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Factors that Affect the Adoption of Liquefied Petroleum Gas in Kinondoni Municipality, Tanzania

Editha Ndunguru [*] ***& Godwin Lema*** [§]

Abstract

Identification of the factors affecting the adoption of Liquefied Petroleum Gas (LPG) is necessary in creating enabling environment for promoting LPG usage in Tanzania. This paper examines factors that affect the adoption of LPG in the jurisdiction of Kinondoni Municipal Council; one of the five municipalities in the city of Dar es Salaam. A cross-sectional research design, involving 466 households from three wards (Msasani, Kijitonyama and Tandale) was employed to capture qualitative and quantitative data. Content analysis was carried out using the Likert scale to observe perceived factors affecting the adoption of LPG. Chi square test and binary logistic regression were performed to examine the likelihood of the adoption of LPG to occur. The findings suggest that at the micro level, several factors do affect the adoption of LPG, but different individuals have different perceptions based on personal experiences. Uncovered factors include the quantity of sell, household income, household size, and the level of awareness. At the macro level, fuel availability is assumed to play an important role in determining the adoption and usage of LPG. Chi square test shows the association between different variables and LPG usage; while logistic regression reveals two variables—education and household expenditure (proxy for income)—as significant factors. The study recommends that the creation of enabling environment for LPG usage in the municipality should pay more attention to issues related to education and income.

Keywords: *liquefied petroleum gas, adoption, factors, enabling environment*

1. Introduction

Of recent, the government of Tanzania has been advocating the use of Liquefied Petroleum Gas (LPG) for household cooking to reduce the reliance on traditional biomass. LPG can change the status of household energy in the developing world by providing considerable and associated benefits for people's health, climate, forest protection, and economic development. In Kinondoni municipality in Dar es Salaam, Tanzania, LPG is widely obtainable. However, many households still rely primarily on wood fuels, particularly charcoal, for domestic cooking.

Although LPG is not a renewable energy source, it remains to be an appropriate cooking fuel in many developing countries because cooking with electricity or

[*] College of Social Science, University of Dar es Salaam, Tanzania: 3ndunguru @gmail.com
[§] College of Social Science, University of Dar es Salaam, Tanzania: godwinlema @gmail.com

natural gas is largely impractical (Matthews & Reissign, 2011; IEA, 2017). As opposed to electricity and natural gas, LPG can be upscaled relatively quickly due to lower infrastructure investments needed, and ease of transportation and storage (Larsen, 2017; Bruce et al*.,* 2017). Electricity supply in most developing countries is unreliable, and electric cookstove devices are relatively expensive. In 2016, for example, less than two-thirds of households in SSA countries (except for South Africa) had reliable access to electricity (Blimpo & Davies, 2019). Besides, electric tariffs are too high for the common people to afford electricity for cooking (Kojima, 2011; IEA, 2017). Statistics provide that between 2014 and 2016 the wholesale electricity price for the Southern Africa Power Pool (SAPP)[1] was approximately USD76/MWh, while in the United States the price averaged USD35/MWh in 2015 (Blimpo et al*.,* 2017). On another hand, using natural gas is difficult even when a country is endowed with the resource. Distributing natural gas to consumer homes is exceptionally expensive with a prolonged period of payback ratio (Bakar & Hashim, 2011). Governments may have inadequate capital to invest in infrastructure, and this may be compounded with poor urban planning to support piped gas infrastructure development (Kojima, 2011).

The LPG sector in Tanzania is administered by the National Energy Policy (NEP, 2015) under the Ministry of Energy. Section 3.1.6 of the policy advocates for the utilisation of LPG as among the alternatives to reduce environmental degradation and improve the quality of the life of the people (URT, 2015a). Recent statistics reveal an increasing trend in household usage of LPG countrywide (URT, 2018; Doggart et al*.,* 2020), especially in urban areas; but charcoal has continued to be the main cooking fuel.

Dar es Salaam, Tanzania's commercial city, has experienced steady growth in the adoption of LPG from the early 2000s. In 2000/2001 the city embraced 0.4% adoption, in 2007 it was 2.2% (Takama et al*.,* 2011), while adoption in 2012 averaged 3.9% (URT, 2014). In 2015 adoption increased up to around 8% (Lokina & Mapunda, 2015), markedly jumping to 30% in 2016, and then drastically increasing to 58% in 2018. Despite the increase, however, only 5% is using LPG for all cooking tasks (Doggart et al., 2020).

