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A Critical Analysis on Access and Affordability of Clean Cooking Fuel in India

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Abstract:
Improving the access to affordable and reliable energy services for cooking is essential and very important for developing countries in reducing adverse human health and environmental impacts which are caused by burning of traditional biomass. In low-income households, perceived health benefits of adopting improved stoves and financial benefits from fuel savings, tend to be outweighed by the costs of improved stoves and increased rates of fuels, even after accounting for the opportunity and cost of time spent collecting biomass fuel. This paper reviews empirical study and analyze the choices of fuel, adoption of improved stoves for cooking in countries where biomass is still the predominant cooking fuel and awareness. It also summarizes the evidence on the significant adverse health impacts from exposure to indoor smoke, especially among women and young children. The review highlights the wide range of factors that influence households cooking fuel choices and adoption of improved stoves, including socioeconomic i.e. access and availability, collection costs and fuel prices, household income, education and awareness, behavioral i.e. food tastes, lifestyle and cultural and external factors both indoor air pollution, government policies. The paper identifies knowledge and evidence gaps on the success of policies and programs designed to scale up the adoption of improved cook stoves, government policies and awareness among general public.

Keywords: Biomass, Health Impacts, Financial Benefits, Awareness

INTRODUCTION:

It is of great importance that improving access to affordable and reliable modern forms of energy services is essential, especially for developing countries in reducing poverty and promoting economic development. In low-income developing nations, household cooking uses more energy than any other end-use service. The common practice of using solid fuels for cooking, such as conventional biomass and coal, can have detrimental effects on climate change, forest/land degradation, and human health. Various studies have mentioned that air pollutants, emitted from solid fuels often burned indoors on inefficient cook stoves is one of biggest challenges to human health in developing countries.

Recognizing the importance of access to modern affordable energy services in developing countries, the United Nations launched the Sustainable Energy for All (SE4ALL) an initiative with three major objectives: (a) ensuring universal access to modern energy services, (b) doubling the global rate of improvement in energy efficiency and (c) doubling the share of renewable energy in the global energy mix by 2030 (UN, 2013). This initiative attracted the world-wide attention on issues related to clean cooking fuels. A key knowledge gap that has emerged in developing these regional efforts to scale up adoption of cook stove initiatives involves the economics of household cooking energy uses. There have

been few recent assessments of the economic rationale for carrying out supply and demand-side interventions such as adopting cleaner cooking technologies and fuels, and implementing community-based fuel wood management practices. More needs to be done to assess costs and benefits of household energy interventions using the latest information.

The East Asia and Pacific region's Clean Stove Initiative (CSI) aims to increase access to high-tech cooking stoves for rural poor households through country-specific technical assistance and a regional knowledge-sharing and cooperation forum. The World Bank has also recently launched a number of global clean cooking initiatives, such as the Africa Clean Cooking Energy Solutions to promote enterprise-based, large-scale dissemination and adoption of clean cooking solutions. In addition to these international projects, there are other clean cooking initiatives. For example, in India, the government has launched National Biomass Cook stoves Program in 2009 to provide 160 million ICS to households currently using solid fuels.

Access to energy is a key determinant of how food is cooked and the associated health implications, the ways in which living spaces are heated and lit, as well as the time required to procure household energy. A huge chunk of poor people's income is spent on obtaining energy access for basic needs. Access to clean and affordable sources of energy is an important requirement for the multiple challenges the world is facing in the form of rapid urbanization, globalization, technological innovation, rising inequalities and the impact of global environmental change.

This study focuses on the issues and challenges in switching to clean cooking fuel in various parts of India. It also focuses on cooking fuel only because the electricity supply for lighting exists. Cooking fuel switching is a low-hanging fruit and has direct health, environment and financial benefits. The study investigates the factors affecting the households' decision of using LPG2 for cooking, the constraints of LPG connections and measures to improve accessibility to LPG connections in poor households. The objective of this report is to review the literature on the household choice for cooking fuels and economic assessments of household cooking energy transitions. In particular, this report highlights the factors influencing household cooking fuel choice and the challenges faced by empirical studies in estimating opportunity costs of biomass fuel collection.

