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Assessing the Extent of Traditional Biomass Cookstove Usage and Related Cooking Practices: Evidence from Rural Households in Northern Nigeria

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Abstract: *Rural households in many developing countries primarily use traditional biomass cookstove (TBC), but much fewer data have been collected on the extent of usage for the cookstove.The use of TBCis detrimental to the environment, health and sustainable development. Based on household survey, this study assessed the extent of TBCusage and related cooking practicesamong rural households in Dessert Frontline States of Northern Nigeria. The survey was performedon 392 households, who were interviewed face-to-face using structured questionnaires from November, 2016 to January, 2017. The outcomes revealed only 7.9% used kerosene as alternative cookstove while other cookstoves usage includingelectric, liquefied petroleum gasand improved biomass cookstoves were non-existence. The average household monthly expenses on fuelwood was ₦3, 433.42 ($9.54) and the average weekly cooking and fuelwood collection hours were 25.48 and 26.62 respectively. The prevalence and large extent of TBC and its related cooking characteristics exert hugeburden on the environment and households. Information gathered from this study can be used by authorities and stakeholders in Nigeria to promote cookstove improvement in order to reduce health, environmental and socio-economic problems associated with traditional biomass cookstove.*

Keywords:*Traditional Biomass Cookstove,Cooking Practices, Rural households, Northern Nigeria*

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I. Introduction

Nigeria is endowed with abundance of energy resources from fossil fuels, hydro, wind, solar, uranium, geothermal and biomass, however, it experiences extreme energy poverty in domestic usage, particularly for cooking [1, 2]. Domestic cooking significantly uses biomass fuels as alternative cooking fuels such as liquefied petroleum gas (LPG), electricity and kerosene are very expensive and unaffordable to over 60% of Nigerians earning below $1 daily [3, 4]. Electric-based cooking option is virtually unavailable, particularly in rural areas as only about 40% of the Nigerian population is connected to the national grid [5, 6, 2], while 90% of rural settings receiving intermittent or no electricity at all [7]. This almost removed electricity among cooking energy options for virtually half the population. Energy options of electricity, kerosene and LPG cookstoves are used in urban areas, and burning of fuelwood in traditional biomass cookstove (TBC) remainsa common practice [6, 4].As such, it makes fuel switching very hard, and to some extent gradually caused many households to move from alternative cooking fuels (i.e. electricity, LPG and kerosene) to traditional solid biomass fuels use [8]. Thus, the proportion of households depending on inefficient cookstoves for domestic cooking significantly increases. Traditional biomass cookstove, typically 'three-stone cookstove' is widely used even in areas where other modern cookstoves are available. Three-stone cookstove is most preferred as it is a cheap and simple traditional cooking device. The design requires only three suitable stones of relatively same height on which a cooking pot is positioned over a fire (Figure 1). Fuelwood is the common and primary solid fuel burn in the three-stone cookstove, while other fuels such as charcoal, crop residues and dung cakes are used as supplements. More than 80% of the population in Nigeria, particularly the rural dwellers burns fuelwood on TBC [2]. TBC has intrinsic detriments which pass across households, villages, communities, national, regional and global levels [9, 10]. For instance, complete combustion is difficult to achieve and only a fraction of the fuel's available energy is captured while cooking with TBC [11]. Hence, the incomplete combustion produces pollutants that are harmful to health and contribute to global burden of diseases [12, 13]. Its inefficiency at

converting energy into heat for cooking makes TBC a practice that consumes huge quantity of fuelwood. Indirectly, such practice leads to unsustainable wood harvesting resulting in increased deforestation and loss of related ecosystem services. Moreover, burning of solid biomass in TBC emits products of incomplete combustion (PIC) to the atmosphere [14, 15]. PIC released from TBC use are more harmful in causing global warming compared to carbon dioxide released from more fossil fuel-burning cookstoves [16]. Furthermore, fuelwood procurement to fulfil TBC usage demand, either via purchase or self-collection result in considerable financial stress on households and imposes a hard labour on household members that collect the fuelwood, mainly women and children, respectively [17, 9, 18, 4]. In spite these detrimental effects, majority of Nigerians, particularly in rural areas rely on TBC usage [4].

