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PMUY AND TRIBAL HOUSEHOLDS: AN ANALYSIS OF ACCESS, ADOPTION AND IMPLEMENTATION CHALLENGES

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ABSTRACT

This study investigates the dynamics of household energy use among tribal communities in Nandurbar District, Maharashtra, with a focus on the implementation and impact of the Pradhan Mantri Ujjwala Yojana (PMUY). Drawing on data from 600 households across eight villages, the research examines how socio-economic conditions, household characteristics, and local contexts influence access to and adoption of clean cooking fuels, particularly LPG. Although PMUY has significantly improved initial access to LPG by offering subsidized connections, sustained usage among tribal households remains limited. Many families continue to rely heavily on firewood due to the high cost of refills, irregular supply chains, and limited awareness of the health risks associated with traditional fuels. This reliance on biomass not only exposes women and children to indoor air pollution but also adds to their daily burden of collecting fuel, often from distant forested areas. Using the Energy Ladder Model and linear regression analysis, the study identifies key factors influencing energy transition, including income, education, family size, and geographic location. It finds that while income plays a role, it is not always a strong predictor of LPG adoption in regions where traditional fuel use is deeply rooted. The duration of LPG usage also emerges as an important factor households using LPG for longer periods are more likely to continue its use. The findings highlight the need for more localized and inclusive policy approaches. To enhance the effectiveness of PMUY in tribal areas, targeted subsidies, improved last-mile delivery systems, and culturally relevant awareness campaigns are essential. Addressing these challenges can support a more equitable and sustainable shift toward clean energy, improving both health outcomes and quality of life for tribal communities.

KEYWORDS: *PMUY, Tribal households, Clean energy, Access, Challenges, Energy transition*

1. INTRODUCTION

Access to clean, reliable, and affordable energy is essential for improving people's lives and achieving sustainable development. It plays a key role in reducing poverty, improving health, supporting gender equality, and creating opportunities for education and income. This importance is recognized globally in Sustainable Development Goal 7 (SDG 7), which calls for universal access to modern energy services by 2030 (UNDP, 2015). However, many people around the world still lack access to clean cooking fuels. In 2021, nearly 2.3 billion people were still using traditional and polluting fuels like firewood, dung, and charcoal for cooking (WHO, 2021). These fuels produce harmful smoke that causes serious health problems especially for women and children who spend long hours cooking in poorly ventilated spaces. According to the Global Burden of Disease study, around 4 million people die prematurely each year because of illnesses linked to indoor air pollution (IHME, 2020).

In India, while cities have made better progress, many rural households still rely on solid fuels. The National Sample Survey (78th Round, 2021) shows that about 47% of rural households continue to cook with traditional fuels, compared to just 6.5% in urban areas. This gap reflects several challenges like poor infrastructure, high fuel costs, and a lack of awareness about cleaner options. The situation is even more difficult for tribal communities, who often live in remote and underdeveloped areas. These communities face deeper problems when it comes to energy access because of their low income, social exclusion, and the physical distance from supply systems. In Maharashtra, about 36% of rural households still do not use clean cooking fuels (NFHS-5, 2021). But in Nandurbar district, where most of the population belongs to tribal groups, this number is much higher nearly 75% of households still rely on firewood and other traditional fuels. This reliance has many consequences. The smoke harms health, especially for women and children. The time spent collecting firewood takes away from other important activities like earning an income, studying, or taking part in community life. In many tribal families, women carry the burden of managing household energy needs, which limits their ability to move out of poverty.

To address this issue, the Government of India launched the Pradhan Mantri Ujjwala Yojana (PMUY) in 2016. The goal was to provide free or subsidized LPG connections to women in poor households, especially in rural areas. The scheme made a big difference in reaching millions of families. As on February 2025, 10.33 crore LPG connections have been distributed across India under PMUY (PPAC, 2022). However, just giving an LPG connection is not enough. Many families in tribal areas struggle to afford LPG refills, face supply issues, and are not fully aware of the long-term health and economic benefits of switching to clean cooking fuels (Choudhury & Mohanty, 2020; Kar et al., 2021).

The Distirct like Nandurbar in Maharashtra, even when tribal households have LPG connections, firewood continues to be the primary fuel. LPG is often used only when necessary or when it is available. This pattern, known as "fuel stacking", shows that the transition to clean energy is not just about access

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it's also about affordability, habits, and local conditions. The time and effort spent on collecting biomass fuel also reduces productivity and increases the burden on women, leading to a cycle of poverty and exclusion (Parikh et al., 2015; Sehjpal et al., 2014). This research looks closely at how tribal households in Nandurbar are using energy, especially in the context of PMUY. It explores how people access clean fuel, whether they continue to use it, and what problems they face. By collecting household data and analyzing key factors like income, education, and location, this study aims to understand what works, what doesn't, and what more can be done to support clean energy in tribal areas.