FUEL USAGE TRENDS IN INDIA:

Developing countries like India are not only going through challenges associated with climate crisis but also tackling with the development and the poverty mitigation. For the sustainable economic growth of a nation, readily available energy resources and its consistent supply are the most essential requirements. The economy of a country is dependent on secure, sufficient and efficient energy facilities. Currently, India tops the energy consumer's list in the whole world. However, per capita final energy consumption in India is very low and there is a wide disparity between urban and rural areas.

1. Barnes, D. F. & Qian, U. (1992). Urban interfuel substitution, energy use and equity in developing countries. World Bank Industry and Energy Department Working Paper, Energy Series Paper 53. Washington, D.C.: World Bank.

The creeping growth of the share of imported energy in demand, threatens the energy security of the nation. India's population and GDP are likely to grow in the future, so, the demand for energy will also experience a substantial rise and consequently there will be increase in greenhouse gas (GHG) emissions as well. Recently, National Institution for Transforming India (NITI) Aayog, adopted a bottom up energy system model and analyzed the future development of India's complex energy system.

Five primary demand sectors industry, agriculture, transit, cookery, and buildings were taken into consideration on the supply side.

In the cooking sector, energy consumption will come down significantly. This will be mainly due to efficiency improvement, as a result of less use of non-commercial biomass, which has extremely low conversion efficiency. The overall efficiency of the cooking sector will improve and energy consumption will decrease despite rising population. The use of electric stoves continues to be negligible as they are costly relative to other options. The share of gas gradually increases; this could be due to improved access in urban and rural areas, a result of existing government policies. The decrease in unclean fuels like biomass and cleaner fuels like LPG, natural gas and biogas, will have a positive effect on the emission reduction probability of the country.

Under Sustainable Development Goals (SDGs) India sets targets to ensure access to affordable, reliable, sustainable and modern energy for all by 2030. However, the SDGs India dashboard indicates that only 43.8% household's use clean cooking fuel like Electricity, LPG/natural gas, biogas, i.e., India needs to cover around 56% households in next coming years. The majority of households in India's rural areas lack access to clean cooking fuel. Four SDGs which profit from investments in clean cooking energy are SDG 3-Good health and well-being, SDG 5- Gender equality, SDG 7-Affordable and clean energy, SDG 13- Climate action.

In India, the major part of the energy requirements in cooking applications is still fulfilled via fossil fuels. India derives the bulk of its cooking energy needs from solid fuels, such as firewood and cattle dung in rural areas and from LPG and kerosene in urban areas. LPG and kerosene are the two cheap clean cooking fuels used in India.

2. Barnes, D. & Floor, W. (1999, Fall). Biomass energy and the poor in the developing countries. Journal of International Affairs, 53(1), 237–259.

Natural gas and electricity are not generally used due to the shortage of common availability for household use. Biogas, which is a biomass-based clean fuel, is not quite used because it has not yet been commercialized.

THEORIES AND STATISTICAL REPORTS:

It is dependent on 3 major theories. They are, Energy ladder theory, Energy stacking theory and Diffusion of innovation theory.

a) Energy Ladder Theory: The energy ladder model classifies household energies as traditional, transition and advanced energy sources. The model assumes that low-income households would use the traditional fuels until their socio-economic status improves and then they will rationally switch completely to the modern fuels. According to this theory, as households income increase, they switched to the other advanced energy sources (Osiolo and Helen H, 2009). The energy ladder model considered as classic and traditional places heavy emphasis on income (affordability) in both explaining and determining a household's energy choice (Masera, et al., 2000). Furthermore, this model has been criticized heavily for its lack of consideration of the intricate interactions that characterize energy transition, demographic factors, personal preferences, etc.

