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EMPIRICAL ANALYSIS OF HOUSEHOLD ENERGY DEMAND USING ALMOST IDEAL DEMAND SYSTEM: A CASE STUDY OF DISTRICT MUZAFFARABAD, AZAD KASHMIR, PAKISTAN

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ABSTRACT

Energy provides input for keeping sustainability in economic growth. This research work is designed to investigate the household energy demand and to explore the factors that determine household energy demand for different forms of energy consumption in district Muzaffarabad of the state of Azad Jammu and Kashmir, Pakistan. By using Linear Approximate Almost Ideal Demand System (LA-AIDS), this study estimated Marshallian price and expenditure elasticities of demand for four kinds of energy components including both rural and urban households. Using primary data LA-AIDS estimation indicated that demand for all forms of energy are price inelastic. Cross price relations indicated that electricity is a substitute for LPG, wood and fuel whereas LPG and fuel are complements. Electricity has most inelastic own-price elasticity which shows that households in Muzaffarabad are insensitive to changes in the price of electricity.

Contribution/ Originality: This study contributes to existing literature by (i) using an estimation method which identifies household energy demand in the study area. (ii) Only district specific investigation about household energy demand using primary data considering four major energy types.

1. INTRODUCTION

Pakistan is geographically divided into five provinces plus FATA and State of Azad Jammu and Kashmir (AJK). District Muzaffarabad is selected for this study as being the capital of AJK and electricity, fuel, wood and LPG are key energy sources of this district. Its area is 1642 square kilometers having 0.454 million population (Azad Jammu and Kashmir at Glance, 2018). The major objective of current research work is to discover the factors that determine household's demand for different types of energy consumption and to estimate price and income elasticities in district Muzaffarabad through primary data.

The present study is organized into five sections, namely, introduction, detailed and rigorous review of literature, methodology, results and discussion and finally concludes and policy of the study.

2. LITERATURE REVIEW

Various studies (i.e. (Rothman *et al.*, 1994; Sahir and Qureshi, 2007; Inglesi, 2017)) give great importance to energy in the process of economic growth. The core of demand for energy and knowledge of its components are of critical prominence for correct prediction of its existing and future needs (Khan and Usman, 2008).

This literature starts from work of Stone by introducing Linear Expenditure System (LES) in 1954. Due to various issue of "LES including proportional income, price elasticities and excluding of complementary association between goods", had unlocked ways to the expansion of more flexible representations like Translog representation (Christensen *et al.*, 1975) and Rotterdam model (Theil, 1965). Later on, "Deaton and Muellbauer (1980) suggested another modelling called as Almost Ideal Demand System (AIDS)". This innovative approach acquired much importance in demand systems and had been used widely in applied research.

To measure household demand for energy, various studies like (Iqbal, 1983) have been conducted in both developed and developing countries through macro-level data as well as micro level data for estimating elasticities with reference to price, income and demographic variables. Studies like (Estrada and Fugleberg, 1989; Narayan and Smyth, 2005) used econometric single equation models for household demand of electricity, gas and fuels through diverse methodologies. A second group used micro data (e.g. (Petersen, 2002; Oladosu, 2003; Berkhout *et al.*, 2004; Labandeira *et al.*, 2006)) for estimation of household energy demand.

Applying "Linear Approximate Almost Ideal Demand system" to 3665 households sample throughout Kenya (Ngui *et al.*, 2011) estimated price and fuel expenditure elasticities of demand. Results indicated "that motor spirit premium (MSP), automotive gasoil (AGO) and lubricants are price elastic while fuel wood, kerosene, charcoal, liquefied petroleum gas (LPG) and electricity are price inelastic. Kerosene is income elastic while fuel, wood, charcoal, LPG, electricity, MSP and AGO are income inelastic rendering Gasoline and Oil as normal goods and LPG being an inferior good in Iran" (Mehrara and Saeedeh, 2011). Kerosene is highly consumed energy source in Oyo, Nigeria. Results revealed that entire energy sources are price inelastic Furthermore, income elasticities less than one indicating energy consumption as necessity (Ogunniyi *et al.*, 2012). Energy demand in Tunisia is generally sensitive to the income level and real prices of energy products (Talbi and Nguyen, 2014). Measures should be taken for reduction in kerosene prices and investment in renewable energy to meat household demand (Onoja and Anthony, 2012). Furthermore, 1% rise in renewable energy consumption raises 21.94% economic growth in Germany (Rafindadi and Ozturk, 2017).

