

Socio-economic Drivers of Energy Consumption Patterns at Household Level in Temeke Municipality: A Case of Mbagala Kuu Ward

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ABSTRACT

The study was conducted at Mbagala Kuu ward in Temeke municipality in Dar es Salaam city to assess the socio-economic determinants of energy consumption patterns at household level. Data for this study were collected 99 households through structured interview using questionnaire. The collected data were analyzed by IBM Statistical Product for Social Sciences (IBM-SPSS version 20) computer software through descriptive statistics and regression analysis to assess the socioeconomic drivers for energy choices. The results showed that most of the households in the study area consume mixture of energy of electricity, charcoal and gas. Being the residential area, most of the households use the energy mix for lighting, cooking and electrical appliances. The results further indicated that income, time, efficiency and affordability are the main drivers for energy choices in the study area. The energy ladder in the study area therefore comprised of charcoal for low income earners and electricity and gas for high and medium income earners. The study therefore, concluded that energy income is the main determinant of energy choices in Mbagala Kuu ward with energy mix of electricity and charcoal together with electricity and gas as the main energy mixes. The study recommends that strategies be developed to ensure good utilization of Liquefied Petroleum Gas (LPG) as it is now readily available and the prices is expected to be low and affordable to many households as a strategy to reduce the use of charcoal that degrades the environment through deforestation.

Keyword: Energy Consumption; Consumption Pattern; Socio-economic drivers

1.0 INTRODUCTION

Energy, being the capacity to do work, is at the heart of all human activities, especially those concerning the production of goods and services. At household level, the availability of energy is an important determinant of the quality of life in

human settlements. It is essential to human life and part of what first defined the human race as separate from animals in pre-historic times (World Bank, 2003). In global energy use, household energy consumption is estimated at 1090 *Mtoe* (Million tons of Oil Equivalent); approximately 10% of total world primary energy demand which is mostly used for cooking and lighting (IEA, 2006). Average per capita household energy use in developed countries is about nine times higher than in developing countries, even though in developing countries a large share of household energy is provided by non-commercial fuels that are often not reflected in official statistics (UN, 1999). Developing countries energy consumption depends both on the type of energy used and on the characteristics of particular appliances. In rural areas of many developing countries, traditional fuels, such as fuel wood, charcoal and agricultural waste, constitute a major portion of total household energy consumption. On the other hand, urban areas use diverse types of energy to include sources like electricity, liquefied petroleum gas (LPG), fossil fuel (Kerosene) and charcoal depending on energy affordability. However, studies have shown that increasing urbanization might as well bring changes in economic and social structure and these in turn may alter pattern of energy use in terms of amount and type (Heimstra-van *et al.*, 2008). According to the energy transition theory, as an economy grows, households will increasingly substitute biomass source of energy with kerosene and electricity (Karekezi *et al.*, 2008). In particular, the transition theory stress that increasing income coupled with the availability of kerosene, electricity and LPG will result in the substitute of charcoal and firewood as primary source of energy (Karekezi *et al.*, 2008). With regard to energy choices at household levels, Reusswig *et al.* (undated) reported that lifestyle and socioeconomic attributes are the most determinant of energy type at household level. However, with increasing disposable income and changes in lifestyles, households tend to move from the cheapest and least convenient fuels (biomass) to more convenient and normally more expensive ones (charcoal, kerosene) and eventually to the most convenient and usually most expensive types of energy (LPG, natural gas, electricity) (UN, 1999).

In Dar es Salaam region, most households generally use a combination of energy sources for cooking that can be categorized as traditional (agricultural residues and fuel wood), intermediate (charcoal and kerosene) or modern (LPG, biogas and electricity). In most urban areas, energy use is mostly characterized by the intermediate use due to their technological efficiency, decreased carbon dioxide emission, time savings and limited undesirable effects on indoors pollution. Rural areas on the other hand are being grouped into the category of traditional as most

of the household cannot afford expensive energy types which are also not available in their areas. However, it has been observed that drivers of energy choices are mostly accessibility, affordability (price), some traditional beliefs and technological requirements. Although the government is trying hard to educate communities to shift to electricity and LPG to save the environment, the efforts are jeopardized by the fact that even the educated people with good income are still insisting on the use of traditional energy sources like charcoal. In this regard, no clear distinction can be drawn on what really determines choice of energy to be used at household level. The present study therefore aimed at assessing the determinants of energy uses at household level in urban areas of Temeke district, Dar es Salaam region.