Figure 3 – Typical three-stone cookstove

A number of studies profiling TBC use were carried out in many developing countries including Sri Lanka, India, Pakistan, Philippines and China [19, 20, 21, 22]. These studies highlighted the extents and patterns of various cookstoves usage among households. In the existing and current understanding about the extent of TBC use in Nigeria, studies are mainly based on general analyses conducted from previously gathered secondary information rather than detailed empirical data [8, 4, 2]. We learn from these available literatures that not much has been studied about the extent of TBC usage in Nigeria. Taking this circumstance into account, this study adds to the literature by reporting the extent of TBC usage and related cooking practices among rural households particularly in desert frontline states of northern Nigeria. Synthesizingthe available information on the extent of TBC use and related cooking characteristics is a milestone in identifying the gaps, impact, and possible interventions required to address the problems associated with TBC in the study area and Nigeria at large.

II. Materials and Methods

This study was conducted in six districts of desert frontline states, Northern Nigeria. Desert frontline states are situated across the northeast and northwest geopolitical zones in the country (Figure2). Based on multistage sampling technique conducted at five distinct stages, 392 households were studied via door-to-door household survey. Firstly, desert frontline states were stratified based on geopolitical zones into the following strata: northwest and northeast. Secondly, after stratifying the states, two states were selected, one from each stratum: Jigawa state from northwest and Bauchi state from northeast. Thirdly, each of the selected state was stratified based on senatorial districts: north, central and south senatorial districts in Bauchi state, while north-west, north-east and south-west senatorial districts in Jigawa state. Fourthly, one Local Government Area (LGA) was randomly selected from each senatorial district of both Bauchi and Jigawa States. In Bauchi State, Gamawa, Ganjuwa and Alkaleri LGAs were selected from Bauchi north, central and south senatorial districts respectively. While in Jigawa State, Maigatari,Birniwaand JahunLGAs were selected from Jigawa north-west, north-east and south-west senatorial districts respectively.Fifthly, one district was selected from each LGAthrough balloting using simple random method. The six districts selected were Gololo, Kafin-Madaki, Pali,Maigatari,Birniwaand Aujaradistricts. Finally, the households were systematically sampled by randomly picking for the first household and then continuing to pick at an interval of five. Households' heads were preferred, except if absent then their representatives participated in the survey. In total, 392 rural households were included in this study.Multistage sampling technique is commonly employed in household energy related studies in various parts of the world [23, 24, 25]. As compared to other approaches such as true random sampling, multistage sampling is reduces

cost and time and makes primary data collection more manageable [26, 27, 28, 29].The questionnaire for this study which was developed by the researchers contains questions regarding primary and secondary cookstove, factors considered in cookstove selection, fuelwood procurement method, fuelwood collector and collection hours, expenditure on fuelwood, cooking frequency and hours and kitchen type. The collected data were sorted, coded, accordingly entered and analysed using Statistical Software for Social Sciences (SPSS) version 20. Data analysis includes the calculation of frequencies, percentages and means of respondents' socio-demographic profile, cookstove usage pattern and choice factors as well as cooking characteristics.

