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CITY HOUSEHOLD ENERGY CHOICES AND THEIR INFLUENCING FACTORS IN PAKISTAN

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ABSTRACT
The dissimilarities of cooking fuel are subjected to several attributes associated with the household's personal life and social life. A household chooses firewood for cooking purposes because of easy access and affordability but also uses multiple energy sources at the same time. These choices become conditional upon a number of factors. These factors can be income, education, location, access, and awareness. The current study attempts to explore the influencing factors of joint energy choices for cooking in the cities of Pakistan. The study is grounded upon the microdata, collected by PSLM at the household level. The study uses Multivariate Probit (MVP) to capture jointly chosen sources of cooking energy and their influencing factors. The study found that households residing in D I Khan and tank city are dominantly using firewood and households residing in Karachi Lahore and Peshawar prefer to cook on gas energy. The study also found that education, internet use, and income are significantly associated with the choice of clean energy such as Gas and LPG for cooking at the household level in the cities of Pakistan. Distance to road and time to markets are negatively associated with clean sources of energy for cooking in Pakistan.
Keywords: Cities, Energy choices, Cooking energy, and Household.
JEL classification Q40 R20

INTRODUCTION

Nearly 3 billion people on planet Earth, residing predominantly rural and urban are underprivileged and involuntary use biomass fuel to meet their dietary energy needs on daily basis. The household uses these energy sources for cooking, water heating, and other household requirements. Demand is high for wood and biomass due to harsh climatic conditions in some of the regions Rehfuess, et al., (2017). According to Kanno, et al., (2021), World Health Survey found that 90% of households do not take care of basic protection measures like Chimneys use to avoid indoor pollution. However, the accumulative number of people relying on biomass fuels for only cooking purposes is around 2.4 billion (Rehfuess, et al., 2017).

It is expected that it will reach 2.7 billion by 2030 due to rapid growth in population. Household requirement for wood and fossil fuel is increasing. In FY 2011 approx. 28.8 percent of Oil energy was consumed Globally Timmons, et al (2014). The high rate of reliance on Biomass has created a huge market for products of bio-fuel energy across developing countries. About 80% of the global energy supply was comprised of biomass energy in 2002, which was reduced to 65% in 2010 and only 10 percent in 2011 Timmons, et al (2014). It is possible to reduce dependency on dirty energy sources. According to Balat, M. (2006), it is important to reduce dependency on charcoal and fossil fuel for cooking and heating to mitigate Carbon emissions, which are contributing to global warming.

It is declining due to several reasons. One of those reasons is the increasing rate of urbanization and the development of cities. This can be tested in the current study by adding location dummies of cities to the econometric model. Second, the development of clean and better energy sources has reallocated the energy demand due to the disposal of substitutes. The rising coverage of electricity and solar energy has also reduced the need for Kerosene oil and biomass energy (Mathiesen, et al., 2012). It is very important to understand that in rural areas, indoor air pollution due to the use of wood and cow dunks for cooking purposes has very serious implications for human health (Klein, & Klein, 2007). It causes a significant amount of health issues to female household members, as they are the ones who spend more time inside the household. In rural areas, female household members are responsible for cooking food, which makes them more vulnerable to smoke and indoor pollution. The irony is that the Multi-dimensional poverty index shows that 69.67 percent of households are deprived of clean energy sources for cooking in Rural Pakistan (Haleem, et al., 2020).

Although, it is expected that the city's household has much fortunate to have an access to clean energy sources like Gas connections, and a continuous electric supply. However, high-polluting energy sources are still extensively used by the majority of the population. In Pakistan, rural households are majorly consuming LPG, LNG, Kerosene oil, Biomass, Dunk cakes, firewood, and electricity. All these sources are commonly used in rural areas of Pakistan. Electricity is rarely used for cooking. However, it is the major source of lighting energy across all the provinces of Pakistan, but in rural areas, gas and kerosene oil are still used for lighting due to repeated load shedding. On the contrary cities have different characteristics. The inhabitants of cities have a higher level of utilities to consume and easy access to cleaner energy sources as compared to rural households.