1.1 Research Questions

1. How effectively has the Pradhan Mantri Ujjwala Yojana (PMUY) reached tribal households in Nandurbar district?
2. What are the main barriers that tribal households face in regularly using LPG, even after getting a PMUY connection?
3. How do factors like distance from the city, income level, education, and traditional practices affect LPG usage among tribal households in different locations (near-city vs. interior villages)?

2. RESEARCH OBJECTIVES

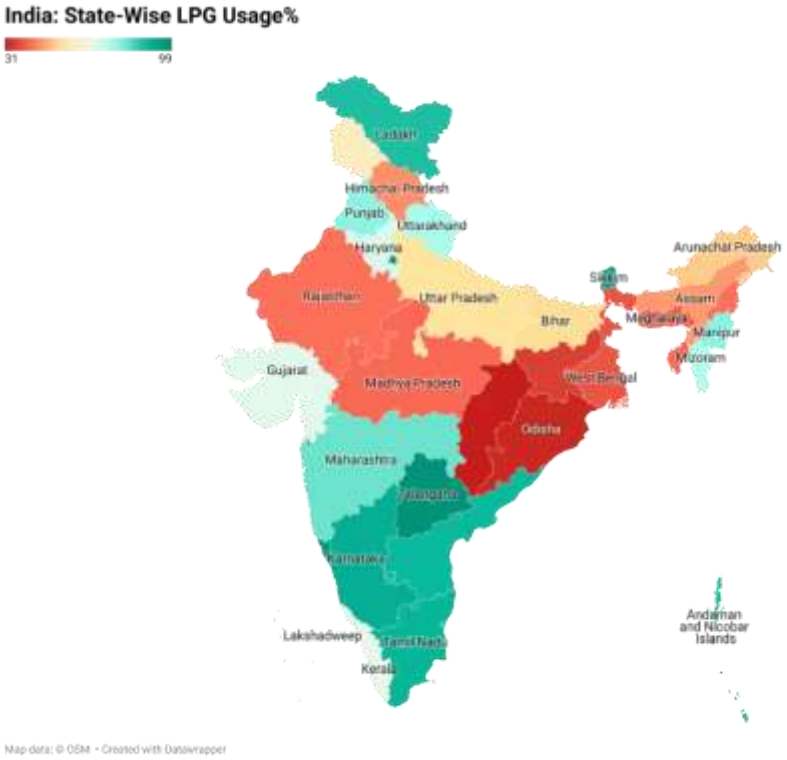
1. To examine the access and usage of LPG under PMUY among tribal households in Nandurbar district.
2. To identify the key socio-economic and geographic factors influencing LPG adoption in near-city and interior tribal areas.

3. METHODOLOGY

This study used a mixed-methods approach to examine PMUY adoption among tribal households in Nandurbar district, focusing on how socio-economic, cultural, and geographic factors affect LPG use. A survey of 600 households from eight villages (both near-urban and remote) was conducted using stratified random sampling. This allowed comparison across different access levels. Focus group discussions (FGDs) with women and key informant interviews with LPG distributors, local leaders, and officials provided qualitative insights. Secondary data from NFHS-5, Census 2011, MIS Dataset 2021 and government reports supported village selection and added context.

