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From Scheme to Stove: Assessing Implementation Gaps in PMUY and the Reality of Sustained LPG Adoption

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Abstract

Pradhan Mantri Ujjwala Yojana (PMUY) was also launched so that the poor households could have access to clean cooking fuel but there is evidence to show that the provision of LPG connections does not always translate to long term household consumption. This research evaluates the implementation gaps in the provision of LPG connection and its sustained usage among the beneficiaries of PMUY. The descriptive and explanatory research design was used to collect primary data on 365 households sampled using simple random sampling. The research is based on the Energy Ladder Theory and the investigation of the effects of socio-economic and implementation factors on the sustained LPG use. The statistical techniques used in interpreting the data were the percentage analysis, Chi-square test, and the multiple regression analysis. The findings indicate that low family income, low education, poor awareness, inability to afford and lack of poor accessibility to LPG distribution centres are the major barriers to continued usage. Despite the fact that PMUY has enhanced the initial access, several households still use traditional biomass fuels, indicating the presence of consistent fuel stacking behaviour. According to the regression model, the best predictors of sustained LPG adoption are income and affordability of refills. The results indicate that there is a necessity to change the connection-oriented policies to usage-based interventions which can combine enhancement to subsidies, better distribution infrastructure, and behaviour change policy. The research adds to the policy discussion because it highlights the need to redesign PMUY to make clean cooking fuels become adopted in the long term, which will contribute to the health promotion, environmental sustainability, and rural inclusive development.

Keywords: PMUY, LPG Adoption, Implementation Gap, Sustained Usage, Energy Ladder Theory, Rural Energy Policy, Clean Cooking Fuel.

1. Introduction

Clean and affordable cooking energy is necessary in ensuring sustainable development, enhancement of the health of the people and gender inequality. In the developing world, an important percentage of households still rely on the use of biomass fuels including firewood, crop residues, and dung cakes that are sources of indoor air pollution, respiratory illnesses, and environmental degradation (World Health Organization [WHO], 2018). The disproportionate impact on women and children accelerates the health vulnerability cycle and time poverty as they have to cook and gather fuel, which is the primary task (Pachauri and Rao, 2013). In order to solve these issues, the Government of India introduced the Pradhan Mantri Ujjwala Yojana (PMUY) in 2016 to cover economically vulnerable families with subsidized LPG connections with the purpose to make the shift to cleaner cooking energy (Ministry of Petroleum and Natural Gas, 2016). Though PMUY has greatly expanded the LPG connection coverage, there are now some evidence suggesting that access is not immediately converted to sustained usage. The utilization of traditional fuels by many beneficiaries as well as LPG is a trend that is characterized by fuel stacking and not total shift (Kar et al., 2019). Other issues that have been cited as significant obstacles to regular LPG use include affordability of refills, unstable income, a lack of awareness, and geographic distance to distribution centres (Jain et al., 2018). Such a disconnect between provision of connection and long term adoption is a weakness that shows the significance of implementation in the scheme.

It is against this background that this current research paper titled From Scheme to Stove: Assessing Implementation Gaps in PMUY and the Reality of Sustained LPG Adoption would discuss the socio-economic and structural variables which would affect sustained use of LPG by PMUY recipients. On the basis of the Energy Ladder Theory, the research will aim to explain why partial transition is a trap that households continue to be caught in despite the provision of access to clean fuel infrastructure, thus adding to the policy discussion on enhancing the effectiveness and sustainability of PMUY.

1.1 Statement of the Problem

Although the Pradhan Mantri Ujjwala Yojana (PMUY) has resulted in the mass-scale distribution of LPG connections, the desired shift to a continued and unified practice of clean cooking fuel usage has been biased and incomplete. Although, according to official reports, impressive levels of coverage are observed, various studies have found that a considerable percentage of beneficiary households still use traditional biomass fuels because of financial problems, unstable income, insufficient awareness, and low access to LPG distribution points (Jain et al., 2018; Kar et al., 2019). This continued fuel stacking behaviour compromises the key goal of PMUY which is to lessen health-related dangers, environmental decadence, and gendered energy loads.

The issue therefore is the lack of connection between the distribution of LPG connection and its long-term use in the household. The level of success of PMUY has been greatly gauged by the number of connections to be emitted as opposed to the frequency of use or refill behaviour, which has made the overall perception of its actual impact shallow. Therefore, an urgent need to empirically look into the implementation gaps that affect the long-term acceptance of LPG and to find out socio-economic and structural factors that limit the scheme to reach the desired results exists. This paper will fill this gap by examining the realities on the beneficiaries of PMUY and assessing the factors that influence further use of LPG at the household level.