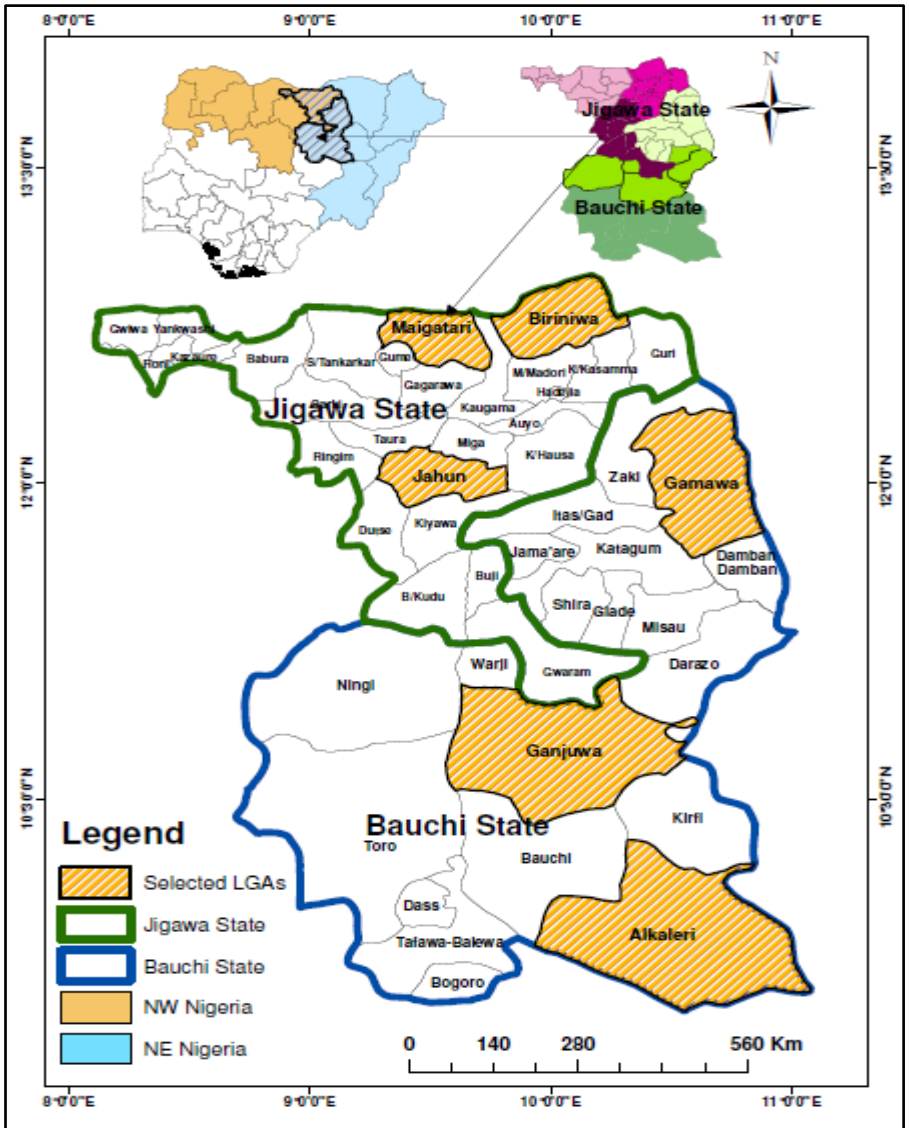

Figure 2: Location of the surveyed districts in Bauchi and Jigawa States of Northern Nigeria.

III. Results and Discussion

a. Socio-demographic profile

Out of the 396 administered questionnaires, 392 responses were found valid and analysed. Four responses were rejected owing to the incompletion of responses. Table 1 presents the socio-demographic profile of the surveyed households. The results from the table revealed that the respondents' average age was 33 years, 89.8% and 84.7% of them were male and married, ultimately the majority respectively. Their average household size was 9, their houses were majority traditional buildings (95.7%) and 84.9% of them live in their own houses. The highest proportion of respondents (31.6%) has no formal education, followed by primary school (29.3%), then secondary school (26.8%) and finally only 12.2% attained tertiary level of education. The households were mainly farmers (49.5%), followed by small business owners (29.3%) and have average monthly gross household income of ₦25, 168.37 ($69.92).

Table 1: Socio-demographic profile

Variables	Freq.	Percentage	Mean
Gender			
Male	352	89.8	
Female	40	10.2	
Age			**33**
Education			
Non-formal Education	124	31.6	
Primary	115	29.3	
Secondary	105	26.8	
College/Polytechnic	48	12.2	
Marital Status			
Single	60	15.3	
Married	332	84.7	
Occupation			
Farming	194	49.5	
Housewife	18	4.6	
Business	115	29.3	
Artisanship	55	14.0	
Civil Service	10	2.6	
Household Ownership			
Owned	333	84.9	
Squatting	59	15.1	
Household Size			**9**
Housing Type			
Traditional	375	95.7	
Modern	17	4.3	
Income (₦)			**25, 168.37 ($69.92)**

Note - $1 = ₦360 at the time the survey was conducted.

b. Cooking Practices

i. Cook stove usage pattern

Figure 3 presents the distribution of households based on primary and secondary cookstove usage. From the figure, with the exception of 7.9% of the surveyed households that used kerosene cookstove as secondary cookstove, all of them primarily used TBC. Other alternative cookstoves including LPG, electric and improved biomass cookstoves do not exist in the area. The popularity and prevalent usage of TBC is not unique to rural households in desert frontline states of northern Nigeria, neither to other Nigerian households. Rural households in other countries such as Sri Lanka, India and many Sub-Saharan African countries extensively used TBC [11, 30, 21].