The choice of energy used in daily life routine has certain economic and environmental consequences for a household economy. In cities, houses are safe havens due to almost zero use of fossil fuel. Instead, the use of electricity and gas is preferred for cooking in cities. The objective is, to examine the influencing factors of joint energy choices at the household level in cities of Pakistan. The problem stated indicates that Jointly consumed energy choices are common but rarely explored in previous literature. Model such types of choices and explore it can contribute to the existing literature on energy economics and it is possible to use such technical papers for policy options when it comes to the development of sustainable cities in Pakistan. A New Wave of PSLM 2019-2020 is available and this paper has utilized the household-level information from this series. Now, the contribution of the current study to the existing literature can be comprehended by the connection, that this study has built between household characteristics and human behavior in terms of making choices in the cities of Pakistan, where they have access to almost every source of energy.

The study assumes that household has a greater level of access to clean energy in cities of Pakistan as compared to rural areas and this assumption is quite realistic and highly supported by the existing literature. This paper argues that a household-level energy choice in the cities, is comparatively cleaner and it is important to explore these choices across major cities in Pakistan for the policy of sustainable cities. This paper helps to comprehend the determinants of energy choices for Cooking in cities for designing the urban energy policy in Pakistan, a sub-component of sustainable cities in Pakistan.

Theoretical Debate on energy choices

In Pakistan, most of the studies have explored the Rural areas' choice of energy at the household level, which is influenced by the availability of alternatives, household income, and prices of other energy products in the market (Awan, & Bilgili, 2022). Tons of studies are focused on household energy choices in both developed and developing countries in different contexts. Especially, a study by Bisu et al., (2016) explored the choice of energy use at the household level by using primary data. This study has provided baseline information on methodologies to explore the determinants of energy choices.

Usually, the important sources of energy for cooking are firewood, LPG, coal, and cow dunks. However, for lighting and some of other household purposes Solar energy is also used in Pakistan (Saif-ur-Rehman, et al., 2017). The availability of energy sources can be assumed if a person is using it, and the existing literature offers a very hardcore disciplinary debate on access to energy and energy choices, not only because it is the most important component of development but also a basic need of human survival. The demand for energy is growing because of human advancement from need base consumption to choice base consumption.

Theoretically, the energy choices at the household level can be elucidated by both the models of energy ladder and fuel-stacking (Heltberg, 2005). This model describes households' energy choices with respect to income level. The model established that if we consider a ladder of energy products, from the left end of the ladder low income households, are expected to use wood or biomass, or fossil fuel. The middle portion represents households, using charcoal, coal and, gas energy products and to the extreme right of the ladder, households with high income use electricity and natural gas.

The energy ladder model highlights that income is the major influencing factor for the choice of energy products at the household level. this notion has acquired a significant amount of attention in social-scientist and economist communities. And received massive support from Hosier and Dowd (1987) and Leach (1992).

However, there are some other studies, which added, some important variables to the model and established that it is not merely income but more than a few socioeconomic, institutional, and market factors are involved to influence a household's choice of energy source Mirza and Kemp (2009) and Nnaji, et al. (2012). The current paper contributes to the literature by empirically testing the multi-factor theories in the case of the urban population in Pakistan. This paper put to the test the energy ladder model in the context of urban households' behavior. Choice of energy use with respect to income level can verify the application of the energy ladder model in Pakistan.

METHODOLOGY

This study is established on secondary data. The study is based on a multivariate binary model. Multivariate probit (MVP) regression analysis, because a single equation probit or Logit regression model is unable to predict joint interdependence of binary outcomes. To understand this, it is important to understand that in cities people have access to multiple energy products ta the same time, including electricity, fossil fuel, gas, etc., which allows households to use multiple sources of energy at the same time. Multi-Variate Probit has an advantage over other binary response models, it enables the authors to capture joint choices at the household level.

It is quite plausible to think that MVP regression is the most feasible and meaningful econometric method to deal with correlated multivariate binary outcomes with fewer limitations comparatively Behera, et al (2015). The use of the (*mvprobit)* method also authorizes the estimation of the joint conditional probabilities, which can be written as follows Pr (**y** = **k**|**x**) for the M-vectors of outcomes **y**. Using multiple independent variables, this model also helps to uncover the influencing factors of these joint interdependence of selected binary outcomes or over each of the discrete dependent variables at the same time despite the fact tolerating error terms to be spontaneously correlated (Lin, et. al (2005) and Zhu, & Lin, (2020).