4. RESULTS AND ANALYSIS

Figure 1: State-wise LPG adoption in India

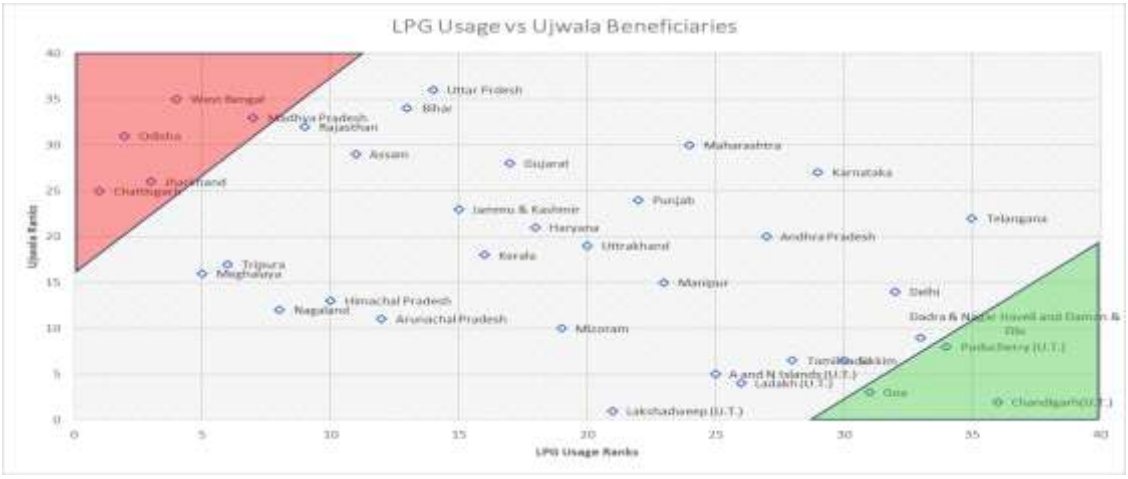


Source: The author's calculation based on the MIS Dataset NSS 78 Round (2021).

The map illustrates the percentage of LPG usage across states, highlighting regional disparities in access to clean cooking fuel. The highest LPG adoption is in Kerala (99%), while Chhattisgarh has the least (5%). Maharashtra, which has a 65 per cent LPG adoption rate, is higher on the scale. States like Kerala, Tamil Nadu, Maharashtra and Punjab have LPG usage above 80 per cent, indicating better infrastructure and affordability. In contrast, Odisha, Chhattisgarh, Madhya Pradesh and West Bengal show LPG usage below 50 per cent, suggesting a continued reliance on traditional fuels like firewood and biomass.

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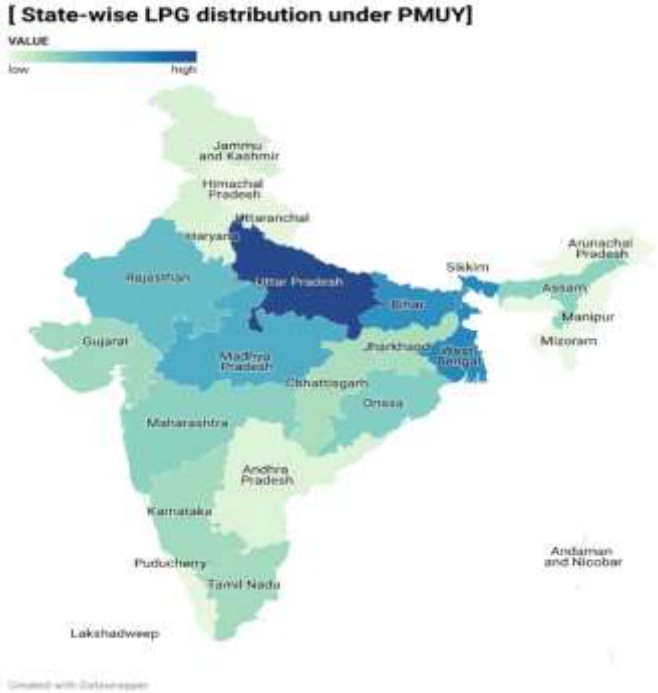
Figure 2: State-level LPG connections and PMUY distribution



Source: The author's calculation based on PMUY, Ministry of Petroleum and Natural Gas, 2021.

The graph compares states by LPG adoption and Ujjwala beneficiaries. South Indian states show high LPG use with fewer beneficiaries (green zone), while North Indian states have many beneficiaries but low usage (red zone), indicating continued reliance on traditional fuels. Maharashtra shows moderate adoption with high beneficiary numbers. States like Goa and Chandigarh have strong LPG access despite fewer Ujjwala users, while West Bengal and Odisha reflect gaps between access and actual usage.

Figure 3: Current state-wise status of PMUY distribution till Feb 2025 (In %)