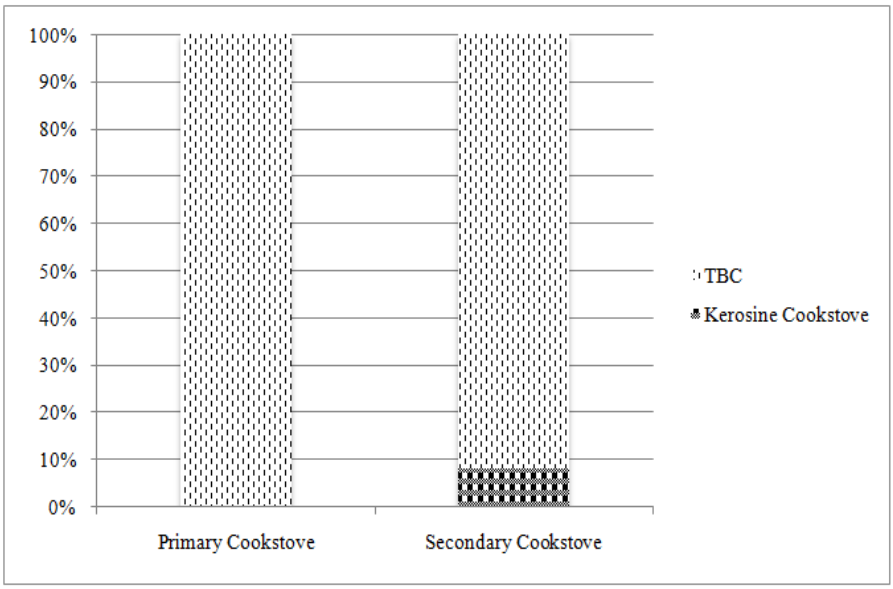

Figure 3 – Primary and secondary cookstoves among rural households in desert frontline states of northern Nigeria

ii. Cookstove choice factors

Our findings from the current study also revealed that the choices for this cookstove among the surveyed households were based on various factors. Many households (42.1%) select cookstoves based on affordability of fuel cost, 25% based on family size, 23.5% based on availability of fuel, then 9.2% based on culture (Figure 4).In the literature, household's energy and/or cookstove choices were reported to be influenced by factors such as availability, affordability, cultural, environmental, socio-economic, behavioural, cookstove features, government policies [31].

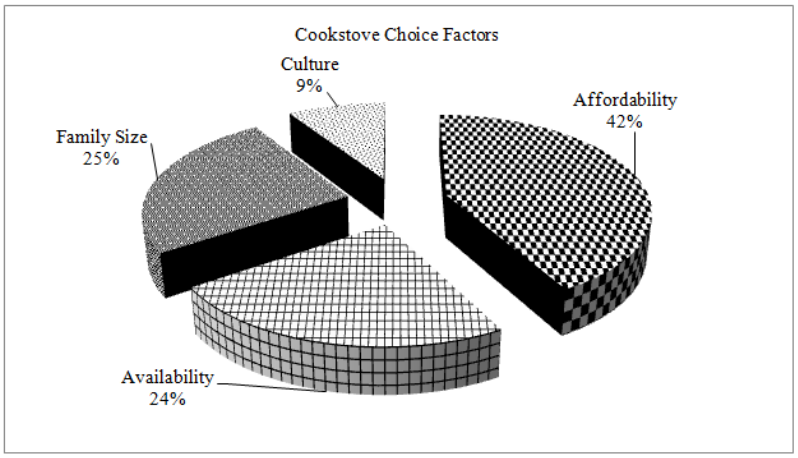

Figure 4 – Cookstove choice factors among rural households in desert frontline states of northern Nigeria