Per head earnings is a main element behind per capita energy use among Beijing's ten suburban districts (Jingchao and Kotani, 2012) a marginal increase in per capita coal consumption strongly shrinks as per capita income rises. According to Guta (2012) expenditure on modern fuels are elastic, but inelastic for traditional fuels due to limited access to commercial fuels, supply dependency and affordability in Ethiopian rural areas. "Electricity demand is positively and significantly associated to many variables i.e. electricity demand in the previous year, income, temperature range etc. furthermore electricity demand is to some extent more responsive to changes in income than to changes in prices" (Jiang and O'Neill, 2004). According to Al-Salman (2007) rise in prices reduced demand for energy and both economic and noneconomic factors influence domestic consumer's demand for electricity. But Petersen (2002) concluded "that electricity consumption depends upon number of children, total expenditure, household size and age level. While, demand for natural gas is found to be independent of the number of children in the household depends on technical characteristics of the house".

The energy consumption of households is affected by the climate, race and income of homeowners in same state, demographics, consumer behaviour, economic variables and weather (Steemers and Yun, 2009). Furthermore, pattern of energy consumption is a function of net income compared to the total expenditure (Jiang and O'Neill, 2004).

Several studies in Pakistan (e.g. (Aqeel and Butt, 2001; Siddiqui, 2004; Malik and Aziz, 2006; Khan and Usman, 2008; Khattak *et al*., 2010)) had conducted on consumer energy demand analysis. Different types of estimation methods have been used for approximating elasticities with different data and commodities.

3. MODEL SPECIFICATION AND DATA

Among various forms of demand systems and system-wide approaches comprise the Rotterdam model, linear and quadratic expenditure systems, simple, double, semi log and trans-log models and the AIDS. During the last three decades AIDS model has acquired popularity to examine consumer demand patterns (Deaton and Muellbauer, 1980). Using it as groundwork, it is important to know primal and dual approaches for investigating consumer's demand for econometric analysis.

3.1. The Primal Approach

Here consumer picks quantities q_1, q_2, q_3, …,q_N of specific good N that maximize utility following budget constraint at known market prices within expenditures (I).

$$\text{“}\max\{q_1,q_2,....q_N\}U(q_1,q_2,.....q_N) \qquad s.t.\sum_{n=1}^{N} p_n q_n \le I\text{”} \tag{1}$$

Evaluation of equation (1) at q* yields indirect utility function. Its derivative by certain price as well as expenditure provides Roy's identity, which is suitable for attaining Marshallian demand function.

3.2. Dual Approach

Here utility level can be obtained via selecting a basket which reduces expenses on that specific level of utility "U (q*).

$$\min(q_1, q_2, \ldots\ldots, q_N), \sum_{n=1}^{N} p_n\, q_n \;\; S.t. U(q) \ge U(q^*) \tag{2}$$

Differentiating this w.r.t. price yields Hicksian Demand Function. Relation between Marshallian and Hicksian demand functions is as follows;

$$h\,(p,u) = q_n(p, e(p,u)), \qquad \forall n = 1,2,\ldots N \tag{3}$$

$$q_n\,(p,I) = h_n(p, v(p,I)), \qquad \forall n = 1,2,\ldots N\text{”} \tag{4}$$

3.3. Expenditure Function

LA-AIDS expenditure shares given by Deaton and Muellbauer (1980) derived from indirect utility function having the following form:

$$W_{it} = \alpha_i + \Sigma_j \gamma_{ij} Ln\, P_{jt} + \beta_i Ln \frac{Xt}{Pt} \tag{5}$$

3.4. Empirical Model Testing

Deaton and Muellbauer (1980) recommended a direct estimate of the nonlinear AIDS model by identifying a linear price index given by: $lnP = \Sigma_{i=1} w_i\, Ln\, P_i$ that gives rise to the linear approximate AIDS (LA-AIDS) model". The LA-AIDS model emerged as a model of choice and "is indirectly non-additive and consistent with the requirements of demand theory, therefore is an appropriate choice for estimating demand for electricity, wood, fuel and LPG". Following conditions required to make the model consistent with the theory of demand:

$$\Sigma_i \alpha_i = 1, \quad \Sigma_i \gamma_{ij} = 0, \Sigma i \beta i = 0 \qquad \text{(Adding- Up Restriction)} \tag{6}$$

$\Sigma j\ \gamma_{ij} = 0$ (Homogeneity) (7)

$\gamma_{ij} = \gamma_{ji}$ (Symmetry) (8)

The "conditions (11) and (12) are linear restrictions which may be tested by standard techniques. Whereas condition (13) is imposed by the model and so is not testable".