1.2 Objectives of the Study

The following are the objectives of the present study:

1. To examine the socio-economic profile of the beneficiary households of PMUY.
2. To investigate the level of long-term LPG use among the beneficiaries of PMUY.
3. To determine the implementation gaps between LPG connection distribution and normal household use.
4. To determine how socio-economic and accessibility factors impact on sustained adoption of LPG.
5. To propose a policy to enhance the effectiveness and sustainability of PMUY.

1.3 Research Gap

The presence of literature regarding the Pradhan Mantri Ujjwala Yojana has been centrally concerned with the levels of coverage of LPG connections, the assessment of policies and the macro level adoption of the policy. Although affordability, fuel stacking, regional inequity, and the shortage of empirical studies have been identified by various researchers, little empirical research has been conducted on the micro-level behavioural realities of the sustained use of LPG by beneficiary households. Further, the majority of the previous studies are based on secondary data or statistics on a national scale, which does not provide any insight into the impact of socio-economic, access, and awareness-related aspects on unchanged LPG use at the household level. It is also deficient of coherent analysis that entails descriptive, association as well as predictive statistical analysis in an attempt to explain the implementation gaps between connection distribution and actual usage behaviour. Hence, this research paper addresses this gap bar as it offers primary data evidence on sustained LPG adoption and the structural and behavioural obstacles that constitute the impediments to the usefulness of PMUY in facilitating a total shift to clean cooking energy.

1.4 Research Hypotheses

The hypotheses based on the objective and conceptual framework of the study were as follows:

H1: Monthly household income and long-term LPG use are significantly correlated in PMUY beneficiaries.

H2: The level of education and the continued use of LPG are significantly related amongst beneficiaries of PMUY.

H3: There is a significant relation between knowledge of the benefits of PMUY and long-term LPG use.

H4: There is no significant effect of distance to LPG distributor on the sustained use of LPG among beneficiaries of PMUY.

H5: The affordability of refill is one of the key predictors of sustained LPG use among the beneficiaries of PMUY.

2. Literature Review

Pradhan Mantri Ujjwala Yojana (PMUY) has been scrutinized extensively in terms of popularizing the use of clean cooking fuel by the economically disadvantaged families. Nevertheless, researchers always claim that the delivery of LPG

connections cannot necessarily ensure its regular use. Jain et al. (2018) noted that the poor households did not show a high refill rate with PMUY because of affordability and fluctuating income. Their research noted that the cost of refills was very high at the initial stages which discouraged the constant use of LPG thus continued use of the traditional fuels. Kar et al. (2019) have conducted an analysis of the sales of LPG and discovered that, although PMUY increased its intake in the beginning, the enduring use was very different among regions. The authors have found that the prevalent practice was that of fuel stacking where households would combine the LPG with biomass fuels in order to cut down on expenses. This trend shows that PMUY has established access but not behavioural transition which supports the position that there is still a gap in implementation at the household level.

Pachauri and Rao (2013) noted that gender aspects of energy poverty influence women more, as they are the ones who are exposed to the traditional cooking methods, which expose them to health risks and time poverty. Their work emphasized that clean energy initiatives should not be reduced to mere provision of infrastructure, but their socio-cultural aspects and behavioural transformation should be taken into consideration. On the same note, Gould and Urpelainen (2018) stated that the transition to sustainable energy needs to be supported by awareness, affordability, and constant policy backing because mere access cannot result in enduring change. Khandker, Barnes and Samad (2012) were able to prove that economic capacity is a decisive factor of clean fuel in rural households. Their results confirm the Energy Ladder Theory which proposes that, income increases permit people to switch to the modern fuels, however, as a result of financial instability poor households are often left in transition phases. This is also in support of other studies by Lewis and Pattanayak (2012) who emphasised the need to have policy efforts that involve both economic incentives and behavioural interventions in order to attain long-term adoption.

The recent research by Singh and Agarwal (2020) demonstrated that the distance between people and the LPG distribution centres has a significant influence on the frequency and consistent usage of refills. Families in rural areas had logistical difficulties, high transaction, and slow deliveries, which discouraged their daily use. These structural issues also increase the implementation gap at PMUY. On the whole, the literature indicates that although PMUY has been successful in spreading the coverage of LPG, its success in guaranteeing sustained consumption has been low because of high cost of fuel, infrastructural, poor awareness, and behavioural addictions to conventional fuels. The already available literature therefore supports the necessity of micro-level research on sustained usage behaviour which the current study aims to cover.

