, 1999,). It has an equatorial climate, with daily temperatures ranging from 20^0 to 28^0C. Annual rainfall varies between 3000mm to 3500mm. The area has two seasons, Dry season (November to March) and a Wet season, (April to October) of each year (Buea Rural Council, 2004, MINEFE, 2004). The vegetation of the area is of a closed-canopy, moist evergreen rain forest of the Guinea-Congolian type (White, 1993, Neba, 1999).

METHODOLOGY

The study area with the help of stratified random sampling, was first divided into two zones on the basis of settlement (urban and rural), and secondly into ten sub zones (urban five and rural five). The urban settlements consisted of the following zones GRA/Clerks Quarters, Great Soppo, Sand Village, Bonduma, Molyko 1 (Check Point area), Molyko 2 (University Junction area), while the rural settlements was made up of Bokwango, Buea Town, Pit/Bakwery, Muea 1 and Muea 11.

From May to September 2005 for the dry season and from November 2005 to April 2006 for the wet season, random sampling was used to select 60 compounds from each of the zones. In each of the 60 compounds, 10 questionnaires were administered onto seven women and three men, giving a total of 600 questionnaires administered for the study. The period of study was selected to reflect the wet and dry seasons, which is a major characteristic of the area with respect to

energy consumption. The questionnaire in combination with some selected Participatory Rural Appraisal Tools (PRA), sought information on domestic energy types/sources, description and household family income spent on each energy type. A section of the questionnaire was administered to kerosene, cooking gas, and fuel wood and saw dust sellers to collect data on their monthly sales, price variations and frequency of sales per month.

RESULTS AND DISCUSSION

Household Energy Types/Source

As table 1. indicates that Fuel wood (FW), Kerosene (K), Saw Dust (SD), Cooking Gas (CG), charcoal (CH), Rubber (RB), Electricity (EL) were identified as the main household energy types/sources used in the Buea Municipality.

Table 1: Household energy types/ sources in the Buea Municipality

Types	Acronyms	Uses	Sources
Fuel wood	FW	Cooking Heating	Forest trees, and crop residue.
Kerosene	K	Cooking Lighting	Fossil fuel
Saw Dust	SD	Cooking Heating	Saw Mills (forest trees)
Cooking Gas (Liquefied Natural Gas)	CG	Cooking	Fossil fuel
Charcoal	CH	Cooking	Forest trees,
Rubber	RB	Cooking	Rubber plantations
Electricity	EL	Lighting Electronics	National power supply

Source field survey 2005-2006

Preference of Use of Energy Types.

Pair wise ranking with user groups and individual energy consumers, identified sawdust and fuelwood as the most frequently used and preferred energy type/source for cooking and heating for both Buea rural and urban. This explains the reason for the gradual and steady degradation of the rich mountain forest resources in and around the study area. The ever increasing population of Buea and its characteristic poverty level of less than a dollar a day and the cold climate that needs substantial domestic heating, push its population to exert an immense pressure on the forest resources of the area. Besides the sourcing of fuelwood from the surrounding forest as a major source of forest degradation, farming activities is an other indisputable form of forest resource degradation

in the area that has and is contributing to high lost of biodiversity and their habitats including the precious mountain forest ecosystem of the study area.

Reasons for Preference

Urban dwellers confirmed that with the constant reduction in their salaries, they were unable to cope with the rising prices for fossil fuel and thus resorted to a cheap energy types, (sawdust and Fuelwood). This is in accordance with the work of Karekezi, (2002a), who demonstrated that the Kenyan rural population depended solely on fuel wood as their main source of energy because of its cheap nature. A bottle of cooking gas and kerosene in 1990 was about 4,000F CFA per 20litre bottle of cooking gas (USD$8) and 150F CFA per litre of kerosene (30 cents) respectively; but by 2005, it had risen to about 6,000F CFA per bottle (USD$14) and 300F CFA per litre (60 cents) respectively. The recent low-cost local technology for the production of energy conserving sawdust pots, introduced in the study area in around 1998, caused rural and urban family expenditure on cooking energy per month to drop from about 8,000F CFA to about 3,500F CFA per month. Bolagi (2005) confirmed that, when the sawdust stove was introduced to the rural communities of Ondo State of Nigeria, in the early nineties, household income expenditure on fuelwood dropped by about 40%.