Based on specifications, an LA-AIDS model of the household energy demand in Muzaffarabad can be given as γ_{ij}, "a precentral variation of the j^{th} good affects the expenditure share of i^{th} good, holding real expenditure (X/P) constant, and variations on real expenditure affects demand through parameters βi".

$$W_E = \alpha_E + \gamma_{EE} \ln P_E + \gamma_{EL} \ln P_L + \gamma_{EW} \ln P_W + \gamma_{EF} \ln P_F + \beta_E \ln \frac{X}{p} \quad (9)$$

$$W_L = \alpha_L + \gamma_{LE} \ln P_E + \gamma_{LL} \ln P_L + \gamma_{LW} \ln P_W + \gamma_{LF} \ln P_F \beta_L \ln \frac{X}{p} \quad (10)$$

$$W_W = \alpha_W + \gamma_{WE} \ln P_E + \gamma_{WL} \ln P_L + \gamma_{wW} \ln P_W + \gamma_{WF} \ln P_F + \beta_W \ln \frac{X}{p} \quad (11)$$

$$W_F = \alpha_F + \gamma_{FE} \ln P_E + \gamma_{FL} \ln P_L + \gamma_{FW} \ln P_W + \gamma_{FF} \ln P_F + \beta_F \ln \frac{X}{p} \quad (12)$$

Where W_{it} is "the consumption share of fuel i in period t, defining W_E (Share of Electricity)", W_L(Share of LPG), W_w (Share of Wood), W_F (Share of Fuel), P_{jt} is the price of the j^{th} good in period t, defining P_E ,P_L, P_w ,P_F ; X_t is the total expenditure in all categories of energy in period t.

3.4.1. "Income Elasticity

The income elasticity shows the percentage change in quantity demanded for a commodity because of variations in consumer's income by one percent, remaining other things constant. Expenditure elasticity is written as;

$$\dot{\eta}_i = 1 + \frac{\beta_i}{w_i} \quad (13)$$

If $\dot{\eta}_i$ greater than 1 it means that good is luxurious while if $\dot{\eta}_i$less than 1 implies that good is in necessities. Here w_i represents the expenditure share of i^{th} commodity and refers the parameter estimated from model.

3.4.2. Price Elasticity

It indicates variations in quantity demanded due to fluctuations in its price. If the price of a commodity varies there will be two effects on consumption, income effect and substitution effect. The substitution effect shows the effect of price change on consumers demand for a particular commodity. The change in demand due to more purchasing power is called income effect. For necessary commodities, income effect is positive while for inferior commodities it is negative. Marshallian elasticities are computed from the estimated parameters of the LA-AIDS model as Hayes *et al.* (1990):

$$\epsilon_{ii} = -1 + \frac{\gamma_{ii}}{w_i} - \beta_i \quad (14)$$

$$\epsilon_{ij} = \frac{\gamma_{ij}}{w_i} - \beta_i \frac{w_J}{w_i} \quad (15)$$

Where, W_i is the budget share of good i, ε_{ii} is the own price elasticity, and ε_{ij} represents the cross-price elasticity, in Marshallian terms (uncompensated)".

3.5. Data and Variables Description

Present study used primary data collected from rural and urban areas of District Muzaffarabad. A questionnaire was prepared which entailed questions on all variables pertinent to current research objectives (see Questionnaire in appendix A). A Sample of size of 200 respondents was selected from both rural and urban areas of District Muzaffarabad. Following table1 contains description of variables used in the research.