iii. Cooking characteristics

Fuelwood is procured among rural households either by self or purchase. Both methods impose burden to the users. Fuelwood collection leads to drudgery particularly on women and children, while the purchase imposes financial burden on households[9, 4]. The current study found that majority of the surveyed households (89.8%) purchase fuelwood. On average, each household spend N3, 433.42 ($9.54) on fuelwood per month. In comparative cooking cost analysis, usually three or two distinct costs including cost of cookstove, fuel cash costs and/or value of fuel collection time are added to come-up with cooking expenses. The monthly average expenses found in this study captured only fuel cash cost. Nevertheless, the amount calculated is indeed very substantial for a country where more than 60% of the citizens live below $1 per day[3, 4].For the remaining 10.2% that collect fuelwood by self, the active households' members responsible for the fuelwood collection were women (47.5%), followed by children (32.5%), then men (20%).This result is not unique to this study, Foell et al., [32]opined that in many countries women and children greatly suffer from the drudgery and heavy physical burden of fuelwood collection. Fuelwood collectors averagely spend 26.62 hours weekly. Scientific literature reported wide-ranging estimates for fuelwood collection. For instance, a review by World Health Organization (WHO) on fuelwood collection among 14 countries in Sub-Saharan Africa revealed that the daily fuelwood collection time ranges between 0.33 and 4 hours [33]. Cooking in majorityof the surveyed households was performed by women (88.3%). This result also agrees with the African culture, where women hold the responsibility of cooking for their families [34].The outcome is also similar to the review by World Bank [35], which highlighted that women spend longer time in kitchens to prepare food for their households. The review highlighted that cooking is primarily considered as women's responsibility. Due to their heavy exposure to cooking duties, studies revealed that women (and even children) in developing countries suffer more of health effects arising from inefficient cookstove usage [36, 35].From the surveyed households, 93.4% cooked meals thrice daily, while only 6.6%cooked twice. The average weekly cooking hours was 25.48 hours.This finding is relatively comparable with the findings around the world that attest that rural households spend significant amount in fuelwood collection and cooking. A review study by World Health Organization shows that households in Niger, Burkina Faso, and Ethiopia spend more time in fuelwood collection due to its scarcity[33].Open-air cooking was practiced by 62% of the surveyed households, while 38% have separate kitchens in their domains.Table 2 shows the distribution of households based on coking characteristics.

Table 2 – Distribution of households based on cooking characteristics

Variables	Freq.	Percentage	Mean
Fuelwood Procurement Method			
Self-Collection	40	10.2	
Purchase	352	89.8	
Fuelwood Collector at Household			
Women	19	47.5	
Children	13	32.5	
Men	8	20.0	
Weekly Fuelwood Collection Hours			**26.62**
Monthly Expenses on Fuelwood (₦)			**3,433.42($9.54)**
Primary Cook at Household			
Women	346	88.3	
Female Children	46	11.7	
Frequency of Cooking Daily			
Twice	26	6.6	
Thrice	366	93.4	
Weekly Cooking Hours			**25.48**
Type of Kitchen			
Separate Indoor Kitchen	149	38.0	
Open Air Cooking	243	62.0	

IV. Conclusion

Access to affordable and reliable modern energy among households in developing countries plays a significant role in ensuring their wellbeing. Such access includes the options to have improved cookstoves for domestic usage among rural households. However, among the crucial efforts in achieving that is to synthesizethe available information on cookstove usage and the households' associated cooking characteristics. Hence, this study investigate the extent of TBC use and related cooking practices among households in desert frontline states of Northern Nigeria using empirical data collected via door-to-door survey. Based on the outcomes of this study, we can conclude that there is significant extent of TBC use where majority of households use TBC as their primary cookstove. Alternative cookstoves were non-existence and only a fraction of the household supplement TBC with kerosene cookstove. This finding implies that the various cookstove improvement and dissemination programmes have no insignificant impact among rural households in desert frontline states of northern Nigeria. It is also concluded that based on the revealed cooking characteristics, the households in the area bear lot of burden including time,health and economicdue to the usage of TBC. It is also noted that various factors, though closely related informed their choices for prevalent TBC use. From the aspect of policy implications, previous experiences in other parts of the world revealed that fuel/cookstove switching takes longer time to occur even in areas where the transition started. Nevertheless, this transition is important as traditional cooking impose significant burden on the households in terms of health, economy and development. It can only be reduced when the cooking activity is improved by adapting to some feasible mitigation measures such as behavioural change to minimize exposure, greater ventilation in cooking areas, and burning only dried fuelwood which could reduce indoor air pollution at household level.Although there is a strong need for supporting cookstove improvement and dissemination programmes particularly that the modern household energy sources such as LPG, electricity, and kerosene, all these energy advancements are inaccessible to rural householdsand to some extent to urban-poor households in Nigeria. In this regards, stakeholders and policy makers should be aware of such challenges and strive to fairly initiate and support households' cookstove improvement programmes, which may eventually provide improved cookstoves to households. Among reliable modern energy recommended is the improved biomass cookstoves (IBCs), as it is noted as the most promising alternatives to TBC, particularly in areas where modern energy sources are inadequate [37]. They reduce the negative implications of the current TBC use through enhancement in efficiency and safety, and reduction in fuelwood consumption, smoke emission and cooking time among others. Many on-going biomass cookstove improvement programmes make a significant footprint in India, rural Mexico, Ethiopia and many other developing countries [17, 38, 39]. This study which synthesizedthe available information on the extent of TBC use and related cooking characteristics is a milestone towards implementing cookstove improvement programmes.