The Kinondoni municipality has a well-developed LPG infrastructure compared to other municipalities in the city. In Kinondoni, LPG kiosks can be found in less than five kilometres radius (Energypedia Survey, 2016). About eight (8) LPG companies are operating in the area. Furthermore, stakeholders of the energy sector have proposed and installed varied strategies—such as subsidy provision, credit, home delivery services, cylinder swaps, and regulatory frameworks—to create an enabling environment for adoption and usage of LPG by households.

[1]A group of 12 countries in southern Africa that coordinate electricity trade among themselves.

Nevertheless, LPG usage has remained to be low despite all these moves. Recent studies revealed that, despite the willingness of charcoal users to use LPG as a primary cooking fuel (Lokina & Mapunda, 2015), many households are not using it (Doggart et al., 2020). Research findings from different parts of the world reveal that low income households are unable to afford LPG due to high initial investment costs that involve cylinder deposits, acquisition of cookstoves, and other accessories (Hollada et al., 2017; Schlag and, Zuzarte, 2008; Puzzolo et al., 2013; Masera et al., 2000; Bruce et al., 2017; UK aid, 2010). This can also account for why LPG is not widely used in Kinondoni municipality.

Studies have been conducted on various issues related to the adoption of LPG in Kinondoni municipality. These have been, for example, on the advantages of LPG; trends of LPG adoption; and the impact of LPG as cooking energy in forest resources protection, among others (Ndifwa, 2011; Mahfudh, 2011; Msangi, 2014; Maswi, 2015; Mayanja, 2016). Nonetheless, little has been done to identify significant factors that affect the adoption of LPG. This study, therefore, ascertains factors that affect adoption of LPG in Kinondoni municipality to pave the way for the creation of an enabling environment for LPG usage.

2. Theoretical Framework

The theoretical framework for the study is anchored in the assumption that the adoption of LPG can be explained based on socio-economic and/or behavioural aspects. To analyse factors that affect the adoption of LPG, the study merged the energy ladder model, energy stacking model, and the theory of reasoned action (TRA) representing econometric and behavioural models, respectively.

The energy ladder model advocates income as the major determinant of energy adoption, elucidating that households tend to abandon traditional dirty fuels and adopt more sophisticated fuels with increased income (Leach, 1992; Heltberg, 2005; Ekholm et al*.,* 2010). Yet, scholars have challenged the limited inclusion of other factors (Jebaraj & Iniyan, 2006), arguing that household energy consumption patterns rely on three energy system decisions simultaneously: energy services, energy carriers, and energy devices (Kowsari & Zerriffi, 2011). Studies from different parts of the world provide that households have been using a combination of diverse energy sources simultaneously despite their economic status (Masera et al*.,* 2000; Heltberg, 2004; Pachauri & Spreng 2004; Ouedraogo, 2006).

The theory of reasoned action (TRA) examines factors that determine intended behaviours of people (Davis, 1989). It explains how an individual's behaviour can be forecasted and comprehended; hence be interfered with to promote constructive behaviours. The theory can define a person's attitude towards the adoption or rejection of LPG by explaining and providing reasons for her/his choice. Evaluating the outcome of using LPG as household cooking fuel is likely to influence the decision on whether to adopt or not.

3. Context and Methods

This study was conducted in Kinondoni[2] Municipality, Dar es Salaam. Kinondoni is located at latitude 6°47'0" S, and longitude 39°16' 0" E (see Figure 1); covering an area of 531km² (Google Map Data, 2019; KMP, 2017; UMP, 2016). In 2016 the municipality was estimated to have a total population of 2,217,884, and about 283,552 households with an average of 4 persons each (KMP 2017; URT, 2014). The choice of the study area was influenced by the extensive placement of LPG retail shops (Energypedia Survey, 2018), and the diversity of household income in the municipality (Lario, 2016).