Table-1. Description of Variables

Variable	Description and measurement
Energy budget share	"Budget share of the j^{th} energy components"
Regions	Dummy variables: 1 for urban and 0 for rural.
Employment category	Dummy variables: 1 for govt. job 0 otherwise.
"Household size	"Number of persons living together in one house"
Price"	Price of energy components in rupees.
Expenditure	Real expenditure on of energy components.
Gender	Household head's gender. 1 if female and 0 otherwise.
"Education"	Education Level. 1 if primary and 2 if secondary.

Source: Literature Survey of the study.

3.6. Sampling Technique

The simple random sampling was used where households are chosen with equivalent probability**.** Sample is divided into urban and rural respondents. Data on household energy consumption expenditure pattern per month is collected. For this purpose study takes price, income, household size, occupation of households as main determinants of energy demand. Instead of income total household expenditure has been used as a proxy.

3.7. Testing for Reliability of the Questionnaire

Cronbach's Coefficient is a measure of internal consistency. It is commonly used as an estimate of the reliability. Cronbach's Alpha statistics is widely used in the social sciences. The theoretical value of alpha varies from zero to one. "Higher values of alpha are more desired. Some social scientists, as a rule of thumb, require a reliability of 0.70 or higher, before they will use it as an instrument. Cronbach's Alpha will generally increase as the inter-correlations among test items increase, and is thus known as an internal consistency estimate of reliability" (Cronbach, 1951).

4. RESULTS AND ANALYSIS

In estimation, "particular attention was given to the household size, energy type and related products prices, occupation, and regional dummies. This conclusion is matching with the "multiple fuel, or fuel stacking, model", which states that household do not simply shift to a new fuel as income rises, but will carry on using more of this indicating that most households use several fuels as a safety net to mitigate themselves against the failure of one source.

Table-2. Reliability Statistics

Cronbach's Alpha	No of Items
0.76	31

Source: Authors calculations from collected data.

The value of Cronbach's Alpha is 0.76, which indicates a high level of internal consistency (because of pre-testing questionnaire before full sample size data collection) for our scale with this specific sample. Therefore, there was no need to eliminate any question.

4.1. Descriptive Statistics

Table 3 presents mean or average value of important variables;

Table-3. Mean value of the important energy demand model variables

Variables/Factors	Mean Values		
	Rural	Urban	Average
Household Size	7.16	6.40	6.69
Units of electricity consumed/month/HH	73.52	135.38	111.87
Price of electricity per unit	7.27	12.96	10.80
Quantity of LPG used /month/HH	0.74	1.42	1.16
Average price of LPG (Cylinder)	902.76	1770.9	1441.01
Wood consumed /month/HH (40 Kgs)	2.90	2.25	2.50
Wood Price (40 Kgs)	336.47	226.96	268.57
Fuel consumed /month/HH (Liters)	15.09	29.49	24.02
Price of Fuel (Liter)	62.53	73.29	69.20
Electricity share in total energy expense /HH	16.42	24.11	21.19
LPG share in total energy expense /HH	26.16	30.17	28.65
Wood share in total energy expense /HH	30.27	14.51	20.50
Fuel share in total energy expense /HH	27.14	31.21	29.67

Source: Authors calculations from collected data.

Table 3 shows household size or number of persons living per household, which is almost near to the socio-demographic statistic of the State of AJK. The analysis revealed that on average (average of one year data), rural households consumed less electricity (74 units) per month compared to urban households (135 units). Overall, the sampled households consumed 112 units of electricity per month and similarly for other energy components. The budget shares of households vary across locality and energy components. The maximum percentage of budget for energy go for fuel is (30%) compared to LPG (29%), electricity (21%) and wood (20%) respectively.

The expenditure elasticities which were directly derived from SUR model presented in Table 4, where "SUR estimation results of LA-AIDS model with homogeneity and symmetry restrictions imposed. Seemingly unrelated regression estimates are calculated while dropping one equation to evade singularity of the error covariance matrix. The parameters of this omitted equation are found by using the imposed theoretical restrictions".

4.2. Elasticities

Table 5 presents full matrices of uncompensated own price and "cross price elasticities". Empirical results indicated that all the estimates of own-price elasticities confirm the law of demand having negative signs. It is surprising that the own-price elasticity for all energy items is below 1. This result is in line with the earlier findings by Ogunniyi *et al.* (2012); Mehrara and Saeedeh (2011).