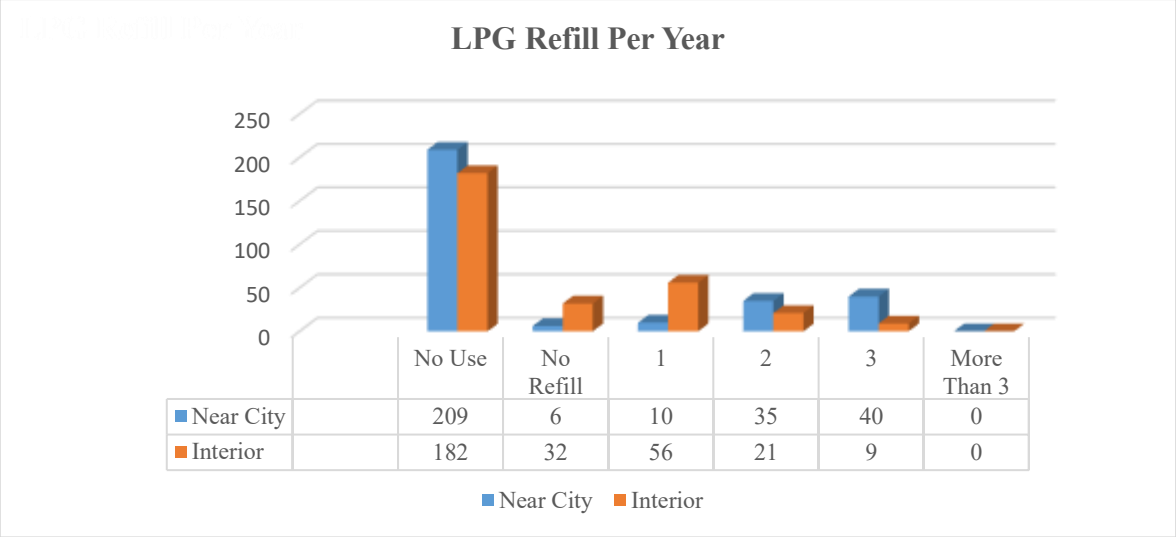


Source: The author's calculation based on the Ministry of Petroleum and Natural Gas Dataset (2025).

The map shows state-wise PMUY LPG distribution, with Uttar Pradesh, West Bengal, and Bihar leading in connections, reflecting focused efforts in high-need rural areas. Central states like Madhya Pradesh and Jharkhand also show strong coverage. In contrast, southern states and northeast/hill regions show lower distribution, likely due to better prior access or logistical challenges. As of February 2025, over 10.33 crore connections have been provided nationwide under PMUY, highlighting a major push toward clean cooking energy.

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Figure 4: LPG refill per year by households.



Source: The author's calculation based on the field survey (2022).

The chart shows how often families in near-city and interior areas refill LPG cylinders. Many still don't use LPG 209 in near-city and 182 in interior villages. Among LPG users, more interior families (32) didn't refill at all compared to just 6 near the city. One refill a year is also more common in interior areas (56 vs. 10), suggesting limited use. In contrast, near-city families refill more often 40 refilled three times, while only 9 did so in interior areas. This shows better access and more regular use near cities, while interior families may still rely on firewood due to cost, distance, or habit.

Table 1: Access to PMUY among sample households

Sr. No.	Variable	Near city		Interior					
		Count	%	Count	%	Total	%	Test	Sig
1	*Access to the PMUY ?*								
	Yes	91	30.3	118	39.3	209	34.8	Chi²	0.021
	No	209	69.7	182	60.7	391	65.2	F Test	0.021
2	*LPG connection under the PMUY?*								
	Yes	91	30.3	118	39.3	209	34.8	Chi²	0.021
	No	209	69.7	182	60.7	391	65.2	F Test	0.021
3	*Subsidy available under the PMUY?*								
	Yes	91	30.3	118	39.3	209	34.8	Chi²	0.021
	No	209	69.7	182	60.7	391	65.2	F Test	0.021

Source: The author's calculation based on the field survey (2022).

The table compares how near-city and interior households view LPG's impact on health costs, PMUY access, and subsidy availability. Around 39.3% of interior households said LPG reduces health costs, compared to 30.3% near-city households, with a significant difference ($p = 0.021$). Similar patterns were seen in PMUY access and subsidies, where interior households reported better access and support. This suggests that interior households benefit more from PMUY, likely due to greater need and government focus in rural areas. Studies by Bruce et al. (2000) and Bhattacharya et al. (2022) support this, showing that LPG use reduces indoor air pollution and improves health, especially for women and children. However, challenges remain in reaching remote and marginalised groups.