b) Energy Stacking Theory: The stacking model is an alternate model that has been suggested in response to the energy ladder model's apparent flaws (Masera O et al., 2000). This model makes the assumption that family energy use habits are influenced by a variety of variables (not just wealth),

including social, economic, cultural, and even individual preferences. Thus, households often consume more fuels overall without actually switching to cleaner fuels, as opposed to making a straight transition to them. Many researchers discovered that the fuel stacking model was accurate and that households with greater incomes tended to employ fuel stacking more frequently (Schlag and Zuzarte, 2008; Kowsari, 2013; Puzzolo, 2013). In other words, as household income increased, so did the number of fuels they consumed.

c) Diffusion of Innovation Theory: Diffusion of innovations, as defined by Rogers (2003), aims to explain how innovations (an idea, action, or object) are embraced by a population. It was first used in communication to describe how an idea or product picks up steam and gradually diffuses (or spreads) among a certain population or social system. Those that are a member of a social system eventually embrace a new idea, habit, or product as a result of diffusion. It makes the claim that people and early adopters in a particular social system have the power to subtly affect the attitudes and behaviours of others in order to facilitate or obstruct the adoption of a new technology.

The diversity that exists within India in the level of economic development and resource accessibility makes it a suitable geographic region for analyzing the question of fuel switching, as it provides a variation on the key independent variables of interest. The households of interest in this study were less well-off, living in either slums or economically weaker section housing societies. A five-step approach was used to carry out the household survey in some parts of Chennai. The detailed questionnaires included information on family structure, socioeconomic conditions, energy-use pattern, housing characteristics, cooking behaviors and willingness to pay for LPG.

The energy-use pattern included information on the consumption of solid fuels and commercial fuels for cooking, where cooking fuel was procured, time and effort involved in procurement, price at which procured, etc. Housing characteristics included information on type of house and location of the kitchen. Further information was collected on cooking behaviour, including number of meals cooked using different fuels in a day, hours of cooking, cooking involvement by male or female members of the household and type of involvement. Reasons for not using clean fuels, willingness to pay for an additional amount of clean fuel and desire to forego the subsidized kerosene quota were also captured. Household-level data were collected from nearly 250 households in four selected locations of Chennai.

Housing societies/colonies with more concentration of middle- and low-income families were identified, and then one housing society from each zone was selected randomly. The housing society with a larger concentration of middle- and low-income families was selected mainly to (a) understand the fuel switching behavior in less well-off households, (b) to understand the policy issues at the middle and bottom of the income pyramid and (c) to capture the diversity it displays with respect to migrants and long-term residence status of the families. The last step was to randomly select sample households for conducting the survey.

3. Barnes, D. & Floor, W. (1996). Rural energy in developing countries: A challenge for economic development. Annual Review of Energy and the Environment, 21, 497–530.

IMPACTS OF SOLID COOKING FUEL:

The various areas of impact and their negative externalities are as follows:

Health:

- Broad range of health conditions associated with HAP
- Burns suffered by household members from traditional fuels/cooking appliances
- Chronic and acute physical ailments due to firewood collection.

Environment:

- Greenhouse gas emissions due to inefficient fuel production and consumption
- Catalytic warming effects of black carbon emissions tied to solid fuel cooking
- Forest degradation and deforestation due to unsustainable fuel collection and production
- Foregone agricultural productivity due to habitat degradation and combustion of dung as fuel

Economic development:

- Excess spending on solid fuel due to reliance on inefficient fuels and stoves
- Lost opportunities for income generation due to time spent on fuel collection
- Lost opportunities for income generation due to extra time spent cooking
- Lost opportunities for education from lost time (due to fuel collection and cooking) particularly for women and girls affects future earning capacity

Gender

- Disproportional effects on women and young girls including:
- Health effects including HAP, burns, and firewood collection injuries
- Reduced educational opportunities/time spent in school and studying
- Reduced opportunities for market employment and resulting status in household
- Reduced leisure time.
- Violence during wood collection.