Table-4. Estimates of the SUR Model

Parameter	Coefficient	Std. Error	t-ratio
Share of Electricity			
LnP_E	0.17	0.03	6.54
LnP_L	-0.04	0.01	-4.11
LnP_W	-0.03	0.03	-1.33
LnP_F	0.12	0.14	0.86
Ln (X/P)	-0.04	0.03	-1.15
D_{loc}	-0.05	0.02	-2.36
Constant	0.09	0.65	0.015
Share of LPG			
LnP_L	0.009	0.016	0.59
LnP_E	-0.035	0.009	-4.11
LnP_W	0.047	0.017	2.63
LnP_F	0.225	0.285	0.79
Ln (X/P)	-0.82	0.046	1.78
D_{loc}	-0.004	0.043	0.10
Constant	-0.366	1.284	0.29
Share of Wood			
LnP_W	-0.033	0.025	-1.33
LnP_E	-0.099	0.046	-2.14
LnP_L	0.047	0.017	2.63
LnP_F	-0.245	0.314	-0.78
Ln (X/P)	0.049	0.067	0.73
D_{loc}	-0.017	0.048	-0.37
Constant	1.044	1.408	0.74
Share of Fuel (Dropped equation)			
LnP_F	-0.100	0.031	-3.22
LnP_E	0.279	0.121	2.31
LnP_L	-0.016	0.072	-0.22
LnP_W	0.016	0.037	0.43
Ln (X/P)	0.073	0.021	3.47
D_{loc}	0.433	0.132	3.28
Constant	0.232	0.931	0.25

Source: SUR estimates from collected data.

Table-5. Price Elasticities (Uncompensated) of HH Energy Demand in MZD

	Electricity	Electricity	Electricity	Electricity
Electricity	-0.23	0.57	0.07	0.45
LPG	-0.73	-0.61	-0.21	0.55
Wood	0.32	-0.41	-0.34	-0.11
Fuel	0.05	-0.03	0.22	-0.37

Source: Elasticity estimates from collected data.

From this table, we find that electricity has the most inelastic own-price elasticity among other energy items; this indicates that households in Muzaffarabad are insensitive to changes in the price of electricity. Also, from the cross price elasticities, some of the estimated value had negative sign implying a complementary relationship. The rest of the estimated values had positive sign, which implies substitution effect.

Table-6. Expenditure Elasticities of the HH energy demand in MZD

Electricity	$\dot{\eta}_{ele}$	0.89
LPG	$\dot{\eta}_{lpg}$	1.01
Wood	$\dot{\eta}_{wd}$	-2.32
Fuel	$\dot{\eta}_{fuel}$	0.43

Source: Elasticity estimates from collected data.

The Expenditure (Income) elasticities directly derived from SUR model has been presented in Table 6. Results depict that expenditure elasticities of all the energy items are less than one except LPG. All the energy items are expenditure inelastic and electricity having highest expenditure followed by fuel and wood while LPG is expenditure elastic.

5. CONCLUSION

Factors that determine HH's demand for different types of energy were analyzed in this study. "Linear Approximate Almost Ideal Demand System" was used for estimation of price (Uncompensated, Marshallian) and spending (income) "elasticities" of demand for four main types of energy in urban and rural households.

The results of SUR estimates showed that fuel is the most highly consumed energy source and the reason for preferring this energy source is its accessibility in area. LA-AIDS estimation of demand functions indicated that demands of all types of energy are price inelastic. Cross price relations indicate both substitution and complementary relationship i.e. electricity is a substitute for LPG, wood and fuel whereas LPG is compliment for electricity and wood except fuel. Electricity is the substitute of wood while LPG and fuel are compliments. Wood and electricity are the substitutes of fuel whereas LPG is a compliment. Electricity has the most inelastic own-price elasticity among other energy items, this indicates that households in Muzaffarabad are insensitive to changes in the price of electricity.

On the basis of these results, it can be suggested that rural infrastructure needs to be developed to reduce rural urban disparity and to reduce demand and supply gaps. Moreover, shift of energy consumption from wood to gas will lead to conservation of precious forests famous for tourism industry.

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REFERENCES

Al-Salman, M.H., 2007. Household demand for energy in Kuwait. Journal of King Saud University, 19(1): 51-60.