References

[1] Eleri, E. O., Ugwu, O., &Onuvae, P. (2012). Expanding access to pro-poor energy services in Nigeria. International Center for Energy, Environment and Development, Abuja, Nigeria.

[2] Ifegbesan, A. P., Rampedi, I. T., &Annegarn, H. J. (2016). Nigerian households' cooking energy use, determinants of choice, and some implications for human health and environmental sustainability.Habitat International, 55, 17-24.

[3] Bello, M. A., &Roslan, A. H. (2010). Has poverty reduced in Nigeria 20 years after.European Journal of Social Sciences, 15(1), 7-17.

[4] Gujba, H., Mulugetta, Y., &Azapagic, A. (2015). The household cooking sector in Nigeria: environmental and economic sustainability assessment. Resources, 4(2), 412-433.

[5] Babatunde, M. A., &Shuaibu, M. I. (2009). The demand for residential electricity in Nigeria: a bound testing approach. Paper presented at the A paper presented at the conference of the African econometric society, AES, Dakar.

[6] Sambo, A. S. (2009). Strategic developments in renewable energy in Nigeria.International Association for Energy Economics, 16(3), 15-19.

[7] Obadote, D. (2009). Energy crisis in Nigeria: technical issues and solutions. Paper presented at the Power sector prayer conference.

[8] Naibbi, A., & Healey, R. G. (2013). Northern Nigeria's dependence on fuelwood: insights from nationwide cooking fuel distribution data. International Journal of Humanities and Social Science, 3(17), 160-173.

[9] Jeuland, M. A., &Pattanayak, S. K. (2012). Benefits and costs of improved cookstoves: assessing the implications of variability in health, forest and climate impacts. PloS one, 7(2), e30338.

[10] Pant, K. P., Pattanayak, S. K., &Thakuri, M. B. M. (2014). Climate change, cook stoves, and coughs and colds: Thinking global and acting local in rural Nepal. Environment and development economics: Essays in honour of Sir ParthaDasgupta, 145-168.

[11] Joon, V., Chandra, A., & Bhattacharya, M. (2009). Household energy consumption pattern and socio-cultural dimensions associated with it: A case study of rural Haryana, India. Biomass and Bioenergy, 33(11), 1509-1512.

[12] Ezzati, M., &Kammen, D. M. (2001). Indoor air pollution from biomass combustion and acute respiratory infections in Kenya: an exposure-response study. The Lancet, 358(9282), 619-624.

[13] Mehta, S., &Shahpar, C. (2004). The health benefits of interventions to reduce indoor air pollution from solid fuel use: a cost-effectiveness analysis. Energy for Sustainable Development, 8(3), 53-59.

[14] Bond, T., Venkataraman, C., &Masera, O. (2004). Global atmospheric impacts of residential fuels.Energy for Sustainable Development, 8(3), 20-32.

[15] Ramanathan, V., & Carmichael, G. (2008). Global and regional climate changes due to black carbon. Nature geoscience, 1(4), 221-227.

[16] Smith, K. R., Uma, R., Kishore, V., Lata, K., Joshi, V., Zhang, J., . . .Thorneloe, S. (2000). Greenhouse gases from small-scale combustion devices in developing countries, Phase IIa: Household Stoves in India. US Environmental Protection Agency, Research Triangle Park, NC, 98.

