DOUBLE ENERGY TRANSITIONS

Connecting climate goals with local realities of Nepal

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A SURVEY REPORT

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List of Abbreviations and Acronyms

ACs	-	Air conditioners
ADB	-	Agriculture Development Bank
ADB	-	Asian Development Bank
Agri	-	Agriculture
ATM	-	Automated teller machine
BAU	-	Business-As-Usual
CEEW	-	Council on Energy, Environment and Water
CFLs	-	Compact fluorescent lights
EAs	-	Enumeration areas
ESMAP	-	Energy Sector Management Assistance Program
EVs	-	Electric Vehicles
GJ	-	Gigajoule
HHs	-	Households
HIG	-	High Economic Growth
IDA	-	Inter Disciplinary Analyst
IRES	-	India Residential Energy Survey
kWh	-	Kilowatt per hour
LCS	-	Low Carbon Society
LEAP	-	Long range Energy Alternatives Planning System
LED	-	Light Emitting Diode
LPG	-	Liquefied Petroleum Gas
LUCSUS	-	Lund University Center for Sustainability Studies
NEA	-	National Electricity Authority
NPR	-	Nepalese Rupee
ODK	-	Open Data Kit
PJ	-	Petajoule
PNG Stoves	-	Piped Natural Gas Stoves
PV Solar	-	Photovoltaic Solar
SDGs	-	Sustainable Development Goals
SED	-	Sustainable Energy Development
SLC	-	School Level Certificate
TV	-	Television
UNDP	-	United Nations Development Programme
UNFPA	-	United Nations Fund for Population Activities
USD	-	United States Dollar
VDCs	-	Village development committees
VR	-	Virtual Reality
WECS	-	Water and Energy Commission Secretariat
Wi-Fi	-	Wireless Fidelity

Preface

DOUBLE ENERGY TRANSITIONS

Connecting climate goals with local realities of Nepal

The recent COP28 agreement acknowledged the need to move from fossil-fuel transition to cleaner energy sources. How does this ambition materialize in countries like Nepal? This survey is the first step of a 4-year research project entitled DOUBLE TRANSITIONS: Connecting climate goals with local realities of Nepal: analyzing changing energy poverty and access patterns in the era of climate change. The project is funded by Swedish Research Council (VR) and led by Dr. Mine Islar from Lund University. It aims to deliver high quality research on household energy transitions along with relevant policy recommendations.

Our core research questions in this project are: How and to what extent is energy access achieved in the transition from fossil-fuel based energy to renewable energy and how are energy poverty and energy transitions related? By providing qualitative and quantitative evaluations of the ramifications of energy access (SDG 7) for other areas of sustainable development, this study contributes to the need to harmonize the global agreement of the Sustainable Development Goals with local realities on the ground.

Energy transition in Nepal runs along two parallel processes: a transition from low-access to high access to modern energy for meeting the demands of the population, and a transition from fossil-fuel based energy to renewable energy. However, little has been known about how these two processes relate to each other, although we are aware that such developments are rarely uniform over space nor time. The high magnitude earthquake in 2015 is an example of a situation creating setbacks in energy access and that aggravated energy poverty as around 30% of the infrastructure in the seismic zone in Nepal was damaged. After several other shocks such as the recent economic crisis, the 2015-2016 economic blockade, and the corona pandemic, our aim here has been to advance knowledge on the relationships between energy transition and energy access in the context of Nepal.

Energy access ultimately has to translate into the ability to derive benefits from energy systems. In this survey we hope to show the general development/status of household energy consumption in Nepal for further analyses. They would highlight differentiated patterns of means, relations, and processes that enable/disable households to use the opportunities of their access to convenient energy sources. They would also provide the basis for policy makers to frame programs for alleviating poverty and deriving benefits from the ongoing energy transition.

Associate Professors Mine Islar and Sara Brogaard
Lund University Center for Sustainability (LUCSUS)
January 2024

Acknowledgements

I am grateful to Associate Professor Dr. Mine Islar and Associate Professor Dr. Sara Brogaard at the Lund University Center for Sustainability Studies (LUCSUS) in taking the lead role in preparing the proposal for this energy survey. This survey is funded under the research project titled Connecting Climate Goals with Local Realities of Nepal: Analyzing Energy Poverty and Changing Patterns of Energy Access in the Era of Climate Change. Also known as VR Double Transitions of Energy, this research is funded by the Swedish Academy. I am grateful towards Swedish Academy for funding this research.

I would like to extend my heartfelt gratitude to the numerous individuals at IDA and Lund University who have played pivotal roles in the successful execution of this project. Their contributions have been invaluable, and I am deeply appreciative of their efforts.

Firstly, I would like to acknowledge Naveen Adhikary and Pankaj Pokhrel for their essential contribution in questionnaire formulation. Their expertise and dedication in shaping the questionnaire were instrumental in ensuring the quality of our data collection process.

Next, I would like to express my sincere appreciation to Tikaram Basnet for his work in translating the questionnaire into Nepali, making it accessible to a broader audience.

I sincerely appreciate the efforts of Dinesh Dangol, Sandeep Thapa and Pankaj Pokhrel who were involved in android programming and related inputs. Their technical skills and support greatly enhanced the efficiency of our data collection methods.

Several individuals played a key role in training enumerators and supervisors – Hiranya Baral, Pankaj Pokhrel, Tikaram Basnet, Dinesh Dangol and Sandeep Thapa. Their dedication to ensuring a well-prepared field team was crucial in gathering accurate and reliable data.

Hiranya Baral deserves special recognition for his role in fieldwork management. I extend my gratitude to Dinesh Dangol for his efforts in dashboard preparation and online monitoring, which allowed us to track and analyze data effectively.

Finally, I would like to thank Dipak Gyawali, Chairman IDA, for providing valuable feedback on the PowerPoint presentation, which provided guidance to us in preparing this preliminary draft report. I am grateful to Dipak Gyawali for writing the forward of this report.

I would like to thank Sandeep Thapa for the design and layout of this preliminary draft report.

I would also like to express my appreciation to the team at Lund University, especially Mine and Sara, for their inputs during the initial pilot test and for their feedback on the questionnaire.

I am grateful to all the participants for their feedback on the program organized by IDA on November 21, 2023. The half a day program organized within IDA premises consisted of sharing the topline findings of the survey followed by an interaction. It was well attended by government officials (MoEWRI, NEA), private sector hydropower developers, professors, academics, researchers and development practitioners. Further iteration of the report has sought to address some of their feedback.

Once again, I extend sincere thanks to all of the above-mentioned names for their dedication, expertise, and hard work. This report is a product of the inputs of all the individuals mentioned above.

Sudhindra Sharma, Ph.D.

Team Leader on behalf of IDA and Executive Director

Foreword

When presenting the results of a first-time nation-wide quantitative study, such as this one on Nepali households' energy consumption and transition, one is forced to reflect on the past and wonder about the future. IDA's over two decades of experience with quantitative surveys has taught us to be routinely surprised when the findings are counter-intuitive and go against widely held conventional wisdom. This report too lives up to that reputation.

But first, some personal reflections to back up those claims. The first occasion that comes to mind is back in early 1989 when India imposed its third (and longest) economic blockade on Nepal. A year-and-a-half earlier, I had quit my government job with the Department of Electricity and founded IDA as a private research firm. The World Bank's resident representative then (who had previously served as a development volunteer in Nepal and spoke Nepali) asked me to study the impact of that blockade, the most severe of which was on the total clampdown of petroleum, kerosene and other fuel supplies to Nepal. The official Nepali government narrative – obviously to gain national and international support – was that it was forcing people to revert back to using firewood, thus contributing to increased deforestation in the country and flooding in Bangladesh.

What I discovered was that in rural areas, the absence of kerosene for cooking made little difference as firewood was overwhelmingly the main fuel source anyway. In core urban areas, absence of kerosene did not see people shifting to firewood in any significantly different numbers (in peri-urban areas, the consumption of easily available firewood too was the same as in rural areas). The reason for it was that there was no petroleum or diesel for trucks and pickup vans to transport the timber to urban depots, and from there to individual homes. Moreover, most urban houses or flats had long given up on their traditional firewood chulo and replaced them with kerosene or electric stoves and had no place to burn firewood even if they wanted to.

What had happened was that the blockade had shut down industries, and the industrial electric load in the hydropower-dominated national grid simply shifted to household electric stoves. A few months after the blockade, kerosene came back, smuggled from across the border to the Nepali users and was available albeit at much higher price but still that one market could bear. Interestingly, it forced the Indian government to impose a "blockade" of sorts in the 15-kilometer stretch in India to prevent smuggling, which ironically contributed to the unpopularity of the ruling party (and its eventual decline) in areas of Bihar, Uttar Pradesh and West Bengal adjacent to Nepal! This survey also looked at stresses such as the 2015 blockade, the earthquake that year, Covid and inflation, and has found similar counterintuitive facts on the ground regarding household energy consumption and transition.

The second occasion was two decades back when I was ex-officio chair of the NEA as minister of water resources and where the conventional wisdom was that Nepal's electricity access was 18%, a number quoted by all and sundry. At that time, Nepal Rashtra Bank released its household survey which put the figure at 36%, double of what NEA believed, leading to much consternation and speculation in the utility that "people were stealing so much of our electricity".1 It ultimately turned out to be a methodological problem: NEA was multiplying the number of household electricity meters it had installed by the average Nepali household size to arrive at the 18% figure. Rashtra Bank on the other hand only asked in their survey if the house had electricity without specifying if it came from the

[1] Recounted in: https://bulletin.ids.ac.uk/index.php/idsbo/article/view/2822/ONLINE%20ARTICLE (and also discussed in Annex1 of this report on November 21, 2003 summary of interactions with experts).

NEA grid, from a community micro-hydro plant or from solar PV panels etc., leading to the much higher figure.

The value of quantitative surveys such as that done then by the Nepal Rashtra Bank or that such as this one by IDA is that they form the firm basis from where myths can be laid to rest and attention can shift to exploring underlying causes of discrepancies, thus leading to better policy formulation. There are similar surprises in this study as well. While electricity coverage has increased to near full for an LDC and mountainous country like Nepal, electricity consumption, however, is dismal and one of the lowest in South Asia. Firewood use has declined somewhat but is still the most significant source of household energy. But then it seems to be done by sustainable harvesting of forests and not mining them, leading to very healthy forest coverage in Nepal. LPG gas penetration and use has sky-rocketed, but its consumption especially in rural areas is very low, operated only as a comfortable source when guests come visiting. Biogas, Nepal's big success story of the 1980s and '90s is still the cheapest source of household energy in rural Nepal but its use is declining rapidly.

What are things so? Quantitative statistical surveys only answer the "what?" question that allows generalization across the country: they do not provide "why?" answers, which have to be ferreted out by other social science means such as key informant interviews (KIIs) and focus group discussions (FGDs). Is the lack of increased electricity consumption due to poor quality of distribution grid that was expanded only with lighting in mind? With the advent of CFL and LED bulbs, power needs for lighting are very low and grids catering to lighting are ill-suited to handle heavier use such as cooking and other household or agriculture implements' loads. How will such a grid replace fossil fuel LPG by clean hydro-electricity? Is the decline of biogas the result of outmigration of youth and the consequent decline of both agriculture and animal husbandry? What policy shift would lead to the revival of this cheap source of both energy and fertilizer, to say nothing of good nutrition that underlies it? Why are most households not interested in increasing their electricity consumption? If internet and mobile use have become the dominant household utility expense, what is nature of their dependence on grid or independent power supplies such as solar PVs with battery backup?

We hope to be able to answer these questions in the months ahead with researchers from Sweden's Lund University during our KIIs. We also hope to conduct similar surveys on Nepal's energy use in transport and industry, the latter being particularly relevant in light of the current conflict between industrialists and the NEA over billing for demand change, dedicated trunk lines and other issues. Given that the cost of solar PVs is plummeting dramatically and industrialists are putting them up on roofs of factories, what will a two-way grid system look like unlike the current linear one-way system of generation to distribution? All these questions (and hopefully answers) are relevant to the debate around the proposed new electricity act pending in parliament for the last fourteen years. It would have to fundamentally revamp the structure of electric utility management and energy supply system from a vertically integrated parastatal monopoly to one of decentralized generation, transmission and distribution systems. This summary report of household energy consumption, and further studies of this project in the months and years ahead, is but a small step towards addressing that larger national conundrum of energy transition in the age of climate change and decentralization.

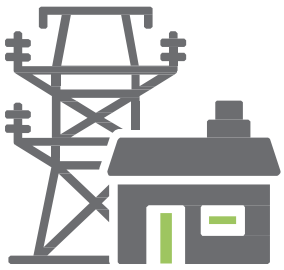
Dipak Gyawali
Chair, Inter Disciplinary Analysts (IDA)

Executive Summary

The Household Energy Consumption and Energy Transition Survey-2023 focuses on household consumption of energy including for lighting, cooking, heating, and cooling purposes; and the household transition of energy in the last 30 years. Its objective is to document the energy consumption patterns within Nepali households, along with examining the transition in these patterns. Additionally, it also aims to gauge the extent of suppressed residential energy demand.

This survey was conducted using a nationally representative sample with a sample size of 1,300 households (HHs), which was selected through a random probability sampling technique. These 1,300 HHs are spread across 21 districts of Nepal situated in all three ecological regions: Mountain, Hill, and Terai. Furthermore, the survey was conducted in both urban and rural settings to ensure a comprehensive representation. It ensured that scientifically every Nepali household had an equal probability of being included in the sample.

From the survey, it was found that a total of 98.1% of households have access to electricity. When the respondents from these households were asked about their primary source of electricity, significant proportion of respondents-- comprising 88.1%-- cited that their household relies on the national grid connection provided by the National Electricity Authority (NEA). Whereas, a smaller proportion, 5.2%, mentioned that their households rely on local mini-grids, indicating localized energy solutions. Some 4.8% of the respondents also shared that they use solar home systems as their primary source of electricity. A minority of households at 1.8% stated that they do not have access to electricity[2].



The distribution of households relying on national grid as their primary source of electricity varies across urban-rural areas and ecological regions. Compared to the rural areas, majority of households in urban areas at 98.9% rely on the national grid connection. When considering ecological regions, the Tarai region stands out with a widespread usage of the national grid connection at 98.9%. However, in the Mountain region, only 31.6% of households have access to national grid connection. In both rural Mountain and Hill households, local mini-grids are an important choice, with 65.2% in the Mountain region and 4.0% in the Hill region relying on them for their electricity needs. Talking about the solar home systems, it was found that 11.0% of the Hill households utilize solar home systems, whereas in the Mountain region, this figure is lower at 1.6%. However, it is important to note that solar home systems are less common in urban areas and in the Tarai region.

Respondents were asked if they were involved in renewable energy projects. Some 11.8% mentioned that they were involved in PV solar. Follow-up questions were asked to those households who were involved in one way or the other with solar PV. These respondents were asked to rate their agreement with regards to specific statements, ranging from “Strongly Disagree” to “Strongly Agree”. A substantial number of respondents (40.6%+38.3%) agreed that the investment in solar PV is beneficial for the household economy, potentially offering a fast return. The majority (52.8%+ 34.5%) of

[2] Nepal has made significant strides in improving electricity access, with efforts to extend the national grid and promote off-grid solutions. According to Nepal Electricity Authority (NEA) in 2009, electricity availability extended to only 43.6% of the population. In 2023 it has reached to 95% of the entire country's population.

respondents also agreed that solar PV systems enhance the stability of the household power supply. A substantial proportion of respondents (51.2%+35.2%) believed that solar PVs contribute additional capacity during grid shortages and a majority of respondents (50.6%+33.8%) viewed solar as environmentally beneficial, with minimal impact on the climate. However, significant proportion of the respondents (21.5%+36.2%) were skeptical that they could obtain government support through a PV subsidy program.

The survey then examined the percentage distribution of different types of utilities used in the households and the cost of these different types of utilities. Among the options presented, electricity and mobile recharge cards were recorded as the most commonly used utilities, with adoption rates of 93.0% and 88.1% respectively. Water services was utilized by 36.6% of the households, while internet/Wi-Fi services were employed by 25.2%. A smaller portion of the household also utilized trash collection services at 13.2%, and cable TV services at 12.6%. Additionally, a relatively smaller percentage of the household utilized the bundled service of cable TV with internet/Wi-Fi, accounting for 11.8% of the responses. The cost of each of these utilities was also asked. It was seen that the households tend to spend more on internet connectivity (monthly average of 1005.64), mobile communication (monthly average of NPR 658.71), electricity (monthly average of NPR. 524.26), and water (monthly average of NPR 191.27) compared to other amenities.

In order to document the energy consumption pattern of the households, a series of questions were asked to the respondents related to the household cooking, space heating, lighting, and household cooling. In the household cooking section, it was initially asked if any food or drink consumed by household members is cooked or prepared within the household dwelling using a cookstove, fire, or any other cooking device. 100% of the respondents said 'yes'. The survey then asked about the different types of fuel used by the households for cooking purposes every day. The data reveals that the preferred cooking fuel for 74.1% of the households is wood, woodchips, or fuelwood.[3] This is followed closely by LPG gas, which was mentioned by 62.4% of households. Some 15.5% of households reported using agricultural or crop residue as a cooking fuel, while 11.9% rely on animal waste or dung. A smaller, 8.4% employs electric energy for cooking, and even smaller percentage, 2.8% utilizes Biogas as their cooking fuel.

An interesting pattern emerges when disaggregating the data. The majority of rural households (79.8%) use wood or fuelwood for cooking, while only 44.6% of urban households do the same. LPG gas is more common in urban areas, with 88.9% using it for cooking purposes, compared to 57.3% who report it in rural areas. The use of agricultural or crop residue is significantly higher in rural areas (17.4%) compared to urban areas (5.4%). In urban areas, almost double the households at 13.9% use electric energy for cooking compared to rural households (7.3%). When considering ecological regions, the Mountain region shows the highest usage of fuelwood for cooking (95.9%), followed by the Tarai region at 79.1% and the Hill region at 65.5%. LPG gas is most widely used in the Tarai region (65.0%), followed by the Hill region (61.0%) and the Mountain region (48.0%). Electric energy for cooking is most prevalent in the Hill region (15.3%) compared to other regions. Cooking fuel preferences also varies across different income levels. While traditional fuels like wood were more

[3] Although firewood still constitutes the biggest form of energy used for cooking purposes in the country, surprisingly there has been an increase in the forest cover. In other words, using fuelwood for cooking purposes does not seem to have depleted Nepal's forest cover – instead the forest cover is growing - it being harvested sustainably and not mixed. This is not simply because of the penetration of LPG, rather, what this implies is that community forestry – which has led to an expansion of the forest cover – seems to have struck a right/good balance between forest conservation and harvesting of forest products for the daily needs and livelihoods of the people, especially in rural areas.

common among lower-income households, the use of modern energy sources like LPG gas and electricity increased with increased income levels.

The survey then asked about the different types of cookstove or device that the households use for cooking purposes every day. The data indicates that the most commonly used cookstove is LPG gas stove at 62.0%. The use of traditional solid fuel stoves (non-manufactured) is also quite high at 57.8% and the usage of manufactured (improved) solid fuel stove follows at 9.3%, while three stone stove/open fire is used by 8.3% of households. On the other hand, electric induction stove is used by 3.2% of households. Overall, the data indicates variations in cooking practices between rural and urban areas. Urban areas generally show a higher reliance on cleaner cooking technologies such as LPG gas-stove, induction cookstoves, and electric coil cookstoves, whereas rural still rely on more traditional cooking methods like three stone stoves and traditional fuel stoves.

The respondents were further asked to share how much their household spends in a month to buy their primary cooking fuel. Three stone cookstoves, used by an average of 64 households, had the highest expenditure at NPR 1537.05. Following closely, LPG gas cylinders, used by an average of 797 households, paid an average of NPR 1175.20. Traditional cookstoves, used by an average of 737 households, paid an average of NPR 875.99 for fuel and improved cookstoves, used by 100 households on average, paid NPR 956.92 on average. Electric cookstove, used by one household, had an average expense of NPR 500.00 and induction cookstoves were employed by 36 households, with an average expenditure of NPR. 474. 48. Biogas that was utilized by 32 households, incurred lowest cost at an average of NPR 8.87.[4]

The breakdown above indicates that using fuelwood is more expensive in comparison to using other sources of cooking fuel like the biogas. Purchasing fuelwood from the community forest is also not an economical option. Surprisingly, instead of opting for the more affordable biogas, many rural households with unreliable electricity still rely on fuelwood because of several challenges associated with biogas adoption. Firstly, maintaining a biogas system requires a daily supply of animal waste equivalent to that produced by two cows, even when the system is not in use. However, due to the significant outmigration of Nepal's active population, rural areas lack the necessary manpower to tend to the livestock consistently. Furthermore, in the past, the Denmark embassy and Agriculture Development Bank (ADB) offered subsidies for biogas system installation, but this support is no longer available. Consequently, people are hesitant to invest in biogas systems independently.[5]

In the household heating section, 77.5% of the respondents confirmed that their household uses heating devices or fire to keep their dwelling warm at some point in the year, while 22.5% mentioned that do not use any heating devices. On average, the households that replied with a 'yes', utilized heating devices for 3 months out of the 12 months. When they were asked what types of fuel they use for household heating purposes, 86.0% of the total respondents mentioned that they use wood/woodchips/fuelwood. Agricultural or crop residues are used by 24.6% of households for heating.

[4] It should be noted that households using three stone cookstoves, traditional cookstoves, and improved cookstoves typically gather the necessary fuel—wood, woodchips, dried branches, or twigs—either from their own property or from community forestry sources. To quantify this, respondents who collected fuel from their personal property were asked, "If you had to pay for it, how much would it have cost?". So, the costs mentioned could be both the payments they have made to community forestry to obtain the fuelwood or converting the fuelwood obtained in their own property into a monetary value.

[5] Feedback provided by the supervisors and enumerators after completion of the survey.

Animal waste or dung is used by 11.3% of households, and the same percentage also rely on electricity for their heating needs. 0.5% cited that they use LPG cooking gas for heating, and an even smaller percentage, 0.2%, use kerosene.

Rural areas favor traditional sources like wood and agricultural residues (90.1% and 27.2% respectively) for heating purposes, while in urban areas only 61.0% use wood- based fuels and only 8.7% use agricultural residues. Urban areas lean more towards electricity and modern fuel sources for household heating at 39.7%, compared to rural areas (6.7%). When considering ecological regions, the Mountain regions heavily rely on wood at 98.4%, while the Tarai region uses more agricultural residue (44.2%) and animal waste (20.9%). The Hill region falls in between, exhibiting a mix of wood (79%) and modern energy sources like electricity (21.6%). There are also some variations in heating fuel preferences based on income levels. Wood remains a dominant fuel source across all income groups. Agricultural residue usage is higher in medium income group, and electricity becomes more prevalent as income levels rise.

The survey also asked about the heating devices utilized by households to warm their homes. The data reveals that the most prevalent heating devices include open fire or three-stone stoves, accounting for 49.2% of usage. Additionally, traditional fuelwood cookstoves are used by 48.6% of the respondents. Electric heaters are used by 9.8% of households as a heating source. Improved cookstoves (Chulos) or charcoal stoves are used by 9.4% of households and the less commonly utilized options include LPG gas heater (0.4%), and air conditioning (0.3%) for household heating purposes.

In the household lighting section, the respondents were asked about the different sources of energy used by households for lighting purposes. Grid Electricity account for the majority at 92.6%, followed by rechargeable flashlight, mobile devices, torches, or lanterns/inverters at 50.1%. Candles contributes to 19.0% of the lighting energy, while solar-generated electricity provides 12.5%. Battery-powered flashlights, torches, or lanterns contribute 10.8%, and Oil lamps are used for lighting accounting for 3.3% of the energy sources.

The sources of energy used for lighting in rural and urban households vary significantly. It is evident that grid electricity is a predominant source in both rural and urban areas, with 91.4% of rural households and 99.0% of urban households relying on it for lighting. Interestingly, the use of rechargeable flashlights, mobile devices, torches, or lanterns powered by inverters is more common in rural households (51.6%) compared to urban households (42.5%)[6]. Solar-generated electricity appears to be more prevalent in rural households (14.3%) compared to urban households (2.8%). Solar PVs are being promoted in Nepal in areas that do not have grid connection – national or local.

When considering the ecological regions, the Tarai region shows a higher dependence on grid electricity and alternative power sources, while the Mountain regions lean more toward solar energy and traditional sources like oil lamps. The Hill region falls between these extremes, with varying energy source usage. The use of rechargeable flashlights, mobile devices, torches, or lanterns powered by inverters is most prevalent in the Tarai region (62.1%), followed by the Hill region (38.3%) and Mountain (30.1%) regions. It is also interesting to note that the use of grid electricity for lighting purposes is not drastically different across various income levels. Low- income households rely on grid- electricity for lighting at 89.0%, middle- income households at 93.0%, and high- income households at 95.9%. This indicates that out of all the other areas like cooking, heating, and cooling,

[6] This could presumably be because there is more load-shedding in rural areas.

the use of electricity for lighting purposes is uniform across all income levels. This shows that there has been significant improvement in household access to electricity as far as lighting is concerned.

In the household cooling section, 62.8% of households indicated that they use something for cooling purposes, while 37.2% cited that they do not use any cooling appliances. When they were asked what types of fuel they use for household cooling purposes, the most common cooling appliance was cited as ceiling fans, utilized by 77.4% of respondents. Following that, manual fans were used by 66.4% of the surveyed individuals and table/pedestal/wall mounted fans were used by 45.5% of respondents. In contrast, air-coolers were used by a smaller proportion, accounting for 2.30%. The least prevalent cooling appliances were air conditioners (ACs) at 0.3%.

When comparing the cooling appliance usage in urban and rural areas, it can be seen that rural areas show a higher usage of ceiling fans (80.6%) compared to urban areas (66.0%). Similar to ceiling fans, manual fans are also more prevalent in rural residences (71.9%) than in urban ones (46.4%). The usage of table/pedestal/wall mounted fans are relatively close between rural (45.1%) and urban (46.9%). When considering the ecological regions, the Mountain region generally requires fewer cooling appliances due to its cooler climate, while the Hill and Tarai regions exhibit higher usage. The usage of ceiling fans is significantly higher in Tarai region (89.6%) than in Hill region (27.6%). Similarly, manual fan usage is relatively higher in Tarai region (81.6%) compared to the Hill regions (4.2%). The Hill regions has a considerably higher usage of the table/pedestal/wall mounted fans (73.7%) compared to Tarai region (38.6%). While there are some variations in cooling appliances preferences based on household income, certain cooling appliances like ceiling fans and manual fans are commonly used across all income levels.

In another section, the respondents were asked if their household's energy needs and energy usage patterns were affected by various 'shocks' like the earthquake in 2015, the economic blockade by India in 2015-16, COVID and related shutdown in 2020- 21, and the escalation of global price--- high inflation--- due to Ukraine Russia war in 2022-23. Overall, a little more than half of the total respondents at 58.1% stated that their household's energy needs and energy usage patterns were not affected by different shocks. Only 2.2% of the total respondents stated that their household's energy needs and energy usage patterns were affected by the earthquake (2015)[7], 12.4% mentioned that it was affected during the economic blockade by India (2015-16), 25.4% shared it was affected during COVID, and 15.4% reported that it is being affected due to high inflation rates. In urban areas, LPG gas was the most popular cooking source during economic blockade, COVID and high inflation period, while in the rural areas, during these three shocks, households used traditional fuelwood cookstoves. However, despite LPG being the top choice, people in urban areas did start using traditional cookstoves along with the LPG gas during both economic blockade and COVID period. During the economic blockade, respondents who experienced LPG gas cylinder shortage were also asked about the frequency of these shortages. Among those who faced such shortages, 51.5% reported that LPG gas cylinders were often unavailable in the quantity they desired, indicating high level of frequent unavailability. In contrast, during the COVID-19 period and the high inflation period, a lot less respondents at 20.5% and 16.1% respectively cited that LPG gas cylinders were often unavailable. The usage of electric induction cookstoves remained low across all periods and areas.

[7] This low figure is probably explained by the fact that the impact of earthquake was only in central Nepal's mainly hilly regions.

The data also suggests that LPG gas cylinder price hikes were a common occurrence during all three periods. The economic blockade had the highest percentage of respondents reporting price hikes (96.9%), followed by the high inflation period (89.5%) and the COVID-19 period (88.7%. Across all three periods, a significant majority of respondents in both rural and urban areas reported that there was a price hike on LPG gas cylinders. The highest reported incidence was during the economic blockade, where almost all urban respondents reported a price hike. The COVID-19 pandemic also saw a substantial price hike, particularly in rural areas. During the High Inflation period, the incidence of price hikes remained high, though slightly lower compared to the Economic Blockade and COVID-19 period.

This data indicates an interesting trend in relation to the change in household energy consumption and usage patterns during the time of shocks. Across all shocks, it was seen that households in both urban and rural areas started using mixed- fuels for cooking purposes. The usage of LPG gas cylinders decreased considerably because of its unavailability and also unaffordability due to the price hike. In place of that, households began to cook meals using traditional fuelwood cookstoves, improved fuelwood cookstoves and charcoal stoves. This indicates that during the times of shocks and economic hardships, households often resort to using mixed fuels as a coping strategy. Fuel stacking hypothesis still acknowledges the hierarchical progression of fuel types, much like the linear, unidirectional energy ladder hypothesis; however, it also states that households continue to use traditional fuels alongside cleaner fuels even after transitioning. Additionally, during the times of shocks and economic hardships, people can regress on the energy ladder, reflecting the complex dynamics of energy usage patterns during such circumstances.

The survey also focused on documenting the household energy transition patterns in Nepal in the last three decades. Thirty years ago, fuelwood dominated as the primary cooking fuel at 97.9%, which has gradually decreased to 67.4% in the present time. Similarly, agricultural residue was used by 29.8% of households three decades ago, declining to 17.3% today. The reliance on cow-dung cakes has also declined from 19.2% to 10.9% at the present time. Conversely, the use of cleaner cooking alternatives like LPG gas and electricity (induction stove/electric cooking coil) has seen a substantial increase, with LPG gas utilization soaring from 0.6% to 64.1% and electricity-based cooking growing from 0.3% to 8.4%. Solar and biogas usage, although minimal, has also shown slight increase.

When we look at rural and urban areas, there is a stark difference in the choice of cooking energy sources. Fuelwood still remains the prominent cooking energy resource in rural areas, with 72.3% of rural households using it for cooking purposes. While in urban areas, the usage has dropped to 41.7%. LPG gas is the primary cooking energy source in urban areas, with 87.7% of urban households using it. It is also popular in rural areas but to a lesser extent, with 59.6% of rural households using it. Agricultural residue is more commonly used in rural areas (19.6%) compared to urban areas (4.8%). Cow-dung is used by 11.9% of rural households and 5.4% of urban households for cooking. Electricity, specifically through induction stoves or electric cooking coils, is more popular in urban areas (12.7%) compared to rural areas (7.6%).

Over the past three decades, there has been a remarkable shift in the sources of household lighting. Thirty years ago, open fires were common, accounting for 14.6% of lighting sources, but now they make up just 5.2%. Similarly, oil-lamps, once widely used at 25.6%, have decreased to 2.1%. Kerosene lamps which were the primary choice for lighting 30 years ago at 85.3%, now stands at 4.2%. The use of candles has also seen a drop from 17.5% to 12.9%. On the other hand, lighting options like battery-powered flashlights, torches and lanterns have decreased slightly from 14.6% to 12.6%. Rechargeable

flashlights, mobile lights, and torches have become much more popular, rising from 4.9% to 51.3%. The most significant change is seen in the adoption of electricity, including solar panels, for lighting, which has surged from 14.1% three decades ago to an impressive 97.6% at the present time. This data reflects the substantial progress made in lighting access and technology adoption, particularly in rural areas.

Over the last thirty years, changes have also taken place in the choices of space heating in the households, although these changes are not as drastic or as impressive as the changes observed in household lighting patterns. Fuelwood was the primary choice for household heating three decades ago at 94.9% and it still remains true at the present time; however, its usage has seen a slight decline at 84.4%. Agricultural residue for heating purposes were used by 27.8% of the households three decades ago, and it has only decreased to 23.4% now. One thing that is common both thirty years ago and now is that coal, kerosene, and LPG gas heaters were rarely used for heating thirty years back and this remains true for present time too. Electric heaters, on the other hand, which were nonexistent 30 years ago, are now used by 8.8% of households at present.

In the past three decades, household cooling methods have also undergone some changes. Thirty years ago, manual fans were the dominant choice, with 50.2% of the households using them. At present, its usage has only decreased slightly at 41.3%. Usage of electric fans, however, have seen substantial growth, from 1.6% three decades ago to 63.0% today. Usage of air coolers that was nonexistent thirty years ago, has reached 1.4% at present. Interestingly, use of ACs still remains low at 0.2%. However, the percentage of households without cooling facilities has only slightly decreased from 48.9% thirty years back to 34.8% at present.

