Shifting Patterns: Analysing the Rise of LPG Consumption in Indian Households - A Comparative Study of IHDS 2005 and 2011

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DECLARATION BY STUDENT

I hereby declare that the data presented in this Dissertation report entitled, **"Shifting Patterns: Analysing the Rise of LPG Consumption in Indian Households - A Comparative Study of IHDS 2005 and 2011"** is based on the results of investigations carried out by me in the Economics at the Department of Economics, Goa University/Goa Business School under the supervision of Prof. (Dr) Pranab Mukhopadhyay and the same has not been submitted elsewhere for the award of a degree or diploma by me. Further, I understand that Goa University or its authorities /Goa Business School will not be responsible for the correctness of observations / experimental or other findings given the dissertation.

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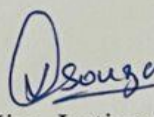

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COMPLETION CERTIFICATE

This is to certify that the dissertation report "**Shifting Patterns: Analysing the Rise of LPG Consumption in Indian Households - A Comparative Study of IHDS 2005 and 2011"** is a bonafide work carried out by Miss Lotina Salu Souza under my supervision in partial fulfilment of the requirements for the award of the degree of **Masters in Arts** in the Discipline of Economicsat the Department of Economics, Goa University/ Goa Business School.

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PREFACE

The transition to clean cooking fuels, particularly LPG, is essential for improving public health, environmental sustainability, and gender equity in Indian households. This research study utilizes data from the India Human Development Survey (IHDS) panel data of 2005 and 2011-12 to analyze the factors influencing the adoption of LPG as a cooking fuel. By employing regression analysis and hypothesis testing, the study aims to uncover the socioeconomic, cultural, and gender-specific determinants of LPG adoption rates. The findings from this research will contribute valuable insights to policy discussions, interventions, and awareness campaigns aimed at promoting sustainable energy transitions and addressing gender disparities in energy access in India**.**

Date:

ABSTRACT

This research study investigates the factors influencing the adoption of LPG as a cooking fuel in Indian households using data from the India Human Development Survey (IHDS) panel data of 2005 and 2011-12. Through regression analysis and hypothesis testing, the study aims to uncover the socioeconomic, cultural, and gender-specific determinants of LPG adoption rates. The transition to clean cooking fuels, particularly LPG, is crucial for public health, environmental sustainability, and gender equity in India. The findings of this research provide valuable insights for policy discussions, interventions, and awareness campaigns aimed at promoting sustainable energy transitions and addressing gender disparities in energy access in the country.

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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Access to modern energy services is essential for meeting foundational social needs, stimulating economic progress, and boosting human development. Recognizing its crucial role as a substance for human advancement, access to clean cooking energy emerges as a transformative force, liberating millions, especially women and children, from the harmful effects of Household Air Pollution (HAP) and the heavy routines of traditional cooking methods. By easing the labour associated with such practices, clean cooking energy not only mitigates time poverty but also empowers families to enjoy improved health outcomes and heightened productivity among their members. There is a pressing need to broaden our perspective on access to clean cooking energy, acknowledging its significance not only in terms of energy provision but also as a fundamental driver of human development.

The use of traditional fuels like firewood, cow dung, and kerosene is deeply entrenched in India's rural households due to longstanding practices and economic constraints. While urban households have increasingly shifted to cleaner fuels such as LPG and electricity, the ruralurban divide remains stark. The government's initiatives have made significant strides in improving access to clean cooking fuels; however, the uptake is not uniform. Many households continue to use traditional fuels as a primary or supplementary source of energy for cooking, often due to the intermittent supply of LPG or financial barriers in refilling cylinders. This reliance on traditional fuels has serious implications for public health, as the smoke from burning biomass is a major contributor to indoor air pollution, leading to respiratory diseases and other health issues. Women and children, who typically spend more time in the kitchen, are particularly vulnerable. the collection of firewood and other biomass fuels contributes to deforestation and environmental degradation, the urgency of transitioning to sustainable energy

sources. Addressing these challenges requires a multifaceted approach that includes enhancing the supply chain of clean fuels, making them affordable, and raising awareness about the benefits of transitioning to cleaner alternatives. The goal is not only to improve health outcomes but also to foster environmental sustainability and gender equity by reducing the time and labor burden on women and girls associated with collecting biomass fuels.(Patnaik & Jain, n.d.)

Liquefied Petroleum Gas (LPG) has been a game-changer in India's transition to clean cooking fuels. As a cleaner and more efficient alternative to traditional fuels like firewood and dung, LPG has significantly reduced the health risks associated with indoor air pollution. The government's push, particularly through the Pradhan Mantri Ujjwala Yojana, has facilitated the widespread adoption of LPG across rural and urban households, aiming to improve air quality and reduce the labour-intensive practices of collecting biomass fuels. The adoption of LPG is not without its challenges. The initial cost of setting up an LPG connection, along with the recurring expense of cylinder refills, can be prohibitive for lower-income families. cultural preferences and cooking practices have led to the continued use of traditional fuels alongside LPG, a practice known as fuel stacking. To encourage a complete switch to LPG, efforts are being made to make it more affordable and accessible, while also educating communities about its benefits over traditional fuels. The emergence of LPG as a dominant cooking solution is a testament to India's commitment to enhancing energy security, improving public health, and promoting sustainable development. With continued support and policy interventions, LPG has the potential to become the primary source of cooking energy, ensuring a cleaner environment and a better quality of life for millions of households. (Gould and Urpelainen,2018)

he LPG consumption in Indian households has seen a notable increase, particularly due to traditional biomass burning. The IHDS panel data from 2005 and 2011-12 has been

instrumental in analysing the transition towards LPG, highlighting the socio-cultural, regional, and economic factors influencing this shift. Cultural practices, such as gifting LPG-based cooking kits at weddings, have a positive impact on LPG adoption among households, Despite the rise in LPG usage, significant disparities persist due to economic status and regional differences, the challenges faced by households in rural and urban areas.

1.2 Objectives

- Analyse how factors such as education, and urban/rural residence influence the likelihood of households using LPG as a cooking fuel.
- Compare LPG consumption patterns between 2005 and 2011 to identify any significant changes over time.
- Analyse LPG adoption rates among men and women with varying levels of media exposure to understand whether there is a correlation between media consumption and LPG usage.
- Aims to analyse household expenditure on different types of fuel using the IHDS data from 2005 and 2011.

1.3 Research Question

- What role do education, and urban/rural residence play in households' choice of LPG as a cooking fuel?
- What notable changes occurred in LPG consumption patterns between 2005 and 2011, and how do these variations differ across demographic groups?
- Is there a link between media consumption levels and LPG adoption rates among men and women, and how does this association vary based on socioeconomic factors?

- What trends can be observed in household spending on different fuel types between 2005 and 2011?

1.4 Research problem

The adoption and consumption patterns of LPG (liquefied petroleum gas) as a cooking fuel in India are influenced by various socioeconomic factors, including income, education, urban/rural residence, and media exposure. Despite governmental initiatives to promote clean cooking fuels like LPG, disparities persist in its adoption across different demographic groups. This research aims to address this gap by analyzing household data from the Indian Human Development Survey (IHDS) for the years 2005 and 2011. The study seeks to understand the role of income, education, and urban/rural residence in households' choice of LPG as a cooking fuel and to identify any significant changes in LPG consumption patterns over time. The research aims to investigate the correlation between media consumption levels and LPG adoption rates among men and women, considering variations based on socioeconomic factors. The study aims to examine trends in household expenditure on different types of fuel between 2005 and 2011.

CAPTURE 2: LITERATURE REVIEW

2.1:Introduction:

The research study delves into the existing literature on factors influencing the adoption of LPG as a clean cooking fuel in Indian households. By reviewing previous research studies, it aims to identify gaps in the literature and provide a comprehensive understanding of the socio-economic, cultural, and environmental determinants shaping household energy choices**.**

2.2: Review of related literature

(**Mishra & Pal, 2022)**The research paper SSRN-id4147057.pdf investigates the relationship between education and the choice of cleaner cooking fuels in Indian households using data from the India Human Development Survey (IHDS). The study merges household-level data with individual-level data from the IHDS dataset to analyse how the educational outcomes of household members influence the adoption of electricity and LPG as cleaner fuel options. The researchers employ regression analysis, including Ordinary Least Squares (OLS) regression and probity regression models, to examine the association between education levels and fuel choice, considering gender dynamics and other demographic variables. The findings suggest a strong association between educational attainment and the use of cleaner fuels, with higher levels of education correlating with increased usage of electricity and LPG. Gender differences in decision-making power within households also play a role, as the study reveals variations in the impact of education on fuel choice between male and female household members. Overall, the research highlights the importance of education in shaping fuel preferences and underscores the need for targeted

interventions to promote the adoption of cleaner cooking fuels for sustainable development and environmental well-being. **(Patel & Kumar, 2020)**The study utilized the India Human Development Survey (IHDS) panel data from 2005 and 2011-12 to investigate the factors influencing the adoption of LPG in Indian households, particularly focusing on vulnerable households in nine low-income states. The data collection involved nationally representative surveys conducted in villages and cities across India, with a re-contact rate of 83% for the second round of interviews. The analysis employed regression analysis techniques to examine variables such as economic status, education level, social group, region, primary income sources, exposure to mass media, and cultural factors. The findings revealed that urban location, higher income, education level, exposure to mass media, and cultural practices of gifting LPG systems in weddings positively influenced LPG adoption. Conversely, social factors like caste disparities and economic determinants like formal employment opportunities played significant roles in hindering or promoting LPG uptake. The study highlighted disparities in LPG adoption rates across different states, emphasizing the importance of inclusive energy policies and targeted interventions to bridge rural-urban divides and promote clean cooking fuel usage in India.**(Srinivasan & Carattini, 2020)**The study "Adding fuel to fire: Social spillovers in the adoption of LPG in India" investigates the adoption of LPG as a clean cooking fuel in Indian households. The data collection process involved leveraging multiple datasets, including the National Sample Survey (NSS) and the India Human Development Survey (IHDS), to analyse trends in cooking fuel usage over several decades. The methodology employed panel data analysis and instrumental variable estimation to account for social spillover effects in the adoption of LPG. The findings suggest that social interactions play a significant role in the decision-making process of households when transitioning to LPG, with

influential segments of society potentially driving adoption rates. Additionally, the results highlight the importance of considering village-specific characteristics and social networks in promoting the use of clean cooking fuels like LPG. **(Sharma et al., 2019)**The study conducted in Raipur and Ranchi districts of India aimed to investigate the factors influencing households' transition to LPG for cooking, post the launch of the PMUY scheme. Data was collected through a survey of 300 households in Ranchi and 510 in Raipur, using a stratified random sampling method to ensure representation from rural and urban areas. The survey included information on demographic characteristics, income status, fuel consumption, LPG usage, and PMUY beneficiary status. Household monthly income was collected using a 30-day recall period for most sources and a 365day recall period for agriculture income. The findings revealed that income level, duration of LPG acquisition, and PMUY subsidy scheme participation significantly influenced households' decision to switch to LPG for cooking. Higher income households and longer LPG users were more likely to adopt LPG, while PMUY beneficiaries showed a positive association with LPG usage. These results underscore the importance of income, duration of LPG ownership, and government subsidy programs in promoting the adoption of clean cooking fuels like LPG among households in India.**(Azam, 2023)**The study by Mehtabul Azam investigates the health effects of fuel transitions in India using panel data from the Indian Human Development Survey conducted in 2004-05 and 2011-12. The research focuses on the impact of switching cooking fuels, particularly from polluting fuels to cleaner options like LPG, on shortterm adverse respiratory health outcomes such as cough and breathing issues. The author employs a difference-in-differences methodology with multivalued treatments to estimate the causal effects of fuel transitions on household health. By categorizing households into groups based on their cooking fuel use and analysing those who

switched fuels versus those who did not, the study aims to eliminate selection issues and identify the health implications of fuel transitions. The findings reveal that households switching from polluting fuels to LPG experience a significant reduction in the probability of household members reporting adverse respiratory health issues. However, transitions to fuel stacking strategies show no impact on health outcomes, while reverting to polluting fuels from LPG increases the likelihood of adverse health effects. Importantly, the study highlights that the positive health effects of transitioning to LPG are more pronounced for women, indicating gender disparities in exposure to household air pollution. These findings underscore the importance of promoting cleaner cooking fuels to improve public health outcomes in India.**(Bahi & Paavola, n.d,2023.)**The article titled "Liquid Petroleum Gas Access and Consumption Expenditure: Measuring Energy Poverty through Wellbeing and Gender Equality in India" by Dhilanveer Teja Singh Bahi and Jouni Paavola, published in July 2023 as Centre for Climate Change Economics and Policy Working Paper No. 424, delves into the critical issue of energy poverty in India. The study focuses on the access and consumption of Liquid Petroleum Gas (LPG) in India, particularly examining how energy poverty can be measured through the lenses of wellbeing and gender equality. The authors highlight the significance of energy access as a fundamental aspect of economic development and wellbeing, emphasizing the challenges faced by a significant portion of the population in India who lack access to modern energy sources. The paper discusses the implications of energy poverty on various aspects of life, including health, gender equality, and overall quality of life. Furthermore, the research sheds light on the role of gender in energy poverty, exploring how access to clean cooking fuels like LPG can impact women's empowerment and wellbeing. By analysing the relationship between energy access, consumption patterns, and expenditure, the