[17] García-Frapolli, E., Schilmann, A., Berrueta, V. M., Riojas-Rodríguez, H., Edwards, R. D., Johnson, M., . . .Masera, O. (2010). Beyond fuelwood savings: Valuing the economic benefits of introducing improved biomass cookstoves in the Purépecha region of Mexico. Ecological Economics, 69(12), 2598-2605.

[18] Urmee, T., &Gyamfi, S. (2014). A review of improved Cookstove technologies and programs.Renewable and Sustainable Energy Reviews, 33, 625-635.

[19] Ekholm, T., Krey, V., Pachauri, S., &Riahi, K. (2010). Determinants of household energy consumption in India.Energy Policy, 38(10), 5696-5707.

[20] Démurger, S., & Fournier, M. (2011). Poverty and firewood consumption: A case study of rural households in northern China. China economic review, 22(4), 512-523.

[21] Elledge, M. F., Phillips, M. J., Thornburg, V. E., Everett, K. H., &Nandasena, S. (2012). A profile of biomass stove use in Sri Lanka. International journal of environmental research and public health, 9(4), 1097-1110.

[22] Jan, I., Khan, H., & Hayat, S. (2012). Determinants of Rural Household Energy Choices: An Example from Pakistan. Polish Journal of Environmental Studies, 21(3).

[23] Peng, W., Hisham, Z., & Pan, J. (2010). Household level fuel switching in rural Hubei.Energy for Sustainable Development, 14(3), 238-244.

[24] Desalu, O. O., Ojo, O. O., Ariyibi, E. K., Kolawole, T. F., &Ogunleye, A. I. (2012). A community survey of the pattern and determinants of household sources of energy for cooking in rural and urban south western, Nigeria. Pan African Medical Journal, 12(1).

[25] Oladimejl, Y., Abdulsalam, Z., &Ayandotun, B. (2016). Rural household fuel consumption and energy crisis: a synopsis of poverty trend in North Central Nigeria. Ethiopia Journal of Applied Science and Technology, 7(1), 59-76.

[26] Kadilar, C., &Cingi, H. (2003). Ratio estimators in stratified random sampling. Biometrical Journal, 45(2), 218-225.

[27] Sekaran, U. (2003). Research Methods for Business. New York: John Milley and Sons: Inc.

[28] Champ, P. A., Boyle, K. J., & Brown, T. C. (2003). A primer on nonmarket valuation (Vol. 3): Springer.

[29] Sundram, V., Rajagopal, P., &Bhatti, M. (2013). Social Science Research Methods: A Quantitative Approach. Petaling Jaya, Selangor: Malaysian Association of Productivity.

[30] Adkins, E., Tyler, E., Wang, J., Siriri, D., &Modi, V. (2010). Field testing and survey evaluation of household biomass cookstoves in rural sub-Saharan Africa.Energy for Sustainable Development, 14(3), 172-185.

[31] Malla, S., &Timilsina, G. R. (2014). Household cooking fuel choice and adoption of improved cookstoves in developing countries: a review.

[32] Foell, W., Pachauri, S., Spreng, D., &Zerriffi, H. (2011). Household cooking fuels and technologies in developing economies.Energy Policy, 39(12), 7487-7496.

[33] World Health Organization. (2006). Fuel for Life: Household Energy and Health. Geneva: World Health Organization.

[34] Mikell, G. (1997). African feminism: The politics of survival in Sub-Saharan Africa: University of Pennsylvania Press.

[35] World Bank. (2011). Household cookstoves, environment, health, and climate change: A new look at an old problem.World Bank.
[36] World Health Organization. 2005. WHO Air Quality Guidelines Global Update 2005.Copenhagen: World Health Organization.
[37] Ruiz-Mercado, I., Masera, O., Zamora, H., & Smith, K. R. (2011). Adoption and sustained use of improved cookstoves.Energy Policy, 39(12), 7557-7566.
[38] Takama, T., Tsephel, S., & Johnson, F. X. (2012). Evaluating the relative strength of product-specific factors in fuel switching and stove choice decisions in Ethiopia.A discrete choice model of household preferences for clean cooking alternatives.Energy Economics, 34(6), 1763-1773.
[39] Kshirsagar, M. P., &Kalamkar, V. R. (2014). A comprehensive review on biomass cookstoves and a systematic approach for modern cookstove design. Renewable and Sustainable Energy Reviews, 30, 580-603.

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