Towards the end of the survey, the respondents were also asked how would they like to change their household energy consumption patterns if cheap and reliable electricity was made available. Almost half of the respondents at 49.0%, stated that they would maintain their current activities and not change their energy consumption pattern. On the other hand, remaining 51.0% of the respondents ticked multiple options, in that, 37.1% cited that if cheap and reliable electricity was available, they would want to switch to using electric appliances for cooking, 24.0% responded that they would utilize that electricity for heating purposes, 22.5% mentioned using electricity for agricultural purposes, 19.7% stated they would use more electricity for cooling purposes, and a small percentage of respondents at 7.4% also cited that they would use it to charge their electric vehicles. These findings deserve deeper disaggregated investigations in the future by academic researches, utilities and government policy formulating entities.

These findings show that Nepal's distribution grid has been designed and expanded for providing mainly domestic lighting; and in the past three decades, there has been a considerable expansion of the distribution network to the extent that today 98 percent of the households have access to electricity. However, while they may have "access" to electricity, except for lighting, it does not allow them to do much else with it including engaging in electric cooking, heating or cooling. Given that Nepal's per capita electricity consumption at approximately 250-300 kWh per annum is one of the lowest in South Asia (India's is 1200), there is a big pent-up or suppressed demand. If electricity supply were more reliable, people would buy more appliances and gadgets both of consumptive and productive nature such as cooking, heating, cooling, and even charging electric vehicles.

The data underscores the extensive utilization of smartphones for communication and entertainment in both rural and urban settings, unveiling variations in ownership and usage trends influenced by geographical location and income levels. Noteworthy findings indicate that 28.3% of individuals possess regular mobile phones, 49.0% own smartphones, and 13.0% have both types. On average, households possess 2.6 mobile phones. Higher ownership of regular phones is observed in rural areas (30.1%), while urban areas exhibit a higher prevalence of smartphone ownership (57.3%). Smartphone ownership is widespread across ecological regions, with the Mountain region displaying the highest affinity for both types. Disparities in mobile technology access are evident in the Tarai region, where a higher percentage lacks phones.

The data also reveals a correlation between income levels and phone types, with the highest ownership of smartphones observed in high-income groups. Ownership patterns remain consistent across income groups for both types. Additionally, the data provides insights into average usage durations (6.8 years for regular phones, 6.1 years for smartphones) and offers information on smartphone usage, highlighting communication as the primary purpose (100%). Urban respondents are more engaged in internet-related activities. In recent times, the widespread use of mobile phones has led to an increase in the demand for electricity since electricity is required for charging mobile devices.

1. Introduction

Household fuels are characterized as energy resources utilized for domestic applications, including cooking, lighting, space heating, and cooling, but excluding fuels designated for transportation and commercial purposes (ESMAP, 2003). The composition of energy sources within a household, or its energy consumption profile, significantly influences various aspects, spanning economic, environmental, gender- related, and health factors (Toole, 2015).

Within the Sustainable Development Goals (SDGs), Goal 7---Affordable and Clean Energy--- acknowledges that "Energy is the dominant contributor to climate change, accounting for around 60 per cent of total global greenhouse gas emissions". Consequently, this goal sets specific targets to ensure universal access to "affordable, reliable, sustainable and modern energy for all" by 2030. The government of Nepal is dedicated to implementing measures that align with the targets of SDG Goal 7 and is striving to enhance the availability of reliable electricity and other eco- friendly and efficient energy resources. It is the goal of Nepali government to gradually transition towards clean energy resources from the traditional ones.[8] For instance, the Nepali government actively promotes better cooking technologies among rural residents through subsidy programs, with a particular emphasis on biogas systems and upgraded cookstoves. Additionally, in those areas where grid electricity is not reliable or accessible, the government encourages the households there to install solar panels (Pokharel & Rijal, 2021).

Nonetheless, due to Nepal's economic status and lack of affordability of clean energy alternatives, rural inhabitants still heavily depend on conventional fuels that are readily accessible within their localities (Pokharel & Rijal, 2021). A significant portion of the rural population, owing to the unavailability and unaffordability of clean commercial fuels (electricity and LPG gas), rely on traditional energy sources (fuelwood, agri-residue, and animal waste) for cooking purposes, making it a sectoral challenge. Among the different types of traditional energy sources, fuelwood is the most used energy type at 84.87% in the residential sector (WECS, 2022). Excessive reliance on traditional energy sources not only hampers the environment, but also affects the health of women and children who spend most of time indoors in the kitchen.

In Nepal's residential sector, as with other developing nations, it is also common to find households using a combination of fuels for their cooking needs. This mix typically includes traditional fuels such as fuelwood, agricultural residues, and animal waste, alongside commercial fuels like LPG and electricity (Pokharel & Rijal, 2021). Furthermore, study by Pokharel and Rijal (2021) also highlights that among Nepali households using mixed- fuels, a significant proportion still primarily rely on fuelwood for cooking purposes, while LPG gas and electricity are used sparingly. This suggests that the transition to cleaner energy sources in Nepal has not been fully realized.

This report focuses on household consumption of energy including for lighting, cooking, heating, and cooling purposes; and the household transition of energy in the last 30 years also within the context of shocks such as the economic blockade, COVID etc. Its objective is to document the energy consumption patterns within Nepali households, along with examining the patterns of transitions. Additionally, it also aims to gauge the extent of suppressed energy demand in the residential sector.

[8] https://climateactiontracker.org/climate-target-update-tracker/nepal/

1.1. Objectives and Scope of the Study

- To document the consumption of energy in the residential sector including for lighting, cooking, heating and cooling purposes
- To document/identify the energy transition between different energy sources on the household level? (lighting, cooking, heating, cooling) during the last 30 years

1.2. To provide a preliminary estimate of the scale of suppressed demand in the residential sector. Review of Literature

When considering various types of fuel in the context of global energy consumption, the utilization of traditional biomass fuel takes the forefront. According to data presented by LP (2016) in his study, the usage of traditional biomass fuel accounts for a significant portion, comprising 60-95% in the most impoverished developing nations, 35% in the developing nations, and 3% in the developed countries. Earlier studies reported that biomass fuels were used as the primary source of energy for cooking and heating purposes in the residential sector by as much as half of the global population (Kandpal and Maheshwari, 1994, as cited in LP, 2016). International Energy Agency (2002, as cited in LP, 2016) anticipated that by 2030, the number of individuals who use biomass fuel for cooking and heating purposes may reach up to 2.6 billion. This heavy reliance on biomass as the major source of energy, especially prevalent in the developing nations, can be partially attributed to the lack of access to reliable electricity.

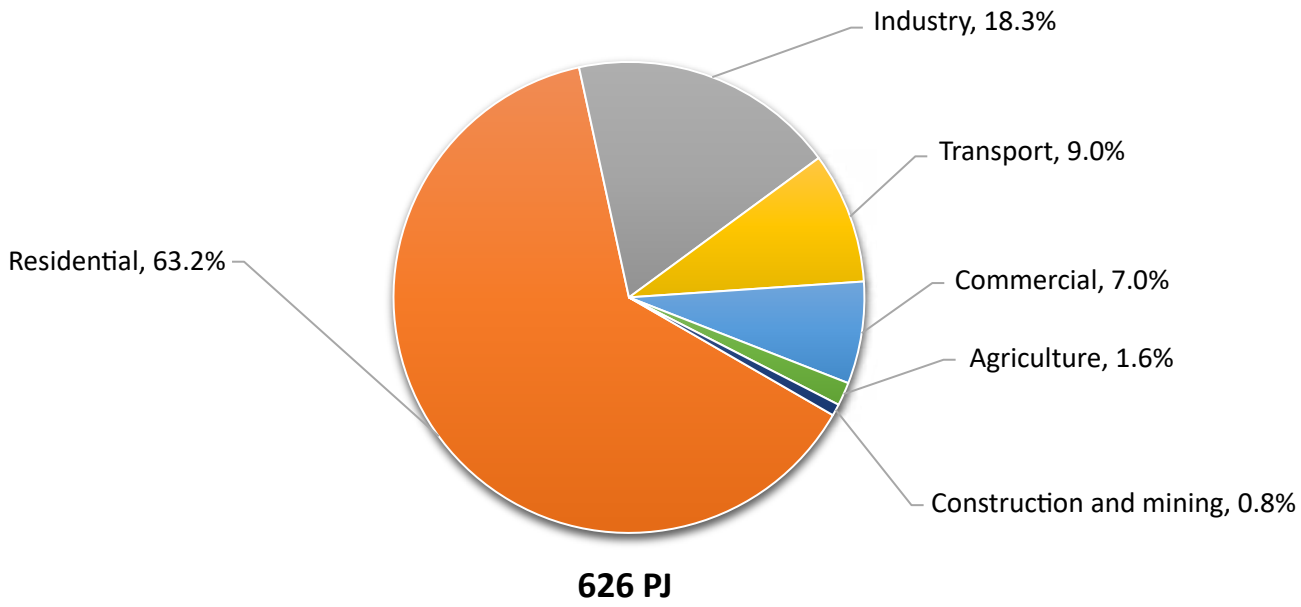
Significant reliance on biomass in developing nations and fossil fuels in developed nations has had and continues to exert substantial effects on both the environment and global population's health (Leach & Gowen, 1987; Jamal, 2005, as cited in LP, 2016). Thus, discussions about climate change must invariably encompass energy consumption (Toman, 2001, as cited in LP, 2016). Within the Sustainable Development Goals (SDGs), Goal 7---Affordable and Clean Energy-- acknowledges that "Energy is the dominant contributor to climate change, accounting for around 60 per cent of total global greenhouse gas emissions". Consequently, this goal sets specific targets to ensure universal access to "affordable, reliable, sustainable and modern energy for all" by 2030. The government of Nepal is dedicated to implementing measures that align with the targets of SDG Goal 7 and is striving to enhance the availability of reliable and renewable? electricity and other eco- friendly and efficient energy resources. Nonetheless, due to Nepal's economic status and lack of affordability of clean energy alternatives, rural inhabitants still heavily depend on conventional fuels that are readily accessible within their localities (Pokharel & Rijal, 2021).

Biomass utilization predominantly governs Nepal's overall energy consumption and because of the dependence on traditional energy resources (fuelwood, agri-residue, and animal waste), there is pressure on natural resources and environment. A significant portion of the rural population, owing to the unavailability and unaffordability of clean commercial fuels (electricity and LPG gas), rely on traditional energy sources for cooking purposes, making it a sectoral challenge. The 2015 economic blockade had some adverse impacts on household fuel choice as many households were forced to rely on firewood for cooking due to the unavailability of LPG. However, to some extent, the blockade also seems to have acted as a push factor for some households towards cleaner sources like electricity largely due to the disruption in the supply of LPG. Utilization of biomass fuels is not only affecting the natural resources and environment but also the health of women and children who spend most of time indoors. Since it is women who take over the household chores like collecting woods for fuel and cooking, they

naturally spend a lot of time cooking in fuelwood, agri-residue, and animal waste. This in turn increases their exposure to indoor air pollution (ADB, 2020). Nonetheless, as indicated by the report from WECS (2022), there has been a slight increase in the adoption of renewable energy sources compared to previous years and albeit slow, the shift to commercial energy options such as LPG, electricity, and petroleum products is becoming evident.

In Nepal, the six major energy-consuming economic sectors in the year 2021, as depicted by figure 1 (WECS, 2022, p. 51) below include residential, commercial, industry, transport, agriculture, and construction & mining. The paragraphs that follow explain the top three energy consuming sectors in Nepal-- Residential at 63.2%, Industrial at 18.3%, and Transport sector at 9.0%[9]—with a major focus on the consumption of energy and the transition of energy in the residential sector.

***Figure 1**: Sector-wise energy consumption in 2021*

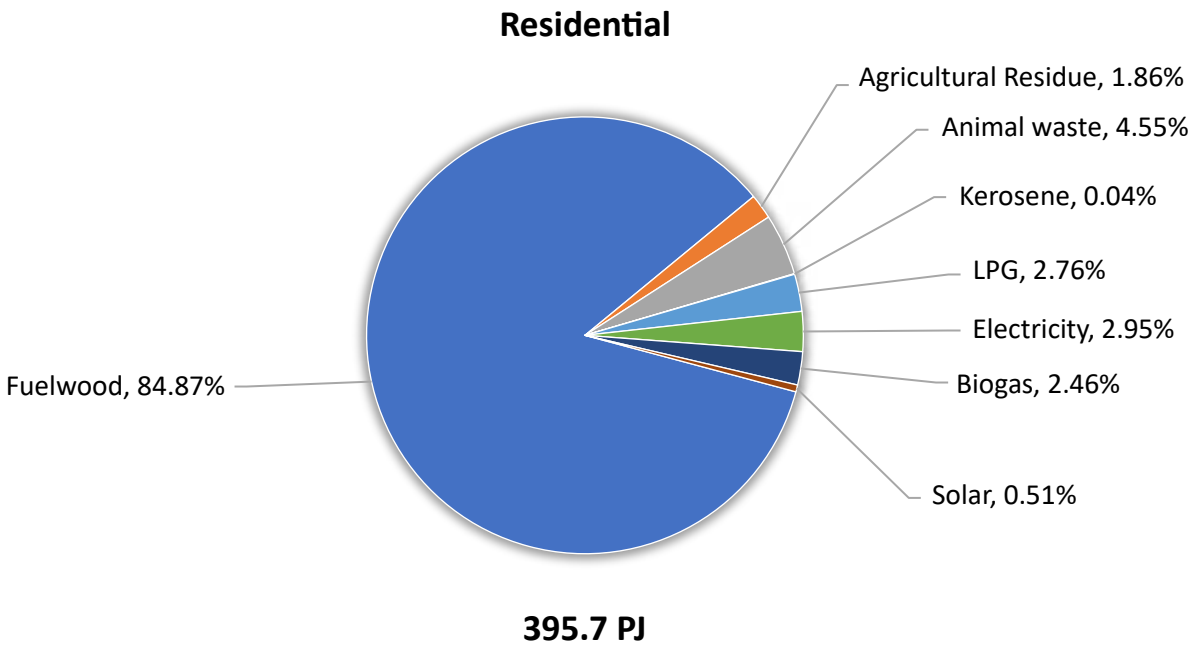


Note: From "Nepal Energy Sector Synopsis Report- 2022", by WECS, 2022, p. 51. Retrieved from https://wecs.gov.np/source/Energy%20Sector%20Synopsis%20Report%2C%202022.pdf

The residential sector in Nepal stands out as the most energy-consuming sector. According to the Nepal Energy Sector Synopsis Report (2022), in the year 2021, this sector consumed a total of 396 petajoules (PJ) of energy. Fuelwood, agricultural residue, animal waste, and biogas are the major sources of energy used in the residential sector. Among these, fuelwood is the most used energy type at 84.87%. However, compared to 2009 when the fuelwood usage accounted for 87%, in 2021, its usage has slightly declined. Over the past decade, the consumption of LPG gas in the residential sector has increased to 2.76% -- more than double the usage a decade ago. The promotion of alternative energy sources has also helped increase the share of biogas usage to 2.46% and solar energy to 0.51%. Furthermore, the use of electricity as an energy source has witnessed an increase from 1% in 2009 to 2.95% in 2021.

[9] The facts and figures presented in this section are drawn from "Nepal Energy Sector Synopsis Report – 2022" published by Water and Energy Commission Secretariat in 2022.

Figure 2: Energy consumption by fuel types Residential sector in 2021



Note. From "Nepal Energy Sector Synopsis Report- 2022", by WECS, 2022, p. 55. Retrieved from https://wecs.gov.np/source/Energy%20Sector%20Synopsis%20Report%2C%202022.pdf

Despite the limited adoption of modern and cleaner energy technologies, the decline in residential energy intensity over the past decade, reducing from approximately 14 GJ per capita to 13.2 GJ per capita in 2019, underscores the tangible impact of this gradual transition. In regions with improved electricity access, Nepal households are also opting for energy efficient electric technologies. However, even though the per capita electricity consumption in 2021, inclusive of alternative energy sources, has reached 265 kWh, this figure still remains below the South Asian average. Therefore, the Nepali government must intensify efforts towards electrification to achieve the ambitious goal of raising per capita electricity consumption to 700 kWh by 2022/23.

Nepal has been successful in getting households access to electricity: moving them from Tier 0 to a higher tier. The challenge going forward will be for households to continue rising from the lower tiers to higher tiers. In Nepal, 93.7% of the households have access at Tier 1 and higher. However, the largest share of households, 31.7%, are concentrated in Tier 3, while 17.9% of the households are in Tier 4 and 17.3% in Tier 5. Tiers 1 and 2 have a total of 26.8% of the households, and only 6.3% of households are in Tier 0. (Nepal- Beyond Connections: Energy Access Diagnostic Report Based on the Multi-Tier Framework)[10].

In Nepal's residential sector, as with other developing nations, it is observed that a majority of households employ a mix of fuels for cooking purposes. This involves utilizing a combination of traditional fuels such as fuelwood, agricultural residues, and animal waste, alongside commercial fuels like LPG and electricity. The concept that investigates this pattern of energy transition where households rely on multiple types of fuel without entirely abandoning the less advanced ones is termed the energy stacking or the fuel stacking hypothesis (Toole, 2015). While the fuel stacking hypothesis

[10] https://openknowledge.worldbank.org/server/api/core/bitstreams/c3f1c8d9-8e7c-57d3-a8d4-35a8f017a379/content

still acknowledges the hierarchical progression of fuel types, much like the linear, unidirectional energy ladder hypothesis, it disputes the notion that households completely abandon biomass as soon as their economic condition allows for them to transition to more superior and cleaner fuels (Toole, 2015). This perspective from the fuel stacking hypothesis is also applicable to Nepali households.

In a study conducted by Pokharel and Rijal (2021), the authors investigated the fuel preference and usage pattern of households in Nepal's three distinct climatic regions: cold, temperate, and subtropical[11]. Their research categorized households into three groups based on fuel usage: traditional (fuelwood, agri- residue, animal waste), mixed (a combination of both traditional and commercial fuels), and commercial (LPG gas and electricity). The study's findings revealed a prevailing inclination among Nepali households to use mixed type of fuel for cooking purposes. The researchers also found out that the decision of households to use more traditional cooking fuels than the clean commercial fuels or vice- versa, was directly proportional to the socioeconomic status of that household.[12]

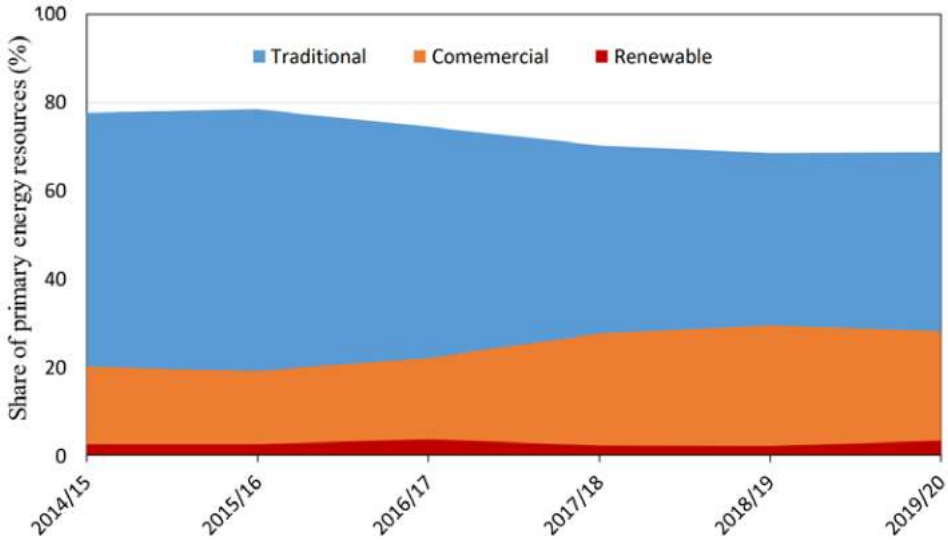
The study pointed out that among the mixed fuel using households, merely 20% used "electricity and LPG at least once a day to cook meals", whereas, the remaining 80% predominantly relied on traditional fuels, turning to cleaner options only occasionally. The investigation highlighted that the prevalence of mixed fuel usage was highest in sub- tropical regions at 86%, followed by cold region at 65%, and quite low in temperate regions at 58% (Pokharel & Rijal, 2021).

In the same study by Pokharel and Rijal (2021) illustrated the Energy Mix transformation in Nepal from 2014/15 to 2019/20. The gradual shift towards commercial energy resources is illustrated in Figure 3 (Pokharel & Rijal, 2021, p.13). Between 2014/15 to 2019/20, it can be seen that the proportion of commercial energy has increased to 28% from 20%, whereas, the share of traditional energy sources has decreased to 68% from 78%. On the other hand, the contribution of renewable energy resources remains relatively minimal, rising slightly from 2.5% to 3.2%. According to Pokharel and Rijal (2021), Nepal has not been able to transition swiftly towards modern energy sources because of the absence of "reserves of coal, natural gas, or oil and insufficient electricity production to fulfil the energy demands of the country" (Pokharel & Rijal, 2021, p. 13).

[11] Cold Regions: The cold regions in Nepal are predominantly in the high Himalayan mountains. These areas have cold temperatures throughout the year and are covered with snow and ice at higher elevations. Notable cold regions include places like Mustang, Manang, and parts of Solu- Khumbu (where Mount Everest is located).
Temperate Regions: The temperate regions in Nepal are found in the mid- hills, which include elevations between the lowlands and the higher Himalayas. These areas experience mild to cool temperatures and are characterized by a variety of flora and fauna. The capital city, Kathmandu, falls within this temperate zone.
Subtropical Regions: These regions are characterized by warm to hot temperatures and relatively high humidity levels. They are found in the lowland Terai region of Nepal, which stretches along the southern border with India.

[12] In this study, the socioeconomic status encompasses elements such as household income, expenditures, occupations, engagement in foreign employment, and household characteristics.

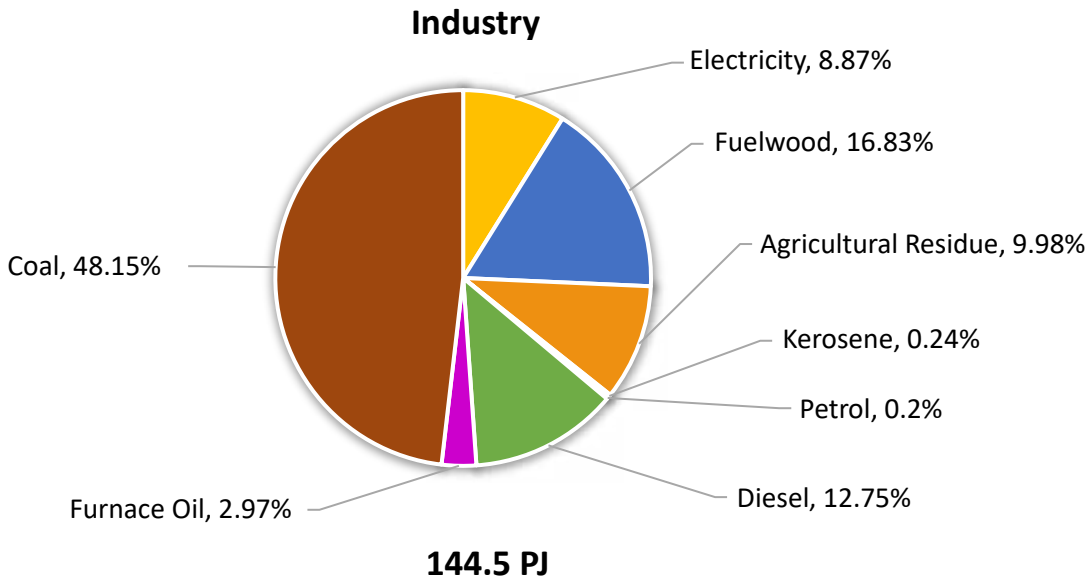
***Figure 3**: Energy Mix in various years*



Note. From "Energy Transition toward Cleaner Energy Resources in Nepal", by Pokharel & Rijal, 2021, p.13. Retrieved from https:// doi.org/10.3390/su13084243

After the residential sector, the industrial sector ranks as the second- largest consumer of energy in the country, consuming a total of 114.5 PJ of energy. Figure 4 (WECS, 2022, p. 54) below shows the breakdown of the fuel types used in the industrial sector. Thermal purposes primarily drive the use of energy in this sector. Coal represents the most extensively used energy source for furnaces at 48%, followed by fuelwood at 17%. Additionally, for boilers, agricultural residue is highly used. Diesel consumption is also quite evident in this sector, which is primarily used for motive power and running generators. In recent years, the trend of using electricity for thermal purposes is slowly increasing due to the presence of modern technologies; however, it appears that the use of old technologies is going to persist unless the pace of replacing them increases.

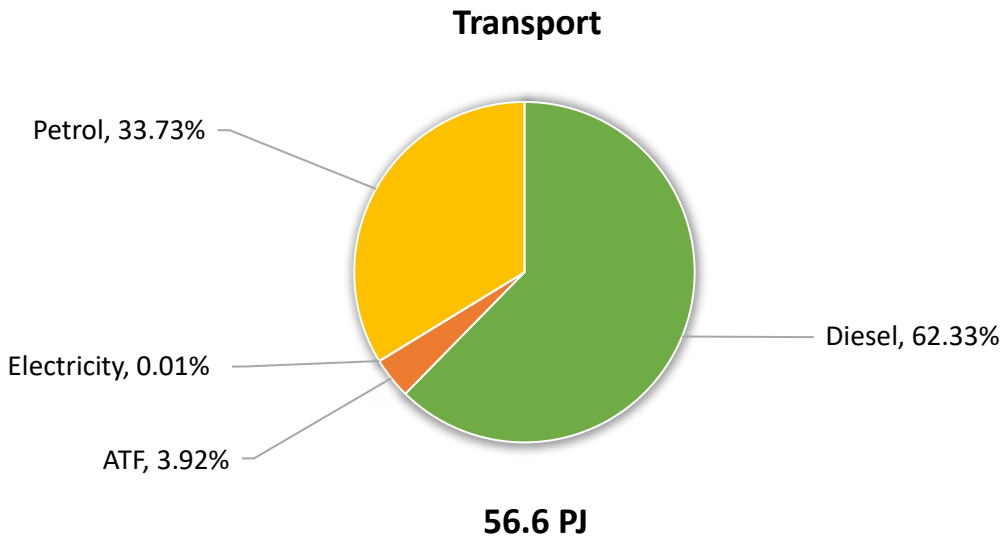
***Figure 4:** Energy consumption by fuel types in Industrial sector in 2021*



Note. From "Nepal Energy Sector Synopsis Report- 2022", by WECS, 2022, p. 54. Retrieved from https://wecs.gov.np/source/Energy%20Sector%20Synopsis%20Report%2C%202022.pdf

Finally, with the total energy consumption at 56.6 PJ as shown in Figure 5 (WECS, 2022, p. 56), transportation sector is the third most energy consuming sector in Nepal. Over time, its share of energy consumption has been increasing due to influence of both economic and demographic factors (WECS, 2022). Transportation sector relies heavily on petroleum products for energy, utilizing less than 1% of electricity. When considering only energy derived from petroleum products, the transportation sector emerges as the highest energy- consuming sector among all sectors. Diesel is the most consumed fuel type in this sector, primarily used by freight vehicles and heavy passenger vehicles. Conversely, petrol is mainly consumed by small private vehicles. Regarding the aviation fuel, more than 50% of the total aviation fuel is consumed by international flights and rest is consumed by domestic flights.

***Figure 5**: Energy consumption by fuel types in Transportation sector in 2021*



Note. From "Nepal Energy Sector Synopsis Report- 2022", by WECS, 2022, p. 56. Retrieved from https://wecs.gov.np/source/Energy%20Sector%20Synopsis%20Report%2C%202022.pdf

Till date, different studies have been conducted in Nepal related to the household energy usage patterns. In one such study conducted by Malla (2013) in Nepal, the focus was on understanding household energy usage patterns and predicting future energy demand within the residential sector. This was achieved through the utilization of Long range Energy Alternatives Planning System (LEAP) framework. "LEAP is a comprehensive integrated scenario-based energy-environment model building tool to estimate the future energy demand and emissions at the local-, national-, and regional- levels" (Malla, 2013, p. 994). Malla's study presented four distinct scenarios—the High Economic Growth (HIG) scenario, the Business-As-Usual (BAU) scenario, the Sustainable Energy Development (SED) scenario and the Low Carbon Society (LCS) scenario[13]--- based on important factors such as

[13]HIG scenario: The HIG scenario is characterized by Nepal being more and more integrated into global markets that lead to high economic growth and there is a faster transition of the economy from agriculture-based economy towards industry- and commerce-based economy. Because of easy access to global technology market and modernization of economic sectors under this scenario, significant improvement in the efficiency of cooking and lighting end-use devices is considered.
BAU scenario: BAU scenario is based on historical trends and it takes account of current government plans and policies. In this scenario, country follows closely the national development plans and policies. The economic growth is moderate and the population projection would be average based on the UN medium variant projection, but urban to rural migration in the country would rise. In addition, moderate energy efficiency improvement of both cooking and lighting devices is proposed.

population growth rate, the country's economic growth, evolving household structures due to increasing income levels, and the nature of governance i.e., centralization vs decentralization (2013). He used 2010 as the starting year and ran the projection period till 2040. The conclusion he derived was:

The household sector accounted for most of the energy consumed in the country in the past and this trend is projected to remain the same in the next 30 years. If the current trend continues, household energy demand is projected to increase from 8765 ktoe in 2010 to 11852 ktoe in BAU scenario in 2040, an increase of 22% or an average growth of 1.1% per year. While demand increases consistently throughout the study period, the growth rate slows from an average of 1.2% per year in 2010–2025 to 0.9% per year in 2025–2040. This shift is attributed largely to a progressive decline in population growth, increase in the share of modern fuels for cooking and improved levels of energy efficiency. With the exception of LCS scenario, household energy demand increases more quickly in the BAU scenario than in HIG and SED scenarios. These two scenarios (HIG and SED) have very modest household energy demand growth between 2010 and 2040, increase of 5% in HIG scenario and 9% in SED scenario. In 2040, energy demand in the HIG scenario is 17% lower than in the BAU scenario due mainly to the lower population growth and higher share of modern fuels for cooking. In contrast, energy demand under the LCS scenario increases the most at 11390 ktoe in 2040, an increase of 30% in 30 years due to higher level of biomass consumption. (Malla, 2013, p. 996)

In another research related to energy usage pattern in the Nepali residential sector, Rahut et. al., (2022) examined the association between caste/ethnicity based social differentiation and the consumption of clean cooking energy in Nepal. The study highlighted a significant pattern observed globally in relation to the marginalized groups all over the world not getting access to clean cooking fuel and stated that ethnic minorities and low- caste—Dalit—families in Nepal are also substantially less likely to have access to clean fuel for cooking. The researchers utilized the "most recent three- year panel data" to investigate this association and draw conclusions. The findings of their study revealed that specific groups, including Madhesi (Terai) Dalit, caste in Madhesh/ Terai known as the low- caste, Hill Dalit and other ethnic minorities are less likely to use clean cooking fuel.

This disparity between high- caste individuals and non- Dalits, compared to low- castes and Dalit communities, stems primarily from exclusion, caste- based discrimination, and disadvantages faced by minorities within Nepali society (Rahut et. al, 2022). Despite the fact that legally, caste-based discriminatory treatment against Dalits was prohibited way back by National Country Code of 1963, by constitution of 1990 (UNDP, 2004), and current constitutional provisions promoting equality, societal practices have sustained discrimination against Dalits. As a result, Rahut et. al (2022) assert that government's Clean Energy Policy should prioritize facilitating access to clean and affordable energy for minorities and Dalits.

The Council on Energy, Environment and Water (CEEW) conducted the India Residential Energy Survey (IRES) 2020, which provides comprehensive insights related to energy access and efficiency within Indian households. This nationwide survey, the first of its kind, covers nearly 15,000 households

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SED scenario: The SED scenario focuses and supports activities that promote sustainable development. The country's economic growth is considerable. However, the population growth would be the same as that of BAU scenario. Clean energy and clean production would be the mainstream of the society in this scenario. Rural energy and electricity development would be the government priorities. The energy efficiency improvement for cooking and lighting devices would be high.

LCS scenario: The LCS scenario is based on the necessity of strong local communities. The economic growth in the country is at low level and the population growth is moderate based on the United Nations medium variant projection. There is also low energy efficiency improvement. The households would have low home appliances ownership. However, shifting from fossil-fuels to domestic energy resources primarily biomass would be given the priorities.

(**Note:** This description of 4 different scenarios have been extracted from Malla, 2013, pp. 994-996)

in 1210 villages and 614 wards in 152 districts across 21 states and offers a wealth of data from a representative sample. Based on the data collected in the survey, different articles have been published that delves into aspects such as clean cooking energy accessibility, energy efficiency awareness and adoption in Indian homes, and state of electricity access, among other topics. In the formulation of survey questionnaire for this report "Household Energy Consumption and Energy Transition in Nepal 2023", we have integrated pertinent questions from the IRES in our survey questionnaire.