Table 2: Linear Regression output

Variable	Coef	St. Err	p-value	Coef	St. Err	p-value
	Near to City			Interior		
LPG connection						
1	0.3	0.008	***	0.442	0.043	**
Respondent's age	0.007	0.228		0.002	0.134	
Occupation						

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Farmer	0.289	0.843		0.172	0.031	**
Milk supplier	0.603	0.361		0.235	0.556	
Teacher	0.795	0.224		0.215	0.106	
Education						
Primary	0.2	0.414		0.052	0.453	
Secondary	0.08	0.294		0.091	0.573	
Junior College	0.052	0.032	**	0.148	0.329	
Degree and above	0.205	0.246		0.334	0.85	
Family size	0.027	0.033	**	0.009	0.051	*
Income (Rs.)						
10K - 20k	0.079	0.44		0.092	0.194	
20k - 30k	0.069	0.08	*	0.061	0.527	
30k - 40k	0.428	0.743		0.092	0.267	
40k - 50k	0.418	0.695		0.213	0.113	
Illness Index	0.085	0.223		0.024	0.363	
Wealth Index	0.036	0.023	**	0.057	0.034	**
Livestock Index	0.047	0.052	*	0.125	0.205	
ID Proof Index	0.119	0.956		0.113	0.392	
Constant	0.191	0.000	***	0.409	0.001	***
Mean dependent var	4.783			4.633		
SD dependent var	1.018					
R-squared	0.597			0.698		
Number of obs?	300			300		
Akaike crit. (AIC)	683.339			507.457		
Bayesian crit. (BIC)	518.568					

Source: The author's calculation based on the field survey (2022).

The regression shows that location, wealth, occupation, education, and family size influence LPG adoption. Remote households are slightly more likely to adopt LPG than near-city ones. Farmers in remote areas and those with junior college education near cities show higher adoption. Larger families and wealthier households are more likely to use LPG across both areas. Age and most occupations have no clear effect. The model explains adoption better in remote areas ($R^2 = 0.698$) than in near-city areas ($R^2 = 0.597$).

5: FINDINGS AND DISCUSSION

- PMUY has increased initial LPG access, especially in rural and tribal areas, aligning with national goals to improve clean energy coverage (Khan, 2017). However, sustained and exclusive use remains limited, especially among economically vulnerable tribal communities.
- Only 34.8% of surveyed tribal households in Nandurbar have LPG connections, and the majority (65.2%) still rely on traditional fuels like firewood, indicating the persistent challenge of energy poverty (NFHS-5, 2021).
- Refill behavior is a major concern. In interior areas, 32 households did not refill their cylinders even once in the past year, and 56 refilled only once. This suggests symbolic or minimal LPG use. These findings mirror observations by Jain et al. (2015) that affordability and access limit LPG's consistent use.
- Cost of refills (₹900–₹1,000) remains a critical barrier. Even with free connections, recurring expenses deter sustained use (Kumar, Rao & Reddy, 2016; Smith, 2017). Most tribal households in the study fall in low-income brackets, with 31.7% earning less than ₹10,000 monthly.
- Education levels are low among women, with 56.3% having no formal education. While awareness of LPG's benefits exists, limited education may reduce ability to access or prioritize modern energy technologies (Baquie & Urpelainen, 2017).
- Gender dynamics restrict energy decisions. Although all respondents were women, only 5.5% of households were female-headed. This reflects broader gendered limitations in energy transitions, where women are responsible for cooking but lack financial autonomy (Bruce et al., 2000).
- PMUY has higher penetration in remote areas, with more interior households reporting access to subsidies. However, this has not translated into regular use, highlighting the difference between distribution and sustained adoption.
- Regression analysis shows location and wealth are significant predictors of LPG use. Households near cities and those with higher wealth indices are more likely to use

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LPG regularly, consistent with findings by Jain et al. (2015) and Patra (2015).

- Larger families are more likely to adopt LPG, possibly due to greater cooking needs and fuel demand. Regression results confirm family size positively influences adoption in both near-city and interior areas.
- The model explained LPG adoption better in interior areas ($R^2 = 0.698$) than in near-city areas ($R^2 = 0.597$), indicating that household-level variables more strongly predict usage in remote regions.
- Social and cultural preferences continue to influence fuel choices. Some respondents preferred firewood due to cooking taste or community norms, a finding also discussed by Wang (2014).

6. CONCLUSION

The study finds that while PMUY has improved LPG access among tribal households in Nandurbar, regular and exclusive use remains low, especially in interior areas. High refill costs, poor supply chains, and cultural reliance on firewood continue to limit adoption. Income, education, and proximity to urban areas positively influence usage, while gender inequality and economic vulnerability hinder it. To achieve a true clean energy transition, PMUY must go beyond connections and address affordability, awareness, infrastructure, and local needs through a holistic, community-based approach. A meaningful transition to clean energy in tribal regions will require a more holistic approach that integrates economic support, behavioral change, localized infrastructure, and community engagement tailored to the unique needs of tribal populations.

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