study provides valuable insights into the complexities of energy poverty in the Indian context. Overall, this article contributes to the existing literature on energy poverty, wellbeing, and gender equality, offering a nuanced perspective on the challenges and opportunities for addressing energy poverty in India. The findings and analysis presented in this paper can inform policy discussions and interventions aimed at improving energy access and promoting sustainable development in the country.**(Singh et al., 2017)** The study conducted by Singh et al. (2017) aimed to assess the net impact on emissions resulting from increased access to LPG for cooking in Indian households between 2001 and 2011. The researchers utilized data from nationally representative socio-economic surveys conducted by the National Sample Survey (NSS) organization to estimate household LPG and fuelwood consumption. By identifying primary and secondary users of LPG and fuelwood, they were able to analyse the transition from traditional biomass cooking to LPG stoves. Statistical matching techniques were applied to create a synthetic dataset of matched households, allowing for the estimation of fuelwood displacement due to increased LPG access. The study employed a Tobit model to predict firewood use in 2011 based on various factors such as LPG quantity, household size, and urban/rural location. The findings indicated a substantial reduction in climate forcing emissions associated with the shift from traditional biomass stoves to LPG stoves in India, highlighting the environmental benefits of promoting cleaner cooking fuels like LPG.**(Vyas et al., n.d.,2020)**The article "Gender, government intervention, and slow LPG adoption in rural north India" presents a comprehensive analysis of the challenges hindering the adoption of clean cooking practices, specifically the use of liquid petroleum gas (LPG), in rural north India. The study draws on a combination of qualitative and quantitative data collected in rural areas of four north Indian states: Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh. The

qualitative data was gathered through in-depth interviews with households, while the quantitative data was obtained from the 2018 Survey of Rural Sanitation and Fuel Use. The researchers employed a mixed-methods approach to explore the impact of patriarchal gender norms on cooking fuel choices and household dynamics. The findings reveal that gender norms and attitudes play a significant role in perpetuating the use of solid fuels, as women are often tasked with activities related to solid fuel preparation and face barriers to accessing and using LPG. Despite government interventions like the Ujjwala Yojana, which aimed to increase LPG ownership, the study highlights the persistence of traditional cooking practices in rural north India due to entrenched gender roles and societal expectations. The research underscores the importance of addressing gender norms and empowering women to drive meaningful change in clean fuel adoption and improve health outcomes in rural communities.**(Kuo & Azam, n.d.)**The study on Household Cooking Fuel Choice in India from 2004 to 2012 utilizes data from two waves of the India Human Development Survey (IHDS) to investigate the determinants of cooking fuel selection in urban and rural regions separately. The research employs a random effects multinomial logit model to account for unobserved household heterogeneity. Data collection involved nationally representative surveys conducted in 2004 and 2011, providing a robust dataset for analysis. The methodology includes a detailed empirical strategy to examine factors influencing fuel choice, such as household characteristics, infrastructure access, and women's bargaining power. The findings reveal significant differences between urban and rural areas, indicating that a clean-break from traditional fuels is more likely in urban settings compared to rural areas. Factors like income, education, and access to paved roads play crucial roles in determining the adoption of clean fuels, with women's empowerment also positively associated with cleaner fuel usage. Additionally, the

study highlights the impact of liquefied petroleum gas (LPG) prices on the likelihood of using clean fuel in urban households, emphasizing the importance of economic factors in fuel choice decisions.**(Couture et al., 2012)**The study "Household energy choices and fuelwood consumption: An econometric approach using French data" focuses on analysing fuelwood consumption and household energy choices in France. The data for the research was collected through a survey conducted in the Midi-Pyrénées region by the BVA polling institute on behalf of the Midi-Pyrénées Regional Energy Observatory. The survey, carried out via phone interviews from February 9th to 18th, 2006, covered the 2004–2005 heating year and included responses from both fuelwood users and nonusers, totalling 1019 and 1235 households, respectively. The questionnaire used in the survey gathered information on household characteristics, income levels, housing attributes, and energy consumption patterns to provide a comprehensive dataset for analysis. The methodology employed in the study involved an econometric analysis to examine the determinants of fuelwood demand and the factors influencing the choice of energy mix for heating in French households. The researchers modelled the endogenous decision-making process regarding the main and back-up energy sources used by households, taking into account the impact of income, socio-economic characteristics, and geographic variables on fuelwood consumption. By addressing selection bias issues and considering the price sensitivity of fuelwood consumption when wood is the primary energy source, the study aimed to provide insights into the complex dynamics of household energy choices and fuelwood consumption patterns. The findings of the study revealed that income and socio-economic characteristics significantly influence the choice of energy mix for heating in households, with price sensitivity playing a crucial role when wood is the main source of energy. The analysis highlighted the importance of understanding household

fuelwood consumption patterns for designing effective energy policies and promoting renewable energy sources like wood biomass. The research contributes to filling the gap in studies on wood energy consumption in developed countries, particularly in the context of increasing interest in renewable energy alternatives and sustainable energy systems.**(Farsi et al., 2007)** The article "Fuel choices in urban Indian households" applies an ordered discrete choice framework to analyse fuel choices and cooking fuel use patterns in urban Indian households. The study utilizes a large microeconomic dataset derived from the Indian

Household Consumer Expenditure Survey conducted by the National Sample Survey Organisation. The data includes information on household characteristics, sociodemographic factors, income levels, prices of fuels, and geographical variations. The methodology involves estimating models to predict households' primary and secondary fuel choices based on factors such as income, prices of fuels, socio-demographic variables, and geographic indicators. The study finds that income plays a significant role in fuel choices, with low-income households often constrained in adopting cleaner fuels due to affordability issues. Additionally, factors such as education level, gender of the household head, household size, and accessibility to LPG distributors influence the likelihood of choosing cleaner fuels. The analysis also highlights the impact of LPG prices on fuel substitution patterns among different income groups. Overall, the research underscores the importance of considering a range of socio-economic and geographic factors in understanding and promoting the adoption of cleaner cooking fuels in urban Indian households.**(Chindarkar et al., 2021)**The study examined the willingness-to-pay (WTP) for exclusive use of liquefied petroleum gas (LPG) for cooking among rural households in India using unique household-level data collected from six energy-access-deprived states in 2018. The data collection

involved implementing the contingent valuation methodology as part of the ACCESS 2018 dataset, which provided insights into households' preferences and WTP for cleaner cooking fuels. The methodology included analysing demographic characteristics, economic status, awareness about LPG's health benefits, diffusion of LPG within the community, and availability of biomass as determinants of WTP. The findings revealed that awareness about the health benefits of LPG and community diffusion of LPG were strong determinants of households' WTP for exclusive use of LPG. Additionally, economic status, household size, regular cash flows, and availability of biomass were identified as factors influencing households' willingness to pay for cleaner cooking fuels. The study highlighted the importance of these determinants in shaping households' decisions regarding the adoption of LPG for cooking and provided valuable insights for policymakers aiming to promote the use of cleaner cooking fuels in rural India.**(Majumdar et al., 2023)**The study on socio-economic factors and clean cooking fuel consumption in India utilizes data from the National Family Health Survey (NFHS) fourth and fifth rounds, collected by the Demographic Health Survey (DHS). The research focuses on analysing the factors influencing the choice of cooking fuel among Indian households, with a particular emphasis on the transition towards clean cooking fuels. The study employs logit regression models to examine the relationship between various socio-economic variables and the use of clean cooking fuels. Independent variables include household size, age of the household head, gender of the household head, caste, religion, place of residence, education level, wealth index, financial decision maker, and drinking water source. The findings reveal that factors such as household size, age, place of residence, education level, wealth status, and caste significantly impact the preference for clean cooking fuels. Interestingly, the study highlights that Muslims and Christians are more

likely to use clean cooking fuels compared to Hindus, indicating variations in fuel choices across different religious groups. Moreover, households with higher educational attainment, better wealth status, and female financial decision-makers are more inclined towards using clean cooking fuels. The research also underscores the positive impact of targeted subsidy regimes, such as the Pradhan Mantri Ujjwala Yojana (PMUY), on promoting the adoption of clean cooking fuels among households, especially those below the poverty line [T1], [T3].**(Islam et al., 2023)** The study on the deepened socioeconomic inequality in clean cooking fuel use in India from 2005-2006 to 2015-2016, published in Heliyon, aimed to investigate the inequities in the adoption of clean cooking fuels, particularly liquefied petroleum gas (LPG), and understand the socioeconomic disparities over time. Data from the third (2005–06) and fourth (2015–16) rounds of the National Family Health

Survey in India were utilized, covering 109,041 and 601,509 households, respectively. The study employed a wealth index as a proxy measure of household socioeconomic status and analysed variables such as access to electricity, household head's education, urbanity, and household size to assess the factors influencing the transition to clean cooking fuels. The findings revealed a significant increase in the use of clean cooking fuels, with LPG becoming the most common primary cooking fuel. However, economic inequalities were observed, with a widening gap in LPG use between the poorest and middle or richer wealth quintiles. Factors such as wealth index and urbanicity played a crucial role in the disparities in clean cooking fuel adoption. These results underscore the need for targeted policy interventions to address socioeconomic disparities and promote equitable access to clean cooking technologies in India to improve public health outcomes and reduce household air pollution exposures.**(Jeuland et al., 2023)**The study conducted in south-central Kallakurichi District, Tamil Nadu, India,

aimed to assess the impact of different levels of discount vouchers on the purchase and consumption of LPG among low-income households. Data collection involved enrolling 580 households, with primary female cooks aged 18-60, who were part of the Pradhan Mantri Ujjwala Yojana (PMUY) and not exclusive users of LPG. Participants were randomized into four study arms receiving varying discount vouchers for LPG cylinder refills. The primary outcome was the total mass of LPG purchased over a sixmonth period, with secondary outcomes including estimated LPG consumption and self-reported cooking practices. The study found that households were highly pricesensitive, with LPG purchases doubling with larger discounts. However, there were no significant changes in self-reported traditional stove use or time spent collecting firewood, suggesting the need for objective measures in future studies. The findings highlight the importance of pricing in influencing LPG use and the need for larger subsidies to achieve near-exclusive use of cleaner cooking fuels among low-income households.**(Biswas & Das, 2022)**The study focuses on exploring the impact of household fuel choice, specifically the use of solid fuel, on educational outcomes among rural adolescent children in India. The data for the study was collected from multiple nationally representative datasets, including the National Family Health Survey (NFHS-4), the Time-Use Survey (TUS), and the Annual Status of Education Report (ASER) survey. The methodology involved using exogenous variation in local forest cover as an instrumental variable to address selection bias and conducting regression analyses to estimate the effects of solid fuel use on school attendance, years of schooling, and grade progression. The findings revealed a significant adverse effect of solid fuel use on educational outcomes, with children from households using solid fuel showing lower likelihood of attending school, fewer years of schooling, and slower grade progression. Additionally, the study found that these educational effects were

more pronounced for females, indicating a gender disparity in the impact of cooking fuel choice on educational outcomes. **(Perros et al., 2023)**The study focused on understanding and addressing fuel stacking behaviours in PAYG LPG customers in Kisumu, Kenya. The research utilized a survey to identify drivers of fuel stacking, developed an intervention based on the survey results using the Behaviour Change Wheel (BCW) framework, and evaluated the effectiveness of the intervention through a pre/post study. Data was collected through telephone surveys and cooking diaries, with a sample of 99 participants randomly selected from a population of 400 PAYG LPG customers. The intervention involved providing pressure cookers, chapatti pans, and training on their use. Findings showed an increase in the use of PAYG LPG and a decrease in charcoal use, with some participants completely stopping charcoal use. However, there were variations in the impact of the intervention across households, highlighting the need for further research and more rigorous study designs to assess the efficacy of fuel stacking interventions.**(Johnson et al., 2014)**The document is a corrigendum to a paper titled "Impacts on household fuel consumption from biomass stove programs in India, Nepal, and Peru." The authors are listed along with their affiliations, which include organizations such as the Berkeley Air Monitoring Group, German Agency for International Cooperation, and United States Environmental Protection Agency. The correction addresses a typo in the abstract where "United States Environmental Projection Agency" should have been "United States Environmental Protection Agency." The original article was published in Energy for Sustainable Development in 2013 with a DOI link provided. The corresponding author's contact information is also included. The document does not provide specific details on the data collection, methodology, or findings of the original paper. **(Gupta & Pelli, 2021)**The paper focuses on analysing the impact of electrification on the choice of cooking fuel

in rural India. The data used for the analysis comes from the National Sample Survey (NSS) for the years 2004-2005 and 2009-2010, containing information on 136,221 households. The methodology employed in the analysis estimates Local Average Treatment Effects (LATE) to study the effect of electrification on households that received a connection due to a change in hydro supply. The study examines both the extensive and intensive margins of the decision regarding the choice of primary cooking fuel, using binary indicators and expenditure shares. The findings suggest that electrification leads to an increase in the adoption of fuelwood and a decrease in the adoption of LPG, particularly among poorer households. The results are robust across various tests and indicate that households react differently to electrification based on their wealth levels, with poorer households experiencing a greater impact on their choice of cooking fuel.**(Ntegwa & Olan'g, 2024)** The study focuses on investigating economic and rural-urban inequalities in the use of clean cooking fuel in Tanzania using data from the National Panel Surveys conducted in 2014/15 and 2020/21. The primary objective is to understand the factors contributing to these inequalities and provide insights for policy interventions. The data collection involved nationally representative samples from the surveys, totaling 8,061 households, with information on various socioeconomic characteristics. Methodologically, the study employed a concentration curve, Erreygers concentration index, and Fairlie decomposition analysis to analyse the economic and rural-urban disparities in clean cooking fuel usage. The findings revealed an increase in economic inequality and rural-urban inequality in the use of clean cooking fuel. Factors such as household head's education, household economic status, and household connection to electricity were identified as significant contributors to the rural-urban inequality. The study recommends policy changes to ensure equitable access to education, electricity, and economic status for both rural and urban hous)