1.3. Preparation of the questionnaire and the first and second pre-tests

Questionnaire Formulation—Preliminary Phase:

In accordance with the goals outlined in the research proposal "Connecting climate goals with local realities of Nepal: Analyzing energy poverty and changing patterns of energy access in the era of climate change", the initial phase revolved around literature review on energy transition along with an extensive review of literature on residential energy consumption and transition. Then, taking into account both the literature review and the objectives of this report, preliminary survey questionnaire was formulated. The questionnaire underwent multiple revisions. The questionnaire was worked upon during January - March 2023.

Field visit to Kavre with Dr. Mine Islar and Dr. Sara Brogaard

The first pre-test – based on the hard copy of the questionnaire – was undertaken in early March 2023. Sudhindra Sharma, Dipak Gyawali, Dilasa Shrestha, Mine Islar and Sara Brogaard were involved in the pre-test on March 2 and 3, 2023. The locations of the pre-test were in Dhulikhel municipality and Panauti of Kavre district. The primary objective of this field visit was to conduct interviews with selected households and assess the survey questionnaire and see areas where the questionnaire needs further revision.

Following the field visit, a meeting was conducted at the IDA office, in which the team (that had visited the field) shared their observations and experiences from the field. These insights helped to further refine the survey questionnaire.

Further changes in the questionnaire were made in April 2023.

One final meeting was conducted via Zoom on May 18 with Dr. Mine Islar and Dr. Sara Brogaard. During this virtual session, the survey questionnaire underwent its finalization phase, which was the product of suggestions and recommendations from both Dr. Islar and Dr. Brogaard, and the IDA team. Based on the feedback, the questionnaire was finalized in hard copy, while a draft final version was prepared in the android version.

Then a second pre-test – this time focused on the android version in the Tablet – was conducted. The pre-test was undertaken on June 12 - 14 by a team consisting of six supervisors and one research associate. These individuals visited four districts within the central development region of Nepal. The selection of these districts took into consideration the country's three ecological divisions, namely--Mountain, Hill, and Terai regions. This was done in order to make sure that questions on the "Household Heating" and "Household Cooling" sections would be captured by the mountain region and the terai region, respectively.

The areas selected for the pre-test were:

In Mountain region:

- Ward no. 1 of Helambu rural municipality in Sindhupalchowk district. A team made up of two individuals undertook a total of 15 surveys as a part of the pre-test.

In Hilly region:

- Ward no. 8 of Shankharapur municipality and Ward no. 10 of Kathmandu Metropolitan city in Kathmandu district. A team of two individuals undertook a total of 20 surveys as a part of the pre-test.
- Ward no. 11 of Dhulikhel municipality in Kavrepalanchowk district. One individual undertook 2 surveys. These were in the same households as during the first round of pre-test.

In Terai region:

- Ward no. 2 and Ward no. 15 of Birgunj metropolitan city in Parsa district. Two individuals undertook a total of 15 surveys.

Thus, a total of 52 surveys were conducted during the second round of the pre-test that covered different locales – urban and rural as well as the different ecological zones – mountain, mid-hills and Tarai.

The selection of these districts was mindful of the nation's three ecological divisions - Mountain, Hill and Tarai regions. This approach ensured that the "Households Heating" and "Household Cooling" sections of the questionnaire would accurately capture data from the mountain and terai regions, respectively. The pre-tests were conducted using android tablets running ODK software.

Based on the insights gathered from the pre-test phase, adjustments and refinements were made to the household survey questionnaire. Simultaneously, software programming which had been developed using Open Data Kit (ODK) platform was further refined. The questionnaire form in ODK was equipped with various validations, including skip patterns and suitable ranges, enhancing data collection efficiency and accuracy to a considerable extent.

Based on the pre-test further revisions were done on the android version of the questionnaire – in both English and Nepali versions - and the questionnaire was made ready for the training.

1.4. Training Enumerators and Supervisors

A rigorous 4-day training for enumerators and supervisors was organized on June 19, 20, 21 and 22 at IDA's training hall in Kathmandu. The training encompassed a detailed walkthrough of the household survey questionnaire, covering both the paper and android versions, and incorporated informative sessions on various subjects along with practice mock interviews.

The first day of the training focused on survey's objectives, outlined the survey - covering both the household energy consumption and energy transition portion of the survey questionnaire. It also briefly went through the outline of the questionnaire – explaining about the main headings that were covered. The first day of the training also went through the hard copy of the questionnaire. (Since the skip patterns would not been seen when going through the android version, the first day, which went through the hard copy of the questionnaire, made an attempt to cover the questionnaire in its entirety).

The second day of the training went through the android version of the questionnaire. Role play and mock interviews were conducted in the third day. In the role plays, the enumerators were asked to

administered the questionnaire (in Tablet form) while the supervisions acted like the respondents. (Some of these supervisors had already been involved in the second pretest and so had a good idea about the content of the questionnaire and how respondents would respond). Based on the role plays and mock interviews, the enumerators and supervisors were also asked to identify glitches and issues in the android Tablets. The fourth day dealt on the role of the supervisors and enumerators, quality control issues, sampling plan. A detailed fieldwork plan was also hammered out. Likewise, the software was finalized and all the field team members were provided with a final updated version of the Tablet.

1.5. Fieldwork, Monitoring and Data Cleaning

For the purpose of gathering data in the field, a team of 18 enumerators and 6 supervisors were deployed. Efforts were made to ensure a balanced gender representation within the survey team. The selection of the field team was based on criteria such as their educational background, gender, and years of practical experience. While the enumerators conducted interviews as part of the household survey, the supervisors not only participated in household survey but also assumed managerial responsibilities for their respective teams. The field team were deployed to their respective locations on June 23, 2023. The fieldwork i.e., data collection activities were completed on July 10, 2023.

To assist in online monitoring, a dashboard was prepared. This dashboard helped in online monitoring of the fieldwork as the fieldwork progressed.

For face-to-face monitoring, Sudhindra Sharma, went to Kaski and Gulmi districts between June 29 and July 4 and interacted with the field teams in these districts.

The initial round of data review was performed by field supervisors during their time in the field. Following the complete receipt of data, additional data cleaning procedures were carried out. This involved verifying consistencies, applying filters, identifying outliers, and coding open-ended responses to ensure data integrity.

1.6. Organization of the Report

The report is structured into ten distinct sections, beginning with the introduction and followed by sections addressing the study's objective, a literature review, and past activities. The next chapter elaborates on the methodologies employed, the field work schedule, study procedures, and highlights data collection limitations.

The third section encompasses the demographic characteristics of the respondents, along with details about household income, expenditures. The fourth chapter discusses utilities and their costs as well as household electricity usage. This section is followed by another that delves into the specifics of household energy consumption patterns, encompassing cooking, heating, lighting, and cooling practices.

Moving forward, the report investigates the interplay between household energy dynamics and gender. The seventh section offers a concise overview of resilience and shocks, such as earthquakes, economic blockades, the Covid-19 pandemic, and periods of high inflation.

In the eighth section, the study's findings concerning the transition of household energy practices over the last three decades are discussed. Subsequently, the nineth section focuses on the role of mobile phones in communication and information dissemination.

Lastly, section ten covers the socio-economic traits of the participants included in the sample and foreign employment.

IDA had organized half a day interaction on November 21, 2023 for sharing the topline findings of the survey and feedback from experts. Government officials (MoEWRI, NEA), private sector hydropower developers, professors, former secretaries of MoEWRI, academics, researchers and development practitioners attended the program and provided their feedback. Further iteration of the report has sought to address some of their feedback. Annex 1 includes the proceedings of the November 21 program. Annex 2 comprises the list of participants of the November 21 program. Annex 3 includes the fieldwork personnel, including supervisors and enumerators.

1.7. Operationalizing Concepts in the Nepali context

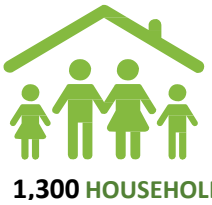
In the context of Nepal, cooking, heating, lighting, and cooling are essential aspects of daily life, and their definitions can be influenced by the country's geography, culture, and economic conditions.

1. **Cooking:** Cooking refers to the process of preparing food for consumption through the application of heat. In Nepal, traditional cooking methods often involve the use of open fires, clay stoves (chulhas), or improved cookstoves. However, there is also a growing trend towards modern kitchen appliances such as gas stoves and electric cookers, particularly in urban areas.
2. **Heating:** Heating involves the provision of warmth, especially during colder seasons or at higher altitudes in Nepal. Traditional heating methods may include using firewood, kerosene heaters, or electric heaters. In rural areas, where access to modern energy sources may be limited, people often rely on traditional means to keep warm.
3. **Lighting:** Lighting refers to the illumination of indoor and outdoor spaces. In Nepal, lighting sources range from traditional methods like oil lamps and candles to more modern options such as electric bulbs and solar-powered lights. While urban areas generally have reliable access to electricity, some remote and rural areas may still face challenges in terms of consistent lighting.
4. **Cooling:** Cooling involves the reduction of temperature, especially during hot weather. In many parts of Nepal, especially in the lowland Terai region, temperatures can get quite high during the summer. Cooling methods may include natural ventilation, fans, and, in urban areas, air conditioning units. In rural areas, people often rely on traditional methods like shade and natural airflow to stay cool.
5. Nepal Government's definition of "rural" and "urban" is the territories within the current rural municipality and municipality/metropolis respectively. If one were to take this as the defining criteria, then more than 66 percent of Nepalis would be residing in urban areas. Since this does not match reality, instead of following the Nepal Government's definition, the study sought to explore criteria such as population size, density, economic activities, infrastructure and services, availability of land, etc. and on the basis of these to characterize whether a place is "rural" or "urban". Further details are in section 3.7.

2. Methods and Procedures of the Study

2.1. Sampling Design

A nationally representative sample survey was carried out for the survey on household energy consumption and energy transition in Nepal. The sample design comprised a nationally representative random sample and the sampling design was developed by taking utmost care regarding representation of the findings at the national level by ensuring a minimum margin of error at 95% confidence level.

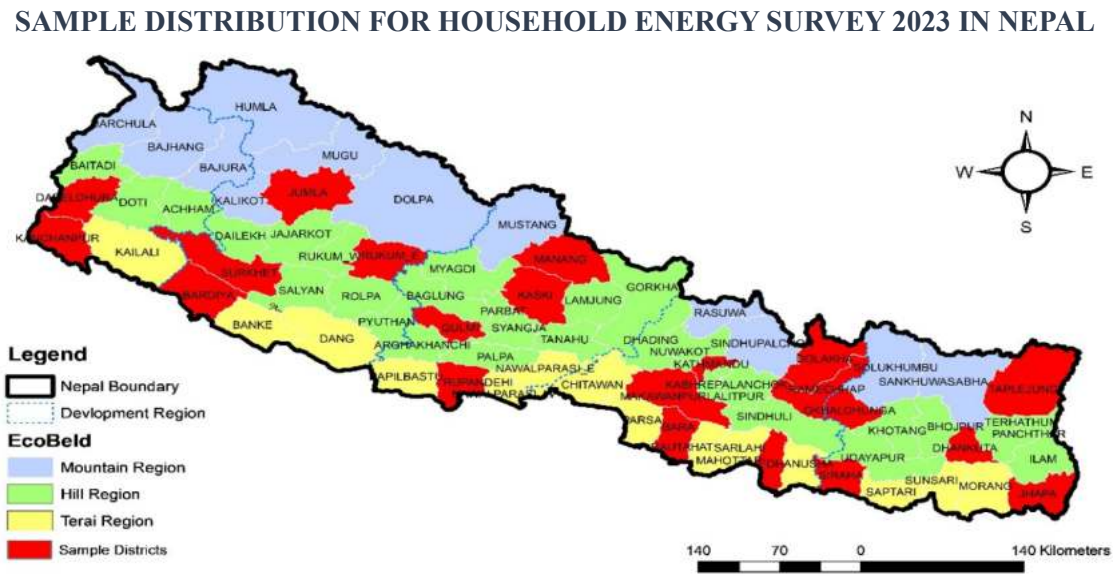


The household energy consumption and energy transition survey 2023 has a sample size of 1,300 HHs, which was selected through a random (probability) sampling technique. These 1,300 HHs are spread across 21 districts of Nepal. This size of HHs sample produced results within a +/- 2.7 percent error margin at the 95 percent confidence level at the national level.

Sampling for the selection of households was done in five stages. The sampling framework is outlined in brief below.

Nepal can be divided along the north-south axis and the east-west axis. Along the north-south axis falls the three ecological regions – mountains, hills, and the Tarai. Along the east-west axis lies the erstwhile five development regions, namely eastern, central, western, mid-western, and far western. Considering these two parameters – ecological region and development region – the country could be grouped into 15 distinct eco-development regions, formed out of a combination of 3 ecological regions and 5 development regions. Kathmandu valley could be treated as a separate region given the fact that the capital city of the country lies in it, and due to its big demographic size. These 16 eco-development regions constituted the "strata," and every stratum tends to have distinct features (i.e., physical, cultural-linguistic, and social), and within a stratum, there was a high degree of homogeneity, while across stratums, there was generally heterogeneity. However, in stratums where population density is low, these could be merged with the adjoining stratums. In the case of Western, Mid-Western and Far-Western Mountain, since the population is relatively very low, the Mountain districts of these regions have been merged with the hill districts of the region, making a single stratum. Hence, the sampling frame could be these 13 strata.

Figure 6: *Sample Districts within Nepal Map*



From these 13 strata, in the second stage, 21 of Nepal's 77 districts were selected using stratified random sampling technique. The number of districts from a particular stratum was decided by employing proportional allocation. Also, the total sample size of 1,300 HHs was proportionally distributed across these sample districts.

Once districts were identified, in the third stage, a proportional number of the erstwhile village development committees (VDCs) and/or municipalities were selected from the sample district through simple random sampling technique. The number of sampled VDCs varied according to the size of the sample district. One VDC was selected for every 20 HHs. For example, if 40 HHs were to be selected from a sample district, two VDCs, each with around 20 HHs, were selected.

Subsequently, in the fourth stage, the VDC was further divided into wards. For a VDC that had been allocated a sample size of 20, then two wards were selected by employing simple random sampling. This meant that for every sampled ward, 10 HHs would be selected. Urban HHs were selected from all the municipalities in each of the sample districts.

In the fifth stage, within the sampled ward, there could be various villages/settlements, and these were regarded as enumeration areas (EAs). The various EAs within a ward were identified and listed once the survey teams reached the localities. From this list, one EA was randomly selected using simple random sampling.

Then, a listing of all the households in the sampled EA was undertaken, and in the sixth stage, systematic random sampling was used to select the households from the list.

In this way, altogether 1,300 households were selected.

Since this was a household survey, the most well-informed member of the household was selected for the interview. The individual who possessed the most comprehensive knowledge of energy-related matters was identified, and the interview was conducted with him/her.[14]

If members of the chosen household were not available or unwilling to participate, another household was selected following the prescribed skip pattern. In this way, in each stage of sampling, probability sampling was adopted to ensure a representative sample.

Figure 7: *Sample Design*

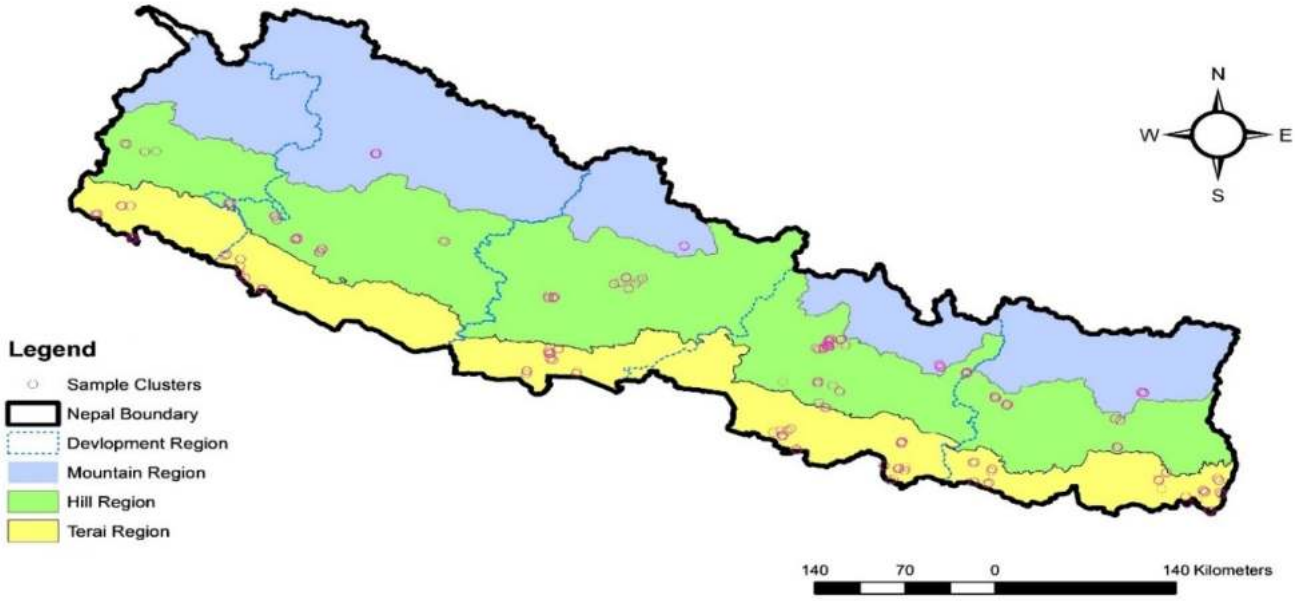
Dev-Eco Regions	• First Stage: Sample Frame (Stratified into 13 strata)
↓	
Districts	• Second Stage: Stratified Random Sampling
↓	
VDCs/Mun.	• Third Stage: Simple Random Sampling
↓	
Ward	• Fourth Stage: Simple Random Sampling
↓	
Households	• Fifth Stage: Right-Hand-Rule
↓	
Respondents	• Sixth Stage: Household Head/Well Informed Person

[14] The person with the most extensive understanding of energy-related topics was identified, and the interview was carried out with him/her. Individuals of any gender, whether male or female, were eligible to participate in the survey interview as long as they were the most well-informed person in the household.

Data weighting: When generating the findings at the national level, weighting was done as per the national census 2021 of Nepal. Consistency weight had been used in the survey data analysis to make the sample consistent (i.e., if it deviates far from the population parameters) with the population parameters. For this survey data analysis, caste/ethnicity of the population had been taken into account while calculating the consistency weight. For instance, in Nepal, the total population of Brahman-Hill are 11.29% as per 2021 census of Nepal but the sample represent are only 8.1%. If we employed the weight, the sample 8.1% will reflect the population 11.29%.

Figure 8: *Sample Distribution in Sample Districts*

SAMPLE DISTRIBUTION FOR HOUSEHOLD ENERGY SURVEY



2.2. Challenges during the fieldwork

The survey fieldwork happened in monsoon, which is a rainy season. Undertaking in-person interviews during the rainy season posed challenges due to the possibilities of floods in the Tarai and landslides in the hills. However, IDA managed to effectively carry out the fieldwork and gather data for the energy consumption survey. Interestingly, conducting interviews proved to be more demanding in urban city and town settings as opposed to rural areas. In rural locals, respondents were more accessible for interviews.

In the section on source of income, the respondents inquired about its purpose and necessity, and were somewhat hesitant to answer. Likewise, the electricity bill is paid infrequently, in a single large payment, leading to difficulties in pinpointing monthly expenses. There was no agreement on the daily electricity usage amount. When asked about when the electricity came to the area, exact date could not be provided, only a vague estimate of years. Determining the cost and current price of firewood posed challenges. It was also problematic to establish the pricing for self-produced household consumer goods. If renting a house in a village is required, it's challenging to determine the amount due, given the absence of renting tradition.

2.3. Limitations of this report

This report is primarily descriptive, and not analytical. It provides descriptive data in the form of frequency or percentage distribution and are presented in the form of charts and tables. Disaggregation has been done with some variables, of which the urban-rural, ecological region and income stand out. However, there is potential for future analysis using various statistical techniques like regression analysis, correlation assessment, multivariate analysis, and determination of significance between different variables.

3. Demographic and Socio-economic characteristic

This section covers the demographic and socio-economic traits of the participants included in the sample. The most well-informed person with regards to energy issues was identified and the interview was conducted with him/her. This was often the household head.

3.1. Caste/ Ethnicity and Religion

The sample comprises of respondents from 58 caste and ethnic communities which closely resembles their presence in the country's population. In Nepal, Chhetri and hill Brahman are the two large castes in the population – these are more or less proportionately reflected in the sample as well. The broad caste/ethnic groups in the sample is presented in the table below.

Table 3.1.1 *Caste and Ethnicity breakdown of the individual survey respondents (Base = 1,300)*

		All	
		Frequency	**Percent**
Caste Group	Hill Caste	413	31.8
	Hill Adibasi/Janajati	343	26.4
	Hill Dalit	117	9.0
	Madhesi Caste (Level -1)	10	0.8
	Madhesi Caste (Level - 2)	203	15.6
	Madhesi (Adibasi/Janajati)	94	7.3
	Madhesi Dalit	54	4.1
	Other Cultural Groups	0	0.0
	Musalman	67	5.1
	Total	1300	100.0

Religion-wise breakdown of sample is shown below. Hindu respondents constitute 82.8% of the sample, while another 7.6% of the sample is made up of Buddhist respondents and Islam are 5.2% of the sample.

Table 3.1.2 *Religion of survey respondents (Base = 1,300)*

		All	
		Frequency	**Percent**
HH1Q15. Religion	Hinduism	1076	82.8
	Buddhism	99	7.6
	Islam	67	5.2
	Kirat	38	2.9
	Christianity	20	1.5
	Total	1300	100.0

3.2. Sex, Age, Marital Status of Respondents

The table below shows the sex of the respondent. As mentioned previously the respondent was the most well-informed person in the household (who more often than not was the household head).

Table 3.2.1 *Age Distribution of the survey respondents (Base = 1,300)*

		All	
		Frequency	**Percent**
Gender	Male	658	50.6
	Female	642	49.4
	Total	1300	100.0

Of the total respondents, nearly three quarter (43.2%) were aged between 46 and above years. The second highest group of respondents belonged to the age group of 36 to 45 years (25.1%).

Table 3.2.2 *Age Distribution of the survey respondents (Base = 1,300)*

		All	
		Frequency	**Percent**
Age Group	18-25	138	10.6
	26-35	275	21.2
	36-45	326	25.1
	46 and above	561	43.2
	Total	1300	100.0

Of the total respondents, an overwhelming majority (85.4 percent) were married.

Table 3.2.3 *Marital Status of the survey respondents (Base = 1,300)*

		All	
		Frequency	**Percent**
Marital Status	Married	1110	85.4
	Unmarried (never married)	80	6.2
	Widow/widower	100	7.7
	Divorced/separated	10	0.8
	Total	1300	100.0

3.3. Education

With regards to education, 23.6% say they are illiterate, 9.2% are literate but have no formal education, 18.9% completed primary level, 6.3% completed lower secondary level and 18.8% completed secondary level education. Some 10.0% of the respondents have completed school level certificate (SLC), 8.7% have completed intermediate and some 4.6% say they have Bachelors' degree and above.

Table 3.3.1 *Educational Attainment of the survey respondents (percent) (Base = 1,300)*

		All	
		Frequency	**Percent**
Educational Group	Illiterate	306	23.6
	Non-formal education	120	9.2
	Primary	245	18.9
	Lower secondary	81	6.3
	Secondary	245	18.8
	SLC	130	10.0
	Intermediate	113	8.7
	Bachelor & above	59	4.6
	Total	1300	100.0

3.4. Household Income

The table below provides the average values of various income sources for the household. First, it asks about income from self-employed agriculture (HIQ1), which includes earnings from farm produce and livestock products such as milk, meat, fish, and eggs. The mean value for this comes to be NPR. 7,113.26 per month. Next, it inquiries about income from agricultural labor (HIQ2), where the mean value comes to be an average of NPR. 1,188.30 per month. The question on income from non-agricultural labor (HIQ3) reveals that the household members earn approximately NPR. 3,813.91 per month from non-agricultural work. The income or profit from the household's own business (self-employed non-agriculture) is discussed in HIQ4. The average monthly value is NPR. 6,280.60. Salaried workers in the household (HIQ5) contribute a mean monthly income of NPR. 8,026.63. Remittances (HIQ6) play a significant role, with the average remittance income being NPR. 11,107.26 per month. Additional sources of income, such as rent, interest income, and capital gains, are considered under "Others" (HHQ7), contributing an average of NPR. 3,383.78 per month. Finally, the table presents the total household income, combining all these sources, which amounts to NPR. 40,913.75 per month. This is captured in the table below.

***Table 3.4.1** Household Income [Base = 1,300]*

	Average Amount in NPR.
HIQ1. [Ask If any of the HH members are involved in self-employed agriculture] How much income does your household would generate in a month from the farm produce and products from livestock (milk, meat, fish, egg, etc.?	7,113.26
HIQ2. [If any of the HH members are involved in agricultural labor] How much income do your household members generate in a month by working as agricultural laborer?	1,188.30
HIQ3. [If any of the HH members are involved in non-agricultural labor] How much income do your household members generate in a month by working as non-agricultural laborer?	3,813.91
HIQ4. [If any of the HH members are involved in self-employed non-agriculture] How much income/profit does your household members generate in a month from own business?	6,280.60
HIQ5. [If any of the HH members are salaried workers] How much income do you household members generate in a month as salary?	8,026.63
HIQ6. Remittance	11,107.26
HHQ7. Others ((for instance from rent, or interest income, capital gains, etc.)	3,383.78
Total Income	40,913.75[15]

The data highlights substantial disparities in income sources and levels between rural and urban households. Rural households tend to earn more from self-employed agriculture and agricultural labor, while urban households have higher incomes from non-agricultural labor, self-employment in non-agricultural sectors, salaried work, and other sources. This indicates the influence of economic activities and opportunities that are distinct to rural and urban environments.

The data also indicates variations across different ecological regions. The Hill tends to have the highest average incomes across several income sources, including non-agricultural labor, self-employment in non-agricultural sectors, salaried work, and income from other sources. The Tarai region excels in remittance income. The Mountain region generally has lower average incomes across most income sources.

Income and expenditure (which are indicators of economic well-being) will be treated as an important variable. Relevant questions will be dis-aggregated based on economic quartiles. Households with a monthly income below NPR 21,000 are categorized as low-income, those with a monthly income equal to or above 21,000 but less than 40,000 NPR fall into the medium-income bracket, and households earning over NPR 40,000 per month are classified as high-income. The distribution of the sample across the three income quartiles is shown below.[16]

[15] *Exchange rate as of September 15, 2023: 1USD = 133.95 NPR*
Converted amount: NPR 40,913.75 ≈ USD 305.44

[16] The concept of income quartiles involves categorizing survey households into three equal sections based on their monthly household income percentile. The total income considered for this classification is the aggregate of various income sources within the household.

Distribution of Samples across Income Categories

		All	
		Frequency	**Percent**
Household Income	Low Income (First Quartile)	434	33.4
	Medium Income (Second Quartile)	442	34.0
	High Income (Third Quartile)	424	32.6
	Total	1300	100.0

3.5. Household Consumption Expenditure

Table 3.5.1 below shows the mean monthly expenditure of the household across various categories. The first question, HCFQ1, asks about monthly food expenses, encompassing a wide range of items such as grains, cereals, lentils, beans, vegetables, milk, meat, fish, fruits, nuts, oil, spices, beverages, etc. The average expenditure on food for the household is approximately NPR. 7,892.20 per month. HCFQ2 focuses on food produced or grown by the household itself. It inquiries about the hypothetical cost the household would need to spend on these self-produced items. The estimated monthly expenditure for these self-produced food items is approximately NPR. 7,040.72. Moving beyond food, HCFQ3 deals with non-food expenses. This includes costs related to fuel, electricity, clothing, transportation, education, health, and other similar expenditures. The household's mean monthly spending on non-food expenses amounts to approximately NPR. 8,411.35. HCFQ4 pertains to durable goods and assets purchased by the household over the past 12 months. On average, the household spends approximately NPR. 3,386.54 on acquiring durable goods and assets within this time frame. The total expenditure, combining all these categories, is presented as "Total Expenditure," with a mean value of NPR. 26,730.80 per month. This figure provides an overview of the overall monthly financial outlay for the household across food, non-food items, and durable goods.

***Table 3.5.1** Household Expenditure [Base = 1,300]*

	Average Amount in NPR.
HCFQ1. On average, how much does your household spend monthly on food-expenses (for instance grains, cereals, lentils, beans, vegetables, milk, meat, fish, fruits, nuts, oil, spices, beverages, etc.)?	7,892.20
HCFQ2. On average, if you and the members of the household consume food produced/grown by the household itself, how much would you normally have to spend in a month to buy these things?	7,040.72
HCFQ3. On average, how much does your household spend monthly on non-food-expenses (for instance fuel and electricity, clothing, transportation, education, health, etc.)?	8,411.35
HCFQ4. On average, how much does your household spent for purchasing durable goods and assets in the past 12 months?	3,386.54
Total Expenditure	26,730.80[17]

[17] *Exchange rate as of September 15, 2023: 1 USD = NPR 133.95*
Converted amount: NPR 26,730.80 ≈ USD 199.55

The data highlights distinct expenditure patterns between rural and urban households. The overall cost of living appears to be higher in urban areas, with increased expenses in various categories, especially food and non-food items. Urban households spend more on food, non-food items, and durable goods compared to rural households. Rural households seem to rely more on self-produced food items, potentially indicating a greater degree of self-sufficiency in rural areas.

The data reveals regional disparities in household expenditures. The Hill region has the highest average expenditure in various categories, including food, non-food items, and durable goods. The Tarai region also shows relatively high expenditures, especially in food and non-food items. The Mountain region generally has lower average expenditures across all categories, indicating in economic conditions and lifestyles that are different than the Hills and Tarai.

3.6. Socio economic characteristic

3.6.1. Major Profession Respondents

Table 3.6.1 shows the occupation composition of respondents. In this survey, majority of respondents were from agriculture background. With regards to the main occupation, 55.8% reported agriculture and next largest group, 16.1% reported non-agriculture is the main occupation. Another 13.5% reported house wife as their main occupation.

***Table 3.6.1**: Occupation of the survey respondents (percent) (Base = 1,300)*

		All	
		Frequency	**Percent**
Occupational Status	Agricultural self-employed	687	52.9
	Housewife	176	13.5
	Non-agri self employed	163	12.5
	Salaried worker	85	6.6
	Non-agri wage labor	54	4.1
	Retired	39	3.0
	Agricultural wage labor	37	2.9
	Student	31	2.4
	Unemployed	21	1.6
	Social Security Allowance	7	0.5
	Total	1300	100.0

3.6.2. Foreign Employment

Among the 1,300 sampled households, 551 households had members engaged in foreign employment, receiving remittances on average from approximately 1.71 individuals per households. These households received an average remittance of NPR. 11,107.26.

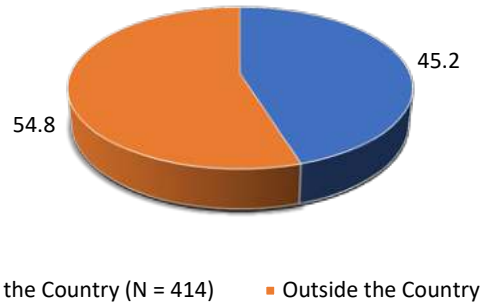
In the analysis of foreign employment, the data reveals a notable gender distribution. Among individuals engaged in foreign employment, the majority, comprising 75.5% of the total, are male.

Conversely, the female participation in foreign employment stands at 24.5%, highlighting a gender disparity in this sector.

The age distribution of foreign employment reveals a significant concentration among individuals aged 21 to 30, accounting for 43.7% of the total. Additionally, those in the 31-40 range contribute 21.7%, making them the second-largest group. Younger workers, aged 11 to 20, comprise 18.2% of the foreign employment, indicating a substantial portion of the workforce in this category as well. Meanwhile, individuals aged 0-10, 41-50, and 51-60 contribute 6.1%, 8.0%, and 1.7% respectively, while those aged 61-70 constitute just 0.4% of the total foreign employment.