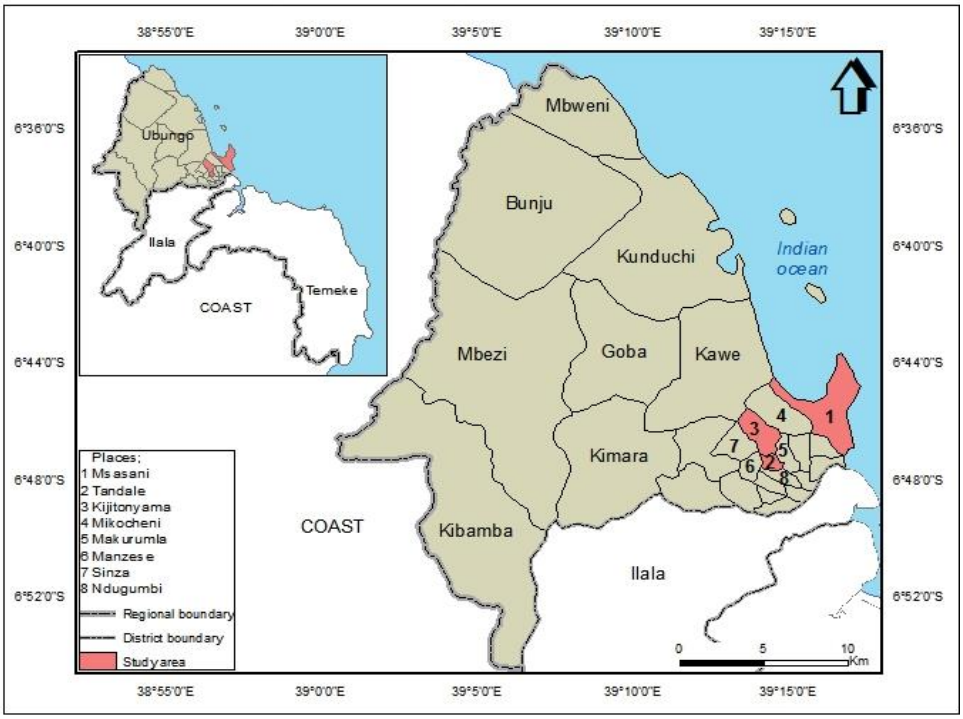

Figure 1: Location of the Study Area

3.1 Sampling and Sample Size

Sampling was accomplished by Cochran's (1977) formula:

$$n_0 = \frac{Z^2 pq}{e^2}$$

From the formula, a sample of 466 respondents was obtained (Masaki 68, Nzasa 211, Kwa Mtogole, 187). Data collection methods involved document

[2] Old Kinondoni Municipality, before its split into two municipalities; (new) Kinondoni and Ubungo

review, household survey, in-depth interviews, focus group discussions, and observations. Both qualitative and quantitative approaches were used in collecting and analysing data. Content analysis was carried out. A five level Likert scale rated '*strongly agree', 'fairly agree', 'not sure', 'fairly disagree'* and '*strongly disagree'* was adopted to analyse respondents' perception on factors affecting the adoption of LPG. Chi square test at 5% level of significance was executed to examine the relationship between the dependent variable (LPG usage) and selected independent variables (socio-economic variables). The Chi square—a test for independence or relatedness in a contingency table (Agresti, 1995)—was guided by the equation:

$$x^2 = \sum \frac{(O - E)^2}{E}$$

Where;

x^2 = Chi square obtained
$\sum$ = Sum of
O = Observed score
E = Expected score

Binary logistic regression was also performed to determine the likelihood of LPG adoption to occur. Using the equation below, binary logistic regression was run to determine the probability of such explanatory variables on LPG adoption.

$$Ln\left(\frac{P}{1-P}\right) = \beta_0\beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k\beta_k$$

Where;

P is the probability of an event happening (using LPG),
β are regression coefficients, and
$x_1, x_2 \ldots x_p$ are predictor variables. This is expressed in odds denoted as [B].

4. Results and Discussion

4.1 Rate of Adoption of Liquefied Petroleum Gas

Research findings reveal that about 64.0% of the respondents are using LPG for domestic cooking activities. Out of the 466 respondents, 297 are using LPG either as primary or supplementary cooking fuel. Disaggregated data from the study sites present comparatively varied adoption rates. A high adoption rate is observed in relatively high-income areas, while low-income areas depict lower adoption rates. In Masaki, all 68 households (100%) are using LPG. This is a rich community area that accommodates wealthy persons such as business tycoons, higher government officials, and popular political figures (RPF, 2005). Most of them are high-income earners who are financially

capable of handling both initial and running costs. Nzasa, a middle-income area, has 77.6% adoption, while Kwa Mtogole embraces 34.9% adoption, which is the lowest of all. These findings resemble those of several other studies around the world that found adoption disparities among areas with dissimilar socio-economic backgrounds (TERI & UNICEF, 2010; Bisu et al., 2016; Pope et al., 2018; Ozoh et al., 2018).