ENERGY CONSUMPTION AND PATTERNS

Aggregate energy consumption

The monthly aggregate consumption of the identified energy type/sources for the study area as summarised in Table 2 was found to be 253M^3 of fuel wood, 744 litres of kerosene, 14602Kg of sawdust, 6360Litres of cooking gas, 20625Kg of charcoal, 3861kg of rubber and about 40,299 kilowatts of electricity.

Table 2: Aggregate Monthly Consumption of identified energy types/sources in the Buea Municipality.

Zones	Energy Type/sources						
	FW (M^3)	**K** (litres)	**SD** (Kg)	**CG** (Litres)	**CH** (Kg)	**RB** (kg)	**EL** (KW)
Bokwango	30.8 (12.15%)	123 (16.53%)	1168.4 (8.02%)	345 (5.42%)	375 (1.81%)	324 (8.39%)	2964 (7.35%)
GRA/Clerks Quarters	33.9 (13.3%)	75 (10.08%)	1219.2 (8.37%)	945 (14.85%)	2625 (12.72%)	90 (2.33%)	4560 (11.31%)
Buea Town	26.6 (10.48%)	69 (9.27%)	1016.0 (6.98)	465 (7.31%)	2750 (13.33%)	144 (3.72%)	3876 (19.61%)
Great Soppo	26.6 (10.48%)	78 (10.48%)	1549.4 (10.64%)	630 (9.90%)	3325 (16.36%)	486 (12.58%)	4446 (11.03%)
Sand Pit	26.2 (10.33%)	93 (12.5%)	1320.8 (9.04%)	960 (15.09%)	250 (1.21|%)	459 (11.88%)	3477 (8.62|%)
Bunduma	25.0 (9.87%)	45 (6.04%)	1803.4 (12.39%)	795 (12.5%)	1375 (6.66%)	513 (13.28%)	4446 (11.03%)
Molyko I	21.6 (8.51%)	45 (6.04%)	1879.6 (12.91%)	795 (12.5%)	3875 (18.78%)	324 (8.39%)	4446 (11.03%)
Molyko II	9.2 (3.64%)	18 (2.41%)	1016.0 (6.98%)	1050 (16.50%)	2625 (12.72%)	308 (7.92%)	4560 (11.31%)
Muea I	23.5 (9.27%)	60 (8.06%)	1778.0 (12.21%)	270 (4.24%)	2625 (3.63%)	576 (14.91%)	4446 (11.03%)
Muea II	30.0 (11.8 5%)	138 (8.54 %)	1803.4 (12.39%)	105 (1.65%)	750 (3.63%)	639 (16.55%)	3078 (7.63%)
Aggregate Total	**253**	**744**	**14602**	**6360**	**20625**	**3861**	**40,299**

Source field survey 2005-2006

GRA/Clerks Quarter sub zone of the study area was observed to be the Sub zone where firewood consumption was highest, with an aggregate percentage consumption of 13.3%. This was closely followed by Bokwango, while Molyko II sub zone had the lowest fuelwood consumption in the study area. This was attributed to the fact that, the GRA/Clerks Quarters sub zone is inhabited mostly by civil servants whose incomes are high enough to pay for more fuelwood. Houses in this sub zone were the old colonial type buildings, which have sitting room chimneys where fire is made for the heating of the house during the cold Wet/Rainy season and the hamattan periods of the Dry season. Most of the fuel wood consumed in this sub zone is used for heating while in the other zones like Bokwango, which is a purely rural area and a village; most of the fuel wood is used for cooking. The Molyko II zone, which has the lowest monthly aggregate consumption of fuel wood (3.6%), is characterised by a high population of University and Secondary/High school students who use cooking gas as their main source of energy.

Kerosene was consumed most by the Bokwango population, with an aggregate percentage consumption of 16.5%, followed closely by Sand Pit (12.5 %). Molyko II was observed to have the lowest aggregate consumption of kerosene (2.41%). Many households in Bokwango use kerosene for lighting, following voluntary disconnection from the Municipal/National electricity grid due to their inability to pay. . Molyko II, which is a student residential area, was observed to depend solely on electrical power supply for lighting. In times of no power supplies (blackouts) the students depend on candles for lighting.