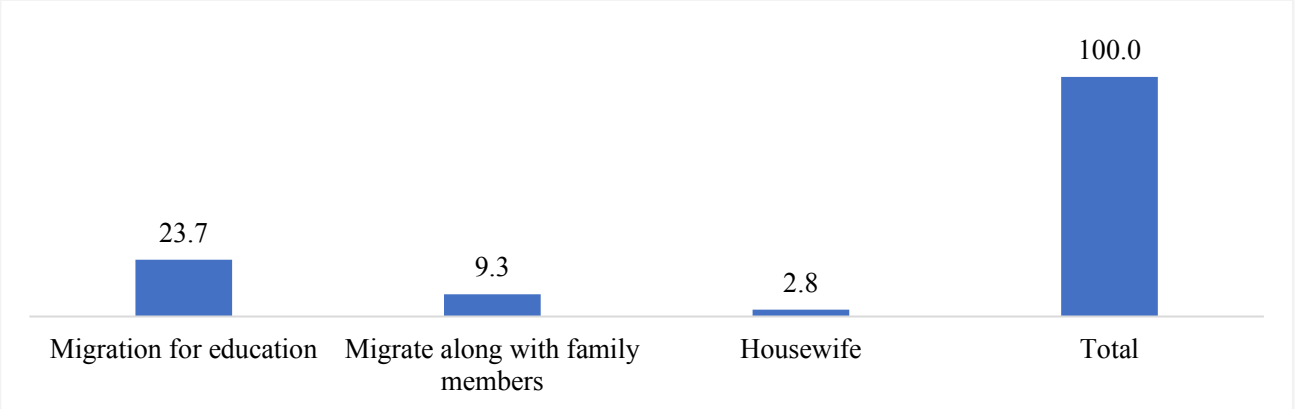
A majority of individuals, accounting for 54.8% of the total, find employment opportunities outside their home country, showcasing a significant trend towards international work opportunities. Conversely, 45.2% of foreign employment occurs within the individual's home country. The data underscores the global nature of employment, with a considerable portion of the workface seeking job prospects abroad.

***Figure 3.6.2.1**: Destination for Migration [Base = 1,300]*



The figure below illustrates the primary reasons for migration, offering valuable insights into the motivations driving individuals to relocate. A significant portion, 64.2%, of individuals embark on migration for work-related purposes, underscoring the crucial role employment opportunities play in the decision to move. Education is also a notable driver, with 23.7% of migrants seeking educational pursuits in their new location. A notable proportion, 9.3%, migrate alongside their family members, highlighting the importance of family unity in the migration process. A smaller percentage, 2.8% consists of housewives, possibly indicating accompanying family members of primary migrants.

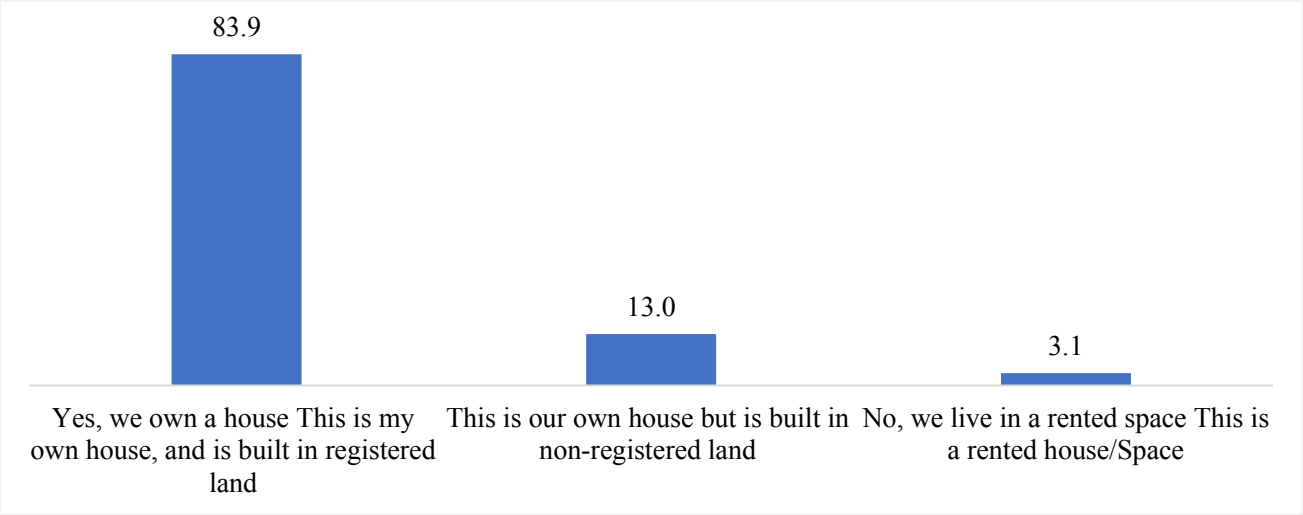
***Figure 3.6.2.2**: Purpose of Migration [Base = 1,300]*



3.6.3. Characteristics of Household

The figure below outlines the housing ownership status of the surveyed families. It indicates that 83.9% of the respondents own a house, specifying that this house is built on registered land and is considered their own. Additionally, 13.0% of the respondents own a house, but it is constructed on non-registered land. In this case, the respondent still owns the house, but it is situated on public land (ऐलानी जग्गा). The remaining 3.1% of the surveyed families live in rented spaces, with the description that it is a rented house or space.

***Figure 3.6.3.1**: Housing Ownership Status [B1, Base = 1,300]*



Ownership rates are higher in both rural and urban areas, with more people owning houses rather than living in rented spaces. Ownership rates are slightly higher in rural areas compared to the urban area. The percentage of respondents owing houses built on registered land is higher than those owing houses on non-registered land in both rural and urban areas. The percentage of respondents living in rented spaces is notably higher in urban areas compared to rural areas.

Ownership rates vary across ecological regions, with the highest rate in the Mountain region and the lowest in the Tarai region. The Mountain region has the highest percentage of respondents owning houses built on registered land. The Tarai region has a relatively higher percentage of respondents owning houses built on non-registered land. The percentage of respondents living in rented spaces is lowest in the Tarai region.

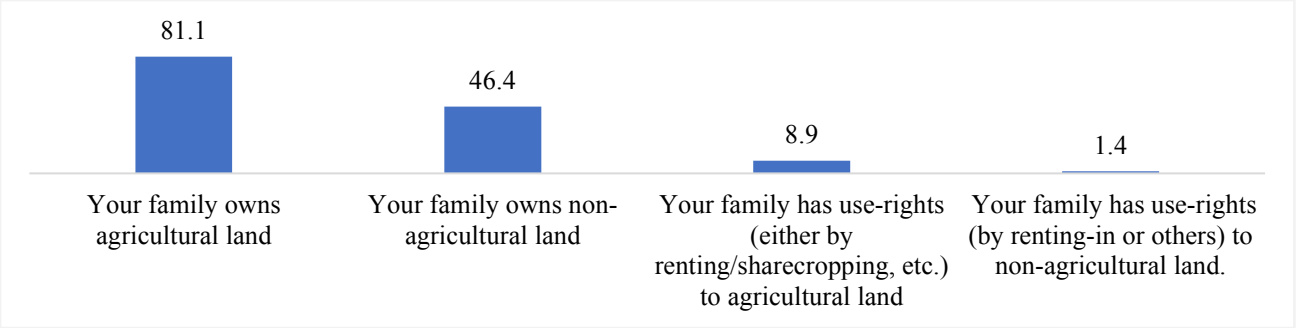
For a household living in their own houses, the estimated monthly rent for the property is approximately NPR. 6,616.25. On the other hand, for household residing in rented houses, the average monthly rent they pay is approximately NPR. 6,312.91.

The survey sought to find out more about rental arrangements. Only 7.4% of the surveyed household indicated that they have either rented out a house they own or have rented out rooms or flats within the house where they currently reside. The majority, accounting for 92.6%, responded that they have not been involved in any such rental arrangements.

A significant majority, accounting for 81.1% of the families surveyed, reported that they own agricultural land. Additionally, 46.4% of the families indicated ownership of non-agricultural land. In terms of use-rights, 8.9% of the families have acquired these rights through methods like renting or sharecropping for agricultural land. A smaller proportion, representing 1.4% of the families, possess

use-rights to non-agricultural land through similar means, such as renting-in. This data provides insights into the land ownership and use patterns among the surveyed families, highlighting the prevalence of agricultural land ownership as well as the lesser occurrence of use-rights for non-agricultural land.

***Figure 3.6.3.2**: Distribution of families' land ownership [B2, Base = 1,300]*



The ownership of agricultural land is more prevalent among families in rural areas (86.9%) compared to urban areas (50.8%). Non-agricultural land ownership is more evenly distributed between rural (44.9%) and urban (54.6%) families. A significantly higher proportion of rural families (10.0%) have use-rights to agricultural land compared to urban families (2.7%). The percentage of families with use-rights to non-agricultural land is relatively low in both rural (0.9%) and urban (4.4%) areas.

Also, the ownership of agricultural land is highest in the Mountain region (93.9%), followed closely by the Hill (81.4%) and Tarai (79.5%) regions. The data suggests a correlation between household income and land ownership/use-rights patterns. Low-income families tend to have higher agricultural land ownership and use-rights, while high-income families have lower ownership and use-rights percentages.

3.7. Criteria to distinguish urban and rural areas

In 2017, the government of Nepal carried out major restructuring of local government units. This restructuring aimed to replace the previous Village Development Committees (VDCs) and Municipalities with new administrative units known as *Gaunpalika* (Rural Municipalities) and *Nagarpalika* (Municipalities). This restructuring process resulted in the creation of numerous Gaunpalikas and Nagarpalikas across the country, which varied in number and size from one province to another.

During this restructuring process, most municipalities were formed by merging previous village development committees and then these were considered 'urban' despite a severe lack of resources and infrastructure. According to current government classification, 66% of the population in Nepal are shown to be residing in *Nagarpalika,* purportedly, urban areas; however, this statistic does not accurately reflect reality.

According to standard international practices such as the definition provided by UNFPA (1996) an urban area is one that 'has an administrative unit, population concentration, the proportion of the population in non-agricultural occupation and availability of infrastructural facilities.'

Thus the Nepal government's approach to categorizing a space as 'urban' doesn't meet the criteria outlined by international standards. Criteria such as, population size, population density, economic activities [non-agricultural based, service-oriented, industry, manufacturing], including the presence

of physical infrastructure like road, water supply, electricity, solid waste management, wastewater management, etc. have not been taken into account by the Nepal government. Many villages in the hills that have been categorized as municipalities, are not even connected to the national road network.

Hence, in this survey, IDA attempted to distinguish between urban and rural areas based on several indicators that have been listed below:[18]

3.7.1. Indicators to distinguish urban-rural municipalities

Q1. In your opinion, is the population density in your ward high or low?

1. It is high (average households – 1,297)
2. It is low (average households – 124)

Q2. In this ward, what is the status of in-migration and out-migration?

1. More in-migration than out-migration
2. More out-migration than in-migration
3. In-migration and out-migration are equal

Q3. What is the situation of the land in this ward?

1. There is plenty of land available
2. Land is scarce

Q4. In this ward, in which sector do most of the people work?

1. Manufacturing, administration, and service activities
2. Agriculture

Q5. How much time does it take to reach your Nearest ATM from your home using the most accessible means of transportation? (It could be by either using a vehicle or by walking)

Less than half an hour	1	More than half an hour	2

Q6. What are the services and amenities mentioned below that are available in your locality?

Good quality Medical Facilities like clinics or hospitals
Public Transportation like buses, minibuses, micro, etc.
Internet connection to the household excluding mobile data
None

Q7. What do you think of the place you stay in – is it rural (गाउँ) or urban (शहर बजार)? [FOR RESPONDENT ONLY]

Q8. What do you think of the place you had interviewed with the respondent in - is it rural (गाउँ) or urban (शहर बजार)? [QUESTION FOR ENUMERATORS ONLY]

[18] In line with established global norms, as outlined by UNFPA (1996), an urban area is characterized by the presence of an administrative unit, a concentrated population, a significant proportion engaged in non-agricultural occupations, and the availability of essential infrastructural facilities.

Out of 8 questions, if at least 6 responses are ticked for rural, the location is classified as rural.

Questions	Options for urban areas	Options for rural areas
Q1	It is high (average population – 5,467)	It is low (average population – 620)
Q2	More in-migration than out-migration	More out-migration than in-migration
Q3	Land is scarce	There is plenty of land available
Q4	Manufacturing, administration, and service activities	Agriculture
Q5	Less than half an hour	More than half an hour
Q6	Good quality Medical Facilities like clinics or hospitals, Public Transportation like bus, minibus, micro, etc., Internet connection to the household excluding mobile data	None
Q7	Urban	Rural
Q8	Urban	Rural

The table below shows the distribution of rural and urban areas. What is interesting to note according to this way of classifying urban and rural is that the coverage of urban is much smaller than the official classification. Only 16.1% is seen to be residing in urban areas (whereas, if one were to take the government classification 66% are supposedly living in urban areas). Interestingly this figure closely matches the classification under the old administrative structure where 17% were shown to be living in Nagarpalika and 83% were shown to be living in VDCs.

Distribution of Samples across Urban-Rural Areas

		All	
		Frequency	Percent
Urban Rural Settlement	Rural	1091	83.9
	Urban	209	16.1
	Total	1300	100.0

The table below shows the distribution of the sample across another important variable – the ecological regions i.e., mountains, Hills and Tarai. Reflecting the actual demography, only a small proportion of the sample resides in mountain areas. Slightly more than 50 percent of the sample resides in the Tarai followed by the Hills.

Distribution of Samples across Ecological Zones

		All	
		Frequency	Percent
Ecological Region	Mountain	70	5.4
	Hill	561	43.1
	Tarai	669	51.5
	Total	1300	100.0

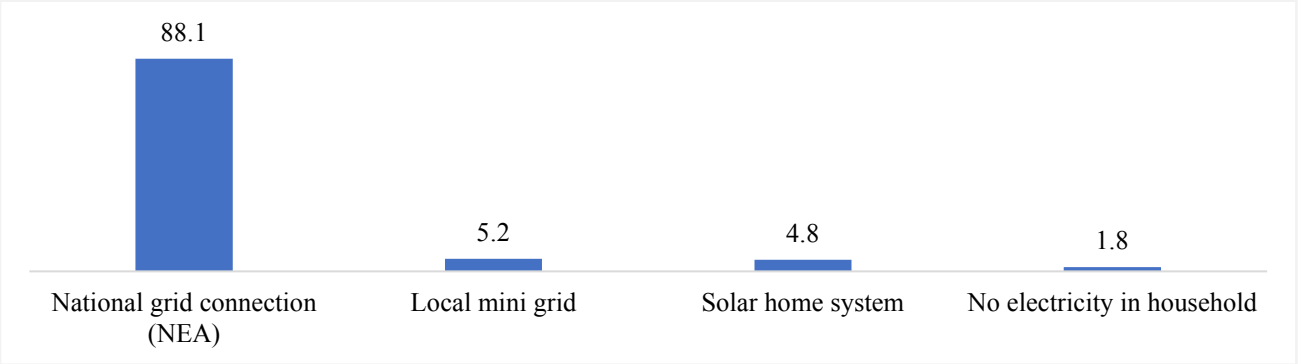
4. Household Electricity

4.1. Main Sources of Electricity in Household

From the survey, it was found that a total of 98.2% of households have access to electricity. When the respondents from these households were asked about their primary source of electricity, significant proportion of respondents, 88.1%, stated that their household relies on the national grid connection provided by the National Electricity Authority (NEA). Whereas, a smaller proportion, 5.2%, mentioned that their households rely on local mini-grids, indicating localized energy solutions. Some 4.8% of the respondents also stated that they use solar home systems as their primary source of electricity. Conversely, a small minority of households at 1.8% reported that they do not have access to electricity.

98.2% of Households have access to electricity

***Figure 4.1.1**. Sources of Electricity [C1, Base = 1,300]*



The table 4.9.2 provides a breakdown of the main sources of electricity in household based on their residence type (rural or urban) and ecological region (Mountain, Hill, or Tarai).

Among households with a national grid connection (NEA) as their primary sources of electricity, the distribution varies across residence types and ecological regions. For urban areas, an overwhelming 98.9% rely on the national grid connection. In the Tarai region, this figure is also high at 98.9%, indicating widespread usage. However, in the Mountain region, only 31.6% of households have access to national grid connection, while in the Hill region, it is notably higher at 82.4%.

Local mini grids represent another source of electricity, with rural Mountain households and Hill households relying on them significantly more than other areas. In the Mountain region, 65.2% of households depend on local mini grids, while in the Hill region, it's 4.0%. In contrast, urban and Tarai households show negligible usage of local mini grids.

Solar home systems are a notable source of electricity in certain regions. In the Hill region, 11.0% of household utilize solar home systems, and in the Mountain region, it's 1.6%. However, this source is less prevalent in urban, and Tarai areas.[19]

Lastly, a small percentage of households across all categories have no electricity, with slightly higher proportions in the Hill and Mountain region compared to Tarai areas.

[19] Grid and solar home system are two different sources of electricity in context of Nepal. A grid system is part of a centralized network that draws power from various sources, while a solar home system generates electricity on-site using solar panels, often providing a more sustainable and independent power solution for individual residences.

Table: 4.1.2: Breakdown of the main sources of electricity in households based on residence and ecological region

	Residence		Ecological Region		
	Rural	Urban	Mountain	Hill	Tarai
National grid connection (NEA)	86.1	98.9	31.6	82.4	98.9
Local mini grid	6.2	0.0	65.2	4.0	0.0
Solar home system	5.8	0.0	1.6	11.0	0.0
No electricity in household	1.9	1.1	1.6	2.6	1.1

4.2. Average Number of Household Appliances

The table below provides the average number of various household appliances or devices owned by the respondents. The first columns list the types of items, while the other columns indicate the average number of those items owned.

On average, the surveyed households own 0.5 television, 0.2 desktop/laptop computer, 0.4 modern/routers for internet or Wi-Fi, 0.1 radio/CD players/sound system, 0.8 normal mobile phone, and 1.8 smartphone/tablets. The ownership of certain items, such as electric geysers, rechargeable electricity storage (inverters), air conditions/coolers, electric hair dryers/hair curlers, electric sewing machines, solar thermostats, dishwashers, and microwave ovens, has an average of negligible, indicating that very few households have these items.

However, there are exceptions, with 1.7 table fans/ceiling fans, 0.3 electric irons, 0.3 mixer grinders, 0.3 rice cookers, 0.1 induction cookstoves, 0.4 refrigerators/freezers, 0.6 torchers/flashlights/lanterns, 0.4 electric water pumps, 0.2 solar PVs, 3.3 compact fluorescent lights (CFLs), and 2.6 LED light bulbs. These average values offer insights into the prevalence of these specific household items among the surveyed respondents.

If one takes into account both normal and smart mobiles (including Tablets), one household has, on average, 2.6 mobile phones[20]. Apart from mobile phones, Nepalis do not own/use household appliances that run on or consume electricity.

Table 4.2.1: Average Number of Various Household Appliances [C2, Base = 1,300]

Appliances	Overall	Residence	
		Rural	Urban
	Mean	Mean	Mean
Television	0.5	0.5	0.8
Desktop/laptops Computer	0.2	0.2	0.3
Modem/router (for Internet or Wi-Fi)	0.4	0.3	0.6
Radio/CD Players/sound system	0.1	0.2	0.1
Normal mobile phones	0.8	0.8	0.7
Tablets/Smartphones	1.8	1.7	2.3

[20] In the context of Nepal, the prevalence and widespread use of mobile phones have become a defining feature of the country's technological landscape. Mobile phones have emerged as the most common and widely adopted electronic devices among the surveyed population.

Electric Kettle	0.2	0.2	0.4
Mixer Grinder	0.3	0.3	0.5
Rice cooker	0.3	0.3	0.3
Induction cookstove	0.1	0.1	0.1
Refrigerator/Freezer	0.4	0.3	0.6
Dishwasher	0.0	0.0	0.0
Microwave oven	0.0	0.0	0.1
Electric (water) rod	0.1	0.0	0.1
Electric Geyser	0.0	0.0	0.0
Rechargeable electricity storage (Inverters)	0.0	0.0	0.1
Air Conditioners/coolers	0.0	0.0	0.0
Table fans/ Ceiling fans	1.7	1.6	2.4
Electric Iron	0.3	0.3	0.5
Electric Hair Dryer/ Hair Curler	0.0	0.0	0.1
Electric Sewing machine	0.0	0.0	0.0
Electric Space Heaters	0.1	0.1	0.2
Solar PVs	0.2	0.2	0.1
Solar Thermostat	0.0	0.0	0.1
Compact Fluorescent Light (CFL)	3.3	3.3	3.3
LED Light Bulbs	2.6	2.4	3.6
Torch/flashlight/lantern	0.6	0.6	0.5
Electric Water Pump	0.4	0.4	0.5

In summary, the data highlights variations in the ownership of electrical and electronics devices between rural and urban households. Urban households tend to have higher ownership of devices related to internet connectivity, smartphones, refrigeration, and modern lighting technologies. Rural households, on the other hand, show higher ownership of traditional devices like radios and ceiling fans.

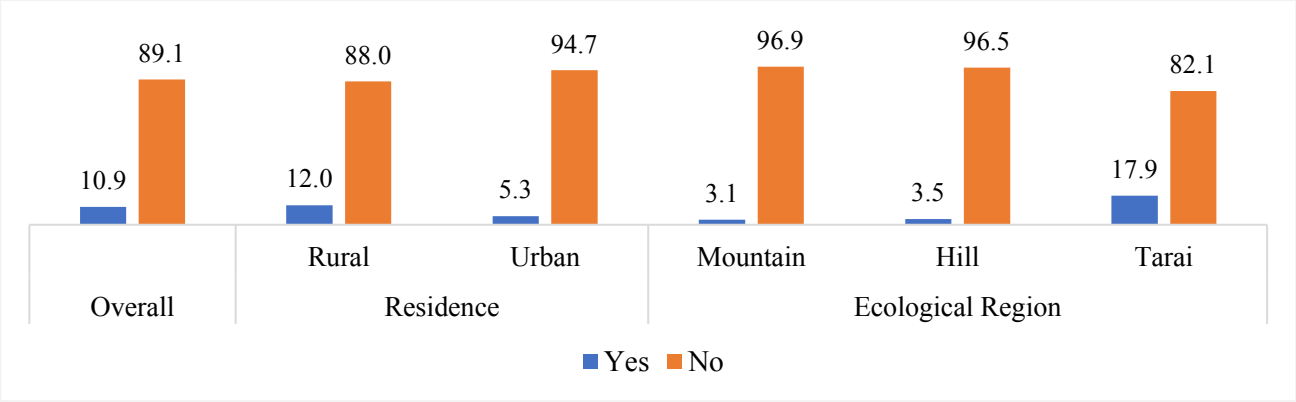
4.3. Usage of Modern Electric Agricultural Appliances/Machinery

Figure 4.3.1 presents the utilization of modern electric agricultural appliances or machinery in households, and the data is categorized based on residence type and ecological region.

Across all respondents, 10.9% of households reported making use of such modern electric agricultural equipment. When considering residence type, rural households showed a slightly higher usage rate with 12.0%, compared to 5.3% for urban households.

The adoption of these appliances varies across ecological regions. In the Mountain region, only 3.1% of households use modern electric agricultural appliances, whereas the usage is slightly higher in the Hill region at 3.5%. In the Tarai, the usage rate is 17.9%, indicating relatively higher usage compared to other areas.

***Figure 4.3.1**: Utilization of Modern Electric Agricultural Appliances [C3, Base = 1,300]*

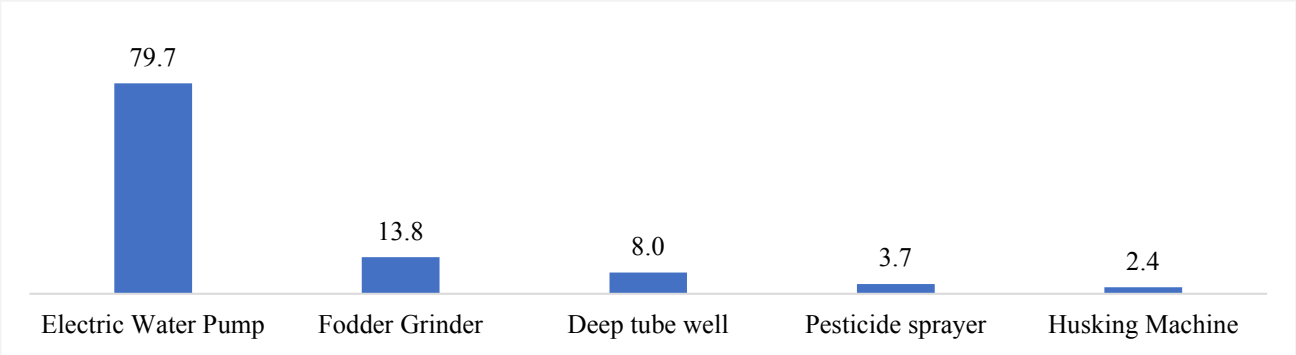


4.4. Types of Modern Electric Agricultural Appliances/Machinery Used by Household

10.9 % of the total respondents who reported that they use various modern agricultural equipment in their households were further asked what specific equipment they use. The respondents had the option to choose multiple responses. The figure below illustrates the percentage distribution of different types of modern electric agricultural appliances or machinery utilized by households. Among the respondents, the most commonly used appliance is the electric water pump, with a significant majority of households, representing 79.7%, employing this equipment. Another appliance, the fodder grinder, is used by 13.8% of households demonstrating a relatively lower adoption rate compared to the electric water pump. Deep tube wells are utilized by 8.0% of households, followed by pesticide sprayers, which are used by 3.7% of the surveyed households. The husking machine is the least commonly used appliance among the respondents, with only 2.4% of households using this equipment for agricultural purposes.

The data highlights the prevalence of electric water pumps in agricultural activities, potentially indicating their essential role in the context of modern electric agricultural machinery. Additionally, while other appliances like the fodder grinder, deep tube wells, pesticide sprayers, and husking machines show lower adoption rates, they still contribute to the overall modernization of agricultural practices in the surveyed households.

***Figure 4.4.1**: Different types of modern electric agricultural appliances or machinery utilized [C4, Base = 142]*



Electric water pumps are widely utilized across various regions, particularly in Tarai region with a usage rate of 93.5%. However, in the Mountain region, the usage drops significantly to 22.3%, and in the Hill region, it's even lower at 2.9%. In rural areas, the usage 82.5% of households use electric water pumps, and in urban areas, this rate is 46.4%.

Fodder grinders, on the other hand, are predominantly used in the Mountain region with a usage rate of 77.7%.[21] In the Hill region, the usage rate is 72.3%. This appliance is not used in urban households and is relatively uncommon in the Tarai and rural areas, with usage rates of 15.0% and 3.0%, respectively.

Deep tube wells show a different usage pattern, with higher utilization in urban areas (36.6%) compared to rural areas (5.7%). Also, the usage of deep tube well is relatively higher in the Hill region (20.2%) compared to Mountain and Tarai region.

Pesticide sprayers are utilized to a limited extent, with the highest usage in urban areas (8.5%). In rural areas, 3.3% of households use pesticide sprayers, but this appliance is not used in the Mountain and Tarai region.

Husking machines are also relatively uncommon, with higher in urban areas (8.5%). In rural areas, 1.9% of households are husking machines, and the usage rates in the Hill and Tarai regions are 7.4% and 1.7%, respectively.

This data provides insights into the regional and residence-based variations in the adoption of modern electric agricultural appliances or machinery, indicating the specific areas where these technologies are more prevalent needed.

***Table 4.4.2**: Breakdown of the usage of different types of modern electric agricultural appliances or machinery based on residence and ecological region*

	Residence		Ecological Region		
	Rural	**Urban**	**Mountain**	**Hill**	**Tarai**
Electric Water Pump	82.5	46.4	22.3	2.9	93.5
Fodder Grinder	15.0	0.0	77.7	72.3	3.0
Deep tube well	5.7	36.6	0.0	20.2	6.2
Pesticide sprayer	3.3	8.5	0.0	0.0	4.4
Husking Machine	1.9	8.5	0.0	7.4	1.7

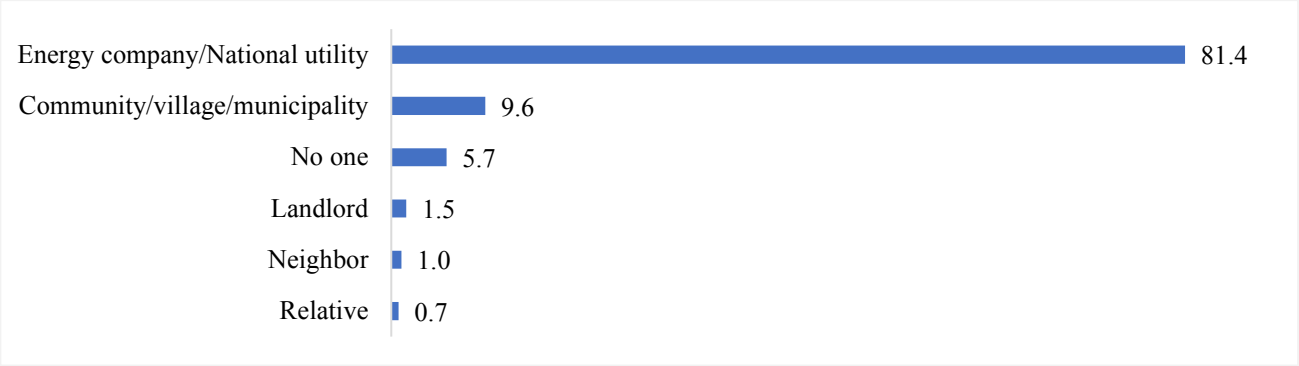
4.5. Payment Recipients for Main Electricity System

The majority of households (81.4%) pay their bills to an energy company or national utility, which is the Nepal Electricity Authority (NEA). A smaller percentage of households (9.6%) make payments to their community, village, or municipality. A small portion (5.7%) do not pay anyone for their electricity[22], while a few pay their landlord (1.5%), neighbor (1.0%), or a relative (0.7%).

[21] This is probably due to the prevalence of stall feeding.

[22] Enumerators and supervisors clarified that the phrase "do not pay anyone for their electricity", implies that households either engage in electricity theft or in other cases, rely on borrowed electricity from their neighbor's or relative's homes.

***Figure 4.5.1**: Household's payment sources for their main energy sources [C6, Base = 1,277]*



Urban and Tarai regions has the highest percentages of households (92.7% and 93.9% respectively) paying their energy bills to energy companies or national utilities. These regions have better access to centralized energy services. The mountain region has the lowest percentage (34.4%) relying in energy companies/national utilities, possibly due to geographical challenges and limited infrastructure.

The mountain region stands out with high proportion (62.5%) of households paying their energy bills to the community, village, or municipality. This could indicate the prevalence of localized energy solutions in this region, which might be driven by specific geographical or community factors.

In rural areas, a notable proportion (6.6%) of households do not pay anyone for their energy source. This might reflect self-sufficiency through non-commercial sources, informal arrangements, or challenges in accessing formal energy services.

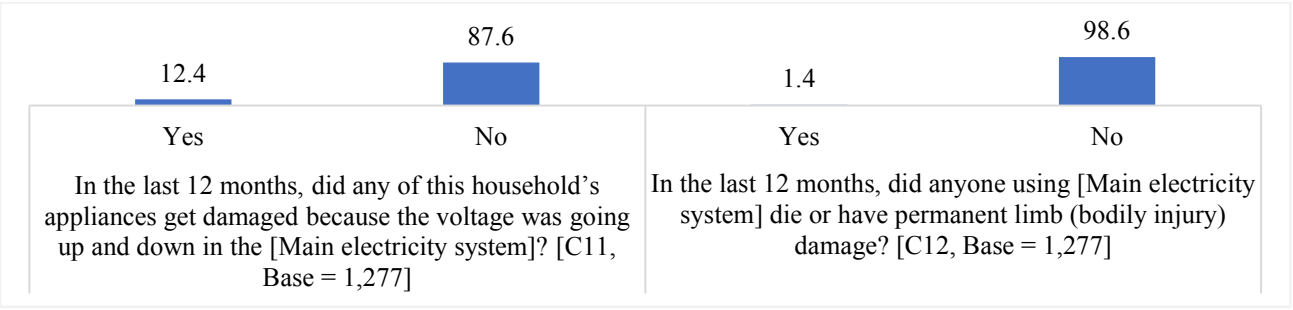
Urban areas (5.1%) have higher percentage of households paying their landlords for energy, suggesting a common practice in these setting. This might be part of rental arrangements where energy costs are included.

Payments to neighbors and relatives for energy are relatively low across all regions, indicating that these sources are not common methods of energy payment.

4.6. Incidents Related to Voltage Fluctuations and Injuries

In the past 12 months, 12.4% of households experienced damage to their appliances due to voltage fluctuations in the main electricity system, while the majority (87.6%) did not encounter such issues. Fortunately, severe accidents resulting in fatalities or permanent limb (bodily injury) damage related to the main electricity system were relatively rare, with only (1.4%) of households reporting such incidents, while 98.6% of households did not experience these severe consequences. This data underscores the importance of addressing voltage stability concerns to prevent appliance damage and highlights the need for continued efforts to ensure the safety and reliability of the main electricity system for all households.