eholds to address the inequality in clean cooking fuel usage.**(Ali & Khan, 2022**)The study focused on analysing the factors affecting the adoption of clean cooking fuel among rural households during the COVID-19 pandemic in India. Data was collected through a survey conducted by the World Bank, ID insight, the Development Data Lab, and John Hopkins University, covering 2731 rural households in Bihar, Madhya Pradesh, and Uttar Pradesh. The survey included questions on socio-demographic characteristics and asset ownership of the households, as well as their access to clean cooking fuel sources. The study used descriptive statistics, chi-square statistics, and binary logistics regression analysis to analyse the data. The findings revealed a decline in the use of clean fuel such as LPG during the pandemic, with only about 20% of rural households having access to clean cooking fuel. Factors such as age, social category, income level, and asset ownership were found to have a significant impact on access to clean fuel, highlighting the need for targeted policies to promote the adoption of clean cooking fuel among rural communities. **(Rawat et al., 2009)**The document discusses the primary source of energy in rural areas of the Himalaya, which is fuel wood. The study focuses on the cold desert of the Lahaul valley and the impact of fuel wood consumption on deforestation due to extreme climatic conditions and lack of resources. Data collection was done through interviews with families in four different altitudinal villages, where fuel wood consumption was recorded based on family size and seasonal variations. The methodology involved weighing fuel wood consumption per household over 24 hours and calculating per capita consumption. Findings revealed that fuel wood consumption was highest in high altitude villages during winter, with variations based on family size. The study also highlighted the labour energy expenditure for fuel wood collection, showing higher values at higher altitudes. Overall, the study provides insights into fuel wood consumption patterns and the need for alternative energy

sources in the region.**(Okyere et al., 2024)**This study examines the adoption of cooking fuel technologies and its effect on health outcomes in the Greater Accra region of Ghana using panel data. The data was collected through four rounds of surveys between AprilMay 2014 and May-June 2015 from 505 households in 16 communities. The methodology employed correlated random effect (CRE) logit and multinomial logit models to determine the determinants of cooking fuel technologies and the inverse probability weighting regression adjustment (IPWRA) estimator to analyze the effect of cooking fuel technologies on health outcomes. The results showed that factors such as tenancy, kitchen design, assets, gender, education, access to internet, and tarred roads influenced the adoption of cooking fuel technologies. Clean cooking fuels were found to decrease female illness incidence significantly, particularly for adult females, while no significant effect was observed for male illness incidence. The study suggests that policies promoting clean cooking fuel technologies can greatly improve the well-being of females in developing countries.**(Halder et al., 2024)** The research article explores the impact of indoor air pollution (IAP) on the self-reported health (SRH) of older adults in India. The study utilized data from the Longitudinal Aging Study in India (LASI) Wave-1, which included 27,090 older adults. The data was collected between 2017 and 2018, focusing on health, socioeconomic status, and overall well-being of individuals aged 45 and above. The study employed a multiple logistic regression model to analyse the factors associated with poor SRH among older adults, considering variables such as type of cooking fuel used, cooking practices, demographic factors, and health conditions. The findings revealed a significant association between exposure to IAP, particularly from solid cooking fuels, and an increased risk of poor SRH among older adults. Factors such as traditional cooking practices, lack of ventilation, and preexisting health conditions like lung diseases, diabetes, cough, and depression were

also identified as contributing to poor SRH. The study highlights the need for targeted public health interventions, policy initiatives promoting clean cooking practices, and improved access to clean fuels to mitigate the adverse effects of IAP on the health of older adults in India.**(Garland et al., 2015)**The study on household energy programs in Benin, Uganda, and India aimed to assess the fuel consumption impacts of different technologies. Data collection was conducted through field studies supported by the U.S. EPA, focusing on a charcoal stove in Benin, an LPG program in Uganda, and a forceddraft wood stove in Gujarat, India. The Kitchen Performance Test (KPT) protocol was utilized to estimate daily fuel consumption, comparing traditional stoves with intervention technologies. In Benin, households using Éclair stoves showed significant reductions in charcoal consumption, translating into environmental benefits. In Uganda, LPG adoption led to lower charcoal use, highlighting the importance of transitioning to cleaner fuels. However, in India, results were influenced by exclusive use of the Eco Chulha, potentially overestimating fuel savings. The findings underscore the need for comprehensive field assessments to understand the real-world performance of household energy programs and emphasize the importance of sustained technology use and displacement of traditional methods for program success. Further research should focus on monitoring technology usage patterns and addressing barriers to full adoption of clean stoves and fuels to maximize health and environmental benefits. **(Das et al., 2021)**The study on the water footprint of food and cooking fuel in self-sufficient rural India provides valuable insights into the water consumption patterns of rural households. The researchers collected data on food and cooking fuel consumption from the National Sample Survey of Consumption Expenditure in India, focusing on per capita consumption in different provinces. They categorized food items into six groups, including rice, wheat, oils and fats, milk, other animal foods, and others, to analyze

their water footprints. The methodology involved quantifying the water footprint of crops using a grid-based dynamic water balance model and considering factors like temperature, precipitation, and nitrogen use. The findings revealed that rural households in India rely on self-production of food and cooking fuel, with smallholder farmers growing crops for consumption and livestock providing eggs, milk, and meat. Fuelwood collection from forests or trees outside forests is a common practice, impacting the water footprint. The study highlights the importance of understanding water footprints in food and fuel production for promoting sustainable water use in rural communities.**(Islam et al., 2022)**This nationally representative population-based study investigated the association between the use of unclean cooking fuels (UCF) and visual impairment among older adults in India. Data was collected from the first wave of the Longitudinal Ageing Study in India (LASI) conducted from April 2017 to December 2018, involving around 72,000 individuals aged 45 years and older. The study utilized a stratified, multistage cluster random sampling method to ensure representation at both national and state levels. Statistical analysis included controlling for various covariates such as household economic status, education level, urban/rural location, and smoking habits. The findings revealed that approximately 45% of older adults in India were exposed to UCF, with 37.1% experiencing visual impairment. Those using UCF were more likely to belong to socioeconomically disadvantaged groups, have lower educational attainment, and reside in rural areas without proper ventilation during cooking. These results underscore the importance of addressing household air pollution from cooking fuels to mitigate visual health issues among older adults in India. **(Gould and Urpelainen,2018)**LPG as a Clean Cooking Fuel: Adoption, Use, and Impact in Rural India" presents a comprehensive analysis of the adoption, use, and impact of LPG as a clean cooking fuel in rural Indian households. The study utilized a survey-based

methodology to gather data on fuel choices, cooking arrangements, and perceptions of LPG among rural households. Data collection involved assessing factors such as overall satisfaction with cooking arrangements, reasons for dissatisfaction with LPG, barriers to LPG adoption, and perceptions of fuel availability and health impacts. The findings highlight challenges such as cost, availability, and maintenance services as key obstacles to the widespread adoption of LPG. Additionally, the study sheds light on the prevalence of traditional biomass fuels like firewood and cow dung, alongside LPG, indicating a need for a more nuanced understanding of fuel stacking practices in rural India.

2.3 :RESEARCH GAP

The research literature lacks a comprehensive examination of how gender dynamics, including women's empowerment and decision-making autonomy, influence the adoption of LPG as a clean cooking fuel in Indian households. Understanding these gender-specific factors is crucial for designing effective interventions to promote sustainable energy transitions and address gender disparities in energy access.

CHAPTER 3: DATA,VARIABLES AND METHODOLOGY

3.1 Data and variables

The IHDS (India Human Development Survey) panel data utilized in this study constitutes a nationally representative and multi-topic survey conducted across India, encompassing a total of 42,152 households. This survey was conducted in 1,503 villages and 971 cities/towns, ensuring broad geographic coverage across the country. The data collection process commenced in 2005, where information was gathered from households. Surveyors revisited the same households in 2011-12 for the second round of interviews, achieving an impressive re-contact rate of 83 percent. This approach allowed for the longitudinal examination of changes within households over time, providing valuable insights into socioeconomic dynamics and household behaviours. The IHDS dataset captures a wide range of socioeconomic variables, including household consumption patterns, income levels, energy usage, infrastructure access, and women's empowerment indicators. The dataset offers detailed insights into cooking fuel choices, allowing researchers to analyse the factors influencing the transition from traditional fuels to cleaner alternatives like liquefied petroleum gas (LPG).

3.1.1 Variables used from IHDS Dataset (2005)

- **FU9: LPG use (2005)**: LPG usage indicates the extent or frequency of usage of LPG (liquefied petroleum gas) for cooking purposes within households or communities. It could represent whether households primarily rely on LPG for cooking or if they use alternative fuels.
- **FU11A: Fuel distance (2005)**: Fuel distance represent the distance travelled to acquire fuel, specifically related to LPG usage for cooking. It provides insight into the accessibility of LPG sources and the effort required to obtain it.
- **FU9B: LPG Rs (2005)**: LPG Rs is the expenditure or cost associated with LPG usage for cooking, expressed in monetary terms. It helps understand the financial implications of using LPG as a cooking fuel.
- **EW7: Women's Education (2005)**: Educational attainment of women within households or communities. It could indicate the level of education achieved by women, which is important for understanding socio-economic dynamics and empowerment.
- **GR1G: Cooking Most Say (2005):** cooking most say represent the most widely used cooking methods or fuels preferred by households or communities.
- **ID17: Place of Origin (2005)**: Place of origin geographical or regional origin of households or individuals. It provides information about the demographic distribution and diversity of the population under study.
- **ID20: Education head's father/husband (2005**): Educational background of the head of the household's father or husband. It provides insights into intergenerational education patterns and influences on household decision-making.

- **FU9A: LPG source (2005)**: It specify whether LPG is obtained from government subsidies, commercial vendors, or other sources, providing insights into the availability and affordability of LPG.
- **SA2A: Vent in cooking place (2005):** It show the presence or absence of ventilation systems in cooking areas. It is important for indoor air quality and safety during cooking activities, as proper ventilation reduces the risk of exposure to harmful pollutants**.**
- **MM5A: TV news regular Men (2005)**: Men's population regularly who watch TV news. It provides insights into the media consumption habits of men specifically regarding television news programs.
- **MM5B: TV news regular Women (2005)**: women's population who regularly watch TV news. It provides insights into the media consumption habits of women regarding television news programs.
- **MM2A: Newspaper regular Men (2005):** Men's population who regularly read newspapers. It provides insights into the media consumption habits of men specifically regarding newspaper reading habits.
- **MM2B: Newspaper regular Women (2005)**: Women's population who regularly read newspapers. It provides insights into the media consumption habits of women regarding newspaper reading habits.
- **MM1A: Radio regular Men (2005):** Men's population who regularly listen to the radio. It provides insights into the media consumption habits of men specifically regarding radio programs.

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- **MM1B: Radio regular Women (2005):** Women's population who regularly listen to the radio. It provides insights into the media consumption habits of women regarding radio programs.

  FU4: HH chulha type (2005): Cooking stoves or chulhas used within households, providing insight into the diversity of cooking methods employed. It helps understand the prevalence of different cooking technologies and their potential implications for indoor air quality and fuel consumption.
- **FU9: LPG use (2005)**: LPG (liquefied petroleum gas) usage for cooking purposes within households, reflecting the adoption of cleaner and more efficient cooking fuels. Understanding LPG use patterns helps assess the transition towards sustainable energy practices and its impact on household health and environment.
- **FU10: Coal/charcoal use (2005)**: It represents the utilization of coal or charcoal as cooking fuels within households, indicating reliance on traditional and potentially polluting energy sources.
- **FU5: Firewood use (2005)**: Usage of firewood as a cooking fuel within households, highlighting dependence on traditional biomass fuels and their environmental implications.
- **FU8: Kerosene use (2005)**: kerosene as a cooking fuel within households, often indicating limited access to cleaner energy sources.
- **CO38: appliances Rs (2005):** Household appliances within the past 365 days in 2005, measured in Indian Rupees (Rs). It includes expenses related to purchasing, maintaining, or repairing various household appliances such as refrigerators, stoves, washing machines, etc.