2.0 METHODOLOGY

The study was conducted in Dar es Salaam region, Temeke municipality located between latitude 6°55'S and longitude 39°25'E and forms the Southernmost part of the Dar es Salaam City. The municipal total area is 652 km² and an estimated population of 1,368,881 people (URT, 2012). The study employed non experimental research design (cross-sectional). Data for this study was obtained from a sample of 99 respondents including key informants from Tanzania Electricity Supply Company, Energy and Water utilities Regulatory Authority (EWURA) and municipal environmental officer. Data were collected using structured interview and focus group discussion. The obtained data were analyzed using IBM-SPSS software programme version 20. The information on the drivers of energy choices were analyzed using multivariate analysis using the following general linear model.

$$Y = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + e$$

Where:

Y = Type of energy used

B₀ = Constant term or intercept

B₁ - B₄ = Coefficient of the respective explanatory or predictor variables

X₁ - X₄ = Predictor variables included in the model (X₁ = income, X₂ = Time

needed; X₃ = Respondents education level and X₄ = accessibility)

e = Random error

3.0 RESULTS AND DISCUSSION

3.1 Energy Consumption Pattern in the Study Area

The study findings showed that majority of the community members in the study area prefer to use combination of energy sources (Table 1). At household levels, the choice for the type of energy is also dependent on the education level and socio-economic status whereas household with tertiary education preferred much to use electricity in combination with either gas or charcoal. The results further revealed that 42.6% of the respondents interviewed with tertiary education and 36.5% of respondents who do private business prefer to use electricity and charcoal (Table 1) whereby they use energy mainly for lightening, cooking and electrical appliances (Table 2). However, because electricity can be used for lightning, cooking and electrical appliances, it was difficult to determine which household use solely electricity for which purpose. With regard to charcoal, although it seems to be cheap in the rural areas, its demand and transportation costs makes it expensive in urban areas. As such, people prefer to combine charcoal with electricity which is readily available but expensive when used for cooking. People who are employed in particular, prefer electricity and gas as it saves time and the fact that their economic status is higher as compared to private business in most cases. Other related studies also have revealed that energy use patterns are closely linked to socio-economic conditions of the people whereby communities with good education background like tertiary education and economic soundness prefer to use modern energy sources than traditional stoves (Ramachandra *et al.*, 2000).

Table 1: Energy used across education levels and respondent's occupation

Type of Energy used	Energy Choices Based on Education Level (n = 99)			Energy Choices Based on Occupation (n = 99)	
	Primary Education	Secondary Education	Tertiary Education	Private Business	Employed
 Frequencies				
Electricity	0	2 (7.2)	3 (4.4)	1 (2.1)	4 (7.7)
Gas	0	0	2 (2.9)	0	2 (3.8)
Charcoal	0	1 (3.6)	0	1 (2.1)	0
Fossil fuel (Kerosene)	0	6 (21.4)	7 (10.4)	5 (10.6)	8 (15.5)
Electricity and Gas	1 (33.3)	9 (32.1)	27 (39.7)	18 (38.3)	19 (36.5)
Electricity and Charcoal	2 (66.7)	10 (35.7)	29 (42.6.)	22 (46.9)	19 (36.5)

Note: Numbers in the parenthesis are respective percentages

Table 2: Purposes for energy uses at household level (n = 99)

Type of Energy	Responses on the Purposes for Energy Use		
	Cooking	Lightning and Cooking	Lightning, Cooking and electrical appliances
 Frequencies		
Electricity	0	1 (2.8)	2(4.2)
Gas	2 (12.6)	0	0
Fossil fuel (Kerosene)	13 (81.2)	0	0
Charcoal	1 (6.2)	0	0
Electricity and Gas	0	20 (55.6)	17 (36.2)
Electricity and Charcoal	0	15 (41.6)	28 (59.6)

Note: Numbers in the parenthesis are respective percentages

3.2 Energy Use and Income Levels

The study results revealed that most of respondents in the study area are earning between 200,000 and 700,000 TShs per month and uses combination of electricity with gas or charcoal (Table 3). Only 4 respondents had the highest income of up to 3,500,000 TShs per month indicating that most of the respondents in the study area are low income earners. The results further showed that 51.5% of the respondents uses electricity and charcoal whereby in average they use 105.9 ± 38.81324 units of electricity and 61.2 ± 32.81332 Kgs of charcoal (Table 4). Findings from this study concur with those of Maliti and Mnenwa (2011) who also revealed that most of the poor urban dwellers are using charcoal and electricity as their important source of energy at household level. These results were further portrayed using energy ladder hypothesis in Fig. 1 whereby charcoal occupies the lowest part of the ladder with electricity and gas being higher up in the ladder which is also determined by income levels. Few people with good education background and economic status prefer to choose expensive energy sources like LPG and electricity to signify their social status. The results from this study also concur with that of Kebede *et al.* (2002) who also revealed that people with low incomes generally use traditional fuels as their main cooking fuel while people with higher incomes tend to use modern fuels. Other studies also demonstrated that income, fuel prices, government policies and household characteristics influence energy consumption levels as the purchase of energy claims a substantial portion of poor people's budgets (Arnold *et al.*, 2006; Bhatia, 1988; World Energy Council, 1999).