For the application of the multivariate probit model, the following variables are measured from PSLM 2019 round data. justification for use of this model is associated with the applicability of this model to real-time data. the study has adopted the methodology of Ahmar et al (2022). The main target of the currently adopted method of applied Micro-Econometric analysis is to estimate the marginal effects of covariates (**x)** on various conditional parameters on a micro data set. Using the Perraillon, M. C. (2019) concept of marginal effects, this paper focuses on the marginal responses of choice probabilities against multiple explanatory variables. The study does not claim to establish causation but it is an attempt to build a causal connection between a selected set of variables and joint energy choices for cooking at the household level.

Measurement of Important variables of the study

Independent Variables	**Measurement**
[1]Average Functional Ability [2]Multiply by Age	A horizontal average of functional abilities across all the category functional abilities is calculated and Multiplied with each category of age subsequently.

[1] It can be either done manually or it can be conducted on software using I. # and C. # commands between age and functional ability in Stata. Before using this technique, the results were vulnerable to interdependency issue across age and functional ability in the last two age categories. The addition of interaction term directly instead using the original variables is feasible and applicable in this case.

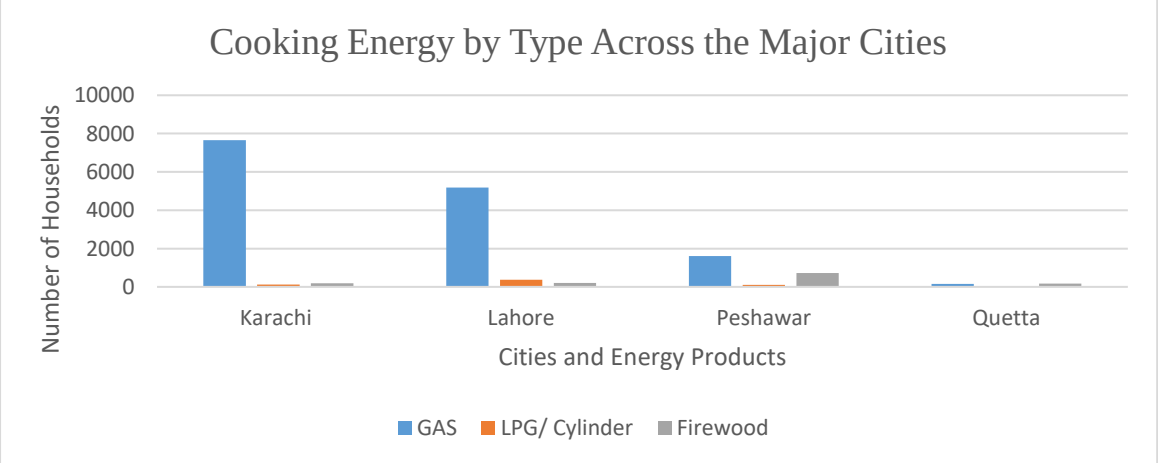
[2] (Xi1*Xi2)

[3]Earned Cash Income	This is a continuous variable, which is the household response to the question. How much money cash did you earn in last month?
Access to Internet	If a household has access to the internet take values one and zeroes otherwise
Mobile phone use	If the person is mobile user takes value one and zero otherwise
Gender House-Head	If the head of a household is male, takes values one and zero otherwise
Education HH	Highest grade completed in the years
Number of rooms	How many rooms are there in the residential building (Number of rooms in a house)
Migration	If the household is migrated from the other place take values one and zero otherwise
Karachi Central	Location dummy = Household residing in Karachi = 1 and zero otherwise
Peshawar	Do
Lahore	Do
Quetta	Do
Distance To Road	It is measured in Kilometers
Time to reach Market	It is measured in minutes

RESULTS AND DISCUSSION

Figure 4.1 shows samples of major energy sources for cooking across major cities of Pakistan. The data is taken from PSLM HIES round 2019-2020 and the sample size varies across cities with respect to the population size of the cities. The largest city in Pakistan is Karachi and more than 7000 household sample is taken for the final estimation. The major sources of energy for cooking are Gas in Karachi, followed by Firewood and LPG users respectively. Lahore is the second largest city in Pakistan, sample of Lahore shows Gas users are greater than other energy sources for cooking in Lahore City. However, LPG users are also greater than Firewood users in Lahore when it comes to the choice of cooking fuel. In Peshawar City, Gas energy is the major fuel for cooking, followed by Firewood and LPG respectively. The sample of Quetta city indicates that Firewood users are greater than Gas users for Cooking at the household level.