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- **FU9B: LPG Rs (2005)**: The expenditure or cost associated with LPG (liquefied petroleum gas) usage for cooking purposes within households in 2005, measured in Indian Rupees (Rs).
  FU10B: Coal/charcoal Rs (2005): This variable represents the expenditure on coal or charcoal usage for cooking within households in 2005, measured in Indian Rupees (Rs). It indicates the financial costs associated with using coal or charcoal as cooking fuels.
- **FU1C: Electricity Rs (2005)**: This variable indicates the expenditure on electricity usage for cooking and other household purposes within households in 2005, measured in Indian Rupees (Rs). It reflects the financial costs associated with using electricity as an energy source.
- **CO4X: Kerosene: Rs (2005):** Kerosene usage for cooking within households in 2005, measured in Indian Rupees (Rs). It indicates the financial costs associated with using kerosene as a cooking fuel.
- **FU5: Firewood use (2005)**: This variable may represent the expenditure or cost associated with firewood usage for cooking purposes within households in 2005.
- **FU7B: Crop residue Rs (2005)**: The expenditure on crop residue or by-product usage for cooking within households in 2005, measured in Indian Rupees (Rs).
- **FU6B: Dung Rs (2005):** Dung cake usage for cooking purposes within households in 2005, measured in Indian Rupees (Rs).

3.1.2 Variable used from IHDS dataset 2011

- **ID17: Type of origin place (2011):** The type of place where households or individuals originate from. It could distinguish between rural and urban areas, specific regions or states, or even different types of settlements like villages, towns, or cities.
- **ID18A: Occupation household head's father/husband's father (2011)**: The occupation or profession of the father or husband's father of the head of the household. It provides insight into the occupational backgrounds of previous generations within households, which can influence socio-economic status and career aspirations.
- **ID18C: Education head's father/husband (2011):** This variable likely represents the educational level attained by the father or husband of the head of the household. It helps understand the intergenerational transmission of education and its impact on household decision-making, socio-economic status, and human capital accumulation.
- **MP6S: Wedding gift in your community LPG (2011):** Wedding customs or traditions within a community, specifically regarding gifts related to LPG. It may indicate whether LPG cylinders or related equipment are commonly given as wedding gifts in the community.
- **FU3: Hours burning stove/Chulha (cooking, heating water, making tea, etc.) (2011)**: The amount of time spent using a stove or Chulha (traditional cooking stove) for various purposes such as cooking meals, heating water, or preparing beverages like tea. It provides insights into cooking habits and energy usage patterns within households
- **FU6: Household chulha type(2011):**Type of cooking stove or chulha used in households. It could differentiate between traditional mud stoves, improved cook stoves, gas stoves, or electric stoves, which has implications for fuel use, indoor air pollution, and cooking efficiency**.**

- **FU13A: Fuel distance one-way (minutes)(2011):** The time taken to travel one way to acquire fuel, such as LPG, firewood, or other cooking fuels. It provides information on the accessibility and convenience of fuel sources, which can influence fuel choice and household energy expenditure.
- **INCOME: Total income (2011):** Total income earned by households within a certain period, such as annually or monthly. It reflects the overall economic resources available to the household and influences consumption patterns, living standards, and socioeconomic status.
- **INCOMEPC: Per capita income (2011):** The income per person within a household by dividing the total household income by the number of household members. It provides a measure of individual economic well-being and can be used to assess income distribution within households.
- **MM1M: How often radio – Men (2011):** Men's population who listen to the radio. It provides insights into the media consumption habits of men specifically regarding radio programs.
- **MM2M: How often newspaper – Men (2011):** men's population who read newspapers. It provides insights into the media consumption habits of men specifically regarding newspaper reading habits.
- **MM3M: How often TV – Men (2011)**: Men's population who watch television. It provides insights into the media consumption habits of men specifically regarding television programs.
- **MM1W: How often radio – Women (2011):** Similar to MM1M, this variable represents the frequency with which women in a population listen to the radio. It

provides insights into the media consumption habits of women regarding radio programs.

MM2W: How often newspaper – Women (2011): Women's population who read newspapers. It provides insights into the media consumption habits of women regarding newspaper reading habits.

- **MM3W: How often TV – Women (2011):** Similar to MM3M, this variable represents the frequency with which women in a population watch television. It provides insights into the media consumption habits of women specifically regarding television programs.
- **FU6: Household chulha type (2011):** the type of cooking stove or chulha used within households in 2011. It provides insight into the diversity of cooking technologies employed, including traditional mud stoves, improved cook stoves, gas stoves, or electric stoves, and their implications for fuel use, indoor air quality, and cooking efficiency.
- **FU7: Use firewood/twigs - main purpose (2011):** firewood or twigs are utilized within households in 2011, such as cooking or heating. It reflects the importance of biomass fuels in meeting household energy needs and their environmental implications.
- **FU8: Use dung cake - main purpose (2011)**: Dung cakes are used within households in 2011, such as cooking or heating. Dung cakes are a traditional biomass fuel commonly used in rural areas, and understanding their main purpose helps assess reliance on traditional energy sources and their impact on indoor air quality and health.
- **FU9: Use crop residue/by-product - main purpose (2011):** Crop residues or byproducts are utilized within households in 2011, such as cooking or heating. Utilizing agricultural residues as fuel contributes to resource efficiency and may have implications for agricultural practices, energy access, and environmental sustainability.

- **FU10: Use kerosene - main purpose (2011)**: Kerosene is utilized within households in 2011, such as cooking or lighting. Kerosene is commonly used in areas where access to cleaner fuels like LPG is limited, and understanding its main purpose helps identify opportunities for improving household energy access and reducing indoor air pollution.
- **FU11: Use LPG - main purpose (2011)**: LPG (liquefied petroleum gas) is utilized within households in 2011, such as cooking or heating. LPG is a clean-burning fuel, and its usage may reflect efforts to transition towards more sustainable and environmentally friendly cooking practices.
- **FU12: Use coal/charcoal - main purpose (2011)**: coal or charcoal is utilized within households in 2011, such as cooking or heating. Coal and charcoal are traditional biomass fuels commonly used in many households, and understanding their main purpose helps assess reliance on traditional energy sources and their environmental and health implications.
- **CO42: Cooking and Household appliances: Total value Rs (2011)**: Cooking and household appliances purchased within the last 365 days in 2011, measured in Indian Rupees (Rs). It includes expenses related to purchasing, maintaining, or repairing various appliances used for cooking and other household purposes.
- **FU7B: Purchased firewood/twigs last 30 days Rs (2011)**: Purchasing firewood or twigs for cooking purposes within households in the last 30 days in 2011, measured in Indian Rupees
- **FU10B: Purchased kerosene last 30 days Rs (2011):** Purchasing kerosene for cooking purposes within households in the last 30 days in 2011, measured in Indian Rupees (Rs).
- **FU11B: Purchased LPG last 30 days Rs (2011)**: Purchasing LPG (liquefied petroleum gas) for cooking purposes within households in the last 30 days in 2011, measured in

Indian Rupees (Rs).

FU12B: Purchased coal/charcoal last 30 days Rs (2011): This variable represents the expenditure on purchasing coal or charcoal for cooking purposes within households in the last 30 days in 2011, measured in Indian Rupees (Rs). It indicates the financial costs associated with acquiring coal or charcoal as cooking fuels.

- **FU8B: Purchased dung cake last 30 days Rs (2011)**: Purchasing dung cakes for cooking purposes within households in the last 30 days in 2011, measured in Indian Rupees (Rs).
- **FU9B: Purchased crop residue/by-product last 30 days Rs (2011):** Purchasing crop residues or by-products for cooking purposes within households in the last 30 days in 2011, measured in Indian Rupees (Rs).
- **FU1C: Electricity Price Rs (30 days) (2011)**: This variable represents the price of electricity used for cooking and other household purposes within households in the last 30 days in 2011, measured in Indian Rupees (Rs). It reflects the cost of electricity consumption over the specified time period.

3.2 Data source

The data has been collected from IHDS (India Human Development Survey) panel data of the year (2005&2011-12), and a selected category of Household data has been taken for the study.

3.3 Methodology:

The data type used in This study is panel data analysis approach to investigate the consumption patterns of LPG (liquefied petroleum gas) in India over the years 2005 and 2011-12. Panel data

analysis allows for the examination of changes within individual units (in this case, households) over multiple time periods, enabling a more comprehensive understanding of the determinants of LPG usage. Through this methodological approach, this study seeks to contribute to the existing literature on household energy consumption and inform evidence-based strategies for promoting clean cooking technologies in India.

3.3.1 Regression Analysis: was employed to investigate the association between household characteristics and the probability of adopting LPG as a cooking fuel. The analysis included variables such as income status, education level, rural and urban usage and exposure to mass media to discern the influential factors affecting LPG adoption. By utilizing regression models, this study aimed to identify the significant predictors of LPG adoption and understand the subtle relationships between household attributes and the likelihood of transitioning to LPG usage. Through this analytical approach, the research sought to contribute valuable insights into the determinants of clean cooking fuel adoption in households.

3.3.2 Descriptive Analysis: To effectively convey these results, a variety of charts and graphs were utilized. Bar graph may has been employed to visualize continuous variable distributions, while bar charts could has been utilized to compare frequencies or proportions of categorical variables. By integrating these visual aids into the descriptive analysis, the researchers were able to offer a concise and transparent summary of household characteristics, aiding in dataset comprehension and key findings communication.

3.4 Hypotheses

Hypotheses of this study:

- -Null Hypothesis (H0): There is no significant relationship between social factors (such as education, and urban/rural residence) and the likelihood of households using LPG as a cooking fuel.

  -Alternative Hypothesis (H1): Social factors (such as education, and urban/rural residence) significantly influence the likelihood of households using LPG as a cooking fuel**.**

3.4.1 Hypothesis related to each variable from (2005 $ 2011-12) IHDS panel Dataset: a)

Education Hypothesis

- Null Hypothesis (H0): There is no significant relationship between the level of education among household women's and LPG usage.
- Alternative Hypothesis (H1): Higher levels of education among Women's are associated with an increased likelihood of using LPG for cooking.

b) Rural-Urban Disparity Hypothesis

- Null Hypothesis (H0): There is no significant difference in LPG usage between urban and rural households.
- Alternative Hypothesis (H1): Urban households are more likely to use LPG for cooking compared to rural households.

c)Media exposure

- Null Hypothesis (H0): There is no significant difference in mass media exposure between male and female individuals.

- Alternative Hypothesis (H1): There is a significant difference in mass media exposure between male and female individuals.

d) Comparing 2005&2011

- Null Hypothesis (H0): There is no significant difference in LPG usage and LPG prices between households in the 2005 and 2011 IHDS datasets.
- Alternative Hypothesis (H1): There is a significant difference in LPG usage and LPG prices between households in the 2005 and 2011 IHDS datasets.

CHAPTER 4:

RESULT AND DISCUSSION

4.1 Introduction :

In the fourth chapter of this study, we embark on a detailed exploration of the determinants of LPG usage, building upon the logistic regression analyses conducted in the preceding chapters. Leveraging methodologies such as logistic regression, we have scrutinized a myriad of variables including socio-economic indicators, media exposure, and household characteristics to unravel the intricate factors influencing the adoption of LPG as a household energy source. This chapter serves as a pivotal platform to present and interpret the statistical findings, elucidating the nuanced relationships between these variables and LPG adoption propensity. Through a rigorous examination of the coefficients obtained from our analyses, we aim to provide a comprehensive understanding of the drivers and barriers shaping household decisions regarding LPG usage, thus contributing to the broader discourse on sustainable energy transitions and household welfare.

4.2:Tables –showing the data of the variables.

4.3: Regression Models-showing the relationsip between the variables .

4.4:Graph- showing the numbers of LPG users .

Table 4.2.1: State-Wise LPG Usage For The Year (IHDS2011)

States	Use LPG: main purpose					
	Fuel not used 1	Mainly cooking 2	Mainly lighting 3	Mainly heating 4	Combination 5	Total
Jammu & Kashmir 01	118	591	0	1	10	720
Himachal Pradesh 02	487	962	22	0	5	1476
Punjab 03	466	933	0	1	302	1702
Chandigarh 04	6	63	0	0	16	85
Uttarakhand 05	223	201	11	1	32	468
Haryana 06	788	895	2	14	79	1778
Delhi 07	29	843	1	2	23	898
Rajasthan 08	1633	989	6	10	62	2700
Uttar Pradesh 09	2528	931	32	1	326	3818
Bihar 10	1138	396	5	0	1	1540
Sikkim 11	9	96	1	1	0	107
Arunachal Pradesh 12	53	100	2	0	0	155
Nagaland 13	2	92	0	0	16	110
Manipur 14	3	80	2	3	0	88
Mizoram 15	10	65	0	1	1	77

Tripura 16	147	70	3	0	0	220
Meghalaya 17	102	29	0	1	2	134
Assam 18	494	483	2	0	2	981
West Bengal 19	1586	820	5	11	10	2432
Jharkhand 20	606	243	4	0	0	853
Orissa 21	1686	309	2	4	57	2058
Chhattisgarh 22	1093	159	4	0	68	1324
Madhya Pradesh 23	2376	659	7	2	79	3123
Gujarat 24	1019	574	1	6	292	1892
Daman & Diu 25	16	42	0	0	1	59
Dadra+Nagar Haveli 26	24	35	0	0	0	59
Maharashtra 27	1600	1068	3	4	631	3306
Andhra Pradesh 28	895	1059	11	12	195	2172
Karnataka 29	2238	1446	7	12	134	3837
Goa 30	5	177	0	6	0	188
Kerala 32	215	1206	3	3	128	1555
Tamil Nadu 33	742	831	1	8	398	1980
Pondicherry 34	11	0	0	1	95	107
Total	22348	16447	137	105	2965	42002

Source(Authors own commutation)

LPG (liquefied petroleum gas) across various states and union territories in India, categorized by its main purposes. The Table depict the number of households or individuals using LPG primarily for cooking, lighting, heating, or a combination of these purposes.In Jammu &

Kashmir, a majority of LPG usage is attributed to cooking, with 591 households using it primarily for this purpose, followed by 118 households using it for a combination of purposes.In states like Punjab and Haryana, a significant portion of LPG usage is also allocated for heating purposes, with 302 and 79 households respectively using it mainly for heating.The data indicates that while cooking remains the predominant use of LPG across most regions, there are variations in the extent to which it is used for lighting, heating, or a combination of these purposes, reflecting diverse household needs and preferences across different parts of the country.