Aqeel, A. and M.S. Butt, 2001. The relationship between energy consumption and economic growth in Pakistan. Asia-Pacific Development Journal, 8(2): 101-110.

Azad Jammu and Kashmir at Glance, 2018. Planning and development department AJK. Available from www.pndajk.gov.pk.

Berkhout, P.H., A. Ferrer-i-Carbonell and J.C. Muskens, 2004. The ex post impact of an energy tax on household energy demand. Energy Economics, 26(3): 297-317. Available at: https://doi.org/10.1016/j.eneco.2004.04.002.

Christensen, L.R., D.W. Jorgenson and L.J. Lau, 1975. Transcendental logarithmic utility functions. The American Economic Review, 65(3): 367-383.

Cronbach, L.J., 1951. Coefficient alpha and the internal structure of tests. Psychometrika, 16(3): 297-334. Available at: https://doi.org/10.1007/bf02310555.

Deaton, A. and J. Muellbauer, 1980. An almost ideal demand system. The American Economic Review, 70(3): 312-326.

Estrada, J. and O. Fugleberg, 1989. Price elasticities of natural gas demand in France and West Germany. The Energy Journal, 10(3): 77-91. Available at: https://doi.org/10.5547/issn0195-6574-ej-vol10-no3-5.

Guta, D.D., 2012. Application of an almost ideal demand system (AIDS) to Ethiopian rural residential energy use: Panel data evidence. Energy Policy, 50(1): 528-539. Available at: https://doi.org/10.1016/j.enpol.2012.07.055.

Hayes, D.J., T.I. Wahl and G.W. Williams, 1990. Testing restrictions on a model of Japanese meat demand. American Journal of Agricultural Economics, 72(3): 556-566. Available at: https://doi.org/10.2307/1243024.

Inglesi, L.R., 2017. Social rate of return to R&D on various energy technologies: Where should we invest more? A study of G7 Countries. Energy Policy, 101(1): 521-523. Available at: https://doi.org/10.1016/j.enpol.2016.10.043.

Iqbal, M., 1983. Residential demand for electricity and natural gas in Pakistan. The Pakistan Development Review, 22(1): 23-36. Available at: https://doi.org/10.30541/v22i1pp.23-36.

Jiang, L. and B.C. O'Neill, 2004. The energy transition in rural China. International Journal of Global Energy Issues, 21(1-2): 2-26. Available at: https://doi.org/10.1504/ijgei.2004.004691.

Jingchao, Z. and K. Kotani, 2012. The determinants of household energy demand in rural Beijing: Can environmentally friendly technologies be effective?. Energy Economics, 34(2): 381-388. Available at: https://doi.org/10.1016/j.eneco.2011.12.011.

Khan, M.A. and A. Usman, 2008. Energy demand in Pakistan: A disaggregate analysis. Pakistan Development Review, 47(4): 437-455. Available at: https://doi.org/10.30541/v47i4iipp.437-455.

Khattak, N.R., M. Tariq and J. Khan, 2010. Determinants of household's demand for electricity in district Peshawar. European Journal of Social Sciences, 14(1): 7–16.

Labandeira, X., J.M. Labeaga and M. Rodriguez, 2006. A residential energy demand system for energy for Spain. Energy Journal, 27(2): 87–112. Available at: https://doi.org/10.5547/issn0195-6574-ej-vol27-no2-6.

Malik, S. and B. Aziz, 2006. Surmising consumer demand system and structural changes using time series data for Pakistan. Pakistan Economic and Social Review, 44(1): 117-136.

Mehrara, M. and A. Saeedeh, 2011. The estimation of the automotive fuel demand in Iran: Almost ideal demand system approach. Australian Journal of Business and Management Research, 1(7): 72-77.

Narayan, P.K. and R. Smyth, 2005. The residential demand for electricity in Australia: An application of the bounds testing approach to cointegration. Energy Policy, 33(4): 467-474. Available at: https://doi.org/10.1016/j.enpol.2003.08.011.

Ngui, D., J. Mutua, H. Osiolo and E. Aligula, 2011. Household energy demand in Kenya: An application of the linear approximate almost ideal demand system (LA-AIDS). Energy Policy, 39(11): 7084-7094. Available at: https://doi.org/10.1016/j.enpol.2011.08.015.