4.2 Factors Affecting the Adoption of LPG

Different socio-economic or cultural factors can positively or negatively affect the adoption of LPG. The most common factors include fuel availability, household income, education, occupation, awareness, and cultural preferences, to mention some. When factors are satisfactory, they enable adoption; but when unsatisfactory, they limit adoption (Price, 2017).

4.3 Perceived Factors Affecting LPG Adoption

The study used a five-level Likert scale to examine respondents' perceptions on factors affecting adoption of LPG as seen in Table 1.

Table 1: Perceived Factors That Affect Adoption of LPG
(n = 466)

	Strongly Agree		**Fairly Agree**		**Not Sure**		**Fairly Disagree**		**Strongly Disagree**	
Factors (F)	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Quantity of sell	150	***32.2***	119	***25.5***	133	***28.5***	50	***10.7***	14	***3.0%***
Household income	113	***24.2***	201	***43.1***	113	***24.2***	34	***7.3***	5	***1.1***
Household size	96	***20.6***	73	***15.7***	96	***20.6***	116	***24.9***	85	***18.2***
LPG availability	74	***15.9***	325	***69.7***	53	***11.4***	7	***1.5***	7	***1.5***
Awareness	59	***12.7***	254	***54.5***	58	***12.4***	73	***15.7***	22	***4.7***
Level of education	57	***12.2***	148	***31.8***	61	***13.1***	133	***28.5***	67	***14.4***
Prestige	35	***7.5***	187	***40.1***	45	***9.6***	146	***31.3***	53	***11.4***
Dwelling status	28	***6.0***	59	***12.7***	67	***14.4***	218	***46.9***	94	***20.2***
Kitchen size	1	***0.2***	89	***19.1***	64	***13.7***	223	***48.1***	89	***18.9***
Food taste	1	***0.2***	29	***6.2***	64	***13.7***	173	***37.1***	199	***42.8***

From Table 1, different variables are perceived to be affecting adoption, especially at the household or micro level. The Likert scale results reveal that most of the respondents 'fairly agree' or 'fairly disagree'; relative to 'strongly agree' or 'strongly disagree', respectively. This suggests that respondents are not extremely optimistic or pessimistic with the idea of adoption.

Large proportions of the respondents 'fairly agree' that LPG availability (69.7%), awareness (54.5%), and household income (43.1%) affect adoption.

Around 48.1%, 46.9% and 37.1% 'fairly disagree' that kitchen size, dwelling status, and food taste, respectively, affect the adoption of LPG; whilst 32.2% 'strongly agree' that the quantity of sell (unit of purchase) affects adoption. Respondents substantiate that LPG is purchased in large amounts (the least being 6kg with an average price of TZS20,000), which are too expensive for ordinary households to afford in a lumpsum. Low-income households have been purchasing energy in small amounts daily due to limited earnings; implying that if LPG is sold in smaller quantities corresponding to their small budgets, they could use it.

From the perceived factors, it is difficult to conclude which ones largely affect adoption because at the micro level different individuals or households have different perceptions based on personal experiences. While 12.2% 'strongly agree' that the level of education affects the adoption of LPG, 14.4% 'strongly disagree', and 13.1% is 'not sure'. Also, while 20.6% 'strongly agree' that household size affects the adoption of LPG, 18.2% 'strongly disagree'. Nevertheless, focus group discussion established that household size affects not only the adoption of LPG but any other energy sources (Box 1).

BOX 1: EFFECT OF HOUSEHOLD SIZE ON ADOPTION OF LPG

"The perception that using LPG to prepare meals for a large household is costly than using charcoal is not true. If you have a large household you cannot avoid the cost. Even if you are using charcoal then you should know that you will use more charcoal which will also be costly" **(1 FGD, Kinondoni, March 2018).**

Results from the Chi square test indicate four independent variables—i.e., age of household head, education of household head, expenditure, and dwelling—to be associated with LPG usage as they have p-values of less than 0.05. Two variables—household head and household size—are not associated with LPG usage (see Table 2).