Table 4.2.2: State-Wise LPG Usage For The Year IHDS(2005)

State code	LPG use:main purpose						
	Invalid skip	Fuel not used	Mainly cooking	Mainly lighting	Mainly heating	Combination	Total
Jammu & Kashmir	26	164	447	27	1	50	715
Himachal Pradesh	8	580	745	2	0	37	1372
Punjab	21	424	681	7	0	460	1593
Chandigarh	0	7	82	0	0	1	90

Uttaranchal	38	221	156	2	2	39	458
Haryana	46	725	830	2	1	14	1618
Delhi	21	97	566	3	0	273	960
Rajasthan	75	1595	665	4	22	124	2485
Uttar Pradesh	299	2253	893	17	4	46	3512
Bihar	71	1016	337	4	1	0	1430

Sikkim	0	4	101	0	0	0	105
Arunachal Pradesh	3	83	78	1	0	0	165
Nagaland	15	53	61	1	0	0	130
Manipur	25	15	2	4	0	59	105
Mizoram	1	6	96	1	0	1	105
Tripura	121	20	86	2	0	0	229
Meghalaya	50	69	40	0	0	2	161
Assam	65	549	383	3	0	17	1017
West Bengal	53	1563	650	2	0	112	2380
Jharkhand	13	688	219	2	0	2	924
Orissa	68	1646	347	2	0	1	2064
Chhatishgarh	189	809	175	0	0	2	1175

Madhya Pradesh	293	2030	344	6	2	130	2805
Gujarat	30	1112	646	5	1	284	2078
Daman & Diu	2	25	28	0	0	5	60
Dadra+Nagar Haveli	0	30	14	0	0	16	60
Maharashtra	52	1822	671	3	4	651	3203
Andhra Pradesh	61	1462	682	3	0	227	2435
Karnataka	99	2811	836	28	3	243	4021
Goa	4	13	123	1	0	24	165
Kerala	18	601	1093	6	0	13	1731
Tamil Nadu	16	1241	610	5	3	223	2098
Pondicherry	1	59	43	0	0	2	105
Total	1784	23793	12730	143	44	3058	41554

Source(Authors own commutation)

LPG (liquefied petroleum gas) across various states and union territories in India, categorized by its primary purpose. Each entry indicates the number of households or individuals in a particular region utilizing LPG for cooking, lighting, heating, or a combination of these purposes.In Jammu & Kashmir, the majority of LPG usage is attributed to cooking, with 447 households using it primarily for this purpose, followed by 164 households using it for a combination of purposes, in states like Punjab and Haryana, a significant portion of LPG usage is allocated for cooking as well, with 681 and 830 households respectively using it mainly for

cooking.The data showcases that cooking is the predominant use of LPG across most regions, with varying degrees of usage for lighting, heating, or a combination of purposes. These variations reflect the diverse household needs and preferences across different parts of the country.

Table 4.2.3 Women Education Year(IHDS 2011)

HQ19 11.6 Highest female adult education	Urban residence from census 2011		
	rural 0	urban 1	Total
none 0	12481	2925	15406
1st class 1	105	26	131
2nd class 2	442	156	598
3rd class 3	608	259	867
4th class 4	883	332	1215
5th class 5	2408	986	3394
6th class 6	633	343	976
7th class 7	1321	752	2073
8th class 8	1766	1037	2803
9th class 9	1616	1124	2740
Secondary 10	1905	1761	3666
11th Class 11	283	238	521
High Secondary 12	1286	1361	2647

1-year post-secondary	109	145	254
2 years post-secondary	190	237	427
Bachelors 15	723	1640	2363
Above Bachelors 16	353	1021	1374
Total	27112	14343	41455

Source(Authors own commutation)

Interpretion:

The table shows the highest female adult education level in rural and urban areas according to the census of 2011. Overall, more females in urban areas have a higher level of education compared to those in rural areas. For instance, 1,361 females in urban areas have a high secondary diploma compared to 1,286 in rural areas.

None: There are more females in rural areas (12,481) with no education compared to urban areas (2,925).

Primary School: The number of females with primary school education is almost equal in both areas (rural: 6,078, urban: 5,910).

Secondary School: More females in urban areas (3,085) have secondary school education compared to rural areas (2,373).

Higher Secondary: More females in urban areas (1,361) have a high secondary diploma compared to rural areas (1,286).

Bachelor’s Degree or higher: More females in urban areas (2,661) have a bachelor's degree or higher compared to rural areas (723).

Model 4.3.1 : LPG usage by Educated womens (2011)

LPG_usage (2011)	coffit (Odds ration)	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
women_education	1.075	.001	80.60	0	.071	.075	***
Constant	3.60	.007	182.99	0	1.267	1.294	***

Mean dependent var	1.693	SD dependent var	1.044
R-squared	0.136	Number of obs	41325
F-test	6495.620	Prob > F	0.000
Akaike crit. (AIC)	114806.524	Bayesian crit. (BIC)	114823.782

Interpretion:

The results of the logistic regression analysis provide valuable insights into the relationship between women's education and LPG usage, after converting the coefficients into odds ratios. The odds ratio associated with women's education is approximately 1.075. This suggests that for every one unit increase in women's education, the odds of LPG usage increase by a factor of about 1.075, holding all other variables constant. This implies that higher levels of education among women are associated with a slightly higher likelihood of using LPG for cooking or heating purposes.

The constant term in the model yields an odds ratio of approximately 3.60. This represents the baseline odds of LPG usage when all other predictor variables are zero or not applicable.

Finding: The importance of women's education in influencing household decisions regarding energy usage, particularly with regard to the adoption of cleaner and more

efficient energy sources such as LPG. Higher levels of education among women contribute positively to the likelihood of LPG usage, emphasizing the role of education in promoting sustainable energy practices and improving overall household welfare.

Ho: the (null hypothsis) is rejected and the H1 (Allternative is accepted) in this model .

Model 4.3.2: LPG usage by rural and urban households (2011)

LPG_usage (2011)	Odd ratio	St.Err.	t-value	pvalue			Sig
urban_rural	2.22	.01	80.22	0			***
Constant	4.11	.006	241.52	0			***

Mean dependent var	1.688	SD dependent var	1.041
R-squared	0.133	Number of obs	42002
F-test	6434.850	Prob > F	0.000
Akaike crit. (AIC)	116573.543	Bayesian crit. (BIC)	116590.834

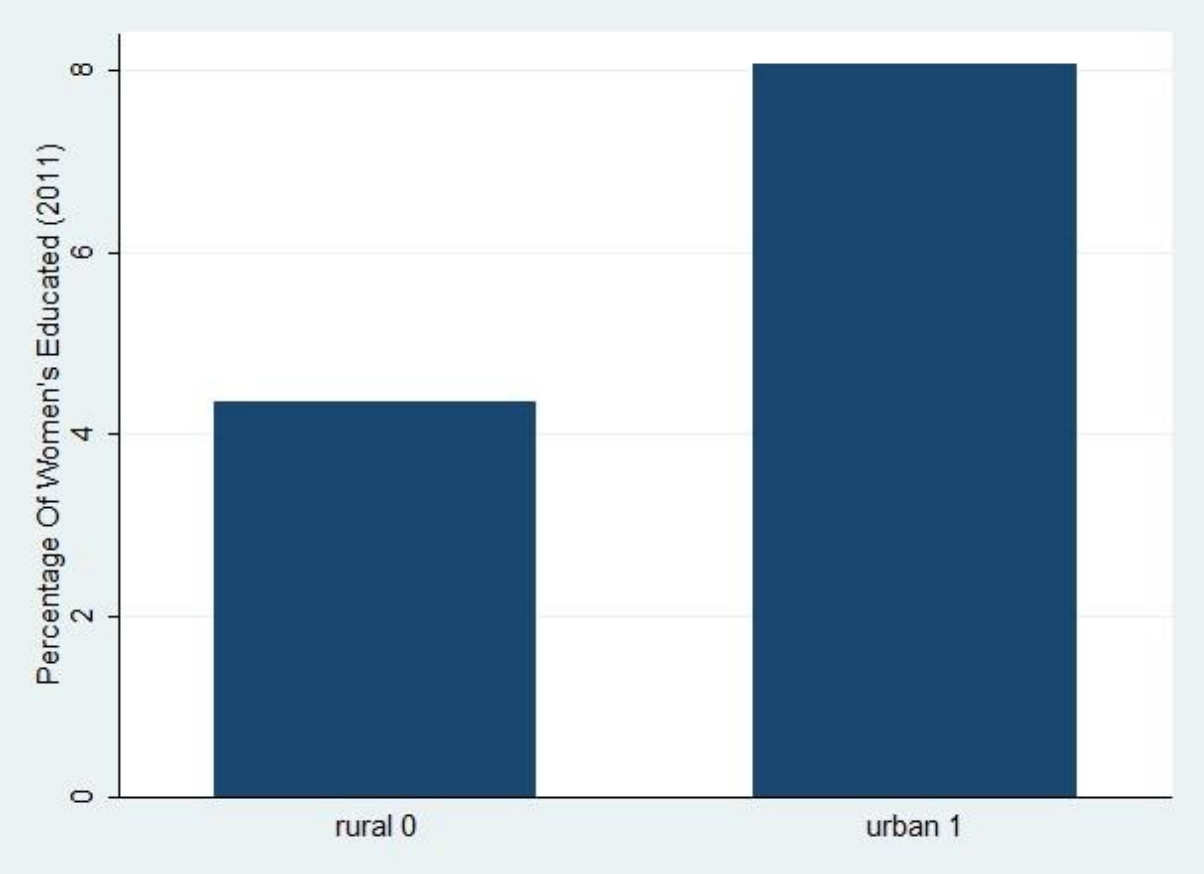
Interpretion:

The logistic regression analysis reveals a significant disparity in LPG adoption between urban and rural areas, as indicated by the odds ratio associated with urban vs. rural residence, which is approximately 2.22. This suggests that households residing in urban

areas exhibit roughly 2.22 times higher odds of using LPG compared to their rural area, holding all other variables constant. The higher odds of LPG usage in urban areas suggest a greater accessibility and acceptance of LPG, potentially driven by factors like convenience and cleaner energy initiatives.

Findings :.Understanding the differential adoption of LPG between urban and rural areas and acknowledging the influence of unmeasured factors, targeted interventions can be developed to facilitate LPG adoption, particularly in rural regions where usage rates may be lower. Efforts aimed at improving infrastructure, raising awareness about the benefits of LPG, and addressing economic barriers could help bridge the urban-rural gap in LPG usage, thereby contributing to more equitable energy access and environmental sustainability

Graph 4.4.1:Number of women's educated in rural and urban area in (2011)



Source(Authors own commutation)

The bar graph shows the percentage of women who have a college degree in rural and urban areas. The y-axis shows the percentage, and the x-axis shows the area (rural or urban).The percentage of women with a college degree is higher in Urban areas than in rural areas. In urban areas, 8% of women have a college degree, whereas in Rural areas, only 4% of women have a college degree.

Table 4.2.4:Women's Education Year (IHDS 2005)

EH19 13.7 EWoman: Education	Census: 2001 village/town		
	Rural	Urban	Total
Valid blank	5595	2902	8497
none	11263	3093	14356
1st class	72	40	112
2nd class	389	139	528
3rd class	492	222	714
4th class	761	316	1077
5th class	2033	1038	3071
6th class	495	376	871
7th class	999	705	1704
8th class	1179	934	2113
9th class	899	765	1664
10th class	1466	1733	3199
11th std	128	155	283

12th std	572	912	1484
1st year	18	45	63
2nd year	33	48	81
Bachelor's	340	1396	1736
Above Bachelors	0	1	1
Total	26734	14820	41554

Source(Authors own commutation)

Table provides a educational level within the village/town, offering insights into the disparities and trends in educational attainment between rural and urban residents.

Model 4.3.3:LPG Usage By Women's Educated

(2005)

LPG_usage2005	Coef/(odd ratio)	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
women_education	**0(0)**	0	25.20	0	0	0	***
Constant	**.439(1.55)**	.007	63.24	0	.425	.452	***

Mean dependent var	0.440	SD dependent var	1.425
R-squared	0.015	Number of obs	41554
F-test	635.119	Prob > F	0.000
Akaike crit. (AIC)	146755.831	Bayesian crit. (BIC)	146773.100

Interpretion:

The regression analysis results indicate a significant relationship between LPG usage in 2005 and women's education levels. The coefficient for women's education is 0, suggesting that there is no direct effect of women's education on LPG usage in 2005. However, this coefficient is accompanied by a high t-value of 25.20 and a p-value of 0, indicating that despite the coefficient being 0, there is strong evidence to suggest that women's education levels are indeed associated with LPG usage in 2005. The confidence interval for this coefficient is from 0 to 0, which aligns with the coefficient being precisely 0. The constant term in the regression equation is 0.439, representing the expected level of LPG usage in 2005 when women's education levels are zero. This constant is statistically significant, with a high t-value of 63.24 and a p-value of 0. The overall model fit is relatively low, with an R-squared value of 0.015, indicating that only 1.5% of the variance in LPG usage in 2005 can be explained by women's education levels.