Figure No. 4.1 Major Cooking Energy by Type across Major Cities of Pakistan



[3] Due to weakness of equal weightage treatment to each of the category this study has avoided the use categorical independent variables, allow model to tolerate the variance interdependencies to its Maximum level.

Exploring the Descriptive statistics of energy choices Across cities.

D.I. Khan City; This section of the paper shows disaggregated results for energy choices with respect to the gender of household heads in different cities of Pakistan. The results for household energy uses are shown in table 1. The data shows that there are six major sources/products of energy. The most dominantly utilized source of energy in D.I. Khan is Firewood, followed by Gas energy. Out of 1171 households headed by a male, only one household uses Charcoal/Coal for cooing in D.I. Khan. 11 households cook on Dunk Cake and 16 households cook their food on crop residuals. Less than 15 percent of the households use GAS and LPG for cooking purposes in D.I. Khan. The district D.I Khan is highly dependent on Firewood markets because very limited access to pipeline gas is provided. The study also found that more than 97 percent of households are headed by a male member of the household in D.I. Khan. This city has the second highest percentage of firewood users for cooking which is 79.51 percent of the total. See table one in Appendix A1: Households Energy Choices in The D.I. Khan City.

Tank City; The results shown in table 2 indicate that Tank City households are using firewood as the primary source for cooking purposes. More than 90 percent of households choose firewood for cooking in Tank city. Only 26 households, out of 443 are using pipe connection gas for cooking, which shows that firewood is dominantly preferred over other sources of energy for cooking in Tank city. It is also possible that people picked firewood over gas because of the disruptive supply of gas and the easy availability of firewood markets. Out of all 443 households, only one household uses LPG, which shows that it is a less demanded source of energy for Cooking in the district. Less than 2 percent of households are using crop residuals for cooking in tank city. This city has only four major sources of energy for cooking at the household level. Charcoal and Dunk cakes are not used for cooking in Tank. It will be interesting to explore that variation in energy choices is associated with multiple factors, which can be improved towards sustainability by alteration in the given household characteristics. However, Tank has also male-dominated culture and most of the households are headed by male members in the cities. See Table 2 in Appendix A2. **Karachi Central;** The results of table 3 show that gas is the dominant source of cooking fuel in Karachi However, some households are still using Firewood as cooking fuel in central Karachi. This indicates that there are some societies, where gas connections are not properly installed. Or it is also possible that people using cylinder Gas and wood for cooking are facing a significant amount of Sludge to connect to main Gas Pipelines. The users in Karachi are facing issues in terms of inconsistent supply of gas, due to which household also puts demand on cylinder gas markets and this use it as substitutes, especially in the winter season. However, Central Karachi is comparatively better off. Firewood is also used in Karachi due the same reason in the winter season. For further details, see Appendix A3: Table 3 Households Energy Choices in major cities of Pakistan.

Lahore City; The data shows that only 3.46 percent of households use Firewood for cooking purposes in Lahore city. Gas is the most dominant source of cooking energy at the household level in Lahore city. In Lahore, 88.46 percent of the households are using Gas for cooking. Interestingly Dunk Cake is more frequently used for cooking in Lahore as compared to Karachi D I Khan and other cities. The reason for this could be the availability of Dunk cake due to animal Farms around the city OF Lahore.

Peshawar city; The data of PSLM shows that there are 2538 respondents from the city population. The data shows that more than a quarter of the household population is predominantly using firewood for cooking in Peshawar city. More precisely 28.60 percent of the households are using firewood for cooking at the household level. Gas use is the dominant choice for cooking in Peshawar with 63.55 percent of the total users. A high proportion of households relying on firewood for cooking is observable in Peshawar city. Due to the load shedding of Gas households alternatively uses cylinder Gas. However, cylinder Gas users are less than 5 percent of the total household population in Peshawar. Less than one percent of households reported the use of Dunk cakes for cooking and only 2.7 percent of the households are using Crop residual for cooking in Peshawar, which includes the fossils of Sugar cane. **Quetta city;** the data shows that a total of 350 households are selected for the analysis, where a significant proportion of households is using firewood for cooking at the household level. 47.71 percent of households are relying on firewood for cooking, which indicates that the larger share of the Quetta population is deprived of clean energy for cooking. It can be established that Firewood is the dominant source of cooking energy in Quetta city, followed by Gas energy for cooking with 46.57 percent of users.