Molyko I, Bunduma and Muea II were observed to be the zones of high sawdust utilisation with an aggregate consumption percentage of 12.9%, 12.4% and 12.4% respectively. Molyko II had the lowest aggregate sawdust percentage consumption of about 7.0%. These areas with high percentage consumption of sawdust were observed to be inhabited by a low-income population who are mostly non-indigenes with low incomes not enough to buy either fuelwood or kerosene. As non indigenes' they also have no access rights to source fuel wood from the surrounding woodlands. Thirdly, these zones coincidentally have a high concentration of the sawmills that produce high quantities of sawdust. The low level of sawdust consumption in Molyko II is not unconnected with the student population, who occupy single rooms in student's hostels (minicités), which were not provided with enough space for sawdust handling and the inconveniences that accompany the use of sawdust (smoke).

Cooking gas was observed, to be consumed highest in Molyko II (16.5%) and lowest in Muea II (1.7%). This is again attributed to the high student population in Molyko II while Muea II is a rural community with low household incomes who depend on less expensive energy types/sources for their cooking.

Charcoal as a source of energy was observed to be used predominantly by road-side fish roasters in the evenings around bars and small drinking places. Molyko I, Great Soppo, and Molyko II were observed to have high aggregate percentage consumption rates for charcoal (18.78%, 16.4%, 13.3% and 12.7% respectively). Sand Pit and Bokwango had low consumption rates of 1.2% and 1.8% respectively. This is not unconnected with the fact that Sand Pit is presently poorly accessible and is at the verge of development but still lacks most of the social activities that orchestrate the roasting of fish at any significant level. Similarly, Bokwango is a village community and is considered rural. It therefore has very few places for socialisation and hence less fish roasting and lower charcoal consumption.

Rubber lumps as a source of energy was found to be valued as a complement to sawdust and not as a potential source of energy on its own. It was used in most occasions for the ignition of the sawdust stoves. It should be noted that in cases where rubber was not available for stove ignition, the people of these high sawdust use zones replace it with either kerosene, plastic paper or waste papers dipped in palm oil, groundnut or engine oil. Lighting the sawdust stove using rubber lumps was observed to be the most effective and time conserving. Less smoke is also produced as the rubber melted along its length, when compared to the other alternatives. This is in line with Nadoma, (1987) and Karekezi (2002b) who pointed out that the consumption of renewable fuel resources in Africa is evolving with a daily introduction of new materials as complements or alternatives.

Electricity was consumed in Molyko II, (11.3%), GRA/Clerks Quarters (11.3%), Great Soppo (11.0%), Bunduma (11.0%), Molyko (11.0%) and Muea I (11.0%) in that order, except in Bokwango (7.4%) and Muea II (7.6%) respectively where its consumption was low. Electricity was generally

consumed for lighting and the supply of domestic power for the operation of electronic gadgets in business places and households. The higher consumption of electricity in Molyko II and GRA/Clerks Quarters could be associated with the fact that GRA/Clerks Quarters was a civil servant's zone, who besides the use of electricity for lighting, also used it for ironing of dresses, and rapid heating of water in the early parts of the morning. Their high-income levels, can afford the extra cost of this source of energy. In the Molyko II sub zone, which inhabited by students, electricity was mostly used for lighting and rare for cooking at moments when they run short of cooking gas. However, immediately when cooking gas is restored, electricity cooking is discontinued to avoid high bills. Most of the rural sub zones households were observed to have very little need for electricity. They argued that, they leave the house as early as 6:00am for the farm and come back at 7:00pm and by 9:00pm they are in bed. Most often they use kerosene lamps for lighting in place of electricity. On the other hand, the high cost and associated taxes that go with electricity consumption make it impossible for them to cope.

Zonal Unit Price of Various Energy Types and Sources

Fuel wood prices were observed to be lowest in Bokwango, Buea Town and GRA/Clerks Quarters (at 300F CFA a bundle). These low prices were also observed in Muea I and II zones, where it was sold at 400F CFA per bundle. In other zones the price was stabilised at 500F CFA per bundle. The low price in Bokwango, Buea Town and GRA/Clerks Quarters is tied to their rural and countryside nature where the forest (where fuel wood is sourced) is nearby. The only exception in this group is the GRA/Clerks Quarters zone, which is not strictly a rural zone and is also not close to any forest but yet fuelwood is cheap. This is attributed to the fact that, GRA/Clerks Quarters is the seat of the Prisons Yard in Buea. The inmates of this prison source fuel wood for sale in the zone at lower prices to survive in the prisons (where feeding of inmates need to be supplemented by the inmate's family). Muea I and II are also rural communities sharing common boundary with the lowland wood lands of Bomaka and Liongo. These provide the communities with a free and natural source of fuel wood.