3. Methodology

3.1 Research Design

The research design taken in this study was descriptive and explanatory research design because it aimed at understanding the implementation gaps within the Pradhan Mantri Ujjwala Yojana (PMUY) with particular focus being on the process of switching the distribution of LPG connections to household usage. This design allowed the researcher to present an analysis of the coverage of LPG under the scheme as well as the behavioural trends affecting the continued adoption of the scheme amongst beneficiaries.

3.2 Theoretical Framework

The basis of the study is based on the Energy Ladder Theory, which is the cause of transition of households using traditional biomass fuels (firewood, dung cakes, crop residues) to clean modern fuels (LPG). This theory holds that the households ascend the energy ladder as income, awareness, and availability are enhanced. Nevertheless in the PMUY scenario, partial transition and fuel stacking implies that there exist gaps between access and sustained use that this research is aimed at investigating.

3.3 Sample Size and Sampling Technique

The sample of the study was composed of 365 households of PMUY beneficiaries. Simple random sampling method was used to make sure that every beneficiary household had an equal opportunity of being selected and reduces the sampling bias thus increasing the representativeness of the data.

3.4 Data Collection

The structured questionnaire was used to gather primary data where the recipients of the PMUY were interviewed directly. The questionnaire was of a closed-ended/ Likert questionnaire type of questions that included frequency of LPG use, refill behaviour, affordability, awareness, accessibility, and dependence on the traditional fuels.

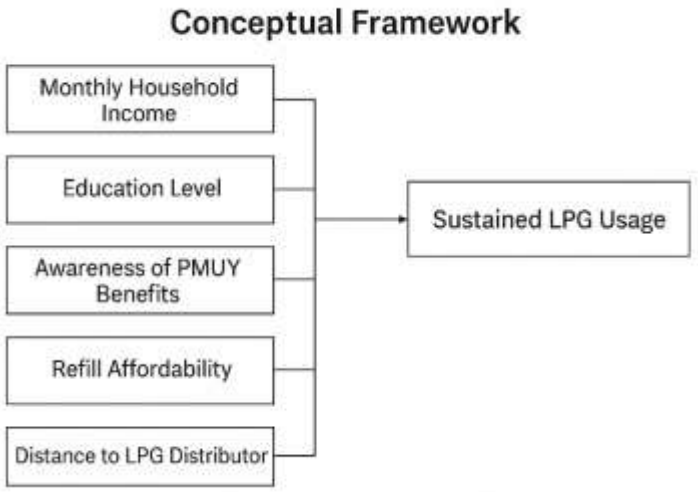
3.5 Variables of the Study

Independent Variables: The awareness level, affordability of refill, distance to LPG distributor, income level, and the presence of subsidy.

Dependent Variable: Durable LPG use.

Control Variables: Household size, education level, and dwelling type.

Figure 1



Source: Author's Contribution

3.6 Tools for Analysis

Simple statistical tools were employed to analyse data and included the following:

- Percentage analysis
- Mean and Standard Deviation
- Cross-tabulation
- Chi-square test to determine the relationship between the use of LPG and implementing factors.

3.7 Study Area

The research was done in the rural and semi-urban regions covered by PMUY with a targeted population as households with LPG connections through the program.

4. Analysis and Interpretation.

4.1 Introduction to Analysis

The section will give the data analysis of the data gathered based on 365 PMUY beneficiaries households in order to find out the socio-economic background of the respondents and how it affects long-term LPG use. Socio-economic factors form significant factors that define cooking fuel preferences, refillability, and adherence in the use of LPG. The age, education, income, occupation, and family size are the direct factors that influence household energy behaviour and provide an insight about the implementation gaps between the distribution of LPG connection and its subsequent use under PMUY.