***Figure 4.6.1**: Experiences of households with the main electricity system [C11 and C12, Base = 1,277]*



4.7. Involvement in Renewable Energy Projects

The table below presents information about household's involvement in renewable energy projects, specifically in the context of individual or collaborative efforts. A significant majority of households, accounting for 86.4%, reported not being involved in any other renewable energy projects individually or through collaborative/cooperative efforts. Among those who are engaged in such projects, 11.8% of households are involved in Photovoltaic Solar (PV Solar) projects, indicating a notable interest in solar energy initiatives[23]. Only 1.1% are engaged in Biogas projects, which signifies a smaller yet noteworthy fraction focusing on bioenergy. Very few 0.7% of households are involved in small-scale hydro power projects, indicating a limited presence in hydropower initiatives.

The data suggests a relatively low overall engagement in renewable energy projects, but notable interest in solar and, to a lesser extent, biogas and small-scale hydro power projects.

***Table 4.7.1**: Household's involvement in renewable energy projects [C13, Base = 1,300]*

	Overall	Residence		Ecological Region		
		Rural	Urban	Mountain	Hill	Tarai
No	86.4	84.9	94.5	70.7	78.9	94.4
Yes, Photo Voltic Solar (PV Solar)	11.8	13.2	5.0	28.6	19.4	3.8
Yes Biogas	1.1	1.3	0.0	0.0	0.4	1.8
Yes, Small-scale Hydro Power	0.7	0.7	0.5	0.7	1.5	0.0
Yes, other system	0.1	0.1	0.0	0.0	0.0	0.2

In urban areas, a higher percentage (94.5%) of households are not involved in other renewable energy projects, while only 5.5% of urban households participate in these efforts. In rural areas, the majority (84.9%) of households reported not being involved in any other renewable energy projects, while a notable portion (15.1%) have some level of engagement in such activities.

Mountain regions show relatively high involvement in PV Solar projects (28.6%), possibly due to favorable solar exposure at higher elevations. Hill regions have a noteworthy participation in PV Solar (19.4%) and small-scale hydro power (1.5%), indicating interest in both solar and hydroelectric energy. Tarai regions display the lowest involvement in renewable energy projects, with the most significant engagement being in PV Solar (3.8%).[24]

[23] While 4.8% reported solar PV as their main source of electricity, those using some sort of solar PV (irrespective of whether it was their main source of electricity or not) is 11.8%.

[24] Mountain and Hill regions exhibit the highest level of involvement in PV solar projects. This could be because clusters do not have transmission lines that connect them to the national grid.

4.8. Agreement with Statements about Solar PV Installation

Follow- up questions were asked to those households who were associated with solar PV. Respondents were asked to rate their agreement with regards to specific statements, ranging from "Strongly Disagree" to "Strongly Agree". A substantial number of respondents (40.6%+38.3%) agreed that the investment in solar PV is beneficial for the household economy, potentially offering a fast return. The majority (52.8%+ 34.5%) of respondents also agreed that solar PV systems enhance the stability of the household power supply. A substantial proportion of respondents (51.2%+35.2%) believed that solar PVs contribute to additional capacity during grid shortages and a majority of respondents (50.6%+33.8%) viewed solar as environmentally beneficial, with minimal impact on the climate. However, a significant proportion of the respondents (21.5%+36.2%) were skeptical that they could obtain government support through a PV subsidy program.

Many respondents (47.0%+36.9%) also believe that storing solar PV energy for household's use is important. A majority of respondents (51.6%+15.2%) find solar PVs to be an interesting technical challenge, with some variation in the level of interest. The majority of respondents (61.6%+22.3%) place significant importance on the safety of solar PV systems. A significant proportion of respondents (50.0%+25.3%) consider the visibility of solar PVs from the outside to be a positive aspect. A majority of respondents (38.4%+32.1%) do not see solar PVs as a strong possibility for them to share or sell energy.

***Table 4.8.1**: Attitudes towards solar photovoltaic (PV) investment and benefits [C14, Base = 187]*

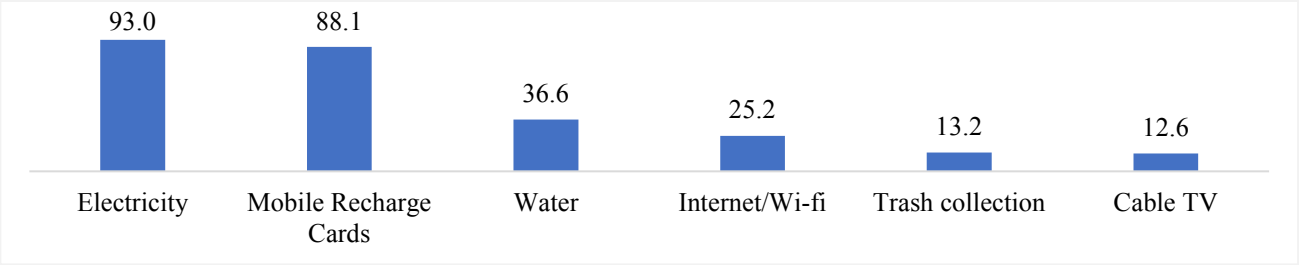
	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
C14a. The investment is good for the household economy (e.g., fast return)	4.6	10.2	6.4	40.6	38.2
C14b. I can get support through PV subsidy program from the government	21.5	36.2	9.6	22.8	9.9
C14c. Solar PV improves stability of the household power supply	1.5	6.9	4.4	52.8	34.5
C14d. Solar PV adds additional capacity in periods of shortage from the grid	2.2	5.1	6.3	51.2	35.2
C14e. Solar PVs are good for the environment (e.g., no impact on the climate)	0.5	8.8	6.2	50.6	33.8
C14f. Solar PV energy should also be stored to be useful for the household	0.5	11.0	4.5	47.0	36.9
C14g. Solar PVs are an interesting technical challenge for me/the household members	3.9	15.7	13.6	51.6	15.2
C14h. It is important that solar PVs have few/no safety issues	0.5	9.0	6.6	61.6	22.3
C14i. It is a plus that solar PVs are also visible from the outside	1.7	10.4	12.7	50.0	25.3
C14j. Solar PVs are a possibility for me to share /sell energy	38.4	32.1	5.1	19.8	4.6

5. Cost of Utilities

5.1. Types of Utilities in Household

The figure 5.1.1 illustrates the percentage distribution of different types of utilities used in the households. Among the options presented, electricity and mobile recharge cards are the most commonly used utilities, with adoption rates of 93.0% and 88.1% respectively. Water services are utilized by 36.6% of the households, while internet/Wi-Fi services are employed by 25.2%. A smaller portion of the household utilities trash collection services at 13.2%, and cable TV services are used by 12.6%. Additionally, a relatively smaller percentage of the household utilities the bundled service of cable TV with internet/Wi-Fi, accounting for 11.8% of the responses. This breakdown provides insights into the utility usage patterns within the household, highlighting the prominent role of electricity and mobile recharge cards in their daily operations.

***Figure 5.1.1**: Different types of utilities used in the household [D0, Base = 1,300]*



The data highlights several differences between rural and urban households in terms of utility usage. Urban areas generally have higher adoption rates for services like water, internet/Wi-Fi, trash collection, cable TV, and cable TV with Internet/Wi-Fi. Rural households, on the other hand, have slightly higher usage of mobile recharge cards, and electricity is prevalent in both settings. These differences are likely influenced by infrastructure availability, economic factors, and lifestyle preferences specific to each setting.

While there are some commonalities in utility usage, there are significant differences across ecological regions. Electricity and mobile communication are widely adopted across all regions. The Hill region seems to have better access to water and higher usage of trash collection services. Digital connectivity (Internet/Wi-Fi) is relatively consistent across all regions. Preferences for cable TV and combined cable TV and Internet/Wi-Fi services are more prominent in the Hill region. Landline phone usage is minimal across all regions.

The data illustrates several trends related to utility usage based on income levels. Electricity is widely used across all groups, while access to water, Internet/Wi-Fi, and trash collection services increases with higher income levels. Cable TV adoption is generally low, and the combined service of Cable TV with Internet/Wi-Fi is more prevalent among higher income households. Landline phone usage is minimal across all income groups.

5.2. Monthly Expenditure on Various Household Utilities

The table below provides information on the average monthly expenses of a household in NPR for various services. The household appears to spend higher for electricity, mobile communication, internet connectivity, and water compared to other amenities.

The household spends a substantial amount on electricity, with an average monthly payment of NPR 524.26. This suggests that electricity is a significant part of their utility expenses. The average monthly payment for water is NPR 191.27, indicating that the household spends a reasonable amount on water services. Only 31 households in the sample have a landline phone services, with an average payment of NPR 436.62. This indicates that landline usage is uncommon. With an average payment of NPR 658.71, mobile recharge cards are a significant part of the household's expenses, suggesting a reliance on mobile communication. The average payment for trash collection is NPR 228.86, indicating a moderate expense for this service.

The household spends a significant amount on internet/Wi-Fi services, with an average of NPR 1005.64, reflecting the importance of internet connectivity in their expenses. The average payment for cable TV services is NPR 470.49, suggesting a moderate investment in entertainment. Interestingly, the average payment for combined cable TV with Internet/Wi-Fi service is higher (NPR 1193.45) than the individual internet/Wi-Fi service, indicating that the household might prefer bundled services. Only one household pays for parking services, with an average payment of NPR 200. This indicates a minimal impact on overall expenses.

The data shows no reported payment for security services, possibly indicating that the household relies on other means of security or the absence of this service in their context. The average payment for other utilities is NPR 480.13, suggesting additional miscellaneous expenses not covered in the previous categories.

The overall average monthly payment across all categories is NPR 1,628.30, which provides an idea of the average total utility expenses for the households.

***Table 5.2.2**: Cost of Utilities [D1-D11, Base = 1,300]*

	N	Mean
Electricity	1207	524.26
Water	472	191.27
Landline phone service	31	436.62
Mobile recharge cards	1127	658.71
Trash collection	148	228.86
Internet/ Wi- fi services	316	1,005.64
Cable tv services	160	470.49
Cable tv with internet/ Wi-fi	161	1,193.45
Parking services	1	200.00
Security services	0	
Others	13	480.13
Total Payment	1,299	1,628.30[25]

[25] *Exchange rate as of September 15, 2023: 1 USD = 133.95 NPR*
Converted amount: NPR 1,628.30 ≈ USD 12.15

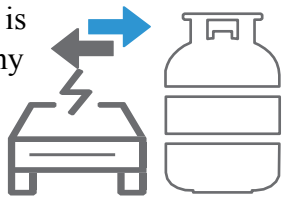
In summary, urban residents tend to have higher utility costs for electricity, water, mobile recharge cards, internet/Wi-Fi services, and cable TV with internet/Wi-Fi. However, rural residents pay more for landline phone service, trash collection, and the "Others" category.

***Table 5.2.3**: Cost of Utilities by Urban-Rural Settlement*

	Overall		Residence			
			Rural		Urban	
	N	Mean	N	Mean	N	Mean
Electricity	1207	524.26	989	462.00	218	825.92
Water	472	191.27	344	178.63	128	226.79
Landline phone service	31	436.62	15	488.01	16	390.12
Mobile recharge cards	1127	658.71	936	665.75	191	621.09
Trash collection	148	228.86	80	270.91	68	188.12
Internet/ Wi- fi services	316	1005.64	236	988.90	80	1054.25
Cable tv services	160	470.49	117	477.78	43	451.10
Cable tv with internet/ Wi-fi	161	1193.45	89	1128.69	72	1283.11
Parking services	1	200.00	-	200.00	-	-
Security services	0	-	-		-	-
Others	13	480.13	13	480.13	-	-
Total Payment	1299	1628.30	1079	1462.70	220	2493.38

6. Household Energy Consumption Pattern

6.1. Usage of Cooking Devices for Food Preparation

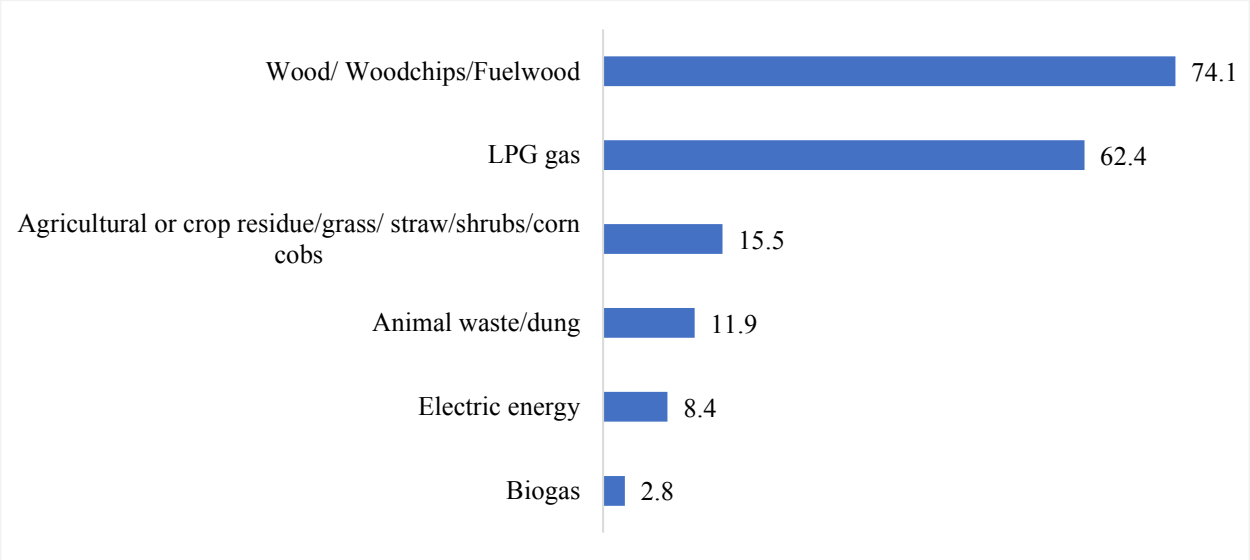


The survey inquired whether any food or drink consumed by household members is cooked or prepared within the household dwelling using a cookstove, fire, or any other cooking device. The data reveals that 100.0% of the respondents answered 'yes', signifying that all household members engage in cooking or food preparation using the mentioned methods.

6.2. Types of Fuel Used for Cooking by Household

The survey then asked about the different types of fuel used by this household for cooking purposes every day. Multiple responses were allowed. The data illustrates that 74.1% of household utilize wood/woodchips/fuelwood as their cooking fuel of choice. Following closely is the usage of LPG gas by 62.4% of households. Additionally, 15.5% of households reported using agricultural or crop residue/grass/straw/shrubs/corn cobs as a cooking fuel, while 11.9% rely on animal waste/dung. A smaller share, 8.4%, employs electric energy for cooking, and even smaller percentage, 2.8% utilizes Biogas as their cooking fuel.

***Figure 6.2.1**: Distribution of Household Cooking Fuel Types [EC2, Base = 1,300]*



The data underscores differences in cooking fuel usages between rural and urban households.

Table 6.2.2: Distribution of Household Cooking Fuel Types by different variables

		Wood/ Woodchips/ Firewood	LPG gas	Agricultural or crop residue/grass/ straw/shrubs/corn cobs	Animal waste/dung	Electric energy
Residence	Rural	79.8	57.3	17.4	13.2	7.3
	Urban	44.6	88.9	5.4	4.8	13.9
Ecological Region	Mountain	95.9	48.0	1.4	0.0	4.3
	Hill	65.5	61.0	0.7	0.0	15.3
	Tarai	79.1	65.0	29.3	23.1	3.0
Household Income	Low Income	87.6	43.8	17.4	13.4	3.9
	Medium Income	79.1	61.6	17.7	10.8	5.5
	High Income	55.2	82.2	11.1	11.4	15.9

Not surprisingly, the majority of rural households (79.8%) rely on wood or firewood for their everyday cooking needs. In contrast, only 44.6% of urban households utilize these traditional sources of fuel. LPG gas is more commonly used in urban areas, with 88.9% of urban households employing it for cooking. In rural areas, 57.3% of households use LPG gas. The use of agricultural or crop residue, along with grass, stew, shrubs, and corn cobs, is significantly higher in rural areas (17.4%) compared to urban areas (5.4%). A similar pattern is observed with the utilization of animal waste or dung for cooking. This practice is more prevalent in rural households (13.2%) compared to urban households (4.8%). Urban households (13.9%) have a slightly higher prevalence of electric energy usage for cooking than rural households (7.3%).

The data also highlights the influence of ecological regions on cooking fuel choices. The utilization of wood, woodchips, or firewood for cooking is highest in the Mountain region (95.9%), followed by the Tarai region (79.1%) and the Hill region (65.5%). LPG gas most widely used in the Tarai region (65.0%), followed by the Hill region (61.0%) and the Mountain region (48.0%). The practice of utilizing agricultural or crop residue and animal waste or dung is significantly more common in the Tarai region (29.3% and 23.1% respectively). The use of electric energy for cooking is most prevalent in the Hill region (15.3%) compared to other regions.

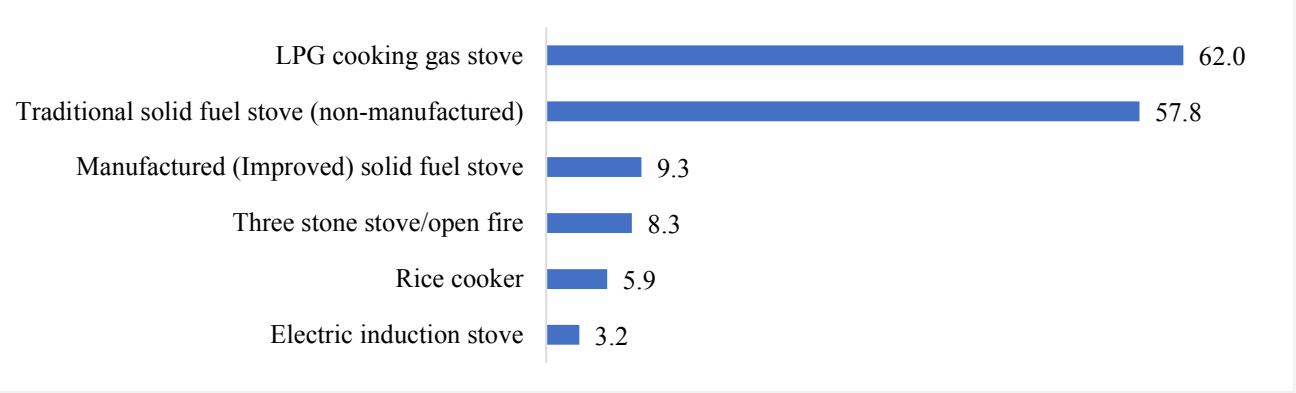
The data showcases how cooking fuel preferences vary across different income levels. While traditional fuels like wood are more common among lower-income households, the use of modern energy sources like LPG gas and electric energy increases with higher income levels. Additionally, the usage of agricultural residue and animal waste is influenced by factors beyond income.

6.3. Types of Cookstoves/Devices Used for Cooking by Household

The survey then asked about the different types of cookstove or device that this household uses for cooking purposes every day. Multiple responses were allowed. The data indicates that the most commonly employed option is the LPG cooking gas stove, accounting for 62.0% of responses. Notably, traditional solid fuel stove (non-manufactured) is also prevalent, chosen by 57.8% of households. Manufactured (improved) solid fuel stove follows at 9.3%, while three stone stove/open

fire is used by 8.3% of households. Additionally, a small portion of households (5.9%) employs a rice cooker for cooking purposes. Lastly, electric induction stove is chosen by 3.2% of households as their cooking appliances of choice. These findings provide insights into the diverse landscape of cookstove preferences and highlight the coexistence of traditional and modern cooking technologies.

***Figure 6.3.1**: Distribution of Household Cookstove [EC3, Base = 1,300]*



The data provides insights into the differences in cookstove and cooking device preferences between rural and urban households.

***Table 6.3.2**: Distribution of Household Cookstove by different variables*

		LPG cooking gas stove	Traditional solid fuel stove (non-manufactured)	Manufactured (Improved) solid fuel stove	Three stone stove/open fire	Rice cooker	Electric induction stove
Residence	Rural	57.1	62.0	10.3	8.5	5.6	2.7
	Urban	87.8	35.4	3.6	7.5	7.5	5.9
Ecological Region	Mountain	48.0	10.1	79.6	8.8	3.1	1.2
	Hill	60.9	41.1	10.4	15.9	9.5	6.7
	Tarai	64.5	76.7	0.9	2.0	3.2	0.5
Household Income	Low Income	43.7	65.0	10.4	12.7	3.7	0.8
	Medium Income	61.6	62.9	9.4	7.7	4.7	1.0
	High Income	81.2	45.0	7.9	4.5	9.5	8.0

Urban households tend to adopt modern cooking technologies like LPG gas stoves and electric induction stoves, while rural households often rely on traditional solid fuel stoves. Urban households (87.8%) show a significantly higher utilization of LPG cooking gas stoves compared to rural households (57.1%). The preference for traditional solid fuel stoves is more pronounced in rural areas (62.0%) compared to urban areas (35.4%). Manufactured solid fuel stoves are used more frequently in rural households (10.3%) compared to urban households (3.6%).

The data also highlights the significant variations in cookstove and cooking device preferences across different ecological regions. The prevalence of LPG cooking gas stoves is highest in Tarai region

(64.5%), followed by Hill region (60.9%) and the Mountain regions (48.0%). The use of traditional solid fuel stoves is also significantly higher in the Terai region (76.7%), followed by the Hill region (41.1%) and the Mountain region (10.1%). The use of manufactured solid fuel stoves is most prevalent in the Mountain region (79.6%), while it is less common in the Hill region (10.4%) and almost negligible in the Tarai region (0.9%). The usage of three stone stoves or open fire, rice cooker and electric induction stoves are slightly more prevalent in Hill region compared to Mountain and Tarai region.

The data indicates that cooking preferences vary significantly across household income levels. While traditional cooking methods persist among lower-income households, higher-income households are more likely to adopt modern cooking technologies such as LPG gas stoves, rice cookers, and electric induction stoves.

6.4. Household Cooking

In this section, first and foremost, the respondents were asked about the different types of fuel and different types of cookstoves or devices used by their household for cooking purposes every day. Then based on their answer, each respondent was further asked for what cooking purposes that particular fuel was used. And series of few other questions like "How much time that fuel/cookstove was used yesterday for cooking?", "How much did the household pay for that cooking fuel in the last month?", and "If any harm or injury occurred when using that fuel/cookstove" were also asked.

6.4.1. Cooking Preferences and Usage Patterns Across Different Stove Types

The data presented in the table below highlights the various cooking preferences and usage patterns associated with different stove types.

Cooking meals (Bihana ko khana, Belka ko khana) using LPG gas/LPG cookstoves accounts for 37.2% of the respondents' choices, while cooking snacks (khaja) and boiling water represent 46.1% and 20.9% respectively. Making tea or coffee is most frequently done with LPG gas/LPG cookstoves, constituting 50.5% of the responses. A notable portion of users, 39.4% opts for using LPG gas/LPG cookstoves for a variety of cooking tasks falling under all of the above.

Electric cookstoves show a significant preference for cooking meals (58.3%) and cooking snacks (69.2%). Boiling water is done by 25.5% of respondents using this type of stove, while making tea or coffee is popular, accounting for 65.9%. Interestingly, only 6.2% of electric cookstove users choose it for all the mentioned cooking tasks.

Electric coil cookstoves are predominantly chosen for cooking meals (57.7%), and they show no usage for cooking snacks, boiling water, or making tea/coffee. Nonetheless, a substantial 42.3% of users utilize electric coil cookstoves for all the task listed.

Three stone stoves exhibit preferences for cooking meals (27.1%) and cooking snacks (11.5%), while they are commonly used for boiling water (13.8%). Making tea or coffee using these stoves represents a smaller percentage, at 2.2%. However, a significant portion, 69.3% respondents using three stone stoves prefer for all the cooking tasks.

Traditional solid fuel stoves are chosen by 34.7% for cooking meals and by 21.4% for cooking snacks. Boiling water and making tea or coffee using these stoves account for 15.2% and 9.1%, respectively. Moreover, 62.5% of traditional solid fuel stove users opt for these stoves for all the cooking tasks listed.

Improved solid fuel stoves are utilized by 26.3% for cooking meals and by 14.7% for cooking snacks. Boiling water and making tea or coffee with these stoves represent 13.3% and 12.6% respectively. An overwhelming majority, 70.9%, of respondents using improved solid fuel stoves prefer them for all the cooking tasks.

Biogas stoves are chosen for cooking meals (45.5%) and cooking snacks (36.5%), and they are popular for boiling water (31.6%) and making tea or coffee (34.4%). About half of the respondents, 48.7%, using biogas stoves, prefer them all the mentioned cooking tasks.

***Table 6.4.1.1**: Cooking Preferences and Usage Patterns Across Different Stove Types*

	Cooking meals (Bihana ko khana, Belka ko khana)	Cooking snacks (Khaja)	Boiling water	Making tea/ coffee	All of the above
EC4. LPG gas/LPG cookstove [Base =813]	37.3	46.1	20.9	50.5	39.4
EC10. Electric cookstoves [Base = 42]	58.3	69.2	25.5	65.9	6.2
EC16. Electric coil cookstove [Base = 3]	57.7	0.0	0.0	0.0	42.3
EC22. Three stone stoves [Base = 108]	27.1	11.5	13.8	2.2	69.3
EC28. Traditional solid fuel stove [Base = 751]	34.7	21.4	15.2	9.1	62.5
EC35. Improved solid fuel stove [Base = 120]	26.3	14.7	13.3	12.6	70.9
EC42. Biogas stove [Base = 35]	45.5	36.5	31.6	34.4	48.7

Overall, the data indicates variations in cooking practices and stove/fuel preferences between rural and urban areas. Urban areas generally show a higher reliance on cleaner cooking technologies such as LPG gas, induction cookstoves, and electric coil cookstoves, whereas rural still rely on more traditional cooking methods like three stone stoves and traditional fuel stoves. For each cooking method/fuel source, the data highlights the preferences for cooking specific types of meals or tasks in both rural and urban settings. It can provide insights into the cooking habits and fuel preferences of the surveyed population in different locations.

Table 6.4.1.2: Cooking Preferences and Usage Patterns Across Different Stove Types and Urban-Rural settlement

		LPG gas/cookstove		Traditional solid fuel stove	
		Rural	Urban	Rural	Urban
For what cooking purposes is this particular fuel used?	Cooking meals (Bihana ko khana, Belka ko khana)	38.2	34.0	33.7	44.2
	Cooking snacks (Khaja)	48.6	38.0	20.2	32.5
	Boiling water	22.8	14.4	14.3	24.0
	Making tea/ coffee	53.0	42.1	9.1	9.6
	All of the above	35.7	51.9	64.1	47.7

6.4.2. Average Usage of Different Cooking Stoves for Various Cooking Activities

The survey results indicates that the traditional solid fuel stove has the highest adoption and usage rate among the stoves listed, followed by the improved solid fuel stove and the LPG cookstove. The data also suggests varying levels of usage of other stoves, with factors as availability, efficiency, and cultural preferences likely influencing these patterns.

Table 6.4.2.1 presents the average usage data for different cooking stoves across various cooking activities per day. Among the stove examined, the LPG cookstove had the highest base of 812 households, i.e., 812 households mentioning they use it, with an average usage of 1.40 hours. The induction cookstove was utilized for cooking by 42 households on average for 0.76 hours. The electric coil cookstove had a base of 1 household and an average usage of 1.00 hour. The three stone stoves were used for cooking by 105 households on average, with a duration of 1.90 hours. Traditional solid fuel stoves showed an average usage of 2.01 hours, based on a larger base of 749 households. Improved solid fuel stoves had a base of 113 households and were used for an average of 2.11 hours. Lastly, the biogas stove had a base of 34 households and an average usage duration of 1.67 hours.

Table 6.4.2.1: Average Usage of Different Cooking Stoves for Various Cooking Activities

	Base (N)	Average Number of Hours
EC5. LPG cookstove	812	1.40
EC11. Induction cookstove	42	0.76
EC17. Electric coil cookstove	1	1.00
EC23. Three stone stoves	105	1.90
EC29. Traditional solid fuel stove	749	2.01
EC36. Improved solid fuel stove	113	2.11
EC43. Biogas stove	34	1.67

The data indicates variation in stove usage between rural and urban areas. Modern stove like LPG and induction cookstoves seem to be more popular in urban areas, while traditional stoves like three stoves and solid fuel stoves exhibit different usage patterns based on location. Improved solid fuel stoves and biogas stoves show relatively consistent usage across both settings.

6.4.3. Frequency of Usage of Different Cooking Stoves

In table 6.4.3.1, the frequency of usage of different stoves over the last week (last 7 days) is depicted. The data reveals the distribution of usage across various frequency categories:

Among households using LPG gas/LPG cookstoves, the majority 72.0%, reported using it several times each day. About 18.4% of households used it about once per day, while 7.8% used it a few times over the week. Only a small portion, 0.7%, used it about once this week, and 1.1% used it less than once this week.

For electric cookstoves, 64.0% of households reported using them several times each day, making it the most common usage frequency. Around 17.2% used them about once per day, and 8.4% used them a few times during the week. A notable 5.2% used electric cookstoves about once this week, and the same percentage used them less than once a week.

Interestingly, the electric coil cookstove had 100% of households using of several times each day, indicating that those who use this type of stove use it frequently and consistently.

Three stone stoves were used several times each day by 80.7% of households, and about 10.7% used them about once per day. A smaller portion, 3.1%, used them a few times during the week. Usage frequency decreased further for less frequent usage, with 1.8% using them about once this week and 3.7% using them less than once this week.

For traditional solid fuel stoves, 77.2% of households used them several times each day, while 14.6% used them about once per day. A total 5.4% used them a few times during the week, 1.4% used them about once this week, and 1.3% used them less than once this week.

Improved solid fuel stoves had 88.3% of households using them several times each day. About 8.4% used them about once per day, and 1.2% used them a few times during the week. Usage was split between using them about once this week (2.1%) and not using them at all this week (0.0%).

Lastly, for biogas stoves, 74.4% of households used them several times each day, and 18.8% used them about once per day. About 6.8% used them a few times over the week, while no households reported using them about once or less than once this week.

***Table 6.4.3.1**: Frequency of Usage of Different Cooking Stoves Over the Last Week (Last 7 Days)*

	Several times each day	About once per day	A few times this week	About once this week	Less than once this week
EC6. LPG gas/LPG cookstove [Base = 813]	72.0	18.4	7.8	0.7	1.1
EC12. Electric cookstoves [Base = 42]	64.0	17.2	8.4	5.2	5.2
EC18. Electric coil cookstove [Base = 3]	100.0	0.0	0.0	0.0	0.0
EC24. Three stone stoves [Base = 108]	80.7	10.7	3.1	1.8	3.7
EC30. Traditional solid fuel stove [Base = 751]	77.2	14.6	5.4	1.4	1.3
EC37. Improved solid fuel stove [Base = 120]	88.3	8.4	1.2	2.1	0.0
EC44. Biogas stove [Base = 35]	74.4	18.8	6.8	0.0	0.0

The data highlights usage variations of different cooking stoves in rural and urban contexts. Urban areas show higher usage of modern stoves, likely due to access to electricity and gas. Traditional stoves are more prominent in rural areas, reflecting practices and potential limitations in modern amenities.

Table 6.4.3.2: Frequency of Usage of Different Cooking Stoves Over the Last Week (Last 7 Days) across urban-rural settlement

		LPG gas/cookstove		traditional solid fuel stove	
		Rural	Urban	Rural	Urban
How often was cooking device used over the last week (last 7 days) for these activities?	Several times each day	68.1	85.1	78.5	65.5
	About once per day	20.4	11.8	13.6	24.0
	A few times this week	9.4	2.5	5.3	5.6
	About once this week	0.8	0.3	1.4	1.4
	Less than once this week	1.4	0.2	1.1	3.4

6.4.4. Average Expenditure (in NPR) on Different Cooking Fuels and Energy Sources

The respondents were further asked to share how much their household spends in a month to buy their primary cooking fuel. Three stone cookstoves, used by an average of 64 households, had the highest expenditure at NPR 1,537.05. Following closely, LPG gas cylinders, used by an average of 797 households, paid an average of NPR 1,175.20. Traditional cookstoves, used by an average of 737 households, paid an average of NPR 875.99 for fuel and improved cookstoves, used by 100 households on average, paid NPR 956.92 on average. Electric cookstove, used by one household, had an average expense of NPR 500.00 and induction cookstoves were employed by 36 households, with an average expenditure of NPR. 474. 48. Biogas that was utilized by 32 households, incurred lowest cost at an average of NPR 8.87.