The price of kerosene, sawdust cooking gas, charcoal, rubber and electricity was observed to be stable in all the zones of the study area. These prices ranged from 300F CFA per litre of kerosene, 700F CFA per 200Kg bag of sawdust, 6,500F CFA per bottle of cooking gas, 1,000F CFA per 50kg bag of charcoal, 150F CFA per bundle of rubber, to 67F CFA per kilowatt of electricity. Although most of the fuel types enjoy a certain level of stability in the set unit price in all the sub zones as summarised in table 3, sawdust and fuel wood still show some variations with the seasons.

Table: 3: Cost of different energy sources in the dry and wet seasons.

No	Energy Type/source	Cost in the dry in CFA	Cost in the wet in CFA
1	FW	500	700
2	K	300	300
3	SD	700	900
4	CG	6500	6500
5	CH	1000	1200
6	EL	67	67
7	RB	150	150

Source field survey 2005-2006

Monthly average household expenditure on the identified energy sources.

The monthly aggregate household expenditure on energy sources in the Buea Municipality amounted to 10,496,640F CFA. The distribution of these amounts among the fuel types and zones are shown on Table 4.

Table 4: Aggregate monthly household expenditure on the identified energy sources in the Buea Municipality in CFA francs.

Zones	Cost of Energy sources						
	FW	**K**	**SD**	**CG**	**CH**	**RB**	**EL**
Bokwango	**120,000**	**36,900**	**92,000**	**126,000**	**15,000**	18,000	**177,840**
GRA/Clerks Quarters	132,000	22,500	96,000	346,500	105,000	5,000	273,600
Buea Town	**103,500**	**20,700**	**80,000**	**170,500**	**110,000**	**8,000**	**232,560**
Great Soppo	1725000	23,400	122,000	231,00	135,000	27,000	266,760
Sand Pit	**170,000**	**27,900**	**104,000**	**352,000**	**10,000**	**25,500**	**208,620**
Bonduma	162,500	13,500	142,000	291,500	55,000	28,500	266,760
Molyko I	140,000	13,500	148,000	291,500	**155,000**	**18,000**	**266,760**
Molyko II	60,000	5,400	80,000	385,000	105,000	17,000	273,600
Muea I	122,000	8000	**140,000**	99,000	105,000	**32,000**	**266,760**
Muea II	156,000	41,400	142,000	38,500	30,000	35,500	184,680
Total	1,338,000	2,223,200	1,146,000	2,332,000	8,25,000	214,500	2,417,940
Grand Total						10,496,640F CFA	

Electricity, cooking gas, kerosene and fuelwood irrespective of their increasing prices, are the four most important energy types in Buea, accounting for over 65% of the aggregate energy expenditures of the sampled households. This high domination of electricity, cooking gas and kerosene is not unrelated to the over-bearing presences of an urban population that has a high affiliation to the use of these energy sources. On the other hand, the rural zones of the metropolis that were expected to have a low consumption , have a high proportion of their population made up of retired Cameroon Development Cooperation (CDC) workers and other civil servants, who became used to these energy sources when they were in active service. They now find it difficult to live without them. The fact that Buea is the Regional Head Quarters of the South West Region of Cameroon makes it home to a multiplicity of civil servants and pensioners with reasonable income earnings that can afford to pay for this energy sources.

On the other hand, fuelwood, sawdust, charcoal and rubber which are other cheaper energy sources than electricity and cooking gas, were associated with a wide range of inconveniences such as smoke, blackening of pots, and lengthening of effective cooking time. In over 80% of the sampled households, these second classes of energy are considered as supplementary energy sources to the three main ones above

Factors affecting energy supply and production

Alternative sources of energy that emerged as a result of new technologies also affected the supply of some of the energy types/sources. The introduction of sawdust pots in most rural areas in Africa has reduced the demand for fuel wood, cooking gas, and kerosene tremendously in these communities, (Bolagi, 2005). This was observed in all the zones except for Molyko II that is highly dependent on cooking gas as the main source of energy for cooking. The high demand for rubber as an igniting form of energy has affected the supply of kerosene in almost all the zones except for Bokwango and Muea II.

CONCLUSION AND RECOMMENDATIONS

Conclusively, the prices, the shrinking forest and the seasons of production of various energy types/sources affected considerably the quantity of energy supplied for consumption in the study area.

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