The Empirical results MVP model Cooking Energy Options at the household level

The results of the MVP are able to contribute to the policy desks by understanding the factors that influence households' choices of cooking fuel for sustainable future cities in Pakistan. But it is quite a

possibility that Multicollinearity between the independent variables can cause under or over-estimation of standard errors and thus it leads to spurious regression estimates Ahmer et al (2022). To avoid such types of Econometric problems, the Authors have calculated the (VIF) Variance Inflation Factor for the reach of the given Variables. Initially, the VIF of some variables was greater than the acceptable range, which is < 10 but through transformation and removal of outliers, all the variables have a VIF of less than 10 and the results of Pearson's Chi-square (χ^2) test values become significant with P values < 0.05. The values of **Cramer's V** are greater than 0.15 for all the indicators except Gender, Access to the internet, and the number of rooms. The Values of Ch-square in a non-parametric analysis are > 38.65 for all the indicators, except gender Access, and the number of rooms, for which the values are 5.39 and 7.89 respectively.

Table 4; Appendix A4 shows MVP Coefficients derived with the application of robust standard errors (RSE).

The Coefficients and Marginal effects indicate that the Choice of Firewood and crop residuals for cooking is positively associated with the interaction term of age and average functional ability of a person. The Income of a household positively influences the choice of household across all the options for cooking. However, the value of the coefficient of income for Gas energy is greater than other joint choices for cooking. Indicates that Gas energy choice dominates over others as the income increases. The results of the households' income indicator are consistent with the findings of Yousaf et al (2021), who established a positive association between demand for clean energy and income increase at the household level, using PSLM data (2018-2019). All the coefficients for Joint energy choices with income as an explanatory variable are statistically significant. Access to the internet is similar across the Firewood and crop residual user households and statistically not significant but highly significant for Gas users as cooking fuel.

This indicates a positive association between access to the internet and joint use choice of Gas and LPG in Pakistan at the household level. Joint use of firewood and crop residuals is negatively but insignificantly associated with Mobile phone use, which means there is no variation across households utilizing Firewood and Crop residuals for cooking at the same time for mobile users.

Gender House-Head (Male) is statistically not significant, it shows that choices of energy for cooking do not vary across the gender of the household head. However, a larger positive coefficient for the first bundle exhibits that the Male headed household will prefer to choose firewood and crop residual as cooking fuel at the household level.

Education HH and clean energy bundle is positively associated at the household level in Pakistan, if we assume Gas as clean energy for cooking. Our results are supported by the study of Ali et al (2019) & Rahut et al. (2019), which also established a positive association between education and clean energy choices at the household level. There is a positive relationship between the number of rooms and the choice of the first cooking energy bundle, which is Firewood and crops residual and it is statistically significant at a 5 percent significance level. The other bundle's choice is statistically not associated with the number of rooms at the household level. The results also show that migrated households choose to survive on Firewood and crop residuals. It is quite practical in Pakistan that migrated households are characterized by low-income attributes, searching for better opportunities for jobs, and businesses, that are not able to afford cleaner energy sources at the struggling stage.

The energy sources vary across locations. In Karachi, household choices for cooking energy are highly concentrated upon the use of Gas and cylinder and there is a significant level of statistical chance that a household residing in Karachi will choose Gas/LPG for cooking at the household level with a 1% of the significance level. On contrary, a household in Karachi has a significant level probability that he/she does not choose firewood for cooking at the household level. Furthermore, the size of positive coefficients across the bundles indicates that the third bundle is preferred over others for cooking in Peshawar but other bundles are also significant for the location of Peshawar.

For D I Khan it will be correct to say that the probability of choosing the first bundle increase if the household belongs to D I Khan. Other bundles are indifferent in D I Khan and other cities. Furthermore, the households residing nearby roads have a higher probability of choosing second and third bundles of cooking energy in Pakistan. Often the Main Pipeline of Gas supply is positioned on Roads sides and people living nearby are better off comparatively in terms of easy and less costly access to the main connection. A long drive to the market indicates long-distance or poor quality of the roads. Both cases restrict a consumer to access cylinder gas and firewood from the market. It also reduces the

chances of being connected to the main pipeline Gas connection. In this situation, households prefer to use crop residuals and or wood fire for cooking. See Appendix A4: Table 4. And table 5 respectively. Influencing Factors of Households' Cooking Energy Choices in Major Cities of Pakistan (Merged).