Table 6.4.4.1: Average Expenditure (in NPR) on Different Cooking Fuels and Energy Sources

	Overall		Residence	
			Rural	Urban
	N	Mean	Mean	Mean
EC7. LPG gas cylinders	797	1,175.20	1,150.09	1,262.00
EC13. Induction cookstove	36	474.48	404.47	637.98
EC19. Electric coil cookstove	1	500.00		500.00
EC25. Three stone stoves	64	1,537.05	1670.26	140.99
EC32. Traditional solid cookstove	737	875.99	906.16	597.96
EC39. Improved solid cookstove	100	956.92	972.53	350.00
EC45. Biogas	32	8.87	9.65	0.00

The breakdown above indicates that using fuelwood is more expensive in comparison to using other sources of cooking fuel like the biogas. Purchasing fuelwood from the community forest is also not an economical option. Surprisingly, instead of opting for the more affordable biogas, many rural households with unreliable electricity still rely on fuelwood because of several challenges associated with biogas adoption. Firstly, maintaining a biogas system requires a daily supply of animal waste equivalent to that produced by two cows, even when the system is not in use. However, due to the significant outmigration of Nepal's active population, rural areas lack the necessary manpower to tend to the livestock consistently. Furthermore, in the past, the Denmark embassy and Krishi Bikas Bank offered decent subsidies for biogas system installation, but this support is now no longer available.

Consequently, people are hesitant to invest in biogas systems in circumstances where there is no government subsidy.

It is also shows that urban residents tend to have higher average expenditures on LPG gas cylinders and induction cookstoves compared to their rural counterparts. On the other hand, rural residents have higher average expenditures on three stone stoves, traditional solid cookstoves, and improved solid cookstoves. Biogas expenditure is negligible in urban areas, and it is minimal in rural areas. The data for electric coil cookstoves is only available for urban areas, where the average expenditure is NPR 500.00.

6.4.5. Frequency of Availability Issues for Different Energy Sources and Services

Table 6.4.5.1 outlines the frequency of availability issues encountered with various energy sources and services over the past 12 months. The data is presented as a percentage distribution across different frequency categories.

For LPG gas/LPG cookstove, respondents reported encountering availability issues as follows: 2.1% experienced these issues often (more than once a month), 7.2% faced sometimes (4-12 times a year), 2.5% encountered them rarely (less than 4 times a year), while the majority, 86.8%, reported that LPG gas/LPG cookstoves were never unavailable. A small percentage of respondents, 1.4% were unsure about the availability situation.

Regarding electric cookstoves, 18.0% of respondents encountered availability issues several times a day, and 9.8% faced them often. About 31.1% experienced these issues sometimes, while 17.1% encountered them rarely (less than 4 times a year). On the other hand, 24.0% reported that electric cookstoves were always available, and no respondents were unsure about availability.

Availability issues for electric coil cookstove were experienced by respondents as follows: 42.3% faced often, indicating more than once a month, while none encountered these issues sometimes (4-12 times a year). For this type of stove, availability issues were not reported as rare or never, with 57.7% of respondents reporting that electric coil cookstoves were always available.

For three stone stoves, availability issues were not applicable several times a day, as reported by respondents. Only 1.0% of respondents experienced these issues often, and an overwhelming majority, 99.0%, stated that three stone stoves were always available. No respondents faced occasional or rare availability issues.

Availability issues for traditional solid fuel stoves were not applicable several times a day. About 4.0% faced these issues often, 2.7% encountered them sometimes, and 3.1% experienced them rarely. In contrast, the majority, 89.7%, reported that traditional solid fuel stoves never unavailable. Only a small percentage of respondents, 0.5%, were unsure about availability.

For improved solid fuel stoves, availability issues were not reported several times a day. Around 19.3% of respondents faced these issues often, while 3.7% encountered them sometimes. Availability issues were reported as rare 0.8% of respondents. The majority, 75.4%, stated that improved solid fuel stoves were always available, and a small percentage, 0.9%, were unsure about availability.

Lastly, availability issues for biogas stoves were not applicable several times a day. About 5.3% of respondents faced issues often, 10.1% encountered them sometimes, and 3.2% experienced them rarely. A significant majority, 81.5%, reported that biogas stoves were always available. No respondents were unsure about availability.

***Table 6.4.5.1**: Frequency of Availability Issues for Different Energy Sources and Services in the Past 12 Months*

	Several times a day	Often (more than once a month)	Sometimes (4-12 times a year)	Rarely (less than 4 times a year)	Never (always available)	Does not know / unsure
EC8. LPG gas/LPG cookstove [Base =813]	NA	2.1	7.2	2.5	86.8	1.4
EC14. Electric cookstoves [Base = 42]	18.0	9.8	31.1	17.1	24.0	0.0
EC20. Electric coil cookstove [Base = 3]	NA	42.3	0.0	0.0	0.0	57.7
EC26. Three stone stoves [Base = 108]	NA	1.0	0.0	0.0	99.0	0.0
EC33. Traditional solid fuel stove [Base = 751]	NA	4.0	2.7	3.1	89.7	0.5
EC40. Improved solid fuel stove [Base = 120]	NA	19.3	3.7	0.8	75.4	0.9
EC46. Biogas stove [Base = 35]	NA	5.3	10.1	3.2	81.5	0.0

The data reveals variations in availability issues for different energy sources and services, with urban areas generally experiencing fewer issues but with some exceptions. Availability challenges for cooking fuels and energy sources can impact households' cooking practices and highlights the need for reliable energy sources, especially in rural contexts.

6.4.6. Incidents of Harm or Injury Associated with Different Cooking Stove Types

Table 6.4.6.1 presents incidents of harm or injury in the past 12 months associated with different cooking stove types. The table displays the percentages for different categories of harm. The data reflects relatively low incidents of harm or injury associated with the mentioned cooking stove types, with the majority of respondents reporting no such incidents across all stove types.

For LPG gas/LPG cookstove, incidents of harm were rare, with 0.2% of respondents reporting a person burned or injured, while no deaths were reported. The majority, 99.8%, reported no incidents of harm or injury.

Regarding electric cookstoves, a slightly higher percentage, 1.4% reported a person burned or injured, while no deaths were reported. The majority, 98.6%, did not experience any harm or injury incidents.

For electric coil cookstoves, all respondents reported no incidents of harm or injury, indicating a safe cooking option.

For three stone stoves, a small percentage, 3.3%, reported a person burned or injured, while no deaths were reported. Most respondents, 96.7%, did not face any harm or injury incidents.

Incidents related to traditional sloid fuel stoves were reported by 1.9% of respondents as a person burned or injured, and a very small percentage, 0.3%, reported a death. The majority, 97.8%, reported no incidents of harm or injury.

For improved solid fuel stoves, incidents of harm or injury were reported by 3.3% of respondents, similar to three stone stoves. No deaths were reported, and 96.7% reported no incidents.

Lastly, for biogas stoves, all respondents reported no incidents of harm or injury, indicating a safe cooking option.

***Table 6.4.6.1**: Incidents of Harm or Injury in the Past 12 Months Associated with Different Cooking Stove Types*

	None	Person burned/injured	Death
EC9. LPG gas/LPG cookstove [Base = 813]	99.8	0.2	0.0
EC15. Electric cookstoves [Base = 42]	98.6	1.4	0.0
EC21. Electric coil cookstove [Base = 3]	100.0	0.0	0.0
EC27. Three stone stoves [Base = 108]	96.7	3.3	0.0
EC34. Traditional solid fuel stove [Base = 751]	97.8	1.9	0.3
EC41. Improved solid fuel stove [Base = 120]	96.7	3.3	0.0
EC47. Biogas stove [Base = 35]	100.0	0.0	0.0

6.5. Household Heating

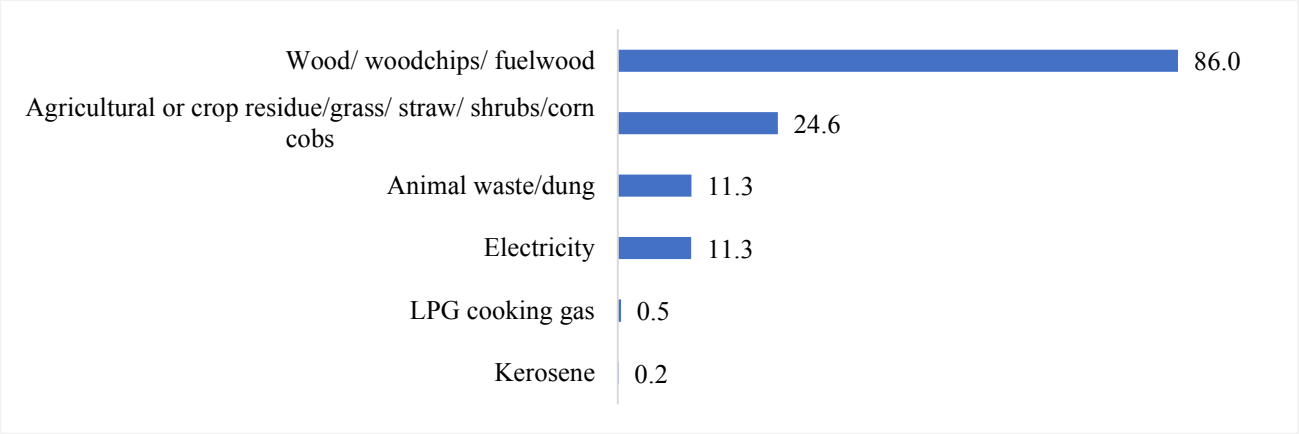
6.5.1. Types of Fuel Used for Heating by Household

The question posed in the survey was whether the household uses any heating device or fire to keep their dwelling warm throughout the year. Among the surveyed households, 77.5% answered affirmatively, indicating that they utilize heating devices or fires. In contrast, 22.5% of households responded negatively, indicating that they do not use such methods for heating.

The survey also sought to ascertain the average number of months for which households have utilized heating devices or fires to maintain warmth in their dwelling over the past 12 months. According to the data, the average duration during which households employed these heating methods is 3 months.

The figure 6.5.1.1 below illustrates the distribution of different types of fuel utilized by households for heating purposes. Among the listed options, wood/woodchips/fuelwood are the most prevalent, accounting for 86.0% of the responses. Agricultural or crop residues, including grass, straw, shrubs, and corn cobs, are used by 24.6% of households for heating. Animal waste or dung is employed by 11.3% of households, while the same percentage also relies on electricity for their heating needs. A smaller proportion, just 0.5%, uses LPG cooking gas for heating, and an even smaller percentage, 0.2%, employs kerosene. This data provides insights into the diverse range of heating fuel sources chosen by households for their living quarters.

***Figure 6.5.1.1**: Distribution of Heating Fuel Types Used by Households (EH3, Base = 1,008]*



The data highlights the contrast in heating fuel preferences between rural and urban areas. Traditional and locally available sources like wood and agricultural residues are more dominant in rural areas, while urban areas have a higher reliance on electricity and modern energy sources. It is evident that wood-based fuels are more commonly used rural areas (90.1%) compared to urban areas (61.0%). Also, the utilization of agricultural residues for heating is more prevalent in rural areas (27.2%) compared to urban areas (8.7%). Similar to agriculture residues, the use of animal waste for heating is higher in rural areas (12.5%) compared to urban areas (3.6%). Electricity is more commonly used as a heating fuel in urban areas (39.7%) compared to rural areas (6.7%). But, the use of LPG cooking gas for heating is very limited in both rural and urban areas.

The data also demonstrates distinct patterns of heating fuel usage across ecological regions. The Mountain regions heavily relies on wood due to its abundance, while the Tarai region shows a higher prevalence of agricultural residue and animal waste usage, likely due to agricultural activities. The Hill region falls in between, exhibiting a mix of wood and modern energy sources like electricity.

There is some variation in heating fuel preferences based on income levels. Wood remains a dominant fuel source across all income groups, possibly due to its affordability. Agricultural residue usage is higher in medium income group., while electricity becomes more prevalent as income levels rise. Animal waste is utilized more in lower-income settings, while LPG remains infrequently used for heating regardless of income.

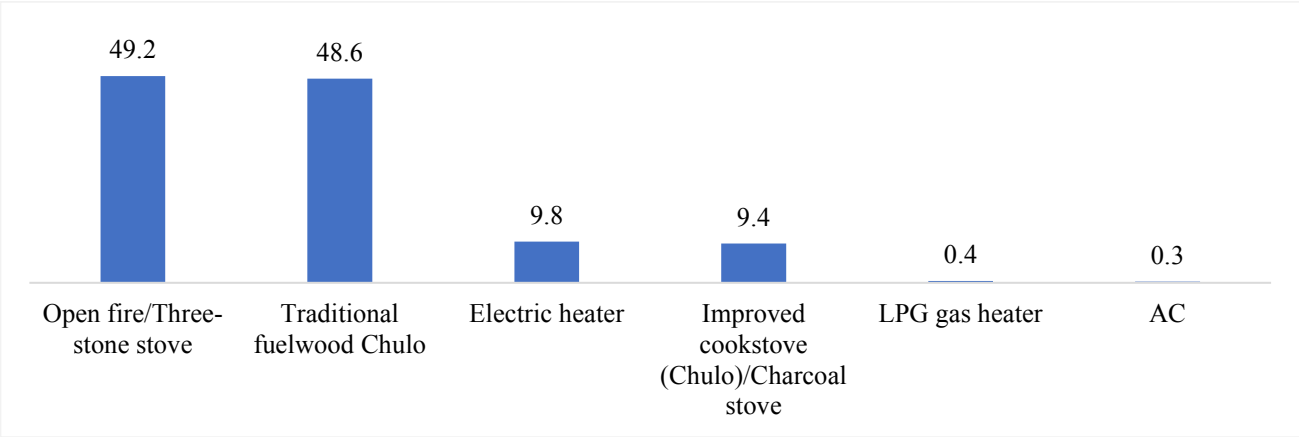
***Table 6.5.1.2**: Distribution of Heating Fuel Types Used by Households by Different Variables*

		Wood/ woodchips/ fuelwood	Agricultural or crop residue/grass/ straw/ shrubs/corn cobs	Animal waste/dung	Electricity
Residence	Rural	90.1	27.2	12.5	6.7
	Urban	61.0	8.7	3.6	39.7
Ecological Region	Mountain	98.4	0.0	0.0	3.3
	Hill	79.0	1.8	0.0	21.6
	Tarai	89.7	44.2	20.9	4.7
Household Income	Low Income	95.1	23.7	12.0	1.6
	Medium Income	90.5	29.6	9.0	4.6
	High Income	70.3	19.9	13.1	30.1

6.5.2. Types of Heating Devices Used in the Household

The survey also provides insights into the heating devices utilized by households to warm their homes. The data reveals that the most prevalent heating devices include open fire or three-stone stoves, accounting for 49.2% of usage. Additionally, traditional fuelwood Chulo are commonly used, representing 48.6% of the responses. Electric heaters are employed by 9.8% of households as a heating source. Improved cookstoves (Chulos) or charcoal stoves are used by 9.4% of households. Less commonly utilized options include LPG gas heaters, constituting 0.4% of responses, and air conditioning (AC), which is used by 0.3% of households for heating purposes. The data highlights the diversity of heating devices employed by households to maintain warmth within their homes.

***Figure 6.5.2.1**: Distribution of Heating Devices Used by Households for Home Heating [EH4, Base = 1,008]*



The data suggests that traditional heating methods (open fires, fuelwood stoves) are more prevalent in rural areas, while modern methods (electric heaters) are more common in urban areas. Open fire/Three-stone stove is more prevalent in rural areas (50.8%) compared to urban areas (39.8%). Similar to the open fire/three-stone stove, traditional fuelwood chulo usage is also higher in rural areas (51.3%) than in urban areas (31.7%). Electric heaters are much more common in urban households (36.6%) than in rural households (5.5%).

The types of heating devices used in households across different ecological regions: Mountain, Hill, and Tarai vary significantly. The usage of open fire/three-stone stoves increase as we move from the Mountain region to the Tarai region, with Tarai having the highest usage. Similar to the open fire/stove trend, traditional fuelwood chulo usage also increases from the Mountain to the Tarai region. Electric heater usage is lowest in the Mountain region and Tarai regions, while it's higher in the Hill region.

Also, the traditional heating methods like open fire/three-stone stoves and traditional fuelwood Chulos are more commonly used in low and medium-income households. Electric heaters are primarily used in high-income households, indicating access to modern heating technologies. Improved cookstoves or charcoal stoves are used to a similar extent across different income groups.

***Figure 6.5.2.2**: Distribution of Heating Devices Used by Households for Home Heating by different variables*

	Residence		Ecological Region			Household Income		
	Rural	Urban	Mountain	Hill	Tarai	Low Income	Medium Income	High Income
Open fire/Three-stone stove	50.8	39.8	25.0	41.4	57.8	53.3	53.6	39.5
Traditional fuelwood Chulo	51.3	31.7	7.2	38.8	60.7	54.4	50.6	39.5
Electric heater	5.5	36.6	3.3	20.6	2.8	1.0	3.7	27.2
Improved cookstove (Chulo)/Charcoal stove	10.7	1.1	76.5	10.0	0.9	10.5	9.6	7.9
LPG gas heater	0.4	0.8	0.0	0.8	0.2	0.1	0.0	1.2
AC	0.2	0.4	0.0	0.5	0.1	0.0	0.0	0.9
Kerosene gas heater	0.1	0.0	0.0	0.3	0.0	0.0	0.0	0.4

6.5.3. Presence of Chimney or Hood for Heating Devices

In response to the question of whether the household has a chimney or hood (excluding cases where the answer pertains to electricity, LPG, AC, or Kerosene), 11.6% of respondents answered affirmatively, indicating the presence of a chimney or hood. The majority, constituting 88.4% of respondents, indicated the absence of a chimney or hood in their households.

6.5.4. Harm or Injury Incidents from Space Heaters, Cookstove, or Devices

Regarding incidents related to the usage of space heaters, cookstoves, or other devices within the past 12 months, the overwhelming majority of respondents, accounting for 98.8%, reported no harm or injury. Among the reported incidents, 0.8% of cases involved poisoning, while 0.5% indicated personal burns or injuries. A very small proportion, only 0.1%, reported incidents of a fire occurring within the house.

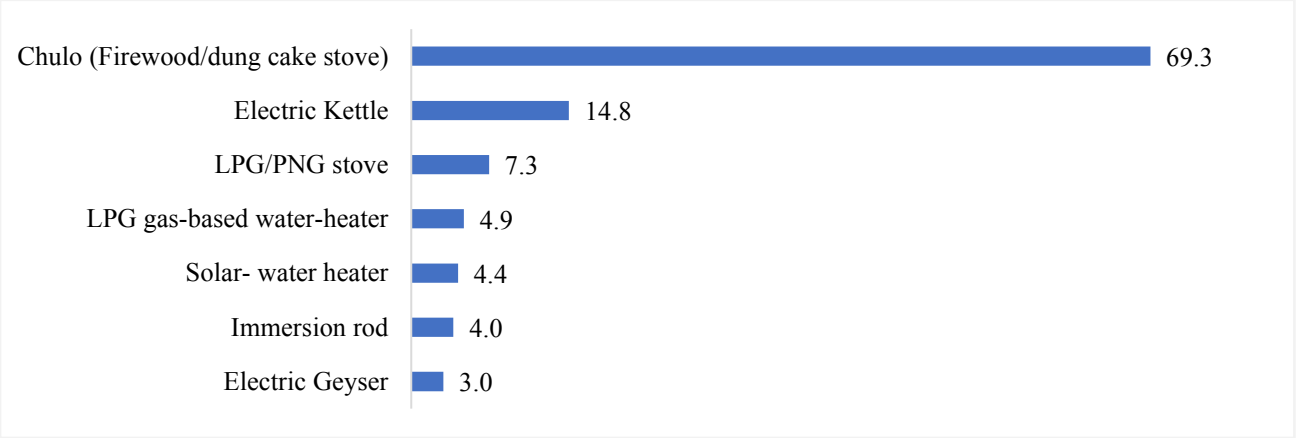
6.5.5. Usage of Hot Water for Bathing in the Household

In relation to the use of hot water for bathing, the data indicates that 54.4% of households responded positively, indicating that they do utilize hot water for this purpose. Conversely, 45.6% of households reported not using hot water for bathing.

6.5.6. Appliances Used for Heating Water for Bathing in the Household

In regard to the household's preferred appliances for heating water for bathing purposes, the majority, accounting for 69.3%, reported using a Chulo (Firewood/dung cake stove). Among other options, 14.8% indicated the utilization of an Electric Kettle, while 7.3% mentioned an LPG/PNG stove. A smaller proportion, 4.9%, reported employing an LPG has-based water heater, and an equivalent 4.4% stated the use of solar-water heater. Additionally, 4.0% reported the use of Immersion rod, while 3.0% indicated reliance on an Electric Geyser.

***Figure 6.5.6.1**: Preferred Appliances for Water Heating for Bathing in Households [EH8, Base = 708]*



There are some variations into the preferences for heating water for bathing based on the location of residence: rural and urban areas. Chulo, a traditional method, is significantly more popular in rural households (77.0%) for heating water compared to urban areas (29.6%). Electric Kettle is more preferred in urban areas (33.3%) than in rural setting (11.2%) for water heating appliances. LPG/PNG stoves are more commonly used for water heating in urban households (16.8%) compared to rural areas (5.4%).

The data demonstrates varying preferences for water heating appliances across ecological regions. Chulo is the dominant choice for water heating across all regions, with its highest usage in the Mountain region. The Hill region appears to show a relatively balanced distribution across appliance types, while the Tarai region leans more towards Chulo and LPG/PNG stoves.

The data reveals distinct preferences for water heating appliances across income levels. Chulo is preferred by a large proportion of low-income households for water heating, whereas medium and high-income households show higher adoption of modern options. The electric kettle becomes more prevalent as household income rises, suggesting diverse choices in medium and high-income households.

***Figure 6.5.6.2**: Preferred Appliances for Water Heating for Bathing in Households by different variables*

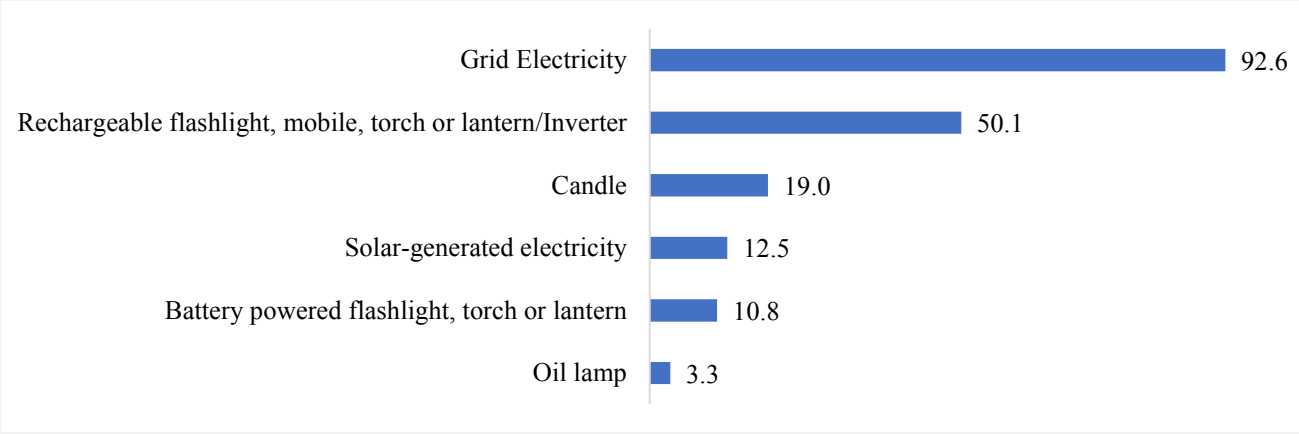
	Residence		Ecological Region			Household Income		
	Rural	Urban	Mountain	Hill	Tarai	Low Income	Medium Income	High Income
Chulo (Firewood/dung cake stove)	77.0	29.6	95.4	60.5	77.2	92.0	76.4	45.6
Electric Kettle	11.2	33.3	14.6	18.8	7.7	2.5	14.8	24.3
LPG/PNG stove	5.4	16.8	0.0	5.8	11.9	6.2	8.0	7.5
LPG gas-based water-heater	3.7	11.4	0.1	7.1	2.4	0.6	2.4	10.4
Solar- water heater	3.4	9.3	4.6	6.7	0.3	0.0	1.0	10.6
Immersion rod	2.9	9.3	1.6	4.9	3.0	0.7	2.5	7.7
Electric Geyser	3.0	3.0	0.0	3.3	3.4	0.0	2.4	5.9
Electric coil stove	0.7	0.0	0.0	0.1	1.6	0.0	0.5	1.2

6.6. Household Lighting

6.6.1. Sources of Energy Used for Lighting in the Household

The primary sources of energy used by surveyed household for lighting or as a light source are as follows: Grid Electricity account for the majority at 92.6%, followed by rechargeable flashlight, mobile devices, torches, or lanterns/inverters at 50.1%. Candles make up 19.0% of the lighting in the household, whereas solar-generated electricity contributes 12.5%. Battery-powered flashlights, torches, or lanterns contribute 10.8%, and Oil lamps are used for lighting accounting for 3.3% of the energy sources.

***Figure 6.6.1.1**: Distribution of Household Lighting Energy Sources [EL3, Base = 1,300]*



The sources of energy used for lighting in rural and urban households vary significantly. It is evident that grid electricity is a predominant source in both rural and urban areas, with 91.4% of rural households and 99.0% of urban households relying on it for lighting. Interestingly, the use of rechargeable flashlights, mobile devices, torches, or lanterns powered by inverters is more common in rural households (51.6%) compared to urban households (42.5%)[26]. Solar-generated electricity appears to be more prevalent in rural households (14.3%) compared to urban households (2.8%). Solar PVs are being promoted in Nepal in areas that do not have grid connection – national or local.

The Tarai region shows a higher dependence on grid electricity and alternative power sources, while the Mountain regions leans more toward solar energy and traditional sources like oil lamps. The Hill region falls between these extremes, with varying energy source usage. The use of rechargeable flashlights, mobile devices, torches, or lanterns powered by inverters is most prevalent in the Tarai region (62.1%), followed by the Hill region (38.3%) and Mountain (30.1%) regions.

It is also interesting to note that the use of grid electricity for lighting purposes is not drastically different across various income levels. Low- income households rely on grid- electricity for lighting at 89.0%, middle- income households at 93.0%, and high- income households at 95.9%. This indicates that out of all the other areas like cooking, heating, and cooling, the use of electricity for lighting purposes is the most uniform across all income levels. This shows that there has been significant improvement in household access to electricity as far as lighting is concerned. [27]

[26] This could be because of more load-shedding in rural areas.

[27] Household electricity access has notably increased nationwide, encompassing both urban and rural areas. Nevertheless, urban dwellers often incur higher electricity expenses due to the greater usage of electric appliances in their homes.

Table 6.6.1.2: Distribution of Household Lighting Energy Sources by Different Variables

		Grid Electricity	Rechargeable flashlight, mobile, torch or lantern/Inverter	Candle	Solar-generated electricity	Battery powered flashlight, torch or lantern
Residence	Rural	91.4	51.6	19.1	14.3	10.7
	Urban	99.0	42.5	18.9	2.8	11.6
Ecological Region	Mountain	96.8	30.1	9.2	25.5	5.3
	Hill	85.0	38.3	6.1	22.9	8.0
	Tarai	98.6	62.1	30.9	2.4	13.8
Household Income	Low Income	89.0	48.8	21.0	11.6	8.8
	Medium Income	93.0	51.1	20.2	13.5	12.7
	High Income	95.9	50.4	15.8	12.4	11.0

6.6.2. Harm or Injury Incidents from Using Lighting Sources

In the previous 12 months, an overwhelming majority of individuals (99.8%) reported no incidents of harm or injury resulting from the use of their chosen lighting sources. However, a small proportion (0.2%) indicated that individuals had experienced burns or injuries associated with the use of these lighting sources.

6.7. Household Cooling

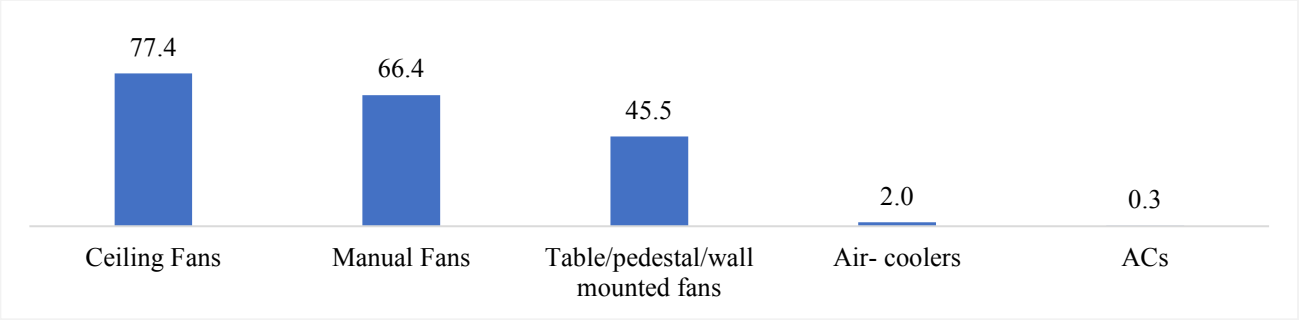
6.7.1. Usage of Cooling Methods in the Household

According to survey data, 62.8% of households indicated that they use something for cooling, while 37.2% not using any cooling methods**.**

6.7.2. Types of Cooling Appliances Used in the Household

The figure 6.7.2.1 presents the percentages of different types of cooling appliances used in the dwelling or living quarters. The most common cooling appliance is ceiling fans, utilized by 77.4% of respondents. Following that, manual fans are used by 66.4% of the surveyed individuals. Table/pedestal/wall mounted fans are employed by 45.5% of respondents. In contrast, air-coolers are used by a smaller proportion, accounting for 2.30%. The least prevalent cooling appliances is air conditions (ACs), with only 0.3% of respondents indicating their use.

***Figure 6.7.2.1**: Distribution of Cooling Appliances Usage in Dwelling/Living Quarters [EC02, Base = 816]*



Some trends can be observed in the prevalence of cooling appliance when disaggregating between rural and urban residences. Rural areas show a higher usage of ceiling fans (80.6%) compared to urban areas (66.0%). Similar to ceiling fans, manual fans are also more prevalent in rural residences (71.9%) than in urban ones (46.4%). The usage of table/pedestal/wall mounted fans are relatively close between rural (45.1%) and urban (46.9%).

The data highlights the significant impact of ecological regions on cooling appliance preferences. The Mountain region generally requires fewer cooling appliances due to its cooler climate, while the Hill and Tarai regions exhibit higher usage as a response to their warmer conditions. The usage of cooling appliances shows a negligible presence in the Mountain region. The usage of ceiling fans is significantly higher in Tarai region (89.6%) than in Hill region (27.6%). Similarly, manual fan usage is relatively higher in Tarai region (81.6%) compared to the Hill regions (4.2%). The Hill regions has a considerably higher usage of the table/pedestal/wall mounted fans (73.7%) compared to Tarai region (38.6%).

While there are some variations in cooling appliances preferences based on household income, certain cooling appliances like ceiling fans and manual fans are commonly used across all income levels. The usage of more advanced cooling options like table-mounted fans and air-coolers tends to increase with higher income.

***Table 6.7.2.2**: Distribution of Cooling Appliances Usage in Dwelling/Living Quarters by Different Variables*

		Ceiling Fans	Manual Fans	Table/pedestal/wall mounted fans	Air-coolers
Residence	Rural	80.6	71.9	45.1	2.1
	Urban	66.0	46.4	46.9	1.5
Ecological Region	Mountain	0.0	0.0	0.0	0.0
	Hill	27.6	4.2	73.7	3.2
	Tarai	89.6	81.6	38.6	1.7
Household Income	Low Income	82.2	79.9	37.8	0.4
	Medium Income	84.1	71.4	42.3	1.1
	High Income	67.2	50.9	54.6	4.1

6.7.3. Usage and Quantity of Cooling Appliances in the Household

The table below provides insights into various aspects of cooling appliance usage in households. For respondents with ceiling fans, the data reveals that the average number of ceiling fans per house is 2.51, with an average usage duration of 6.11 months per year. Additionally, these households use ceiling fans for an average of 12.81 hours per day. Among those with table/pedestal/wall mounted fans, the average number is 1.66 fans per house, used for about 4.88 months per year, with an average daily usage of 8.01 hours. Respondents with air coolers have approximately 1.00 air cooler per house, used for an average of 3.45 months per year, with a daily usage duration of 6.76 hours. The small group with air conditioners in their houses has an average of 1.00 air conditioner, used for an average of 8.47 hours per day.