Ogunniyi, L.T., A.A. Adepoju and O.F. Olapade, 2012. Household energy consumption pattern in Ogbomoso Metropolis, Oyo State Nigeria. Continental Journal of Agricultural Economics, 6(1): 10-16. Available at: https://doi.org/10.5707/cjae.2012.6.1.10.16.

Oladosu, G., 2003. An almost ideal demand system model of household vehicle fuel expenditure allocation in the United States. Energy Journal, 24(1): 1-21. Available at: https://doi.org/10.5547/issn0195-6574-ej-vol24-no1-1.

Onoja, O. and O.I. Anthony, 2012. Econometric analysis of factors influencing fuel wood demand in rural and peri-urban farm households of Kogi State. The Journal of Sustainable Development, 8(1): 115-127.

Petersen, L.S., 2002. Microeconometric modelling of household energy use: Testing for dependence between demand for electricity and natural gas. Energy Journal, 23(4): 57-84. Available at: https://doi.org/10.5547/issn0195-6574-ej-vol23-no4-3.

Rafindadi, A.A. and I. Ozturk, 2017. Impacts of renewable energy consumption on the German economic growth: Evidence from combined cointegration test. Renewable and Sustainable Energy Reviews, 75(1): 1130-1141. Available at: https://doi.org/10.1016/j.rser.2016.11.093.

Rothman, D.S., J.H. Hong and D.M. Timothy, 1994. Estimating consumer energy demand using international data: Theoretical and policy implications. The Energy Journal, 15(2): 67-88. Available at: https://doi.org/10.5547/issn0195-6574-ej-vol15-no2-4.

Sahir, M.H. and A.H. Qureshi, 2007. Specific concerns of Pakistan in the context of energy security issues and geopolitics of the region. Energy Policy, 35(4): 2031-2037. Available at: https://doi.org/10.1016/j.enpol.2006.08.010.

Siddiqui, R., 2004. Energy and economic growth in Pakistan. The Pakistan Development Review, 43(2): 175-200. Available at: https://doi.org/10.30541/v43i2pp.175-200.

Steemers, K. and G.Y. Yun, 2009. Household energy consumption: A study of the role of occupants. Building Research & Information, 37(5-6): 625-637. Available at: https://doi.org/10.1080/09613210903186661.

Talbi, B. and D.K. Nguyen, 2014. An empirical analysis of energy demand in Tunisia. Economics Bulletin, 34(1): 452-458.

Theil, H., 1965. The information approach to demand analysis. Econometrica, 75(1): 67-87.

APPENDIX

AN EMPIRICAL ANALYSIS OF HOUSEHOLD ENERGY DEMAND IN AZAD JAMMU AND KASHMIR

(A CASE STUDY OF MUZAFFARABAD)

Questionnaire No _____

Section "A"

Date of the interview	**Interviewer**
District	Urban
Tehsil	Rural

Section "B" (Demographic Profile)

1) Name of the respondent _____
2) Gender of the household head(F/M) _____
3) Age(years) _____
4) Education (years) _____
5) Residence sector/ward/Name of locality? _____
6) No of household members (permanent residents) _____
7) No of family members (Age wise)

   Male <5_____ 6-30_____31-45_____46>_____

   Female<5_____ 6-30_____31-45_____46>_____
8) Contact No _____
9) Marital status _____
10) Monthly Saving _____

EMPLOYMENT

Type of work (Govt. employ / Private job)	Place of work	Income per month (Rs.)

SOURCE OF INCOME

Income from foreign remittances	Rs/m	Income from rent	Rs/m
Income from agriculture	Rs/m	Livestock	Rs/m
Business	Rs/m		

EXPENDITURES

Commodity	**Quantity (Kilogram /Ton/ Litre /M3)**			**Price/ unit**	**Cost (Rs)**
	Day	**Week**	**Month**		
Electricity					
LPG					
Fuel					
Wood					

HOUSING

1 Type of house

1. Mud house 2. RCC house

2 Ownership of the house:

1. Owned 2. Shared 3. Others

3 No of Rooms

4 Type of Roof

1. Cemented 2. T-Iron 3. Other

5 Do you live in?

1. Joint family system 2. Separately