However, the F-test for the overall significance of the model is highly significant, with a value of 635.119 and a p-value of 0.000, indicating that the model as a whole is statistically significant. The Akaike and Bayesian information criteria suggest that while the model fit is not particularly strong, it still provides valuable insights. In summary, although the coefficient for women's education is 0, the results suggest that women's education levels are indeed associated with LPG usage in 2005, albeit indirectly or through complex interactions with other variables.

Model 4.3.4:LPG Usage By Rural And Urban Household (2005)

LPG_usage2005	Coef.(odd ratio)	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
urban_rural	**1.024(2.78)**	.014	74.73	0	.997	1.051	***
Constant	**.075(1.08)**	.008	9.11	0	.059	.091	***

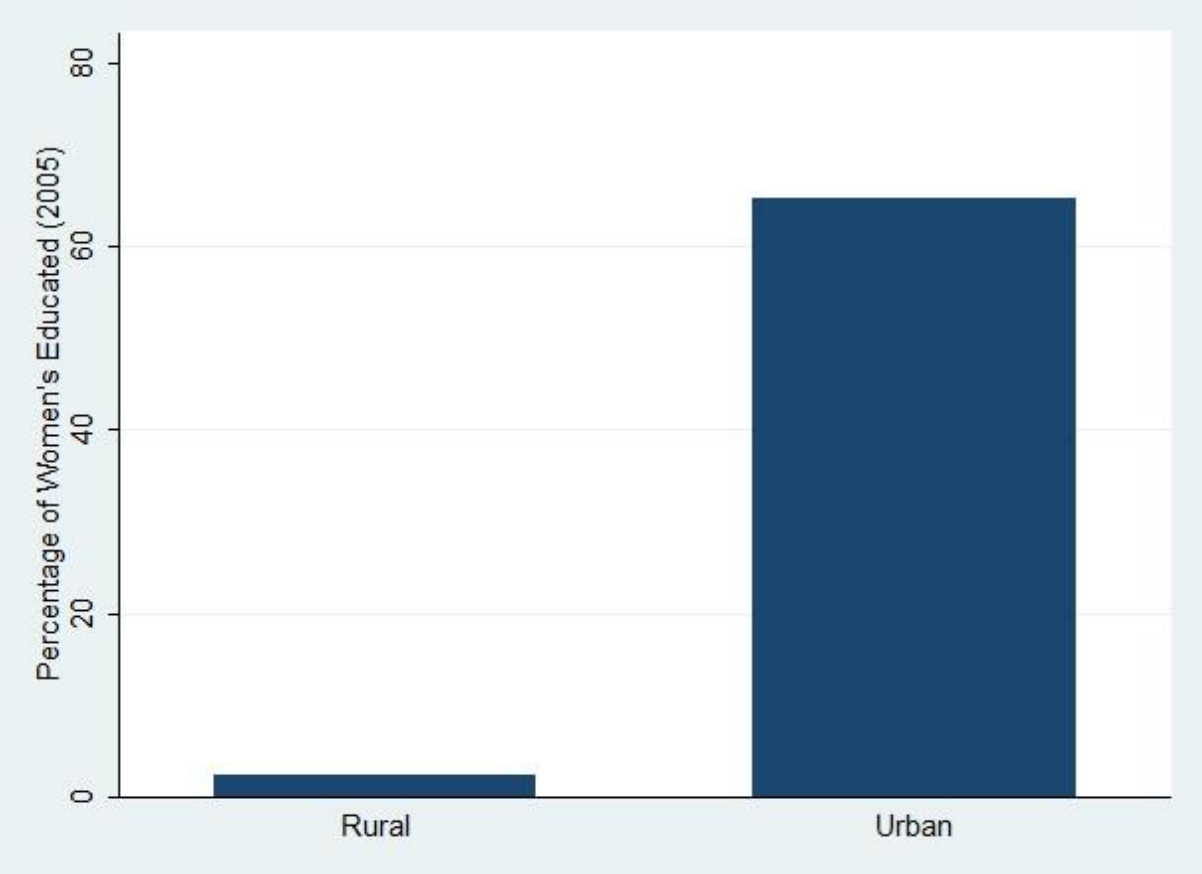
Mean dependent var	0.440	SD dependent var	1.425
R-squared	0.118	Number of obs	41554
F-test	5584.794	Prob > F	0.000
Akaike crit. (AIC)	142145.874	Bayesian crit. (BIC)	142163.143

Interpretion:

The logistic regression analysis highlights a significant disparity in LPG adoption between urban and rural areas, as indicated by the odds ratio associated with urban vs. rural residence, approximately 2.78. Households residing in urban areas exhibit roughly 2.78 times higher odds of using LPG compared to their rural area , holding all other variables constant. The higher odds of LPG usage in urban areas signify a greater accessibility and acceptance of LPG, potentially driven by factors like convenience and awareness campaigns.

(Ho)The null hypothesis is rejeceted

Graph 4.4.2:Number of women's educated in rural and urban area in (20



Source(Authors own commutation)

Model 4.3.5:Regression On Fuel Usage IHDS 2011

LPG_usage2011	Coef(odd ratio)	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
origin_place	**-041(0.96**)	.031	-1.32	.188	-.103	.02	
occupation_head	**0(1)**	.001	0.04	.967	-.001	.001	
_fa~r							
edu_head_household	**0(1)**	.004	-0.01	.996	-.007	.007	

wedding_gift	**.138(1.148)**	.018	7.79	0	.103	.173	***
hours_burning_chul~h	**-.031(0.970)**	.012	-2.66	.008	-.053	-.008	***
chulah_type	**.137(1.147)**	.022	6.08	0	.093	.181	***
fuel_distance	**-.111(0.895)**	.035	-3.17	.002	-.18	-.042	***
total_income	**0(1)**	0	0.74	.457	0	0	
percapita_income	**0(1)**	0	-1.70	.089	0	0	*
Constant	**2.221(9.218)**	.134	16.57	0	1.958	2.484	***

Mean dependent var	2.617	SD dependent var	1.206
R-squared	0.019	Number of obs	6415
F-test	13.468	Prob > F	0.000
Akaike crit. (AIC)	20509.088	Bayesian crit. (BIC)	20576.752

Interpretion:

The odds ratio (0.96) for origin place suggests that residing in urban or rural areas doesn't significantly impact the odds of LPG usage. households receiving wedding gifts exhibit approximately (1.148) times higher odds of using LPG, implying the influence of social or cultural norms in promoting LPG adoption. For every additional hour spent burning traditional chulah, the odds of using LPG decrease by approximately 3%, highlighting the resistance to transition from traditional cooking methods. Households using a specific chulah type have approximately (1.147)times higher odds of using LPG, Indicating the compatibility of certain

chulah designs with LPG technology. Moreover, for every unit increase in fuel distance, the odds of LPG usage decrease by about 10.5%, underlining the significance of fuel accessibility in promoting LPG adoption. The constant term yields a baseline odds ratio is (9.218), representing a significantly elevated likelihood of LPG usage under certain conditions.

Model 4.3.6: **REGRESSION ON FUEL USAGE IHDS 2005**

LPG_usage2005	Coef.(odd ratio)	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
fuel_distance		.001	-0.89	.374	-.002	.001	
lpg_price	**-.001(0.999)**	0	41.93	0	.005	.005	***
women_education	**.005(1.005)** **.011(1.011)**	.002	4.56	0	.006	.016	***
cooking	**-.013(0.987)**	.009	-1.42	.155	-.03	.005	
place_origin	**.009(1.009)**	.021	0.41	.684	-.033	.05	
vent_in_cooking_place	**.012(1.012)**	.005	2.45	.014	.002	.022	**
LPG_source	**.053(1.055)**	.007	7.44	0	.039	.068	***
household_headmale~u	**.001(1.001)**	.001	0.56	.576	-.001	.002	
Constant	**-.048(0.953)**	.037	-1.28	.201	-.121	.025	
Mean dependent var	0.852	SD dependent var	1.516				

R-squared	0.334	Number of obs	11897
F-test	746.523	Prob > F	0.000
Akaike crit. (AIC)	38832.227	Bayesian crit. (BIC)	38898.683

Interpretion:

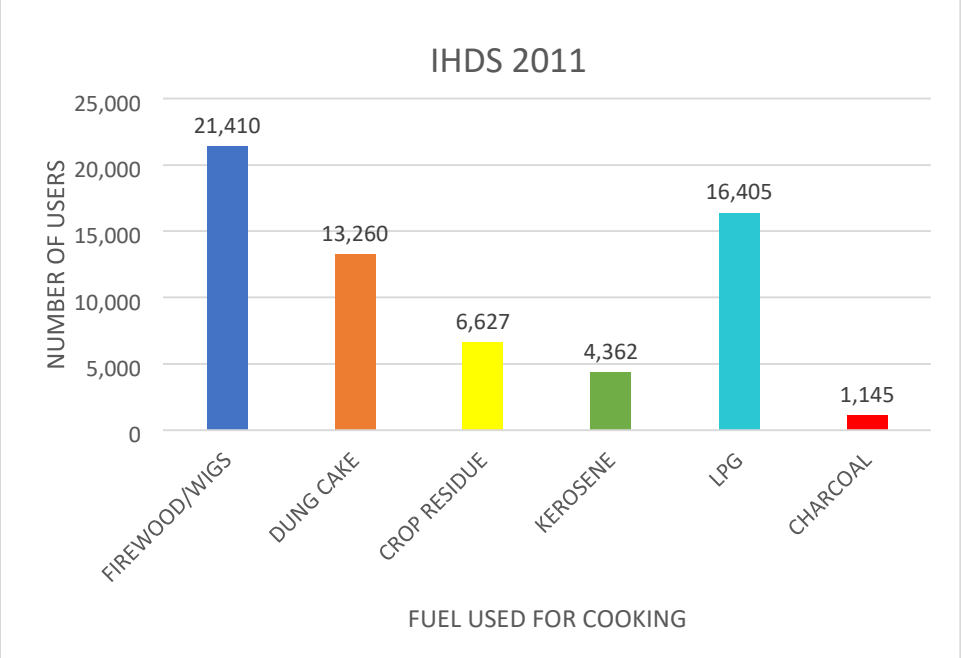
The odds ratios shed light on the impact of various factors on LPG usage in 2005. Factors such as lpg prices, women's education, ventilation in cooking place, and LPG source are positively associated with higher odds of LPG usage, with odds ratios ranging from approximately 1.005 to 1.055. This suggests that as LPG prices increase, as women's education levels rise, as there are vents in cooking places, and as households have access to LPG sources, the likelihood of using LPG also increases. Cooking and fuel distance show negative associations with LPG usage, with odds ratios around 0.987 and 0.999,. This shows that longer distances to fuel sources and factors affecting cooking practices may decrease the odds of LPG usage. The odds ratio for place of origin and household headmale are close to 1, indicating that these variables have minimal impact on LPG usage.The odds ratio for the constant is approximately 0.953, suggesting a slight decrease in the baseline odds of LPG usage.

Table 4.2.5:IHDS 2005 CHULAH TYPE

CHULLAH TYPE	NUMBER OFUSERS
FIREWOOD/WIGS	21,410
DUNG CAKE	13,260
CROP RESIDUE	6,627
KEROSENE	4,362
LPG	16,405
CHARCOAL	1,145

Source(Authors own commutation)

Graph 4.4.3: IHDS 2005 CHULAH TYPE



Source(Authors own commutation)

Interpretion:

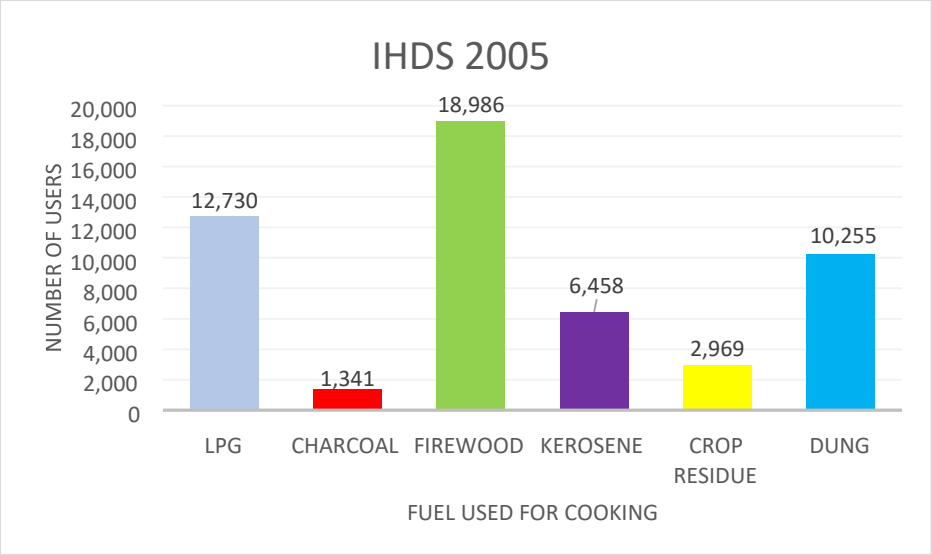
The number of users of different fuels used for cooking in the United States in 2011. Here's a breakdown of what the chart shows Firewood was the most commonly used fuel for cooking in the United States in 2011, with over 25,000 users. Dung cake is the second most commonly used fuel for cooking, with over 21,410 users. Crop residue is the third most commonly used fuel for cooking, with over 16,405 users. Kerosene is the fourth most commonly used fuel for cooking, with over 13,260 users. LPG is the fifth most commonly used fuel for cooking, with over 6,627 users. Charcoal is the least commonly used fuel for cooking, with over 4,362 users.