Table 1

Socio-Economic Profile of the PMUY Beneficiary Respondents

Socio-Economic Variables	Category	No. of Respondents	Percentage (%)
Age Group (Years)	Below 30	78	21.4
	31 – 40	112	30.7
	41 – 50	95	26.0
	Above 50	80	21.9
Educational Status	Illiterate	97	26.6
	Primary	124	34.0

	Secondary	96	26.3
	Higher Secondary & Above	48	13.1
Monthly Household Income (₹)	Below 8,000	138	37.8
	8,001 – 12,000	121	33.2
	12,001 – 16,000	63	17.3
	Above 16,000	43	11.8
Occupation of Household Head	Agricultural Labour	146	40.0
	Small Farmer	89	24.4
	Self-employed	72	19.7
	Salaried	58	15.9
Family Size	Up to 3 members	84	23.0
	4 – 5 members	167	45.8
	Above 5 members	114	31.2

Source: Author's Contribution

The socio-economic background of the respondents shows that economically and socially vulnerable groups represent the large part of PMUY beneficiaries. Most of the respondents (30.7) are aged between 31-40 years and 47.9% are aged 40 years and above and this represents active decision makers in their households and also representing long-standing practices. Educational level demonstrates that 60.6% of the respondents have no more than primary school education, or they are illiterate, which means that they are not aware and do not fully understand the benefits of clean energy, which can also be one of the reasons why people do not use LPG regularly. The income distribution shows that most of the households, 71 percent, earn less than 12000 per month, which is a pointer that it is not affordable to buy LPG regularly.

The occupational statistics indicate that 64.4% of the respondents rely on agriculture and its allied labour which is characterised by unpredictable income which further strengthens financial insecurity in maintaining the use of LPG. Moreover, 77 percent of the households have over three people, which raises the cooking demands and fuel consumption, thus the latter eventually necessitates the further use of biomass as a complementary fuel. On the whole, the socio-economic profile shows that the structural financial constraints, in combination with low education and the relying on fluctuating livelihoods contribute immensely to the transition to the stable LPG use, thus supporting the implementation gap between policy intention and the domestic level behavior.

4.2 Chi-Square Chi-square Results and Chi-square Hypothesis Testing

In order to test the relationship between socio-economic and implementation variables and the continued LPG use among beneficiaries of PMUY, the Chi-square test construct was used. The sustained LPG use was determined by the regular refill behaviour and the use of LPG only in cooking.

Hypothesis Framing

H 0a: Monthly household income and a long-term use of LPG do not show a significant relationship among the beneficiaries of PMUY.

H 1a: PMUY beneficiaries have a significant relationship between household income monthly and continued LPG use.

H 0b: The level of education has no significant relationship with continued LPG among PMUY beneficiaries.

H 1b: PMUY beneficiaries have a significant relationship between education and long-term LPG use.

H 0c: The distance to LPG distributor is not significantly associated with the sustained LPG usage amid PMUY beneficiaries.

H 1c: Distance to LPG distributor is significantly related to sustained LPG use among the beneficiaries of PMUY.

Table 2
Chi-Square Test Results on Factors Influencing Sustained LPG Usage

Variables	Chi-Square Value (χ^2)	df	Sig. Value (p)	Result
Monthly Household Income vs Sustained LPG Usage	18.64	3	0.001	Significant
Education Level vs Sustained LPG Usage	14.27	3	0.003	Significant
Distance to LPG Distributor vs Sustained LPG Usage	9.58	2	0.008	Significant
Awareness of PMUY Benefits vs Sustained Usage	6.21	2	0.045	Significant
Family Size vs Sustained LPG Usage	4.03	2	0.134	Not Significant

Source: Author's Contribution

Table 3
Summary of Hypothesis Testing

Hypothesis	Decision
H_{01} (Income vs Usage)	Rejected
H_{02} (Education vs Usage)	Rejected
H_{03} (Distance vs Usage)	Rejected
Family Size vs Usage	Accepted

Source: Author's Contribution

The outcomes of the Chi-square tests show that there are important relationships between a range of important socio-economic variables and the long-term LPG use by the PMUY beneficiaries. There is a very significant positive correlation between monthly household income and a continuous use of LPG (χ 2 = 18.64, p = 0.01), resulting in the null hypothesis (H 0 1) being rejected. This means that the higher income households are more likely to refill their LPG cylinders and use it as the main fuel of cooking, although low-income households would resort to other traditional fuels. Equally, level of education also exhibits a high connection with perpetuated LPG use (0: 14.27, p < 0.01), which leads to the rejection of H 0. Educated respondents were more conscious of health and environmental benefits and this had a better impact on the regular use of LPG.