***Table 6.7.3.1**: Average Usage Statistics of Cooling Appliances in Households*

	Base (N)	Average Number/Hours
ECo3. (If they have ceiling fans) How many ceiling fans do you have in your house?	632	2.51
ECo4. How many months in a year do you use ceiling fans?	632	6.11
ECo5. On an average, what is the total hours of ceiling fan use per day in your house?	632	12.81
ECo7. (If they have table/ pedestal/ wall mounted fans) How many such table/pedestal/wall mounted fans do you have in your house?	371	1.66
ECo8. How many months in a year do you use table/pedestal/wall mounted fans?	371	4.88
ECo9. On an average, what is the total hours of table/pedestal/wall mounted fan use per day in your house?	371	8.01
ECo11. (If they have air coolers) How many air coolers do you have in your house?	16	1.00
ECo12. How many months in a year do you use air coolers?	16	3.45
ECo13. On an average, what is the total hours of air cooler use per day in your house?	16	6.76
ECo15. (If they have air conditioners in their house) How many air-conditioners do you have?	2	1.00
ECo17. On an average, what is the total hours of air conditioner use per day in your house?	2	8.47

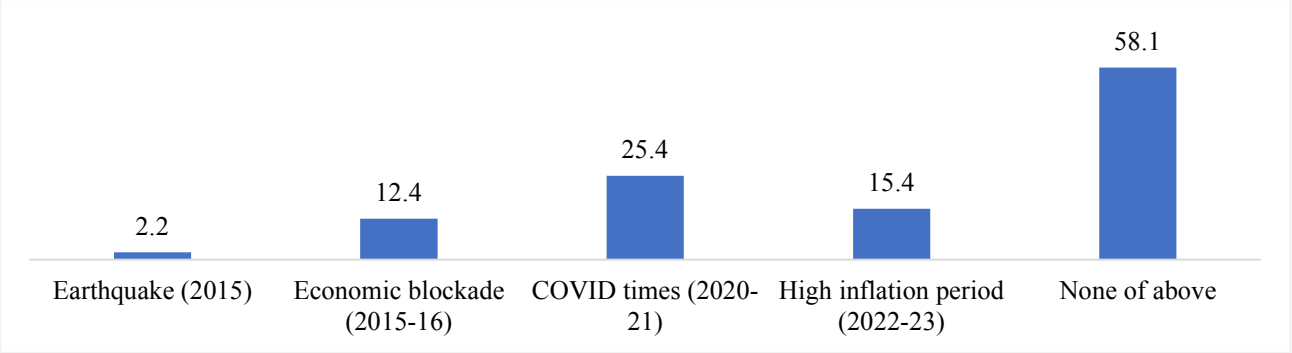
Among the respondents, 38.6% reported never using ceiling fans while using an air-conditioner, while the majority, comprising 61.4% of the respondents, indicated that they use ceiling fans in combination with air-conditioners occasionally or sometimes.

7. Shocks and Resilience

7.1. Impact of Various Shocks on Household Energy Needs and Uses

When considering the energy requirements and utilization within their households, individuals were asked whether they were impacted by various shocks in the past ten years. The shocks listed include the earthquake of 2015, where 2.2% of respondents indicated being affected in terms of impact on energy, the economic blockade of 2015-16 where 12.4% reported being affected, the COVID times spanning from 2020 to 2021 where 25.5%, reported being affected and the high inflation of 2022-23 where 15.4% reported being affected. A majority of 58.1% responded that they were not affected by any of the aforementioned shocks.

***Figure 8.1.1**: Household Impact Assessment of Various Shocks on Energy Needs and Uses [G0, Base = 1,300]*



The data provides insights into how different shocks affected households in rural and urban areas, with urban areas experiencing more pronounced impacts, especially during the COVID-19 pandemic and economic blockade periods. The impact of COVID-19 was particularly pronounced in urban areas, with 43.3% of urban households reporting an impact compared to 22.0% in rural areas. The economic blockade also had a higher impact on urban households (24.1%) compared to rural areas (10.1%). Generally, a higher proportion of rural household responded that they were not affected by any of the mentioned shocks compared to urban households.

Different ecological regions experienced varying levels of impact from the listed shocks. The COVID-19 pandemic had a notably higher impact on household in Tarai regions (32.0%) compared to Mountain (25.2%) and Hill (17.5%) regions. Hill regions had a relatively higher impact from the economic blockade (15.5%) compared to Tarai (10.5%) and Mountain (5.2%) regions. Overall, the percentage of households reporting no impact (None of the above) was highest in Hill region (64.8%) and lowest in Mountain region (57.2%).

The data underscores how the impact of shocks varies across different income groups with differences in response rates between earthquake, economic blockade, COVID-19, and high inflation periods. COVID-19 had a relatively higher impact on households across all income levels, with medium and high-income households slightly more affected. The economic blockade had a more pronounced impact on high income households (19.2%) compared to medium (12.2%) and low (5.8%) income households. High inflation had a relatively lower impact on high income households (12.0%) compared to low (15.2%) and medium (18.9%) income households. The percentage of households reporting no impact was higher in low-income households (64.0%) compared to medium (55.9%) and high (54.5%) income households.

***Table 7.1.2**: Household Impact Assessment of Various Shocks on Energy Needs and by Different Variables*

		Earthquake (2015)	Economic blockade (2015-16)	COVID times (2020-21)	High inflation period (2022-23)	None of above
Residence	Rural	2.3	10.1	22.0	14.5	62.7
	Urban	1.7	24.1	43.3	20.5	34.4
Ecological Region	Mountain	1.5	5.2	25.2	13.6	57.2
	Hill	3.5	15.5	17.5	12.6	64.8
	Tarai	1.2	10.5	32.0	18.0	52.7
Household Income	Low Income	3.4	5.8	23.3	15.2	64.0
	Medium Income	1.1	12.2	26.2	18.9	55.9
	High Income	2.2	19.2	26.7	12.0	54.5

Out of the total 1,300 households included in the survey, only 29 households encountered some household energy related challenges during the earthquake 2015 mainly because only a few hill districts of Central Nepal were affected. Given the limited size of this sample, conducting an analysis of energy-related questions for these households would not yield statistically significant results, and thus, it has been excluded from the report's analysis.

7.2. Households Energy Sources for Cooking During Different Shocks

The table below provides data on the different sources of energy used by a household for cooking purposes during three distinct periods: the 2015-2016 Economic Blockade, the COVID-19 pandemic in 2020-2021, and the high inflation period in spring 2022 to 2023. The data indicates some interesting trends in energy source for cooking. The household's reliance on LPG gas decreased over time, while traditional fuelwood and improved fuelwood chulos/charcoal stoves gained popularity, possibly due to economic factors. Electric induction stoves and rice cookers remained less commonly used throughout the three periods.

The usage of LPG gas has decreased from 77.8% during the economic blockade to 61.5% during COVID-19 and further to 53.3% during the high inflation period. Traditional fuelwood chulo saw a significant increase in usage from 33.2% during the economic blockade to 51.0% during COVID-19, likely due to economic considerations. Usage decreased slightly to 48.8% during the high inflation period but remained a prominent source of cooking energy.

***Table 7.2.1**: Households Energy Sources for Cooking during Economic Blockade, COVID, and High Inflation Periods*

	2015-16 Economic Blockade (2015-16) [Base = 161]	COVID (2020-2021) [Base = 330]	High Inflation period (Spring 2022 - 2023) [Base = 201]
LPG gas	77.8	61.5	53.3
Electric Induction stove	1.0	1.3	1.1
Three stone cookstove	10.5	7.7	9.0
Traditional Fuelwood chulo	33.2	51.0	48.8
Improved fuelwood chulo/Charcoal stove	5.9	8.7	10.3
Rice cooker	3.7	2.1	1.5

LPG gas was the most popular cooking source in urban areas throughout all three periods, while in rural areas, traditional fuelwood chulos were frequently used. The COVID period saw an increase in traditional fuelwood chulo usage in both rural and urban areas, possibly due to supply disruption and economic constraints. The usage of electric induction stoves remained low across all periods and areas. Improved fuelwood chulos/charcoal stoves were used moderately and remained relatively consistent over time.

A series of questions were posed to households that utilized LPG gas for cooking purposes during different shocks.

7.3. Shortage of LPG Gas During Different Shocks

The data also reflects fluctuations in the availability of LPG cooking gas during these three periods. The economic blockade had the most severe shortage, followed by the COVID-19 period, and the high inflation period showed a relatively lower shortage, with a significant portion of households reporting no shortage.

The data shows that there was a severe shortage of LPG cooking gas during the economic blockade and the COVID-19 pandemic, particularly in urban areas where 100% of households reported a shortage during the economic blockade. While there was some improvement in the availability of LPG gas during the high inflation period, a significant percentage of households in both rural and urban areas still reported shortages.

7.4. Frequency of LPG Gas Cylinder Shortage During Different Shocks

During the economic blockade of 2015-2016, respondents who experienced LPG gas cylinder shortage were asked about the frequency of these shortages. Among those who faced such shortages, 51.5% reported that LPG gas cylinders were often unavailable in the quantity they desired, indicating high level of frequent unavailability. Additionally, 40.1% stated that shortages occurred sometimes during this period. A smaller percentage, 8.4%, reported that LPG gas cylinders rarely faced unavailability.

In contrast, during the COVID-19 period of 2020-2021, the situation improved somewhat. Among respondents who experienced shortages, 20.5% reported that LPG gas cylinders were often

unavailable, while a larger proportion, 70.7%, indicated that shortages occurred sometimes. Only 8.8% reported rare shortages during this period.

In the high inflation period of spring 2022 to 2023, the frequency of shortages continued to decrease. Of those who experienced shortages, 16.1% mentioned that LPG gas cylinders were often unavailable, and 67.9% said they occurred sometimes. A slightly large percentage, 15.9%, reported rare shortage during this period.

***Table 7.4.1**: Frequency of LPG Gas Cylinder Shortages during Economic Blockade, COVID, and High Inflation Periods (2015-2023)*

	2015-16 Economic Blockade (2015-16)	COVID (2020-2021)	High Inflation period (Spring 2022 - 2023)
Often	51.5	20.5	16.1
Sometimes	40.1	70.7	67.9
Rarely	8.4	8.8	15.9

During the Economic Blockade, both rural and urban areas faced significant issues with LPG gas cylinder availability, with 'often unavailability' being the dominant response, especially in urban areas.

During the COVID-19 pandemic, rural areas faced more issues with LPG gas cylinder availability compared to urban areas. However, in both cases, 'sometimes unavailability' was the most common response.

During the High Inflation period, there was a decrease in the frequency of 'often unavailability' in both rural and urban areas, but 'sometimes unavailability' remained a significant concern.

7.5. Occurrence of LPG Gas Cylinder Price Hikes During Different Shocks

The data also suggests that LPG gas cylinder price hikes were a common occurrence during all three periods. The economic blockade had the highest percentage of respondents reporting price hikes (96.9%), followed by the high inflation period (89.5%) and the COVID-19 period (88.7%. Across all three periods, a significant majority of respondents in both rural and urban areas reported that there was a price hike on LPG gas cylinders. The highest reported incidence was during the Economic Blockade, where almost all urban respondents reported a price hike. The COVID-19 pandemic also saw a substantial price hike, particularly in rural areas. During the High Inflation period, the incidence of price hikes remained high, though slightly lower compared to the Economic Blockade and COVID-19 period.

During the economic blockade of 2015-2016, the COVID-19 period of 2020-2021, and the high inflation period of 2022 to 2023, households that experienced a price hike on LPG gas cylinders were asked to quantify the extent of the increase in cost for a single gas cylinder. The data illustrates that the most frequently reported price increase was '25% more of the price', with percentage consistently around 57.9% during all three periods. This suggests that a significant proportion of households faced a 25% higher cost for one gas cylinder throughout these challenging economic phases.

***Table 7.5.1**: Percentage Increase in LPG Gas Cylinder Prices during Economic Blockade, COVID, and High Inflation Periods (2015-2023)*

	2015-16 Economic Blockade (2015-16)	COVID (2020-2021)	High Inflation period (Spring 2022 - 2023)
25% more of the price	57.9	57.9	64.9
50% more of the price	31.3	25.4	29.6
75% more of the price	1.8	10.1	5.5
100% more of the price	3.8	6.5	0.0
200% more of the price	2.6	0.0	0.0
500% more of the price	2.6	0.0	0.0

The findings indicate that households experienced price increase for LPG gas cylinders during these periods, with the most common increment being 25% more. Such price hikes can have significant financial implications for households, especially in rural aeras where affordability may be a greater concern.

The consumption of traditional fuelwood chulo was recorded at 33.2% during 2015-16 economic blockade. As the COVID-19 pandemic unfolded in 2020-2021, there was an increase in usage, reaching 51.0%. Subsequently, during the high inflation period spanning from 2022 to 2023, the consumption of traditional chulo slightly decreased to 48.8%.

Also, the households that used traditional fuelwood chulo for cooking purposes during various challenging situations were further subjected to a set of inquiries.

7.6. Shortage of traditional fuelwood chulo During Different Shocks

The percentage of people reporting a shortage of traditional fuelwood chulo is highest during the COVID-19 times, particularly in urban areas (38.7%). During the high inflation period, the shortage is considerably lower across all categories. Rural areas generally have lower reported shortages compared to urban areas. During all the three shocks period. In general, there is a trend of decreasing shortages over time, with the lowest shortage reported during the high inflation.

***Table 7.6.1**: Lack of availability of traditional fuelwood chulo amidst various adverse situations*

			Yes	No
Economic Blockade (2015 -2016)	Overall		16.6	83.4
	Residence	Rural	13.5	86.5
		Urban	25.9	74.1
COVID times (2020 -2021)	Overall		19.3	80.7
	Residence	Rural	14.7	85.3
		Urban	38.7	61.3
High Inflation period (2022 -2023)	Overall		4.2	95.8
	Residence	Rural	3.1	96.9
		Urban	11.5	88.5

However, compared to LPG cylinders, traditional fuelwood was not unavailable during the three shocks.

7.7. Frequency of traditional fuelwood chulo Shortage During Different Shocks

Generally, the frequency of frequent shortages increased from economic blockade to COVID-19 times and further increased during the high inflation period. Rural areas consistently reported more frequent and sometimes shortages compared to urban areas.

Table 7.7.1: Incidence of traditional fuelwood chulo scarcity amid diverse disruptions

			Often	Sometimes	Rarely
Economic Blockade (2015 -2016)	Overall		10.1	79.7	10.2
	Residence	Rural	0.0	83.4	16.6
		Urban	26.1	73.9	0.0
COVID times (2020 -2021)	Overall		13.9	80.4	5.7
	Residence	Rural	17.4	73.3	9.3
		Urban	8.2	91.8	0.0
High Inflation period (2022 -2023)	Overall		20.5	50.1	29.4
	Residence	Rural	32.2	55.6	12.3
		Urban	0.0	40.6	59.4

However, compared to LPG cylinders, those reporting often unavailability of fuelwood is much lower.

7.8. Average monthly expenditure for utilizing a traditional fuelwood chulo during various periods of shocks

The average monthly expenditure for utilizing a traditional fuelwood chulo decreased during the high inflation period compared to the previous two periods. Rural areas consistently higher average monthly expenditure for traditional fuelwood chulo usage compared to urban areas during all three shock periods.

Table 7.8.1: Average monthly spending on the use of a traditional fuelwood chulo across different periods of disruptions

			Mean Amount
Economic Blockade (2015 -2016)	Overall		1447.92
	Residence	Rural	1700.68
		Urban	698.72
COVID times (2020 -2021)	Overall		1354.60
	Residence	Rural	1420.90
		Urban	1087.43
High Inflation period (2022 -2023)	Overall		1026.13
	Residence	Rural	1074.39
		Urban	672.32

8. Household Energy Transition

The survey also focused on household energy transitions aimed to gain insights into the current trends and perceptions surrounding the shift from conventional energy sources to more sustainable options within residential settings. Even if the answer represents an estimate of the conditions prevailing some time ago (30 years back to present times) we believe that the data is valuable and sufficiently accurate to capture the important trends.

8.1. Cooking Energy Sources Over Time

Over the past few decades, there has been a significant shift in the sources used for cooking purposes. Thirty years ago, fuelwood dominated as the primary cooking fuel at 97.9%, which gradually decreased to 67.4% in the present time. Similarly, agricultural residue was used by 29.8% of households three decade ago, declining to 17.3% today. The reliance on cow-dung cakes also witnessed a decline from 19.2% to 10.9% over the same period. Notably, coal and kerosene usage remained relatively low, with coal usage increasing 0.0% to 0.1% and kerosene seeing a decrease from 4.4% to negligible levels. In contrast, the use of cleaner cooking alternatives like LPG gas and electricity (induction stove/electric cooking coil) has experienced a substantial rise, with LPG gas utilization soaring from 0.6% to 64.1% and electricity-based cooking growing from 0.3% to 8.4%. Solar and biogas usage, although minimal, also showed slight increases, highlighting the diversification of cooking fuel sources in recent years.

***Table 8.1.1**: Evolution of Cooking Energy Sources Over Time: Comparing Usage Trends from 30 Years Ago to Present [Base = 1,300]*

	30 years back	20 years back	10 years back	5 years back	present time
Fuelwood	97.9	95.5	87.5	78.0	67.4
Agricultural residue	29.8	28.5	24.4	21.5	17.3
Cow-dung cake	19.2	19.2	15.2	12.9	10.9
Coal	0.0	0.0	0.2	0.3	0.1
Kerosene	4.4	6.8	1.2	0.4	0.0
LPG gas	0.6	5.4	28.1	51.0	64.1
Electricity (induction stove/electric cooking coil)	0.3	0.6	3.0	5.3	8.4
Solar	0.0	0.0	0.0	0.1	0.6
Biogas	0.4	0.7	2.3	2.6	2.4

The data highlights the disparities in cooking energy sources at the present time between rural and urban residences. Firewood remains a prominent cooking energy source in rural areas, with 72.3% of rural households using it for cooking. While in urban areas, the usage drops to 41.7%. LPG gas is the primary cooking energy source in urban areas, with 87.7% of urban households using it. It is also popular in rural areas but to a lesser extent, with 59.6% of rural households using LPG gas. Agricultural residue is more commonly used in rural areas (19.6%) compared to urban areas (4.8%). Cow-dung is used by 11.9% of rural households and 5.4% of urban households for cooking. Electricity, specifically

through induction stoves or electric cooking coils, is more popular in urban areas (12.7%) compared to rural areas (7.6%).

The data illustrates the diverse cooking energy source preferences across ecological regions. Firewood is the dominant cooking energy source in all three ecological regions. It is most prevalent in the Mountain region at 93.2%, followed by Tarai (67.4%) and Hill (64.1%). LPG gas is commonly used for cooking in all regions, although its usage varies. It is most popular in the Tarai region (68.1%), followed by Hill (60.5%) and (Mountain (54.5%).

***Table 8.1.2**: Cooking Energy Sources at present time by different variables*

	Residence		Ecological Region			Household Income		
	Rural	**Urban**	**Mountain**	**Hill**	**Tarai**	**Low Income**	**Medium Income**	**High Income**
Firewood	72.3	41.7	93.2	64.1	67.4	79.3	71.9	50.4
LPG gas	59.6	87.7	54.5	60.5	68.1	45.6	65.4	81.6
Agricultural reside	19.6	4.8	1.8	0.9	32.6	17.9	19.9	13.8
Cow-dung cake	11.9	5.4	0.0	0.0	21.1	10.6	10.8	11.2
Electricity (induction stove/electric cooking coil)	7.6	12.7	7.1	12.8	4.9	4.5	6.1	14.8
Biogas	2.8	0.7	0.0	0.8	4.1	1.7	2.4	3.2
Solar	0.7	0.0	0.0	0.0	1.2	1.3	0.0	0.5
Coal	0.2	0.0	1.2	0.2	0.0	0.4	0.0	0.0

8.2. Lighting Energy Sources Over Time

Over the span of the last three decade, there has been a significant transformation in the sources of energy employed for lighting within households. Thirty years ago, open fires were a prevalent source, accounting for 14.6% of usage, which was progressively decreased to 5.2% in the present time. Oil lamps were also commonly utilized, constituting 25.6% of lighting sources three decades ago, but this figure has dwindled to 2.1% currently. A prominent change can be observed in the usage of kerosene lamps, which were once the primary choice for lighting at 85.3%, but have diminished remarkably to 4.2% today. Candles, too, saw variations in usage, experiencing a decrease from 17.5% to 12.9% over the years. In contrast, modern lighting alternatives have gained traction, with battery-powered flashlight, torches, and lanterns declining from 14.6% to 12.6%. Rechargeable flashlights, mobile lights, torches, and lanterns have become increasingly popular, rising from 4.9% to 51.3% within the same period. The most significant transformation is evident in the adoption of electricity, including solar panels, for lighting, which has surged from 14.1% to an impressive 97.6%, highlighting a remarkable shift towards more efficient and sustainable energy sources for lighting purposes.

***Table 8.2.1**: Evolution of Lighting Energy Sources Over Time: Comparing Usage Trends from 30 Years Ago to Present [Base = 1,300]*

	30 years back	20 years back	10 years back	5 years back	present time
Open fire	14.6	13.4	8.6	6.2	5.2
Oil lamp	25.6	18.9	9.6	4.5	2.1
Kerosene lamp	85.3	69.9	27.6	10.5	4.2
Candle	17.5	19.3	18.1	16.9	12.9
Biogas lamp	0.2	0.3	0.0	0.0	0.1
LPG lamp	0.2	0.1	0.4	0.0	0.2
Battery powered flashlight, torch or lantern	14.6	19.0	17.4	15.4	12.6
Rechargeable flashlight, mobile, torch or lantern	4.9	12.2	34.8	47.2	51.3
Electricity (including solar panels)	14.1	39.4	88.0	96.4	97.6

The data reflects the substantial progress made in lighting access and technology adoption, particularly in rural areas. The high usage of electricity, including from solar panels, signifies a positive shift towards more reliable and sustainable lighting sources. Rechargeable devices play a significant role in both and urban households, providing flexibility and efficiency. While traditional sources like candles and open fires are still utilized to some extent, they are gradually being replaced by safer and more modern alternatives.

The data highlights differences in lighting energy sources at the present time across ecological regions. Electricity, including solar panels, remains the primary sources in all regions, indicating progress in electrification efforts. Rechargeable devices are more popular in the Tarai region, which could be attributed to better accessibility and technological adoption. Traditional sources like candles, open fires, and kerosene lamps are still used to some extent, with higher usage in less accessible regions like the Mountain.

***Table 8.2.2**: Lighting Energy Sources at present time by different variables*

	Residence		Ecological Region			Household Income		
	Rural	Urban	Mountain	Hill	Tarai	Low Income	Medium Income	High Income
Electricity (including solar panels)	97.8	96.8	97.7	97.3	97.9	95.2	98.6	99.1
Rechargeable flashlight, mobile, torch or lantern	51.5	50.3	32.9	40.8	62.1	47.6	51.3	55.2
Candle	12.6	14.6	3.5	6.1	19.6	11.9	13.7	13.0
Battery powered flashlight, torch or lantern	12.5	13.0	8.1	9.9	15.3	10.6	15.9	11.3
Open fire	4.9	6.9	4.0	2.9	7.3	8.5	4.5	2.7
Kerosene lamp	4.1	4.6	7.6	1.1	6.4	4.9	6.0	1.5
Oil lamp	2.1	2.3	3.1	1.1	2.8	3.6	1.5	1.1
LPG lamp	0.2	0.0	0.0	0.2	0.2	0.4	0.2	0.0
Biogas lamp	0.2	0.0	0.0	0.0	0.3	0.0	0.4	0.0

8.3. Heating Energy Sources Over Time

Over the course of the past three decades, the sources used for heating purposes have undergone notable changes. Thirty years ago, fuelwood was the predominant choice, utilized by 94.9% of households, and this preference remained relatively consistent until the present time, although with a decline to 84.4%. Agricultural residue also played a significant role, providing heat for 27.8% of households initially and gradually decreasing to 23.4%. Cow-dung cakes were employed by 14.0% of households three decades ago, and this figure has decreased over time to 9.9%. Interestingly, coal, kerosene, and LPG gas heaters were not commonly used for heating at any point in the past or present. The adoption of electric heaters, however, has shown a steady increase, starting from negligible usage three decades ago to 8.8% in the present time, reflecting a shift towards more modern and convenient heating methods. Moreover, other unspecified heating methods gained some prominence, accounting for 1.2% of usage initially and growing to 3.9% in the present time, indicating a certain degree of diversification in heating sources over the years.

***Table 8.3.1**: Evolution of Heating Energy Sources Over Time: Comparing Usage Trends from 30 Years Ago to Present [Base = 1,300]*

	30 years back	20 years back	10 years back	5 year back	present time
Fuelwood	94.9	94.9	91.9	87.7	84.4
Agricultural residue	27.8	27.7	26.6	25.0	23.4
Cow-dung cake	14.0	13.8	12.4	11.7	9.9
Coal	0.0	0.0	0.0	0.0	0.0
Kerosene	0.0	0.1	0.2	0.0	0.0
LPG gas heaters	0.0	0.0	0.2	0.4	0.5
Electric heaters	0.0	0.5	3.7	7.7	8.8
Nothing	1.2	1.2	2.0	2.6	3.9

The data suggests differences in heating methods at the present time between rural and urban areas. The highest percentage of households in both rural (88.1%) and urban (65.2%) areas use fuelwood for heating purposes. Around 26.0% of households in rural areas use agricultural residue for heating, whereas only 10.1% of households in urban areas do the same. Similarly, 10.6% of households in rural areas use cow-dung cake for heating, compared to 6.3% in urban areas. Electric heaters are more commonly used in urban areas, with 26.2% of households using them, compared to only 5.5% in rural areas.

The data illustrates the variation in heating methods across different ecological regions. The predominant heating method across all ecological regions is fuelwood. It is used by a high percentage of respondents in each region: 98.5% in the Mountain region, 78.8% in Hill region, and 87.6% in the Tarai region. Agricultural residue is almost non-existent as a heating method in the Mountain region, but it's used by 1.2% of households in the Hill region and 44.6% in the Tarai region. Electric heaters are more popular in the Hill region (16.7%) compared to the Mountain region (3.0%) and the Tarai region (2.9%).

Table 8.3.2: Heating Energy Sources at present time by different variables

	Residence		Ecological Region			Household Income		
	Rural	Urban	Mountain	Hill	Tarai	Low Income	Medium Income	High Income
Fuelwood	88.1	65.2	98.5	78.8	87.6	92.6	86.8	73.6
Agricultural residue	26.0	10.1	0.0	1.2	44.6	24.3	28.2	17.7
Cow-dung cake	10.6	6.3	0.0	0.0	19.3	10.7	8.7	10.5
Electric heaters	5.5	26.2	3.0	16.7	2.9	0.8	3.2	23.0
Nothing	2.4	11.9	0.0	6.1	2.4	2.2	3.9	5.6
LPG gas heaters	0.4	0.7	0.0	0.7	0.4	0.0	0.5	0.9

8.4. Cooling Energy Sources Over Time

Over the past three decades, there have been notable shifts in the methods used for cooling purposes in households. Thirty years ago, manual fans were the primary means of cooling, with 50.2% of households relying on them. While this percentage has decreased slightly to 41.3% in the present time, manual fans continue to be a popular choice. Electric fans, on the other hand, have experienced a substantial increase in usage, starting at 1.6% three decades ago and steadily rising to 63.0% today, indicating a significant shift towards more automated cooling options. Air coolers were virtually non-existent as a cooling method thirty years ago, but their usage has grown over the years, from 0.3% a decade ago to 1.4% at present. However, the usage of air conditioning (AC) has remained quite low throughout the years, accounting for only 0.2% of cooling methods today. Interestingly, a decline trend can be observed in the percentage of households that reported using no cooling methods at all, dropping from 48.9% three decades ago to 34.8% in the present time, which could be attributed to the increased availability and affordability of various cooling options.[28]

Table 8.4.1: Evolution of Colling Energy Sources Over Time: Comparing Usage Trends from 30 Years Ago to Present [Base = 1,300]

	30 years back	20 years back	10 years back	5 years back	present time
Manual fans	50.2	49.5	44.7	42.7	41.3
Electric fans	1.6	11.5	47.4	57.7	63.0
Air Coolers	0.0	0.0	0.3	0.4	1.4
AC	0.0	0.1	0.0	0.0	0.2
None	48.9	47.4	41.7	38.2	34.8

The data suggests that electric fans and manual are the most popular cooling methods in urban and rural areas, with urban areas having higher usage of electric fans. Electric fans are significantly more popular in urban areas (87.3%) compared to rural areas (58.4%). The usage of manual fans is relatively similar in both urban and rural areas, with slightly higher usage in rural areas. The data also shows a much larger portion of rural resident (39.5%) do not use any cooling method compared to urban residents (10.5%).

[28] This could be due to a combination of two factors – increasing temperature and increased purchasing power.

The usage of electric fans is highest in the Tarai region (97.5%), followed by the Hill region (29.9%), and it's almost non-existent in the Mountain region. Manual fans are used to a larger extent in the Tarai region (78.9%), followed by the Mountain region (2.2%) and the Hill region (1.2%). Respondents who do not use any cooling method are most prevalent in the Mountain region (97.9%), followed by the Hill region (68.5%), and it's virtually non-existent in the Tarai region.

Table 8.4.2: *Cooling Energy Sources at Present Time by Different Variables*

	Residence		Ecological Region			Household Income		
	Rural	**Urban**	**Mountain**	**Hill**	**Tarai**	**Low Income**	**Medium Income**	**High Income**
Electric fans	58.4	87.3	0.0	29.9	97.5	51.8	66.0	71.5
Manual fans	42.1	37.0	2.2	1.2	78.9	44.5	45.7	33.3
None	39.5	10.5	97.8	68.5	0.0	44.6	32.9	26.8
Air Coolers	1.4	1.3	0.0	0.9	1.9	0.2	0.7	3.2
AC	0.1	0.6	0.0	0.1	0.2	0.0	0.1	0.4

8.5. User Satisfaction Ratings for Different Home Arrangements

When it comes to overall satisfaction with various household arrangements, the responses reveal intriguing patterns. For cooking arrangements, a significant of individuals, 51.0% express being very satisfied, while 39.9% are somewhat satisfied. Dissatisfaction levels are notably lower, with only 6.0% somewhat dissatisfied and 3.0% very dissatisfied.

Moving to lighting arrangements, the majority 63.7% are very satisfied, and 30.7% are somewhat satisfied. Dissatisfied levels are minimal, with 3.7% somewhat dissatisfied and merely 1.9% very dissatisfied.

However, when it comes to heating arrangements, the picture shifts slightly. While 37.6% express being very satisfied, a higher percentage, 52.1% fall into the somewhat satisfied category. Dissatisfaction levels remain relatively low, with 6.5% somewhat dissatisfied and 2.1% very dissatisfied.

Cooling arrangements also display a similar trend, with 40.8% being very satisfied and 31.8% somewhat satisfied. Dissatisfaction levels are again limited, with 2.5% somewhat dissatisfied and 1.2% very dissatisfied.

Table 8.5.1*: Satisfaction Ratings for Different Home Arrangements [Base = 1,300]*

	Very Satisfied	**Somewhat Satisfied**	**Somewhat Dissatisfied**	**Very Dissatisfied**	**NA**
H21. Cooking Arrangement	51.0	39.9	6.0	3.0	0.0
H22. Lighting Arrangement	63.7	30.7	3.7	1.9	0.0
H23. Heating Arrangement	37.6	52.1	6.5	2.1	1.7
H24. Cooling Arrangement	40.8	31.8	2.5	1.2	22.8

Urban respondents tend to be slightly more satisfied with their cooking, lighting, and cooling arrangements compared to their rural counterparts. In heating satisfaction, rural respondents have a higher percentage of somewhat satisfied responses compared to urban respondents. Dissatisfaction levels are generally low across all categories, indicating that a majority of respondents are at least somewhat satisfied with primary arrangements.

Tarai region tends to have the highest satisfaction levels across all categories, followed by the Hill region, and then the Mountain region. The Hill regions shows mixed results, having the highest satisfaction in heating and lighting, but also relatively higher dissatisfaction in cooling.

8.6. Perceptions of Health Impact and Consideration of Change Regarding Traditional Fuel Use for Cooking/Heating/Lighting/Cooling

The survey results shed light on perceptions regarding the potential health impacts of using traditional fuel sources such as fuelwood, cow dung cakes, and agricultural residue for various household purpose. A substantial majority, 80.7%, believe that there is no negative impact on their health resulting from the use of these sources for cooking, heating, lighting, or cooling. In contrast, 13.6% of respondents express concerns about potential health consequences. Additionally, 5.8% of participants mention that they do not use such traditional fuels at all.

For those who acknowledge health concerns arising from the use of these sources, a significant portion, 72.8%, have contemplated making a change to address these issues. On the other hand, 27.2% have not considered making any alterations to their current practices despite acknowledging the potential health impacts. This indicates a notable willingness among respondents to take action if they believe their health could be affected, yet a significant proportion remains hesitant to initiate changes.