Table 4.2.6:IHDS 2011 CHULAH TYPE

TYPES OF FUEL	USED FOR COOKING
LPG	12,730
CHARCOAL	1,341
FIREWOOD	18,986
KEROSENE	6,458
CROP RESIDUE	2,969
DUNG	10,255

Source(Authors own commutation)

Graph 4.4.4: IHDS 2011 CHULAH TYPE



Source(Authors own commutation)

Interpretion:

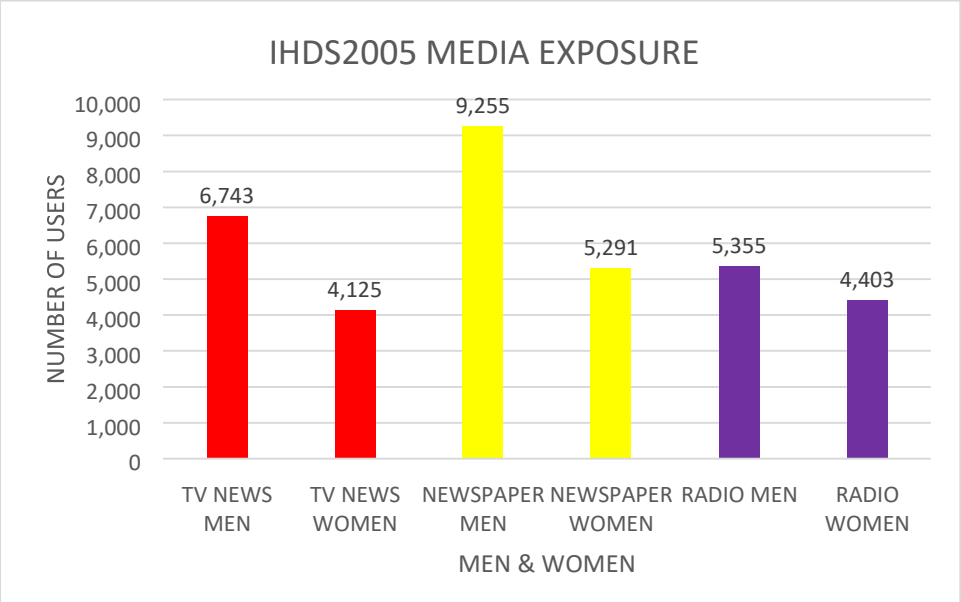
The number of users of different fuels used for cooking according to a 2005 Indian Human Development Survey (IHDS). LPG is the most commonly used fuel for cooking, with over 20,000 users. Charcoal is the second most commonly used fuel for cooking, with over 18,986 users. Firewood is the third most commonly used fuel for cooking, with over 12,730 users. Kerosene is the fourth most commonly used fuel for cooking, with over 10,255 users. Crop Residue is the least commonly used fuel for cooking, with over 6,458 users. Dung Cake is not shown on the chart, but the caption mentions it was also included in the survey.

Table 4.2.7MEDIA EXPOSURE IHDS 2005

MEDIA EXPOSURE	REGULAR USERS
TV NEWS MEN	6,743
TV NEWS WOMEN	4,125
NEWSPAPER MEN	9,255
NEWSPAPER WOMEN	5,291
RADIO MEN	5,355
RADIO WOMEN	4,403

Source(Authors own commutation)

Graph 4.4.5:Media Exposure IHDS 2005



Source(Authors own commutation)

Interpretion:

The graph titled "IHDS2005 Media Exposure" shows the number of users for six media categories: TV news men, TV news women, newspaper men, newspaper women, radio men, and radio women. Overall, TV news media has the highest number of users, with both TV news men and TV news women exceeding 9,255 users. Newspaper media comes in second place, with newspaper men at 6,743 users and newspaper women at 5,291 users. Radio media has the fewest users, with radio men at 4,125 and radio women at 4,403 users

Model 4.3.7: LPG usage due to media exposure

LPG_usage2005	Coef.(odd ratio)	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
tv_news_men	**.234(1.263)**	.009	25.77	0	.217	.252	***
newspaper_men	**.34(1.405)**	.012	29.31	0	.318	.363	***
radio_listen_men	**-.225(0.799)**	.014	-15.92	0	-.252	-.197	***
tvnews_women	**-.142(0.867)**	.006	-22.08	0	-.154	-.129	***
newspaper_women	**.284(1.328)**	.013	22.09	0	.259	.309	***
radio_women	**.145(1.156)**	.015	9.94	0	.116	.173	***
Constant	**.092(1.096)**	.009	10.34	0	.075	.11	***
Mean dependent var	0.440		SD dependent var		1.425		

R-squared	0.131	Number of obs	41554
F-test	1042.209	Prob > F	0.000
Akaike crit. (AIC)	141570.068	Bayesian crit. (BIC)	141630.512

Interpretion:

The odds ratios provide insights into the association between media exposure and LPG usage among men and women. Men, exposure to TV news and newspapers increases the odds of LPG usage by approximately 26.3% and 40.5%. While listening to the radio decreases the odds by about 20.1%. For women, exposure to TV news and newspapers decreases the odds of LPG usage by approximately 13.3% and 13.3%, whereas listening to the radio increases the odds by around 15.6%. The constant term indicates a baseline increase in the odds of LPG usage by approximately 9.6%. These findings suggest that media exposure, particularly through TV and newspapers, may influence LPG adoption differently for men and women, with radio exposure showing contrasting effects.

The null is rejected

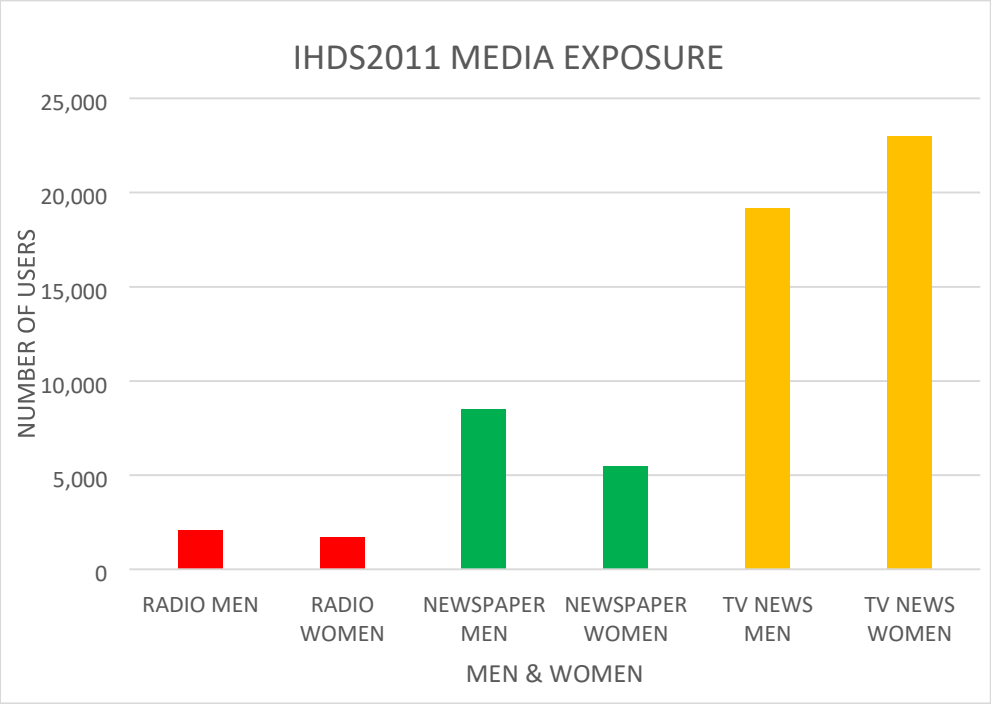
Table 4.2.8:MEDIA EXPOSURE IHDS 2011

MEDIA EXPOSURE	REGUALR USERS
RADIO MEN	2,065
RADIO WOMEN	1,681
NEWSPAPER MEN	8,500

NEWSPAPER WOMEN	5,493
TV NEWS MEN	19,182
TV NEWS WOMEN	23,003

Source(Authors own commutation)

Graph 4.4.6:Media Exposure IHDS 2011 source(authors own commutation)



Radio is the most popular media source for news consumption, with a significantly higher number of people reporting radio use compared to those who watched television news or read newspapers. Interestingly, a gender gap emerged in radio listenership, with a higher number of men reported listening to the radio compared to women. Newspaper readership and television viewership appeared to be lower than radio listenership for both genders.

Model 4.3.8 :LPG usage due to Media exposure (2011)

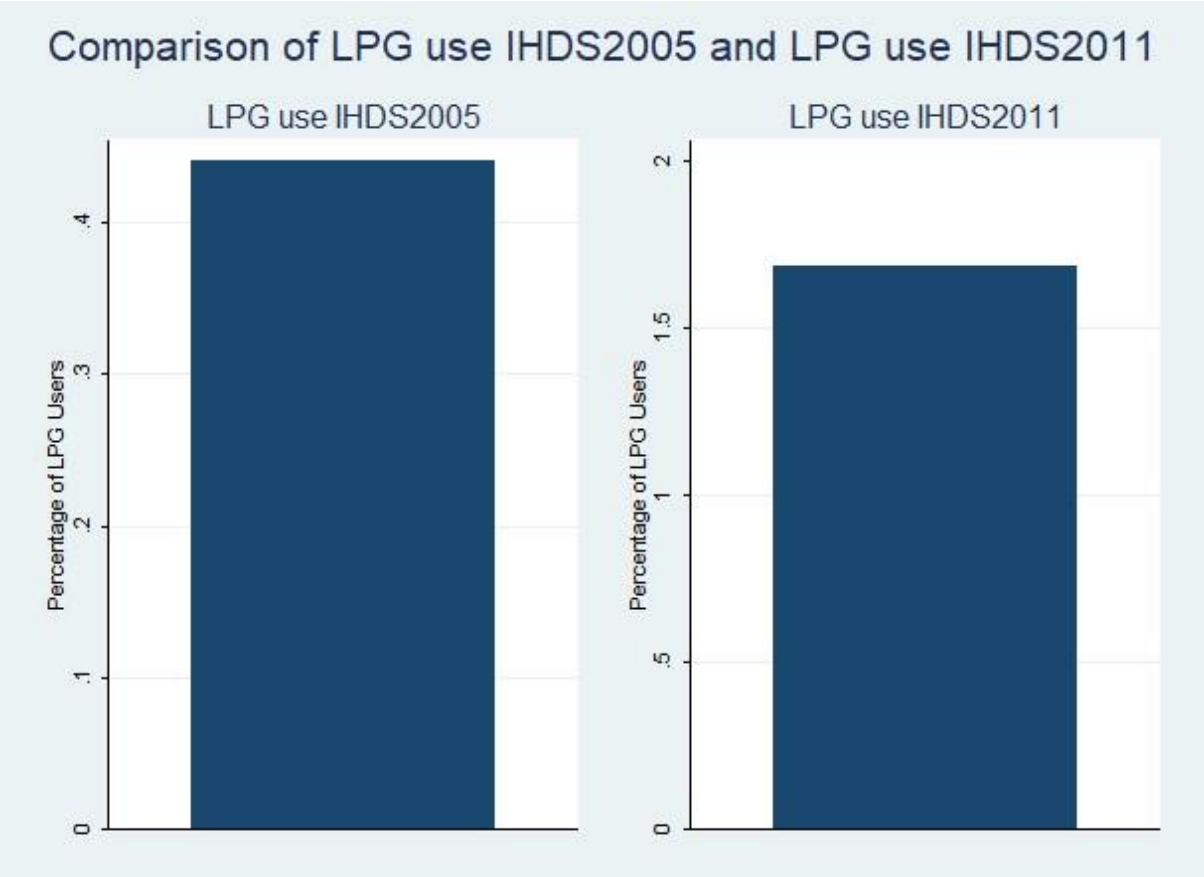
LPG_usage2011	Coef.	St.Err.	t-value	pvalue	[95% Conf	Interval]	Sig
men_listens_radio	-.006(0.994)	.015	-0.41	.681	-.035	.023	
men_read_newspaper	.191(1.21)	.009	21.37	0	.173	.208	***
men_watch_tv	-.018(0.982)	.012	-1.48	.14	-.043	.006	
women_listen_radio	.01(1.01)	.016	0.65	.517	-.021	.041	
women_read_newspaper	.266(1.304)	.009	28.15	0	.247	.284	***
women_watch_tv	.294(1.341)	.012	24.88	0	.271	.317	***
Constant	.323(1.381)	.019	17.38	0	.286	.359	***

Mean dependent var	1.698	SD dependent var	1.047
R-squared	0.188	Number of obs	39422
F-test	1525.234	Prob > F	0.000
Akaike crit. (AIC)	107262.318	Bayesian crit. (BIC)	107322.392

Interpretion:

The results of the logistic regression analysis reveal insightful associations between various media consumption habits and LPG usage. After converting the coefficients into odds ratios, it becomes evident that certain media habits have significant impacts on the odds of LPG usage. men, reading newspapers and watching TV are positively associated with higher odds of using LPG, with odds ratios of 1.21 and 0.982, for women, reading newspapers and watching TV also exhibit significant positive associations with LPG usage, with odds ratios of 1.304 and 1.341, These findings suggest that individuals who engage more in these media activities are more likely to use LPG. Ratios for listening to the radio, for both men and women, do not show statistically significant effects on LPG usage. It's essential to note that these interpretations are based on associations observed in the data and may not imply causation. The constant term indicates that even in the absence of these media habits, there exists a baseline likelihood of LPG usage, which is approximately 1.381 times higher than the reference odds. Overall, these results shed light on the influence of media consumption behaviors on LPG usage patterns.