The distance to LPG distributor is substantially connected with the long-term LPG use (2 = 9.58, p < 0.05) which causes the rejection of H 0 3. Homes that were more distant to distribution centres had logistical problems, inconsistent supply, and extra transportation expenses, which minimised the frequency of refills. The awareness of PMUY benefits demonstrates statistically significant correlation with sustained use (p < 0.05), which defines that awareness campaigns are critical in contributing to the adoption of behaviour. Nevertheless, the family size is not statistically significantly correlated with the sustained LPG usage (2 = 4.03, p > 0.05) and, therefore, the null hypothesis is accepted. This implies that, despite the fact that the larger families consume more fuel, their choice of remaining in LPG is more determined by affordability and availability as opposed to size of the household.

4.3 Regression Analysis

The multiple regression analysis was used to determine the degree to which the chosen socio-economic and implementation variables were predicting the sustained LPG use among beneficiaries of PMUY. The method assists in comprehending the relative effect of the independent variables including income level, level of education, awareness, refill affordability and distance to LPG distributor on the dependent variable, i.e., sustained LPG usage. The regression model can therefore give an insight on the factors that have the highest impact towards the implementation gap between LPG connection distribution and its further usage by households.

Table 4
Multiple Regression Results Predicting Sustained LPG Usage

Independent Variables	Unstandardized Coefficient (B)	Standard Error	Standardized Beta (β)	t-value	Sig.
Constant	1.214	0.312	—	3.89	0.000
Monthly Household Income	0.368	0.074	0.421	4.97	0.000*
Education Level	0.214	0.063	0.267	3.40	0.001*
Awareness of PMUY Benefits	0.189	0.058	0.231	3.25	0.002*
Distance to LPG Distributor	-0.156	0.071	-0.183	-2.19	0.029*
Refill Affordability	0.295	0.069	0.342	4.28	0.000*

Source: Author's Contribution
Dependent Variable: Sustained LPG Usage
*Significant at 5% level
Model Summary:

$R = 0.741$
$R^2 = 0.549$
Adjusted $R^2 = 0.542$
$F = 88.36$
Sig. = 0.000

The regression model estimates 54.9% ($R^2 = 0.549$) of the change in sustained LPG among PMUY beneficiaries that shows that the choice of independent variables is strong in explaining the change. The total model proves significant ($F = 88.36$, $p < 0.001$), which proves the fact that all these factors have a joint impact on sustained LPG use. The monthly household income turns out to be the strongest predictor (0.421, $p < 0.001$), which proves that the higher the income of a household, the more likely that it will continue to use LPG. This strengthens the affordability barrier as one of the implementation gaps in PMUY. The effect of refill affordability is also very positive ($\beta = 0.342$, $p < 0.001$) meaning that those households who consider the cost of refills to be affordable, tend to be more reliable in the usage of LPG.

There are strong positive effects on education level (= 0.267, p = 0.01), on awareness of PMUY benefits (= 0.231, p = 0.01), which is an indication of knowledge and awareness influencing sustained adoption of clean cooking fuels. The distance to distributors of LPG is also negatively affecting it (0.183, $p < 0.05$), which means that the households that were farther have more practical obstacles in their way, which does not encourage frequent refill and continuous use. On the whole, the regression results provide a clear picture of the fact that the idea of sustained LPG use depends mainly on the economic capacity, the perception of affordability, awareness, and accessibility. These findings underline that the implementation gap in PMUY is not the coverage of the connections but the barriers in the structure so that regular usage can be done, especially the monetary and logistical limitations.

5. Discussion of Findings

The research results indicate that the distribution of LPG connections under the Pradhan Mantri Ujjwala Yojana (PMUY) and the further use of clean cooking energy by households has a significant disconnect, and the gaps in the implementation process remain to be addressed to achieve a total shift to the use of clean cooking energy. The socio-economic profile analysis has determined that most of the PMUY beneficiaries are the household of low-income, low-education, and agriculturally dependent, which itself predisposes these households only to be able to afford LPG refills on a regular basis. This population base is the reason behind fuel stacking behaviour whereby, the households depend on both LPG and conventional biomass fuels.

The Chi-square test proved that sustained LPG use had statistically significant relationships with such key variables as monthly income, education level, awareness of PMUY benefits and distance to LPG distributor. These results indicate that access is not the sufficient factor that leads to further use, but socio-economic capacity and access to infrastructure have a critical influence on the energy practices on the household level. In contrast, family size was not found to be significantly related to the sustained LPG usage, which suggests that the usage patterns rely more on the economic and logistic factors rather than the need to consume LPG in the household. Regression was one more tool which reinforced these associations by revealing the most powerful predictor of sustained LPG usage to be monthly household income, then comes the affordability of refills and the level of education. Lack of awareness and closeness to LPG distribution centres also became important determinants, and distance had a negative influence on sustained usage. Having the model account close to 55 percent of the difference in the sustained adoption of LPG, the findings show that the implementation gap is multifaceted with affordability, knowledge gaps and access being some of the major factors in the implementation gap.