From the Chi square results, four variables (age, education, expenditure, and dwelling) were considered for logistic regression. Binary logistic regression was performed to assess the effect of these independent variables on the dependent variable on LPG usage. Only those independent variables that showed significant relationships at the 5% level with the dependent variables were considered in the regression analysis. The effect of each independent variable is indicated by the odds ratio (Table 3).

Table 2: Chi-square Test of Association

Variable	Category	Adopters n *(%)*	Non-adopters n *(%)*	P-value	Chi-square
Age of household head	Less than 20 years	O: 0 *(0)* E: 0.6 *(60)*	O:1 *(100)* E: 0.4 *(40)*		
	20-29	O: 54 *(53.5)* E: 64.4 *(63.8)*	O: 47 *(46.5)* 36.5 *(36.1)*	**0.000**	**22.772**
	30-39	O: 99 *(64.7)* E: 97.5 (*63.7)*	O:54 *(35.3)* E: 55.5 *(36.3)*	**0.000**	**22.772**
	40-49	O: 79 *(65.3)* E: 77.1 *(63.7)*	O: 42 *(34.7)* E: 43.9 *(36.3)*		
	50-59	O: 43 *(89.6)* E: 30.6 *(63.8)*	O: 5 *(10.4)* E: 17.4 *(36.3)*		
	60 or above	O: 22 *(52.4)* 26.8 *(63.8)*	O: 20 *(47.6)* E: 16.2 *(38.6)*		
Education of household head	Non-formal	O:7 *(58.3)* E:7.6 *(63.3)*	O: 5 *(41.7)* E: 4.4 *(36.7)*		
	Primary	O:68 *(41.2)* E:105.2 *(63.8)*	O: 97 *(58.8)* E: 59.8 *(36.2)*		
	Secondary	O: 114 *(69.9)* E:103.9 *(63.7)*	O: 49 *(30.1)* E:59.1 *(36.3)*	**0.000**	**66.544**
	Vocational	O:46 *(80.7)* E:36.3 *(63.7)*	O: 11 *(19.3)* E:20.7 *(36.3)*		
	Tertiary	O:62 (89.9) E:44.0 *(63.8)*	O: 7 *(10.1)* E: 25.0 (36.2)		
	Retired	O:7 *(43.8)* E: 10.2 *(63.8)*	O: 9 *(56.3)* E: 5.8 *(36.3)*		
Household size	1-3	O:118 (*63.1)* E: 119.2 (*63.7)*	O: 69 *(36.9)* E: 67.8 *(36.3)*		
	4-6	O:144 *(65.2)* E:140.9 *(63.8)*	O: 77 *(34.8)* E: 80.1 *(36.2)*	**0.515**	**0.773**
	Above 6	O: 35 *(60.3*) E:37.0 *(63.8)*	O: 23 *(39.7)* E: 21.0 *(36.2)*		
Household head	Male	O: 215 *(65.7)* E: 208.4 (*63.7)*	O: 112 *(34.3)* E: 118. *(36.3*)	**0.165**	**1.926**
	Female	O: 82 *(59.0)* E: 88.6 *(63.7)*	O: 57 *(41.0)* E: 50.4 *(36.3)*		
Household expenditure per day (proxy for income)	5,000	O: 114 *(55.5)* E: 133.2 *(63.7)*	O: 95 *(45.5*) E: 75.8 *(36.3*)		
	10,000	O: 89 *(57.8)* E: 98.2 *(63.8)*	O: 65 *(42.2*) E: 55.8 *(36.2)*		
	15,000	O: 27 *(75.0)* E: 22.9 *(63.6)*	O: 9 *(25.0)* E: 13.1 *(36.4)*	**0.000**	**50.088**
	20.000	O: 20 *(100)* E: 12.7 *(63.5)*	O: 0 *(0)* E: 7.3 *(36.5)*		
	25,000	O: 24 *(100)* E: 15.3 *(63.8)*	O: 0 *(0)* E: 8.7 *(36.3)*		
	30,000 or more	O: 23 *(100)* E: 14.7 *(63.9)*	O: 0 *(0)* E: 8.3 *(36.1)*		
Dwelling (number of rooms occupied)	Single room rooms (shared facilities)	O: 105 *(56.1)* E: 119.2 *(63.7)*	O: 82 *(43.9)* E: 67.8 *(36.3)*		
	2-3 rooms (renting)	O: 58 *(86.6)* E: 42.7 *(63.7)*	O: 9 *(13.4)* E: 24.3 *(36.3)*	**0.000**	**19.792**
	Full house	O: 134 *(63.2)* E: 135.1 *(63.7)*	O: 78 *(36.8)* E: 76.9 *(36.3)*		