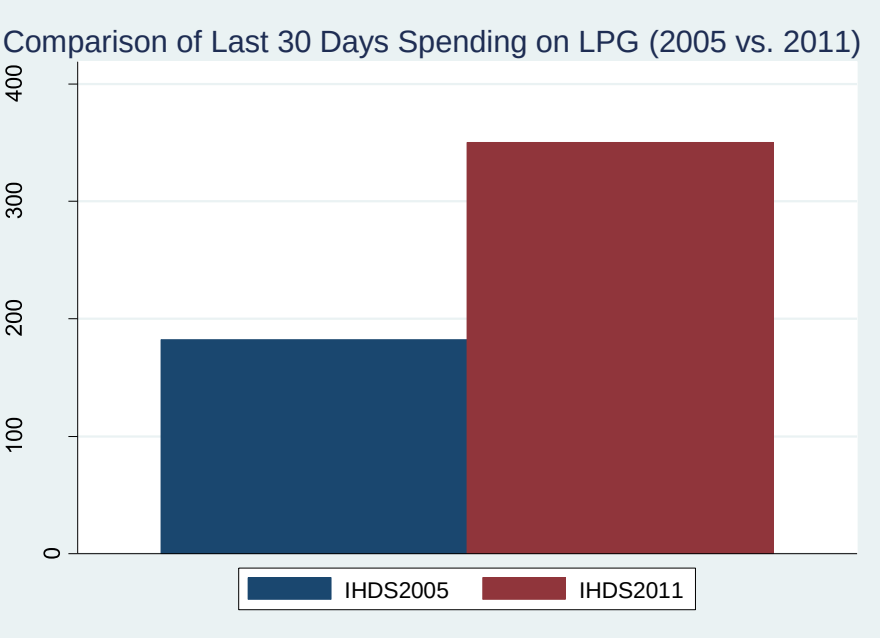
Graph 4.4.7:Comparison of LPG usage using IHDS data 2005 and 2011



Source(Authors own commutation)

In the above graph oon the x axis we have the LPG usage for the year 2005 and 2011,and on the y axis we have percentage of LPG users for thoses years .the results shows that in 2011 the LPG usage is more(1.7%) than in 2005 (0.4%).It clearly showa that in 2011 there was more usage of LPG than in 2005.

Graph 4.4.8:PRICE COMPARISON OF FUEL LPG FROM IHDS2005 & IHDS2011



Source(Authors own commutation)

Interpretion:

The graph compares the average spending on LPG (Liquefied Petroleum Gas) in the last 30 days of 2005 and 2011. The y-axis represents the mean LPG spending in rupees (Rs) and the x-axis represents the year. There are two data series plotted in the graph, labeled IHDS2005 and IHDS2011.the average spending on LPG in 2011 (IHDS2011) was higher than in 2005 (IHDS2005). In 2005, the average spending was Rs 300, whereas in 2011 it was Rs 400. This suggests that the cost of LPG increased between 2005 and 2011

Chapter 5: FINDINGS, CONCLUSION AND SUGGESTIONS

5.1 FINDINGS:

The analysis of the IHDS panel data from 2005 and 2011-12 revealed several key findings regarding the adoption of LPG in Indian households. These findings include the significant influence of women's education on energy usage decisions, the disparities in LPG adoption between urban and rural areas, the impact of media exposure on LPG usage rates, the role of

social and cultural factors in promoting LPG adoption, and the challenges faced by rural households in transitioning to cleaner cooking fuels.

5.1 CONCLUSION:

In conclusion, the study underscores the importance of addressing socio-economic, cultural, and infrastructural factors to promote the adoption of LPG as a cooking fuel in India. While progress has been made, disparities persist, necessitating targeted interventions to bridge the urban-rural gap and overcome barriers to LPG adoption. The results shows that the social factore have realtioship with the LPG usage .

5.3 SUGGESTIONS:

To address the findings and conclusions of the study, it is recommended to enhance awareness campaigns to educate households about the benefits of LPG, improve accessibility through expanded distribution networks, promote women's empowerment to drive decision-making on energy usage, implement policy interventions to incentivize LPG adoption, and conduct ongoing research to monitor the effectiveness of government schemes and interventions. By implementing these suggestions, stakeholders can work towards sustainable energy transitions, improved public health, and enhanced human development in India.

REFERENCES

- Akter, S., Mathew, N. M., & Fila, M. E. (2023). The impact of an improvement in the quality and reliability of rural residential electricity supply on clean cooking fuel adoption: Evidence from six energy poor Indian states. *World Development*, *172*, 106366. https://doi.org/10.1016/j.worlddev.2023.106366
- Ali, J., & Khan, W. (2022). Factors affecting access to clean cooking fuel among rural households in India during COVID-19 pandemic. *Energy for Sustainable Development*, *67*, 102–111. https://doi.org/10.1016/j.esd.2022.01.006
- Aslam, J., Ali, R., & Ahmad, N. (n.d.). *LPG AS AN ALTERNATIVE REFRIGERANT-REVIEW*.
- Azam, M. (2023). Health Effects of Fuel Transitions in India: Evidence from Panel Data. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4319005
- Biswas, S., & Das, U. (2022). Adding fuel to human capital: Exploring the educational effects of cooking fuel choice from rural India. *Energy Economics*, *105*, 105744. https://doi.org/10.1016/j.eneco.2021.105744
- Chindarkar, N., Jain, A., & Mani, S. (2021). Examining the willingness-to-pay for exclusive use of LPG for cooking among rural households in India. *Energy Policy*, *150*, 112107. https://doi.org/10.1016/j.enpol.2020.112107
- Choudhuri, P., & Desai, S. (2020). Gender inequalities and household fuel choice in India. *Journal of Cleaner Production*, *265*, 121487. https://doi.org/10.1016/j.jclepro.2020.121487

- Couture, S., Garcia, S., & Reynaud, A. (2012). Household energy choices and fuelwood consumption: An econometric approach using French data. *Energy Economics*, *34*(6), 1972–1981. https://doi.org/10.1016/j.eneco.2012.08.022
- Das, K., Gerbens-Leenes, P. W., & Nonhebel, S. (2021). The water footprint of food and cooking fuel: A case study of self-sufficient rural India. *Journal of Cleaner Production*, *281*, 125255. https://doi.org/10.1016/j.jclepro.2020.125255
- Dey, B., Ahmed, R., Ferdous, J., Halim, M. A., & Haque, M. M. U. (2024). Biomass or LPG? A case study for unraveling cooking fuel choices and motivations of rural users in Maheshkhali Island, Bangladesh. *Sustainable Futures*, *7*, 100152. https://doi.org/10.1016/j.sftr.2024.100152
- Garland, C., Jagoe, K., Wasirwa, E., Nguyen, R., Roth, C., Patel, A., Shah, N., Derby, E., Mitchell, J., Pennise, D., & Johnson, M. A. (2015). Impacts of household energy programs on fuel consumption in Benin, Uganda, and India. *Energy for Sustainable Development*, *27*, 168–173. https://doi.org/10.1016/j.esd.2014.05.005
- Gill-Wiehl, A., Brown, T., & Smith, K. (2022). The need to prioritize consumption: A difference-in-differences approach to analyze the total effect of India's below-the-poverty-line policies on LPG use. *Energy Policy*, *164*, 112915. https://doi.org/10.1016/j.enpol.2022.112915
- Gupta, R., & Pelli, M. (2021). Electrification and cooking fuel choice in rural India. *World Development*, *146*, 105539. https://doi.org/10.1016/j.worlddev.2021.105539
- Halder, M., Kasemi, N., Roy, D., & Majumder, M. (2024). Impact of indoor air pollution from cooking fuel usage and practices on self-reported health among older adults in India: Evidence from LASI. *SSM - Population Health*, *25*, 101653. https://doi.org/10.1016/j.ssmph.2024.101653

•

Islam, S., Upadhyay, A. K., Mohanty, S. K., Pedgaonkar, S. P., Maurer, J., & O'Donnell, O. (2022). Use of unclean cooking fuels and visual impairment of older adults in India: A nationally representative population-based study. *Environment International*, *165*, 107302. https://doi.org/10.1016/j.envint.2022.107302

• Jeuland, M., Desai, M. A., Bair, E. F., Mohideen Abdul Cader, N., Natesan, D., Isaac, W. J., Sambandam, S., Balakrishnan, K., Thangavel, G., & Thirumurthy, H. (2023). A randomized trial of price subsidies for liquefied petroleum cooking gas among lowincome households in rural India. *World Development Perspectives*, *30*, 100490. https://doi.org/10.1016/j.wdp.2023.100490

• Johnson, M. A., Pilco, V., Torres, R., Joshi, S., Shrestha, R. M., Yagnaraman, M., Lam, N. L., Doroski, B., Mitchell, J., Canuz, E., & Pennise, D. (2014). Corrigendum to "Impacts on household fuel consumption from biomass stove programs in India, Nepal, and Peru" [Energy Sustain Dev 17 (2013) 403-411]. *Energy for Sustainable Development*, *21*, 113. https://doi.org/10.1016/j.esd.2014.05.001

• Kumar, P., Kaushalendra Rao, R., & Reddy, N. H. (2016). Sustained uptake of LPG as cleaner cooking fuel in rural India: Role of affordability, accessibility, and awareness. *World Development Perspectives*, *4*, 33–37. https://doi.org/10.1016/j.wdp.2016.12.001

• Majumdar, D., Koley, M., & Chatterjee, P. (2023). Socio-economic factors and clean cooking fuel consumption in India: A household level study. *Energy for Sustainable Development*, *76*, 101298. https://doi.org/10.1016/j.esd.2023.101298

• Mishra, S., & Pal, D. (2022). Do Households with Educated Adults Use Cleaner Fuels? Evidence from India. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4147057

• Ntegwa, M. J., & Olan'g, L. S. (2024). Explaining the rise of economic and rural-urban inequality in clean cooking fuel use in Tanzania. *Heliyon*, *10*(1), e23910.

- https://doi.org/10.1016/j.heliyon.2023.e23910

  Okyere, C. Y., Abu, B. M., Asante-Addo, C., & Kodua, T. T. (2024). Gendered health effects of cooking fuel technologies in southern Ghana. *Technology in Society*, *77*, 102525. https://doi.org/10.1016/j.techsoc.2024.102525

- Patel, U., & Kumar, D. (2020). The Indian Energy Divide: Dissecting Inequalities in the Energy Transition Towards LPG. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3647097

- Perros, T., Allison, A. L., Tomei, J., Aketch, V., & Parikh, P. (2023). Cleaning up the stack: Evaluating a clean cooking fuel stacking intervention in urban Kenya. *Renewable and Sustainable Energy Reviews*, *188*, 113900. https://doi.org/10.1016/j.rser.2023.113900

- Pillarisetti, A., Ghorpade, M., Madhav, S., Dhongade, A., Roy, S., Balakrishnan, K., Sankar, S., Patil, R., Levine, D. I., Juvekar, S., & Smith, K. R. (2019). Promoting LPG usage during pregnancy: A pilot study in rural Maharashtra, India. *Environment International*, *127*, 540–549. https://doi.org/10.1016/j.envint.2019.04.017

- Rawat, Y. S., Vishvakarma, S. C. R., & Todaria, N. P. (2009). Fuel wood consumption pattern of tribal communities in cold desert of the Lahaul valley, North-Western Himalaya, India. *Biomass and Bioenergy*, *33*(11), 1547–1557. https://doi.org/10.1016/j.biombioe.2009.07.019

- Sharma, A., Parikh, J., & Singh, C. (2019a). Transition to LPG for cooking: A case study from two states of India. *Energy for Sustainable Development*, *51*, 63–72. https://doi.org/10.1016/j.esd.2019.06.001

- Sharma, A., Parikh, J., & Singh, C. (2019b). Transition to LPG for cooking: A case study from two states of India. *Energy for Sustainable Development*, *51*, 63–72.

- https://doi.org/10.1016/j.esd.2019.06.001

  Singh, D., Pachauri, S., & Zerriffi, H. (2017). Environmental payoffs of LPG cooking in India. *Environmental Research Letters*, *12*(11), 115003. https://doi.org/10.1088/1748-9326/aa909d

- Tekin, B., & Dirir, S. A. (2023). Examination of the factors contributing to environmental degradation: Does LPG consumption still matter? *Environmental Science and Pollution Research*, *31*(5), 6815–6834. https://doi.org/10.1007/s11356023-31484-7