4. Trevor J., V. Antony, and S.K. Jindal. 2013. "The effect of biomass fuel exposure on the prevalence of asthma in adults in India – review of current evidence." doi:10.3109/02770903.2013.849269.

Other social effects

- Negative esthetic effects (e.g., poor lighting and soot-darkened home environment).
- Poorer nutrition as a result of undercooked food or tighter food costs.
- A rise in poverty as a result of the use of scarce resources to pay for gasoline.

STATISTICAL REPORTS:

The India Residential Energy Survey:

The IRES 2020 covered 14,850 households, urban as well as rural from 152 districts in the 21 most populous states in the country, which account for 97 per cent of India's population. The IRES employed a stratified multistage probability design for sampling, where districts were the primary sampling units and households were the ultimate stage units. About 96–97 households were surveyed in each of the sampled districts. A team of 154 trained enumerators and 40 supervisors conducted the surveys in-person, using handheld tablets, between November 2019 and March 2020. The surveys

typically lasted for 35 minutes and were conducted in 11 Indian languages. The IRES captured diverse household information, including demographics, economic status, types of energy sources used, quality of energy services, and usage patterns, among other things.

We conducted thorough data quality checks to address diverse sources of errors typical to any survey data. A key limitation of the IRES data is the high non-response rate (26 per cent), primarily in areas with a higher share of urban and economically better-off households. Thus, our assessment of parameters that are strongly correlated with household income levels is likely to be conservative. Further, the estimates presented in this report are entirely based on survey responses, and, hence, they could be prone to recall bias and social desirability bias. Throughout the study, we have used design weights to account for the unequal probabilities of selection while estimating population estimates unless specified otherwise.

5. Thurber, M.C., H. Phadke, S. Nagavarapu, G. Shrimali, and H. Zerriffi. 2014. "'Oorja' in India: Assessing a large-scale commercial distribution of advanced biomass stoves to households." Energy for Sustainable Development 19:138-150.

6. Simon, G. L., A. G. Bumpus, and P. Mann. 2012. "Win-win scenarios at the climate–development interface: Challenges and opportunities for stove replacement programs through carbon finance." Global Environmental Change 22 (1):275-287.

Why still no LPG connection in many households?

We asked all households without an LPG connection (15% of the total) their reasons for not having one. Inability to afford LPG emerged as the most critical barrier: 80% of households without an LPG connection (non-LPG households) cited the high connection cost or the recurring expense of LPG refills as the reason for not taking an LPG connection. An LPG user typically needs to pay INR 6,000 for a new connection, which includes the connection cost (INR 3,300), the cost of an LPG stove and safety hose (INR 1,500), and the LPG refill cost (~INR 1200 for a 14-kg cylinder). Under the aegis of PMUY, the government subsidized only the LPG connection cost, and consumers had to pay the remaining amount either through a loan from OMCs or in cash. Both the initial and recurring expense represents a substantial outlay for them. Three-fourths of households without LPG connections earn less than INR 10,000 per month and live in kuchha (temporary) or semikuccha homes. Also, the majority of these households depend on labor-related activities as their main source of income.

CONCLUSION:

As per our analysis, India has made phenomenal progress in improving household access to clean cooking fuels. However, 15 per cent of Indian homes still do not have access to clean cooking energy. Most households without an LPG connection are located in traditionally energy-poor states. The major reasons why some households have not applied for an LPG connection, though they vary across states, include affordability and administrative hurdles. Government support through schemes like PMUY has been effective in bridging the access gap. With the roll out of PMUY 2.0, there is an opportunity to identify and support more households from marginalized socioeconomic backgrounds. However, more than one-fourth of the non-users we surveyed explicitly cited that the high recurring expenditure on LPG refills was the reason they did not have an LPG connection. Thus, efforts to improve LPG access would need to be supplemented by incentives to make LPG consumption affordable.