Table 3: Binary Logistic Regression

Variables in the Equation						
Step		**B**	**Wald**	**df**	**Sig.**	**Exp(B)**
1[a]	Age of household head	.052	.334	1	.563	1.054
	Level of education of household head	.680	31.598	1	**.000**	**1.974**
	Household expenditure per day	.554	21.202	1	**.000**	**1.741**
	No. of rooms occupied	.123	1.082	1	.298	1.131
	Constant	-2.092	26.810	1	.000	.123

[a] Variable(s) entered on step 1: Respondent's age, Level of education attained, Household expenditure per day, Status of residence.

At significance level, binary logistic regression shows education of a household head and household expenditure having p-value of less than 0.05; while respondents' age and the number of rooms have p-values above 0.05. Hence, education of a household head and household expenditure are significant factors in explaining the adoption of LPG. These results replicate Hammeed et al. (2016) who found education and income to be significant variables in the use of LPG in Badagry; but not age, household size, or marital status. However, our study findings divert from Ouedraogo (2006) whose analysis indicate a significant relationship between use rates of LPG and household size; as well as Parikh et al. (2016) who observed from a logit model that a one-unit increase in the log of family size is associated with a 2.67 decrease in the relative log odds of using LPG versus traditional fuel.

4.3.1 Education

From the binary logistic regression, wald estimates present that household heads with relatively higher education are 31.598 times likely to adopt LPG than those with a relatively lower levels of education. The odds ratio suggest that a one-unit increase in the level of education increases the odds of LPG usage by 1.974.

The results correlate with several other studies that reveal a positive association between education and LPG usage (Vitali, 203; Toft et al*.,* 2016; Makonese et al*.,* 2017; Heltberg 2005; Makonese et al*.,* 2017; Ozoh et al*.,* 2018; Bisu et al*.,* 2016). The achievement of formal education is believed to increase the probability of a household using cleaner fuels, including LPG; and the probability amplifies with increased education achievements (Mwaura et al., 2014). The education of a household head encourages the transition from traditional 'dirty' to modern 'clean' fuels as it improves awareness on the risks associated with biomass consumption, and the relatively higher opportunity cost of solid biomass. Education also helps to understand the benefits of using clean energy and the health implications of using traditional fuels for cooking. Apart from influencing knowledge that encourages energy transition, well-educated persons have higher chances of securing good paying jobs.

4.3.2 Household Expenditure

Logistic regression results present wald estimates showing that households with relatively higher expenditure per day (proxy for income) are 21.202 times more likely to adopt LPG, as opposed to those having a relatively lower expenditure per day. The odds ratio suggest that a one-unit increase in household expenditure increases the odds of LPG usage by 1.741. These findings are similar to other studies across different places (Pope et al*.,* 2018; Mekonnen & Kohlin, 2008; Gupta & Kohlin, 2006; Nlom & Karimov, 2015; Hollada et al*.,* 2017; Schlag & Zuzarte, 2008; Ouedraogo 2006; van de Kroon et al*.,* 2011; Farsi et al*.,* 2007; IEA, 2013). In Bangladesh, for example, 46% of the income non-poor were also energy non-poor; while 81% of energy poor were also income poor (Barnes et al*.,* 2012): the reasons for lower rates of LPG usage in poor communities being the inability of poor households to afford prohibitive stove and cylinder prices (USAID, 2005; Elgarah, 2011).

In Cameroon, households with incomes above the Cameroon national average (50 k CFA) are significantly more likely to use LPG, and those with the highest incomes (100 + CFA) having a greater chance to report using LPG (OR = 4.68; 95% CI = 1.64, 13.4) (Pope et al*.,* 2018). In India, LPG usage was discovered to be limited to the middle and upper classes; while lower classes continued to rely on traditional wood fuels (Srinivasan & Carrattini, 2019; Goulda & Urpelainen, 2018). This is similar to the findings reported from the three study sites: that a high income area has a high adoption rate, followed by middle income (constituting above 50%), and finally the low-income area that recorded far less than 50% adoption rate. Generally, these findings validate the energy ladder theory: that the adoption of modern clean energy—including LPG—usage is a function of increased income. High-income areas portray high levels of adoption, while low-income areas portray low levels of adoption. However, this may not be justifiable across countries or regions.