Based on this interpretation through the Energy Ladder Theory, the results show that PMUY has been effective in opening the gap between households who do not access clean fuels at all and those who do not access the initial access but have not been effective in fully closing the gap to get to the exclusive use of clean fuels. Rather, a large number of beneficiaries are left in the middle of the energy ladder and they have to resort to fuel stacking as a result of economic instability and erratic supply systems. Altogether, the combined analysis shows that PMUY has already taken impressive steps to cover the distribution of LPG connections, but it is still less effective in providing an established energy shift. The policy does not resolve but the ground level implementation of policies where structural socio-economic vulnerabilities, infrastructural inadequacy, present systemic challenges to the long term behavioural change. These observations highlight that there should be a policy shift that goes beyond provision of connections to durable financial support systems, enhanced creation of awareness and better distribution facilities to facilitate a consistent use of LPG by the worst affected households.

6. Implications

This research study suggests that the Pradhan Mantri Ujjwala Yojana needs a strategic redesign in order to be no longer based on a connection-based policy but rather a usage-based policy that could guarantee the sustained adoption of LPG. It should be emphasised that PMUY should focus on regular refill behaviour as one of the key performance indicators, reinforce and rationalize refill subsidy programmes among low-income households, and scale up decentralised distribution channels to enhance last-mile access. Considering that income and affordability are very influential factors, the flexible payment systems and income based support systems would be a welcome initiative to ease financial strain on vulnerable families. At the same time, the targeted behavioural change campaigns should be carried out through the active role of local organisations like self-help groups and frontline workers to make people more aware of the benefits of health and environment. The timely corrective interventions may further be made possible by incorporating digital monitoring systems to monitor the refill frequency and identify fuel stacking behaviour. All in all, PMUY needs to incorporate the economic assistance, infrastructure development and behavioural modifications so that the LPG connections needed to be translated into regular, permanent household use and provide a real energy transition.

7. Future Research and Study Limitations

Although the current research has furnished desirable information concerning the implementation lapses and long-term use of LPG within the framework of PMUY, its drawback is the fact that data utilised in the study is cross-sectional and is limited to a single geographical region with divergent socio-cultural and infrastructural setting. Reporting refill behaviour and exclusive LPG use may also be subject to response bias because of using self-reported responses. Also, the research is more inclined towards the chosen socio-economic and the implementation variables without considering the psychological, cultural and seasonal variables which might affect the cooking fuel preferences. Further studies can increase the extent of this by embracing longitudinal designs to trace the progress of LPG usage over a period of time, comparative studies of various states, and gender dynamics, cultural practices, and environmental perceptions in the adoption process. It is also possible that further research can be conducted regarding how technological innovations, including smart cylinders and digital subsidy platforms, might enhance the effectiveness and sustainability of PMUY.

8. Conclusion

The paper has shown that although the Pradhan Mantri Ujjwala Yojana has been successful in increasing the reach of LPG connections to economically disadvantaged household, it has not been able to achieve success in terms of ensuring sustained and exclusive use of LPG as a cooking fuel. The fuel stacking behaviour and uneven refill patterns are indicative of a great discrepancy between policy intent and the household practice. Poor awareness, low-income, low level of education, socio-economic factors, and physical distance to LPG distributors would remain as the key obstacles to a full switch to clean cooking energy. The results verify that simple delivering of connections is not sufficient to promote behaviour change, and further adoption requires constant economic and infrastructural assistance.

Moreover, the paper highlights the necessity of the paradigm shift in the implementation strategy of PMUY toward not necessarily numerical coverage but the sustainability of the usage in the long term. Increasing subsidy systems, developing better distribution systems, better awareness programmes, and incorporation of livelihood support programs are essential towards filling the access-adoption gap. The proposed solutions to the structural and behavioural challenges shown in this case allow PMUY to be a step closer to its goals of enhancing the health of the population, minimizing environmental degradation, and reducing the gendered burden of traditional fuel use, which in turn can help to reach the clean energy transition and sustainable development targets in India.

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