7. Budya, H., Arofat, M., 2011. Providing cleaner energy access in Indonesia through the megaproject of kerosene conversion to LPG. Energy Policy 39, 7575–7586.
8. Burnett, R., Pope, A.I., Ezzati, M., Olives, C., Lim, S.S., et al., 2014. An integrated risk function for estimating the global burden of disease attributable to ambient fine particulate matter exposure. Environmental Health Perspectives 122, 397–403.

Our analysis of the cooking energy choices of Indian households indicates a high prevalence of fuel stacking, mainly in rural areas. Akin to the reasons for gaps in LPG access, affordability and availability of LPG along with taste preferences and easy biomass access continue to hinder sustained LPG use in the country. Further, most households that stack LPG with traditional cooking fuels are concentrated in certain states. To reap the benefits of all the investments made in the PMUY scheme over the past four years, India must address the barriers hindering sustained LPG use. Making LPG affordable by resuming subsidies would be the first step. However, in place of a universal subsidy scheme, it would be fiscally prudent to target deserving households.

Several households still favour the flavour of meals cooked in chulhas. Addressing such cultural barriers would require concerted and decentralized outreach to convince people of the benefits of using LPG and nudge behaviour change. Through LPG Panchayat's, the government runs awareness campaigns about the adverse health impacts of using biomass. Efforts are also needed to strengthen the LPG supply chain to improve its availability, particularly in states with new connections. We also need to introduce higher commissions for distributors that serve rural consumers or operate in areas with low consumer density.

Finally, it is important to note that just addressing one of the barriers in isolation might not be sufficient to ensure sustained LPG use in the future. All of these interventions will have to be implemented in tandem with each other. Kerosene is not the popular fuel of choice for cooking, as merely 2% households exclusively use kerosene for cooking, and 20 per cent of the households use both LPG and kerosene for cooking. Further, it was observed that the kerosene quota allotted to the poor households was diverted to other uses, as it is rarely used for lighting. The majority of poor households surveyed use electricity or wax candles for lighting. Considering the COVID-linked economic crisis, both the Government of India's ability to subsidize LPG and people's capacity to pay for non-subsidized LPG has reduced. The only way out of this will be to develop an easy-to-administer targeting approach that helps the poor continue to use clean cooking fuels without putting additional pressure on government resources.

9. Banerjee, M., Prasad, R., Rehman, I.H., Gill, B., 2016. Induction stoves as an option for clean cooking in rural India. Energy Policy 88, 159–167.
10. Bond, T., Templeton, M., 2011. History and future of domestic biogas plants in the developing world. Energy for Sustainable Development 15, 347–354.

REFERENCE:

1. Barnes, D. F. & Qian, U. (1992). Urban interfuel substitution, energy use and equity in developing countries. World Bank Industry and Energy Department Working Paper, Energy Series Paper 53. Washington, D.C.: World Bank.
2. Barnes, D. & Floor, W. (1999, Fall). Biomass energy and the poor in the developing countries. Journal of International Affairs, 53(1), 237–259.

3. Barnes, D. & Floor, W. (1996). Rural energy in developing countries: A challenge for economic development. Annual Review of Energy and the Environment, 21, 497–530.
4. Trevor J., V. Antony, and S.K. Jindal. 2013. "The effect of biomass fuel exposure on the prevalence of asthma in adults in India – review of current evidence." doi:10.3109/02770903.2013.849269.
5. Thurber, M.C., H. Phadke, S. Nagavarapu, G. Shrimali, and H. Zerriffi. 2014. "'Oorja' in India: Assessing a large-scale commercial distribution of advanced biomass stoves to households." Energy for Sustainable Development 19:138-150.
6. Simon, G. L., A. G. Bumpus, and P. Mann. 2012. "Win-win scenarios at the climate–development interface: Challenges and opportunities for stove replacement programs through carbon finance." Global Environmental Change 22 (1):275-287.
7. Budya, H., Arofat, M., 2011. Providing cleaner energy access in Indonesia through the megaproject of kerosene conversion to LPG. Energy Policy 39, 7575–7586.
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