For example, a study in Nigeria provides unnoticeable difference as it exposed that a proportion of LPG users that earned less than ₦20,000 (USD60) was similar to the proportion of those who earned over ₦100,000 (USD300) (Ozoh et al*.,* 2018). Meanwhile, Labriet et al. (2015) uncover that differences in the amount of LPG consumed by urban households across expenditure levels in Guatemala are negligible, implying that income differences did not matter in the use of LPG. Thus, income cannot precisely be established as the key determinant of LPG adoption. Qualitative data analysis provides that the adoption can be affected by different socio-economic or cultural actors such as awareness, food taste, dwelling status, unit of sale and kitchen size; suggesting the applicability of the energy stacking model, which postulate that income is not the sole factor determining energy consumption: there is a combination of other factors.

4.3.3 Fuel Availability

Findings from the study verify that fuel availability is a key factor that affects the adoption of LPG at the macro level. The fact that Kinondoni and the rest of the country rely on imported LPG validates that availability is connected to institutional frameworks. Availability within a geographical or administrative area is crucial for stimulating the adoption of LPG. Widespread availability, coupled with consistent supply, reduces the chances for frequent disruption, and also increases competition, leading to reduction of consumer prices. Availability issues may be caused by the lack of effective policies, lack of infrastructures such as storage facilities, limited refill centres, or poor distribution networks (Argus media.com, 2014). These consequently affect household consumption even if other adoption factors at the micro level are satisfactory.

The Energy and Water Utilities Regulatory Authority (EWURA) of the Ministry of Energy confirms that the government declared import tax exemption on LPG to increase availability. Following the import tax exemption, increasing number of suppliers, and improved infrastructure, LPG is extensively available in Kinondoni municipality. As of August 2019, there were about 8 registered LPG marketing companies and widespread placement of retail outlets—approximately one-kilometre radius (Energypedia Survey, 2018). This gives the assurance that most of the residents in Kinondoni can obtain LPG close to their residencies. Observations made in Indonesia (WB, 2013), and South Africa (IIEC, 2005) confirm that availability positively affects the adoption of LPG. However, it may not be universally applicable. For example, some parts of Nigeria recorded low LPG usage despite of its extensive availability in their areas (Ahmed, et al*.,* 2005); while some other places had LPG shortages despite domestic production (Dalaba et al*.,* 2018).

In countries like Tanzania where LPG is imported, availability involves policy arrangements to facilitate and support importation. The government, through the Ministry of Energy, endorsed tax exemption to encouraging importation. Moreover, it has been appealing for new investments in the LPG sector, and constantly regulates the LPG market to promote effective competition and economic efficiency.

5. Conclusion

This study found numerous factors to be affecting LPG adoption in Kinondoni Municipality, Dar es Salaam. At the micro level, the adoption of LPG is affected by the quantity or unit of purchase, household income, household size, awareness, level of education, and food taste, among others. Statistically, data analysis established education and household expenditure as significant factors that affect LPG adoption in Kinondoni Municipality. The adoption of LPG can be the best choice at present as the national energy policy is

advocating the utilisation of alternative fuels to minimise biomass utilisation. Using it as an alternative to traditional biomass—specifically charcoal—will not only improve access to clean cooking but also deliver associated benefits. It will contribute to minimising indoor air pollution, exposure to respiratory diseases, poor participation in income generating activities, and poor participation in education and decision-making. LPG usage may also help mitigate climate change by reducing greenhouse gases. Scientific studies provide that if two billion biomass and wood fuel users would switch to LPG, the additional impact would not even reach a 2% increase in overall global greenhouse gas emissions (Smith et al*.,* 2000). Using LPG as an alternative offers a higher probability of climate mitigation. As the government and other stakeholders try to promote and encourage LPG usage, identification of the significant factors could help figure out strategies that should be proposed and installed to create a conducive enabling environment.

This study has a pro-poor policy implication since the adoption and usage of LPG contributes to the attainment of various socio-economic goals connecting to overall poverty reduction through improved health, education, gender equality, and environmental sustainability.

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