Table 3: Income levels and energy choices (n = 99)

Income levels per Month (TShs)	Responses on Energy Choices (Frequencies)				
	Electricity	Gas	Charcoal	Electricity & Gas	Electricity & Charcoal
200,000 – 700,000	1 (1.2)	2 (2.5)	1 (1.2)	34 (42.0)	43 (53.1)
800,000 – 1,300,000	0	0	0	1 (33.3)	2 (66.7)
1,400,000 – 1,900,000	0	0	0	1 (100)	0
2,000,000 – 2,500,000	1 (10.0)	0	0	5 (50.0)	4 (40.0)
3,000,000 – 3,500,000	0	0	0	2 (50.0)	2 (50.0)
TOTAL	2 (2.0)	2 (2.0)	1 (1.0)	43 (43.5)	51 (51.5)

Note: Numbers in the parenthesis are respective percentages

Table 4: Amount of energy consumed and income levels (n = 99)

Variable	Maximum	Minimum	Mean \pm SD
Income levels (TShs)	3,500,000	200,000	724,242 \pm 688,067
Amount of energy used			
▪ Electricity (Units)	200.0	5.0	105.9 \pm 38.81324
▪ Gas (kg)	80.0	0.0	46.6 \pm 18.53503
▪ Charcoal (kg)	150.0	0.0	61.2 \pm 32.81332
▪ Fossil Fuel (Kerosene) (Liters)	16.0	0.0	1.5 \pm 4.23391

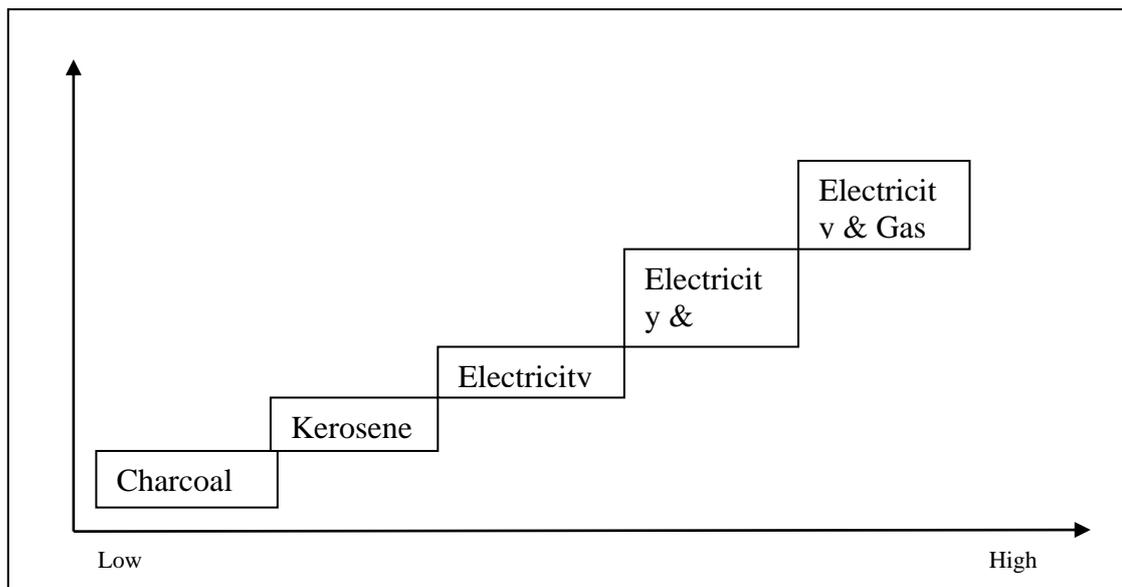


Fig. 1: Schematic presentation of energy ladder in the study area

3.3 Drivers of Energy Choices

In standard economic models, individual decision-making on choices of a particular source of energy to use is based on the assumptions of rational behavior

and self-interest to maximize their well-being or utility under the constraints they face (Mikalauskiene *et al.*, Undated). In the present study, respondents showed that income, time efficiency and accessibility are the main drivers for energy choices in the study area (Table 5). The analysis revealed that income is the main determinant for most of the energy sources. The results further showed that people prefer to use LPG (Gas) as it is time efficient and also easily accessible for people in urban areas. Contrary to other studies which demonstrated that increase in literacy level among the community would directly benefit it in the form of less energy consumption (Ramachandra *et al.*, 1999), these results demonstrated that level of education is not the main determinant for energy choices.

Table 5: Drivers of energy choice

Dependent variable	Independent variable			
	Income	Time	Education	Accessibility
.....P values				
Electricity	0.023*	0.767	0.171	0.368
Gas	0.018*	0.018*	0.224	0.043*
Charcoal	0.008*	0.199	0.493	0.727
Kerosene	0.835	0.715	0.63	0.53

* = Significant at 5%

4.0 CONCLUSION

The study concluded that people in the study area prefer to use energy mix mainly because of affordability (income), time efficiency and accessibility. The study further revealed that most of the residents in the study area are low income earners getting 200,000 to 700,000 Tshs per month thus, decide rationally to use energy type that they can afford. The energy ladder in the study area therefore comprised of charcoal for people with low income and a mix of electricity and gas for people with higher income. The study recommends that people should be motivated to use LPG (gas) as it is now readily available and can assist to reduce the use of charcoal which has a detrimental effect to the forest resources.

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