The results of the study show the marginal effects of MVP on joint energy choices. The marginal effects of choice of the second bundle are greater than the marginal effects of the First joint choice bundle for cooking energy at the household level but the first is highly significant and the third is not significant statistically. It shows that the probability of the third bundle joint energy choice does not respond to one unit change in Age-ability interaction and it is not significant in this case. Firewood arrangement requires significant energy and energy is connected to the age of the household head, which influences the choices of household energy for cooking in Pakistan. Marginal effects of income increase on choices of a clean bundle are greater as compared to the first two bundles which consist of Firewood and fossil fuel energy sources for cooking at the household level.

The marginal effects of internet access suggest that a cleaner bundle for cooking is positively connected to the households' internet accessibility, which increases the level of awareness about health and the environment and consequently aware and conscious households have a higher probability to choose Gas for cooking.

Table No. 5 Marginal effects

[4]FW/CR			[5]PG/ F		[6]PG/CG	
IND-Variables	[7]Margin	Std-error	Margin	Std-error	Margin	Std-error
Average Functional Ability By Age	0.1224***	0.000	0.2281*	0.016	-0.0132	0.191
Earned Cash Income (Ctg)	0.1581*	0.029	0.159**	0.013	0.1809***	0.006
Access to Internet	-0.0027	0.012	0.129*	0.010	0.0241**	0.020
Mobile phone use	-0.0141*	0.010	0.0151*	0.013	0.0701	0.280
Gender House-Head (Male)	0.0121	0.009	0.0214	0.019	0.0332	0.069
Education HH	-0.0501**	0.003	0.1329**	0.011	0.2039***	0.018
Number of rooms	0.0931*	0.010	0.0081	0.021	0.1035	0.312
Migration	0.0720**	0.018	0.1027*	0.010	0.0290	0.110
Karachi Central	-0.0341	0.030	0.1099	0.022	0.3303**	0.006
Peshawar	0.0900*	0.019	0.1592**	0.008	0.2519***	0.006
Lahore	-0.1350	0.110	-0.0581*	0.013	0.2301**	0.058
DI Khan	0.1631**	0.017	-0.0927	0.120	0.0817	0.057
Tank	0.0239**	0.014	-0.01081	0.109	0.1143	0.132
Distance To Road	0.1210	0.231	-0.1414**	0.021	-0.170***	0.006

[4] If a Household is using Firewood + Crop residuals for cooking at the same time = (1) and zero otherwise

[5] Gas + Firewood = (1)

[6] Gas+ LPG = (1)

[7] Margin = marginal effects

Time to reach Market	0.019*	0.003	0.0329	0.103	-0.702	0.890

Continuously insignificant variables across all the bundles are omitted.

CONCLUSION AND POLICY OPTIONS FOR FUTURE

Energy is one of the most essential requirements of household life. Energy use at the household level has been accelerated due to the increasing population, limiting the access of the underprivileged and the availability of energy products in the different parts of the world. In Pakistan, a household uses Firewood, Charcoal, Crop residual, Dunk Cakes, connection Gas, and Cylinder-Gas for cooking purposes. For Lighting Kerosene oil, Candles, Grid electricity, Solar energy, and Gas is still under high pressure of increasing demand. Household chooses energy source/type for cooking on the basis of several household characteristics, which encourages or discourages the intentions and behavior of a household toward a specific type of energy for household-level activities. These characteristics are associated with regional attributes, personal attributes, and social attributes. It is possible that a household with a better-off status such as high income and geographic advantage has different choices regarding cooking energy as compared to ones with ravenous conditions, in terms of means of life. This study unfolds the influencing factors for different bundles of energy choices at the household level with the utilization of the latest secondary Micro data set provided by the PSLM survey (2019-2020). The study used Multivariate probit regression analysis to estimate the marginal effects of joint energy choices and their influencing factors. The study revealed that Gas is predominantly used for cooking in cities, followed by the demand for firewood and LPG respectively. The increasing level of education tends to push household choices towards cleaner sources of energy for cooking. The use of the internet and mobile phone also encourages cleaner choices for cooking. The probability of choosing firewood for cooking is comparatively low for the residents of Karachi, Lahore Peshawar as compared to Quetta and high for D I Khan and Tank city residents as compared to referenced category. The study concludes by highlighting the importance of education and access to the market for clean and healthy choices in terms of energy for cooking at the household level in Pakistan. To encourage cleaner sources of energy, there is a need for reallocation of Gas supply lines in a way that households residing off the roads can also have the opportunity to get a connection of gas from the main line.