For those respondents who have not considered making changes despite acknowledging potential health impacts from the use of traditional fuel sources, the survey reveals significant factors influencing their decision. A primary obstacle identified by 60.0% of individuals is financial constraint, indicating that economic limitations play a crucial role in deterring them from switching to alternative options. Furthermore, 34.0% cite convenience and easy availability of the current fuel sources as a factor preventing them from making a change. Additionally, a smaller percentage, 5.9%, attribute their lack of decision-making power as a barrier, suggesting that their ability to choose alternative fuel sources might be limited by external factors or decision maker in their households.

8.7. Decision-Making Dynamics for Changing Energy Sources in Different Household Activities

The decisions regarding changing the energy source for various purposes within the household are distributed among different individuals. When it comes to the energy source for cooking, approximately 40.3% of respondents indicated that they themselves would make this decision. For the spouse, this proportion was slightly lower at 39.2%. Around 20.3% of respondents mentioned that other household members would play a role in this decision, while only 0.2% of other non-household members and 0.1% of respondents who were unsure or couldn't say were involved in this decision-making process.

Similarly, when considering a change in the energy source for heating purposes, the pattern remains consistent. Around 40.3% of respondents would take the lead in deciding to change the energy source for heating, with 38.6% attributing this decision to their spouse. Other household members were mentioned by 20.8% of respondents, while a mere 0.3% indicated the involvement of other non-household members.

The decision-making dynamics for changing the energy source for lighting showed a similar breakdown. Approximately 40.2% of respondents would make this decision themselves, while 38.5% would involve their spouse. Other household members were considered by 21.0% of respondents, and a small fraction 0.3% mentioned other non-household members as part of the decision-making process.

Lastly, concerning a change in the energy source for cooling, the distribution of decision-making was again somewhat consistent. About 40.8% of respondents indicated that they would take charge of this decision, and 38.1% attributed it to their spouse. Around 20.5% of respondents thought that other household members would have a say, while 0.4% mentioned other non-household members. An even smaller portion of 0.2% were uncertain or unable to provide an answer about the decision-making process.

***Table 8.7**: Household Decision-Making for Changing Energy Sources by Relationship Status [Base = 1,300]*

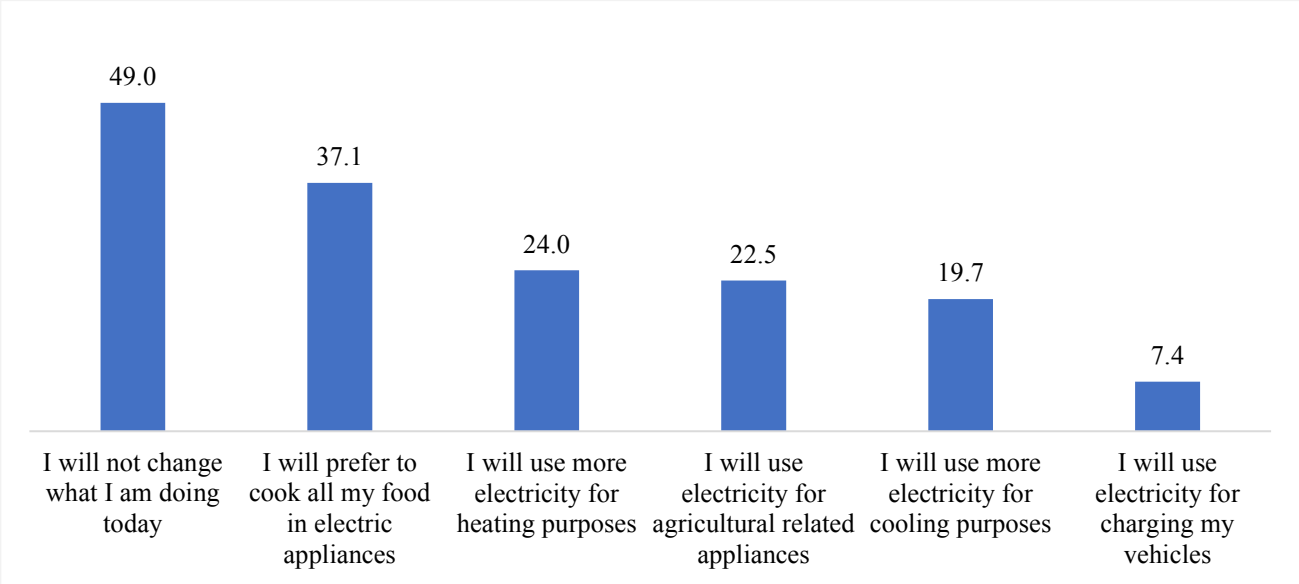
	SELF	SPOUSE	OTHER HH MEMBER	OTHER NON-HH MEMBER	Don't know/Can't say
H28. If you need to change the energy source for cooking anyway, who would make this decision?	40.3	39.2	20.3	0.2	0.1
H29. If you need to change the energy source for heating anyway, who would make this decision?	40.3	38.6	20.8	0.3	0.0
H30. If you need to change the energy source for lighting anyway, who would make this decision?	40.2	38.5	21.0	0.3	0.0
H31. If you need to change the energy source for cooling, who normally makes this decision?	40.8	38.1	20.5	0.4	0.2

8.8. Intended Uses of Cheap and Reliable Electricity in the Household

The respondents were also asked how would they like to change their household energy consumption patterns if cheap and reliable electricity was made available. Almost half of the respondents at 49.0%, stated that they would maintain their current activities and not change their energy consumption pattern. On the other hand, remaining 51.0% of the respondents ticked multiple options, in that, 37.1% cited that if cheap and reliable electricity was available, they would want to switch to using electric appliances for cooking, 24.0% responded that they would utilize that electricity for heating purposes, 22.5% mentioned using electricity for agricultural purposes, 19.7% stated they would use more electricity for cooling purposes, and a small percentage of respondents at 7.4% also cited that they would use it to charge their electric vehicles.

These findings show that Nepal's distribution grid has been designed and expanded for providing mainly domestic lighting; and in the past three decades, there has been a considerable expansion of the distribution network to the extent that today 98 percent of the households have access to electricity. However, while they may have "access" to electricity, except for lighting, it does not allow them to do much else with it including engaging in electric cooking, heating or cooling. Given that Nepal's per capita electricity consumption at approximately 250-300 kWh per annum is one of the lowest in South Asia (India's is 1200), there are possibilities for Nepali households to consume more electricity. Some 51% reported that if cheap and reliable electricity is available, they would like to use it for cooking, heating, agricultural purposes, cooling, and even charging electric vehicles.

***Figure 8.8**: Intended Usage of Cheap and Reliable Electricity [H32, Base = 1,300]*



The table below reveals respondents' intentions and preferences regarding the utilization of cheap and reliable electricity in their households, categorized by residence, ecological region, and household income. A substantial percentage of respondents across all categories express a reluctance to change their current electricity usage habits, with the highest percentages indicating "I will not change what I am doing today." Overall, the data provides valuable insights into the diverse electricity usage preferences of different demographic groups.

Overall, higher income quartile is more amenable to using more electricity is cheap and reliable electricity is available. This is true for all activities i.e., cooking, heating, cooling and charging vehicles but not true for agriculture related appliances.

Urban residents, especially those in the Tarai region, show a higher inclination towards using electric appliances for cooking. Respondents in the Hill region display a higher interest in using more electricity for heating purposes compared to other regions.

Overall, a higher proportion of rural residents would like to use cheap and reliable electricity for agricultural appliances compared to urban residents. Overall, however, there is a relatively low percentage of respondents expressing a desire to use electricity for agricultural-related appliances. This may indicate that agriculture may not be a primary consideration for increased electricity usage among respondents.

There is a consistent positive correlation between household income and the willingness to use more electricity for various purposes. High-income households consistently show higher percentages for using electricity for various purposes, suggesting a potential link between economic status and openness to increased electricity usage.

Urban areas, particularly in the Tarai region, express a higher preference for using more electricity for cooling purposes.

***Table 8.8.1**: Intended Usage of Cheap and Reliable Electricity, by Residence, Ecological region, Household income [H32, Base = 1,300]*

	Residence		Ecological Region			Household Income		
	Rural	**Urban**	**Mountain**	**Hill**	**Tarai**	**Low Income**	**Medium Income**	**High Income**
I will not change what I am doing today	47.4	57.2	52.8	43.2	53.4	57.2	47.3	42.4
I will prefer to cook all my food in electric appliances	37.3	35.6	39.3	50.8	25.3	26.2	38.7	46.4
I will use more electricity for heating purposes	24.1	23.6	30.7	30.8	17.6	17.6	26.3	28.2
I will use electricity for agricultural related appliances	24.6	11.7	15.5	17.5	27.4	20.5	28.3	18.5
I will use more electricity for cooling purposes	18.1	28.3	5.3	16.4	24.0	11.1	20.0	28.2
I will use electricity for charging my vehicles	6.8	10.5	8.2	8.6	6.3	1.9	7.5	12.9

The data which categorizes responses based on broad caste-ethnic groups, provides insights into the potential utilization of cheap and reliable electricity in households across various communities. Notably, a significant percentage of respondents across all caste groups express a reluctance to alter their current electricity usage habits, with the highest percentages falling under the category "I will not change what I am doing today." This trend suggests a common inclination towards maintaining existing practices regardless of broad caste-ethnic affiliation. However, variations emerge in preferences for specific electricity applications. Hill Dalit and Madhesi Dalit groups exhibit a higher interest in using electric appliances for cooking, while Hill Adibasi/Janajati and Madhesi Dalit groups show greater interest in using more electricity for heating purposes. Additionally, Madhesi Caste (Level - 2) and Madhesi (Adibasi/Janajati) groups demonstrate a notable preference for using electricity for agricultural-related appliances. The data also indicates relatively consistent percentages across broad caste-ethnic groups regarding the intention to use electricity for cooling purposes, while interest in using electricity for charging vehicles is generally low across all groups.

When examined through the lens of occupation, distinct patterns emerge in preferences for specific electricity applications. Agricultural self-employed individuals demonstrate a relatively higher interest in using more electricity for agricultural-related appliances, aligning with the nature of their work. Non-agricultural self-employed and salaried workers express a preference for cooking all their food with electric appliances, potentially influenced by urban lifestyles. Students exhibit a notable interest in using electricity for cooling purposes, which may be attributed to the younger demographic's emphasis on modern amenities. Unemployed and retired individuals express a higher willingness to maintain their current electricity usage habits.

The data segmented by educational groups, provides additional insights into the anticipated utilization of cheap and reliable electricity in households. Firstly, there is a common inclination to maintain

existing practices irrespective of educational background. However, distinct patterns emerge in preferences for specific electricity applications based on educational attainment. Individuals with higher education levels, specifically those with a Bachelor's degree and above, express a strong preference for cooking all their food with electric appliances. This could be attributed to a potentially greater awareness of modern cooking technologies and convenience among individuals with advanced education. Additionally, respondents with lower educational attainment, particularly those who are illiterate, show a higher interest in using electricity for agricultural-related appliances. This suggests that the perceived value of electricity for specific purposes may vary with educational background.

The data presented in the table reflects the average household monthly payment for utilities in Nepalese Rupees based on respondents' preferences for utilizing cheap and reliable electricity. Among the responses, the average expenditure for households expressing the intent to maintain their current electricity usage patterns without any changes is NPR1,415. This indicates that it is the people with relatively low incomes that do not want to change their energy using habits even if cheap and reliable electricity were to be made available. For those inclined to use electricity for cooking all their food with electric appliances, the average monthly payment is NPR1,928. Similarly, households planning to increase electricity usage for heating purposes show an average expenditure of NPR1,843. For respondents who would use more electricity for cooling purposes, the average monthly payment is NPR2,111. Those intending to use electricity for charging their vehicles have an average monthly payment of NPR2,409. Lastly, households looking to utilize electricity for agricultural-related appliances show an average expenditure of NPR1,500. This data provides valuable insights into the potential shifts in household electricity consumption patterns and the associated financial considerations.

***Table 8.8.2**: Intended Usage of Cheap and Reliable Electricity, by Income level [H32, Base = 1,300]*

	If cheap and reliable electricity were to be available in your household, what would you use it for?					
	I will not change what I am doing today	I will prefer to cook all my food in electric appliances	I will use more electricity for heating purposes	I will use more electricity for cooling purposes	I will use electricity for charging my vehicles	I will use electricity for agricultural related appliances
Average household monthly payment for different utilities in Nepalese Rupees	1,415	1,928	1,843	2,111	2,409	1,500

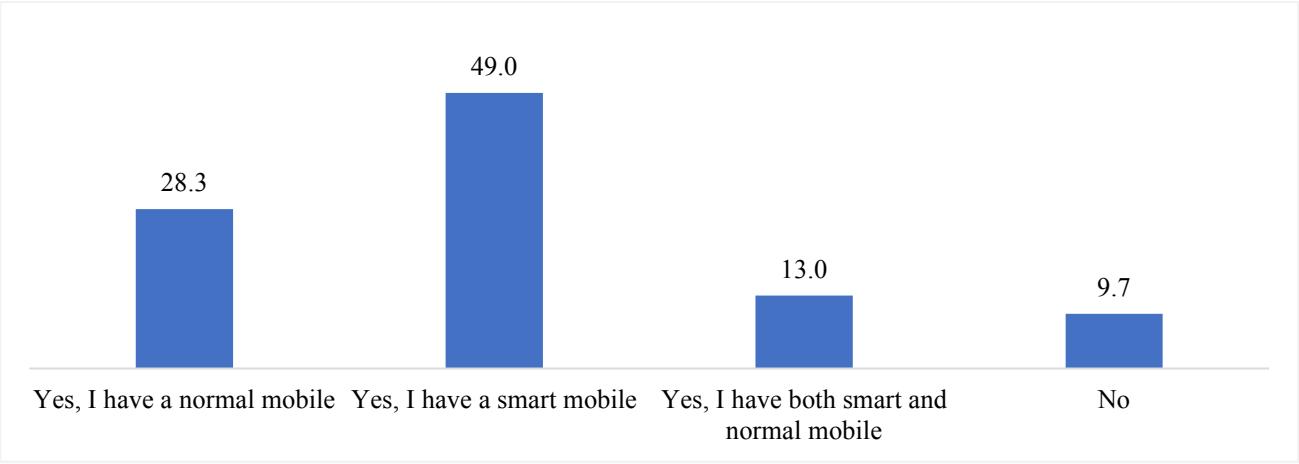
To conclude, what could be said is that the proclivity to increase the consumption of energy if cheap and reliable energy is to be available is a function of income level of the households. Those households that are in the lower income quartile and which on average pay less for the various utilities, are not inclined to use more energy even if it is cheap and reliable presumably because they are already financially stretched.

9. Mobile Phones for Communication and Information

9.1. Ownership of Mobile Phones

The figure 9.1.1 provides information on the distribution of respondents based on their possession of mobile phones. Of the respondents, 28.3% reported having a regular mobile phone, 49.0% owned a smartphone, while 13.0%possessed both a regular and a smart mobile phone. A smaller proportion, 9.7%, indicated that they did not have any mobile phone.

***Figure 9.1.1**: Mobile Phone Ownership and Usage Distribution by Type [I1, Base = 1,300]*



In rural areas, 30.1% of respondents have a normal mobile phone, while in urban areas, this number drops to 18.8%. In terms of owing a smart mobile phone, 47.4% of rural respondents have one compared to 57.3% of urban respondents. Those who have both a smart and a normal mobile phone are less prevalent, with 12.2% in rural and 16.9% in urban areas. The percentage of respondents who do not have a mobile phone is 10.2% in rural areas and 7.0% in urban areas.

The data also suggests that smartphone ownership is more prevalent than normal mobile phone ownership across all three ecological regions. The Mountain region has the highest ownership of both smart and normal mobile phones, suggesting a higher affinity for having multiple types of mobile devices in that region. The Tarai region has the highest percentages of people without mobile phones, which might indicate disparities in access to mobile technology in that area.

The data provides insights into how mobile phone ownership varies based on household income. It suggests that there is a correlation between income level and the type of mobile phones owned. Smart mobile phone ownership is generally higher across all income groups, with the highest ownership percentage in the high-income group. The percentage of respondents owing only a normal mobile phone is higher in low and medium-income groups compared to high-income group. Ownership of both smart and normal mobile phones is fairly consistent across income groups. The proportion of respondents not owing a mobile phone decrease as income levels increase, with the lowest percentage in the high-income group.

The finding show that the average number of mobile phone usages varies slightly based on the source of electricity. Regions connected to the national grid exhibit a slightly higher frequency of mobile phone usage (an average of 2.7 mobile phones) compared to areas dependent on local mini-grids or solar power (an average of 2.5 mobile phones). The fact that people living in areas that have a local

mini grid or solar have reported an average of 2.5 mobile phones is interesting. The mini grid solar plays an invaluable role in charging the mobiles. Because there is local mini grid or solar in these locations (where the state has not been able to extend the national grid) it is possible to charge mobiles in these locations.

***Table 9.1.2**: Mobile Phone Ownership and Usage Distribution by Type by different variables*

	Residence		Ecological Region			Household Income		
	Rural	**Urban**	**Mountain**	**Hill**	**Tarai**	**Low Income**	**Medium Income**	**High Income**
Yes, I have a normal mobile	30.1	18.8	34.7	29.5	26.7	34.9	31.2	18.6
Yes, I have a smart mobile	47.4	57.3	52.9	51.7	46.3	38.6	45.8	63.0
Yes, I have both smart and normal mobile	12.2	16.9	5.2	9.9	16.3	12.1	13.5	13.3
No	10.2	7.0	7.2	8.9	10.7	14.5	9.5	5.1

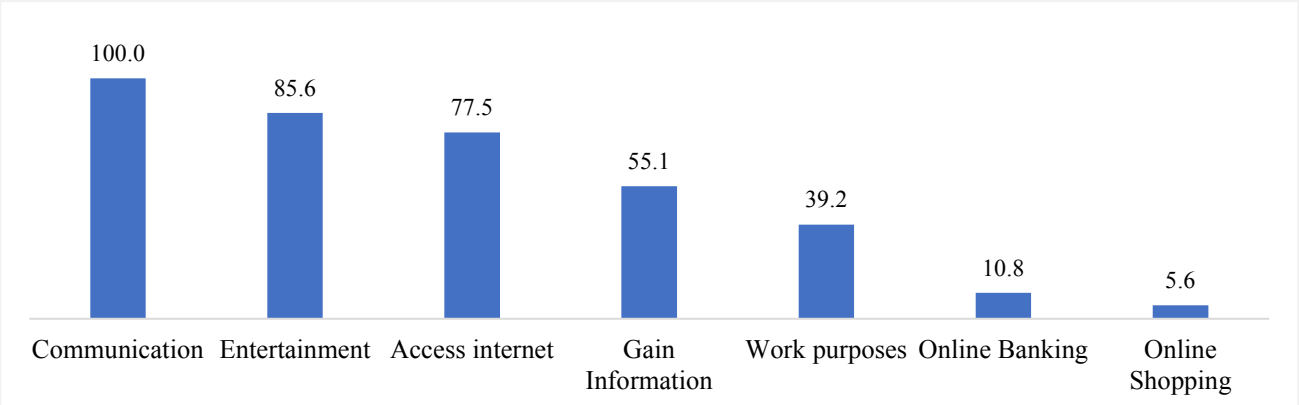
9.2. Average Number of Years Since Starting to Use Mobile Phones

The survey endeavor the average number of years respondents have using different types of mobile phones. For those using regular mobile phones, the average duration of usage was 6.8years, while for smart mobile phone users, the average duration of usage was slightly lower at 6.1years.

9.3. Purposes of Smartphones Usage in the Household

The survey also depicts the diverse reasons why household members utilize their smartphones. Communication emerges as the primary purpose, with 100% of respondents using their smartphones for this reason. Following closely, entertainment accounts for 85.6% of smartphone usage, while 77.5% of respondents use their smartphones to access the internet. Approximately 55.1% of users employ their smartphones to gain information, while 39.2% use them for work-related purposes. A smaller proportion, 10.8%, utilize smartphones for online banking, and an even smaller group, 5.6%, engage in online shopping through their smartphones. These findings shed light on the diverse array of functions that smartphones serve within households.

***Figure 9.3.1**: Smartphone Usage Distribution by Purpose [I4, Base = 805]*



The data suggests that smartphones are widely used for communication and entertainment purposes in both rural and urban areas. Urban respondents tend to use smartphones more frequently for internet-related activities, gaining information, online banking, and online shopping compared to their rural counterparts.

There are some variations in smartphone usage patterns among the ecological regions, certain trends emerge. Communication, entertainment, and internet access are widespread uses of smartphones across all regions. The Tarai region appears to have higher smartphone usage for work-related tasks, gaining information, and accessing the internet.

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Annex 1

Presentation and Interaction
Survey Findings on Household Energy Consumption and Transition
November 21, 2023 (8:30 am to 12:30 pm)
Inter Disciplinary Analysts' Office

1. Findings of the presentations are informative and useful

- The findings from the survey on energy consumption and transition are an example of how empirical data could contribute to informed policy making. The survey data could also significantly benefit university students.
- The collaboration between IDA and LUCSUS is commendable. It is recommended that IDA prepare policy briefs for high-level discussions. Based on the data, specific messages could be targeted to policy makers, to the national utility and to the consumers.
- The slight difference between what the consumers say about electricity coverage and what the NEA data say need to be addressed.
- One of the participants noted, "This survey has set a precedent by emphasizing the need to explore the demand side. It has clarified various aspects of Nepal's energy demand, revealing distinct scenarios in the process."
- One of the participants expressed appreciation to IDA and LUCSUS for providing a realistic portrayal of the country's energy demand i.e., perspectives from the point of view of consumers. The participant also observed that though sharing the findings in its current form is good, it may also be better to prepare a comprehensive analytical report with detailed interpretations at a later date.

2. Suggestions for additional analysis

Household Expenditure and Energy usage

The survey should include an analysis of how modern energy usage, particularly in cooking, contributes to reducing household health expenditure. Since cooking in firewood leads to adverse effects on health, transitioning from firewood to electricity or LPG has consequences for health-related expenditure. This information is crucial for policymakers to comprehend the broader societal impact of energy transitions.

A participant proposed a more detailed analysis of lighting devices used, such as fluorescent lamps, LED bulbs, or tungsten lamps. This detailed approach can provide insights into how different devices impact energy consumption and expenditure across diverse demographics and geographic locations.

Detailed Expenditure

Further analysis of respondents' expenditure based on various variables could enhance the insights available for formulating effective tariff policies. This would offer a more nuanced understanding of the factors influencing expenditure patterns and contribute to the development of targeted and well-informed policy measures.

3. Access to Energy

- A participant raised concerns about the lack of a clear definition of "access to electricity" in the survey. The slight discrepancy between the survey and NEA data in electricity access percentages was noted, urging a more thorough examination.
- It was suggested that the reported 97.6% figure for electricity access be examined more carefully. The disparities between NEA and CBS data were acknowledged[29]. National Association of Community Electricity Users Nepal (NACEUN) was of the opinion that the official government data over-estimated electricity coverage.
- IDA team's observation: There was an interesting discussion on how NEA generates its data about electricity coverage. Participants mentioned the need to unpack some of the assumptions based on which NEA generates its data. It works on the basis of the number of households that have access and then assumes how many members there are in a family. Based on the assumption regarding the number of family members per household, the coverage figures – in terms of the percentage numbers – could vary. As per the census figures, the number of members per family is going down. In actuality, IDA's household energy consumption survey data, CBS data and NEA data are close.
- A participant asked about the energy being used by households for irrigation and agricultural purposes. IDA team mentioned that this figure is in the survey findings but had not been included in the ppt due to time limitations.

4. Energy Consumption Trends

- There should be definitional clarity about what the study means when talking about "lighting", "cooking", "heating" and "cooling". For instance, "heating" may refer to space heating and keeping the house warm in Sweden but in Nepal it may refer to keeping one's body warm.
- Though it is good that the study has come up with its own understanding and definition of what constitutes "rural" and what constitutes "urban", in circumstances where the rest of the variables are ones that are defined by the government, it may be more worthwhile to stick to the Nepali government's definition of urban and rural to have more policy relevance.
- A government official mentioned the data on transition across the 30-year period resonates closely with his own experience.
- Participants emphasized key trends in energy consumption, recognizing a decline in the use of traditional fuels and a simultaneous increase in the adoption of LPG. They stressed the critical need to reduce dependence on imported petroleum, particularly for LPG, as evident in its substantial rise from 0.6% to 64% over a 30-year period.
- The discussion on energy consumption patterns reveals that 49% of residents perceive their energy use as inelastic, suggesting resistance to changing habits even with affordable and reliable electricity. It was pointed out that this need not necessarily be seen as unchangeable.

[29] This has been persistent methodological problem. See: https://bulletin.ids.ac.uk/index.php/idsbo/article/view/2822/ONLINE%20ARTICLE

The potential for reducing this ratio could come about through strategic policy formulation, infrastructure development and physical interventions.

- The main impediment to increased consumption of electricity for cooking, is the electricity distribution system. The distribution infrastructure needs to be upgraded and revamped.
- One of the participants stated that, a pilot study in Mangaltar by Community Rural Electrification Entities (CREE) demonstrated that it was possible to double energy consumption if infrastructure could be revamped.
- A participant mentioned that in terms of total energy consumed by households there has not been any substantial increase in the past 30 years. This may come as a surprise but households with electricity today are consuming similar units of energy they used to consume some 30 years back. This is because of energy efficient light bulbs and appliances that have emerged in the market that consume less electricity.
- This participant mentioned that the irony is that the coverage has increased substantially in the past 30 years. However, the amount of energy used per household has not increased. So the challenge for the residential sector is how to actually increase the electricity consumed.
- A participant asked what the hypothesis of the study were. The IDA team replied that instead of hypothesis testing which would be relevant for research designs that were either descriptive or analytical, since this was an exploratory study, its purpose was to explore and document the consumption of electricity across the four domains rather than to test any particular hypothesis, which is a matter for further study and analysis. Even then, it is felt that trends are helpful in drawing some preliminary conclusions for policy formulations.
- The per capita consumption of energy in Nepal is very low. Policy makers should be thinking about how per capita energy consumption could be increased to reach levels at least of other South Asian countries.
- A participant mentioned that there should be incentives for households to increase the use of electricity. Given that the residential sector is the sector that consumes most of electricity, how to further increase consumption in the residential sector should receive priority.

5. Subsidies and Entrepreneurship

- One of the participants suggested to explore the evolving landscape of entrepreneurship, especially rural during the energy transition phase, seeking to understand its development within this dynamic context.
- It was pointed out that there are subsidies in electricity use. Though one set of groups was the target of these subsidies, these are being enjoyed by another set of people, who need not be given subsidies. There needs to be a more equitable distribution of such benefits to those that actually deserve it.
- Several participants mentioned that there needs to be a greater investigation between educational levels and energy consumption and transition. This could shed light on the socio-economic factors influencing the ongoing changes in energy consumption patterns. There needs to be a multi-faceted approach that explores the intersectionality between entrepreneurship, subsidies, and educational variables within the broader context of energy transitions.

- The incentive structure for electricity consumption needs to be revised to encourage higher consumption. For instance, if the cost of electricity increases significantly beyond a certain threshold, residents may be discouraged from using more electricity. This needs to be revised for encouraging consumption.

6. Energy Efficiency and Policy Interventions

- Government intervention in the electricity consumption through tariff revisions and incentives for energy-efficient appliances, can further promote energy conservation.
- Participants proposed that effective financial incentives and improved infrastructure can boost energy consumption, leading to economic growth and better living conditions. Additionally, they recommended taking into account the economic cost of the time spent in collecting firewood, especially for women and children, when shaping energy policies.
- Most of the participants suggested the 49% figure needs to be further unpacked. It would have been good to explore why they would not want to change their behavior. This is the proportion that reflects inelastic demand viz. the respondents who said they would not change what they are doing if they get cheap and reliable energy. They proposed a thorough examination of this percentage, as it holds key insights into the reasons behind the nation's stagnant electricity demand especially from the residential sector.

7. Other general suggestions provided by the participants

- There is a need to coordinate closely with WECS – the government mandated body to study and provide policy advice on energy and water related issues, perhaps a separate presentation of these findings.
- Participants highlighted the importance of looking into energy security, especially concerning possible blockades. If there is an economic blockade – as there was in 2015-16 – how would this impact energy security?
- Industry may have access to electricity that may be relatively cheap but it may be unreliable. To ensure the continuity of appliances in the factory, it may have installed diesel plants. However, it ends up paying much more through the back up diesel plant. Therefore, it may be better to increase the tariff and provide more reliable electricity to the industry.
- Even if it be through a follow up qualitative study, it would be good to explore the willingness-to-pay. It would be good to know how much people are willing to pay for cooking, heating, lighting, and cooling.
- A participant suggested that the IDA team should review a study done by the Asian Development Bank and the World Bank on citizens' willingness to pay. The said study could offer insights into inelastic demand of energy for household consumption.

Annex 2

List of participants at the Household Energy Consumption and Transition presentation and interaction (November 21, 2023)

S.N.	Name	Affiliation
1	Ms. Anju Maharjan	Senior Officer, NEA
2	Mr. Anup Kumar Upadhyaya	Former Secretary, MoEWRI
3	Mr. Anurag Pokhrel	VRock & Company (Consulting Company)
4	Mr. Aslesh Shrestha	PEI Researcher (Consulting Company)
5	Dr. Bikram Acharya	Policy Research Institute (Government Thinktank)
6	Dr. Rabin Shrestha	Former World Bank Advisor
7	Mr. Hitendra Dev Shakhya	Former Managing Director, NEA
8	Mr. Kumar Pandey	Private Hydropower Developer / IPPAN
9	Mr. Laxman Biyogi	Editor, Urja Khabar (Energy News)
10	Mr. Madhav Belbase	Public Service Commission Member (Former Secretary, Ministry of Water Supply; WECS)
11	Mr. Narayan Gyawali	NACEUN-Chairman
12	Mr. Nasib Man Pradhan	Director, NEA
13	Mr. Naveen Adhikary	Central Department of Economics, Tribhuvan University.
14	Mr. Prabin Dhakal	Kathmandu University
15	Prof. Jagan Nath Shrestha	Professor Emeritus, Institute of Engineering, Pulchowk
16	Mr. Ram Gopal Lageju	Under Secretary, MoEWRI
17	Dr. Ram Prasad Dhital	Former Member of NERC
18	Mr. Ratna Sansar Shrestha	Chartered Accountant and lawyer specialized in hydropower sector
19	Mr. Sanjay Dhungel	Former Joint Secretary, DoED
20	Mr. Saroj Parajuli	Enumerator, IDA
21	Mr. Sujan Poudel	PFAN
22	Mr. Suman Man Singh Basnyat	Parliamentary Committee on energy and infrastructure development
23	Ms. Taenaj Shakir	PhD candidate, University of Lausanne, Switzerland
24	Mr. Dipak Gyawali	Chairman, IDA
25	Mr. Hiranya Baral	Field Manager, IDA
26	Mr. Chandra K.C	Senior Statistician, IDA
27	Mr. Pankaj Pokhrel	Research Officer, IDA
28	Mr. Dinesh Dangol	Software Programming Consultant, IDA
29	Mr. Sandeep Thapa	IT Associate, IDA
30	Mr. Tikaram Basnet	Research Associate, IDA
31	Mr. Himal Khanal	Research Associate, IDA
32	Dr. Sudhindra Sharma	Executive Director, IDA

Annex 3

Data collection team for household energy consumption and transition survey

S. N	Name	Gender	Designation	Districts
1	Basanti Lama	Female	Supervisor	Taplejung, Jhapa and Mahottari
2	Sarita Rajbanshi	Female	Enumerator	
3	Sagar Aryal	Male	Enumerator	
4	Mahesh Rijal	Male	Enumerator	
5	Lal Babu Sah	Male	Supervisor	Siraha, Mahottari, Bara and Makwanpur
6	Bhanu Yadav	Male	Enumerator	
7	Pinki Yadav	Female	Enumerator	
8	Pooja Kumari	Female	Enumerator	
9	Lila Mainali	Female	Supervisor	Kathmandu, Dolakha, Ramechhap and Okhaldhunga
10	Sharmila Budhathoki	Female	Enumerator	
11	Saroj Parajuli	Male	Enumerator	
12	Sangam Sapkota	Male	Enumerator	
13	Deba Raj Dhakal	Male	Supervisor	Manag, Kaski, Gulmi and Rupandehi
14	Nirajan Khadka	Male	Enumerator	
15	Jamuna Kumal	Female	Enumerator	
16	Sumita Dangol	Female	Enumerator	
17	Buddhi Gautam	Male	Supervisor	Rukum, Surkhet and Jumla
18	Nabin Shahi	Male	Enumerator	
19	Nanda Budha	Male	Supervisor	
20	Dev Raj Shahi	Male	Enumerator	
21	Juna Kandel	Female	Supervisor	Bardiya, Kanchanpur and Dadeldhura
22	Shital Koirala	Female	Enumerator	
23	Ravi Varn Chaudhary	Male	Enumerator	
24	Subodh Ram	Male	Enumerator	

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