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Appendixes

Appendix A1: Table 1: Households Energy Choices in The D.I. Khan City

District 1.00 D.I.KHAN		**Gender of Household head**		**Total**
		Male	Female	
SF1q 08 What is the main fuel used for cooking?	Firewood	932	11	943
	Gas	151	2	153
	LPG/ Cylinder	60	0	60
	Dung Cake	11	0	11
	Crop residue	16	2	18
	Charcoal/Coal	1	0	1
Total		1171	15	1186

Appendix A2: Table 2: Households Energy Choices with respect to gender in Tank City

TANK City		**Gender of Household head**		**Total**
		Male	Female	
What is the main fuel used for cooking?	Firewood	403	4	407
	Gas	25	1	26
	LPG/ Cylinder	1	0	1
	Crop residue	8	1	9
Total		437	6	443

Appendix A3: Table 3 Households Energy Choices in major cities of Pakistan

DIST			Gender of person		Total
			1 Male	2 Female	
4.00 KARACHI	SF1q08 = What is the main fuel used for cooking?	Firewood	174	6	180
		Gas	7178	479	7657
		LPG/ Cylinder	124	2	126
		Kerosene oil	2	1	3
		Electricity	1	1	2
		Dung Cake	1	0	1
		Charcoal/Coal	9	0	9
		Others (Spedify…….)	4	0	4
	Total		7493	489	7982
5.00 LAHORE	SF1q08	Firewood	200	3	203
		Gas	4876	301	5177
		LPG/ Cylinder	363	10	373
		Electricity	1	0	1
		Dung Cake	41	1	42
		Crop residue	6	0	6
		Charcoal/Coal	24	0	24
		Others (Spedify…….)	25	1	26
	Total		5536	316	5852
6.00 PESHAWAR	SF1q08	Firewood	658	68	726
		Gas	1509	104	1613
		LPG/ Cylinder	104	4	108
		Electricity	1	0	1
		Dung Cake	12	2	14
		Crop residue	63	6	69
		Charcoal/Coal	4	0	4
		Others (Spedify…….)	3	0	3
	Total		2354	184	2538
7.00 QUETTA	SF1q08	Firewood	163	4	167
		Gas	160	3	163
		LPG/ Cylinder	16	1	17
		Charcoal/Coal	3	0	3
	Total		342	8	350

Appendix A4: **Table 4** Influencing Factors of Households' Cooking Energy Choices in Major Cities of Pakistan (Merged)

[8]FW/CR			[9]PG/ F		[10]PG/CG	
IND-Variables	[11]Coef	Std-error	Coef	Std-error	Coef	Std-error
Average Functional Ability By Age	1.1429**	0.073	1.2281	1.116	1.032	0.931
Earned Cash Income (Ctg)	2.8581*	0.749	3.059**	0.713	4.909***	0.013
Access to Internet	-0.0127	0.022	0.529	0.310	0.124*	0.020
Mobile phone use	-0.1581*	0.114	0.3190*	0.133	0.2701	0.280
Gender House-Head (Male)	0.0251	0.041	0.0214	0.019	0.0132	0.069
Education HH	-0.3101*	0.023	0.3429	0.211	0.5239***	0.013
Number of rooms	0.1250**	0.026	0.0581	0.050	0.1435	0.312
Migration	0.1131**	0.018	0.1427	0.210	0.0190	0.120
Karachi Central	-0.9381*	0.209	0.1399	0.122	0.8903***	0.000
Peshawar	0.2201*	0.189	0.3592**	0.090	0.5089***	0.006
Lahore	-0.1550*	0.049	-0.2581*	0.051	0.5491***	0.038
DI Khan	0.8131***	0.027	-0.1127	0.220	0.0127	0.117
Tank	0.9439***	0.019	-0.1581*	0.109	0.1143	0.132
Distance To Road	0.6901**	0.052	-0.9734*	0.183	-1.015*	0.235
Time to reach Market	0.1795**	0.013	0.192*	0.043	-0.212	0.103
Constant[12]	-2.890**	1.360	-3.110***	0.397	0.931**	0.057

[8] If a Household is using Firewood + Crop residuals for cooking at the same time = (1) and zero otherwise
[9] Connection Gas/ Firewood = (1)
[10] Connection Gas/Cylinder Gas
[11] Coef = coefficient
[12] Quetta is referenced city against all the location dummies.