

Socio-Economic Analysis of Alternative Energy Consumption in Urban Nepal

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Abstract:- Alternative energy means renewable sources of energy or clean energy that is non-polluting. The sources of alternative energy are not only renewable but also perennial in nature or they are inexhaustible in supply. Among various sources of alternative energy, Nepal has high potential for solar power and hydroelectricity. Hydro electricity production and electric cooking has high prospects in Nepal as many hydroelectric projects are likely to produce electricity in the near future. LPG is the major source of energy for cooking among majority of urban households in Nepal. Electricity is one of the cleanest sources of fuel for cooking. The benefits of electric cooking are reduction of the cost of cooking, promotion of health and healthy environment, fuel savings, time saving and global environmental benefits due to greenhouse gas reduction. Electric cooking is becoming popular and increasing at very fast rate. Nepal has tremendous hydropower potential, efforts should be made to create high demand of it in household use to replace LPG by electric cooktops. Electric cooking is comparatively cheaper and better in terms of convenience and has higher aesthetic value. To make electric cooking reliable increasing hydroelectricity production, improving electricity transmission & distribution system, house-wiring quality, connection capacity, policy interventions and other infrastructures are required. On the other hand, to replace LPG use, it should be much cheaper in terms of life cycle cost, especially cost of health care. The import of fuel is one of the main reasons for Nepal's increasing trade deficit with India. The electricity authority of Government of Nepal has moved a step ahead promoting electric cooktops as an alternative to LPG. Electric cooking is pollution free and helps to reduce import of LPG in Nepal. This study analyses socio-economic benefits of electric cooktops to LPG stoves in urban area of Surkhet. The study includes data of LPG and electricity consumption for households.

The study drew the results that about one-half of households of the study population are benefited economically from the adoption of electric cooktops in place of LPG. The use of an electric induction cooktops is around 50 % cheaper than the LPG in term of running cost.

Keywords:- Alternative energy, Renewable energy, Electric cooking, LPG, Induction, fuel switching, air pollution.

I. INTRODUCTION

Energy switching is replacing traditional sources of energy with cleaner and economical alternatives. Energy switching would be possible by promoting electric cooking, electric vehicles and productive uses of electricity which ultimately results to increase domestic demand of electricity.

LPG is one of the popular source of energy for cooking purposes in Nepal. But electric cooking has high prospects in Nepalese context as many hydroelectric projects are likely to produce electricity in the near future. The development of electrical energy in the world does not have long history, it was started only 140 years ago. In Nepal, its history is just 110 years long. Within this short period of time, it is felt as one of the human needs of high priority. It has become one of the basic needs for each individual. Some few years ago, rural solar electrification, biogas, micro hydro, improved cooktops would be understood as the alternative energy. Environmental balance, human health, production cost, everlasting supply, reliability, availability, affordability are the major motivating factors for the promotion and development of modern alternative energy. For the country's journey towards economic prosperity through the renewable energy, the government of Nepal has given high priority to development of alternative energy. To achieve national goal of 'Prosperous Nepal, Happy Nepali', the government has decided to mark 2018-2028 as the 'energy and water resource' decade.

Nepal has been remarkably progressing in hydroelectricity generation. On the other hand, it has high trade deficit caused mainly by imports of petroleum products. So, energy economists and policymakers have suggested to minimize imports of petroleum products to tackle with the country's trade deficit. It has high economic cost to the economy as there is no local production and it is imported resulting to negative impact on balance of payment situation in Nepal. Nepal imported 477752.0 MT LPG with its share of 2.5 percent of the country's total import bill of NPR 1.5 trillion in fiscal year 2077/78. Nepal's trade deficit can simply be balanced by replacing LPG with electricity for cooking. Electric cooking is clean, smokeless and it reduces indoor air pollution and thus, minimizes respiratory diseases. Hydroelectricity is an alternative and renewable source of energy. Nepal has high potential for hydropower generation from perennial and run off rivers. Various researches have shown that electric cooking is economic when compared with LPG use.

Solid biomass, which causes household air pollution, is a major source of fuel for cooking in Nepal (CBS 2016). WHO (2016) has presented the fact that there is high annual premature death of around 22,841 people caused by respiratory disease. Promotion of electric cooktops is an urgent need to save environment as well as human health. It also reduces adverse effect of household air pollution generated from biomass and LPG fuel for cooking. Shift to electric cooking can be the best alternative with respect to the probable electricity surplus scenario, health and economic implication of traditional cooking practices in the country.

Nepal imports nearly 260,000 tons of Liquefied Petroleum Gas (LPG) and other fossil fuels annually from India resulting to Nepal's trade deficit with India. The Government of Nepal has initiated promotion of electric induction stoves for replacing LPG as these are pollution free and are meant to reduce Nepal's dependence on LPG (Dahal, 2020). In 2077/78, Nepal imported 477752.0 MT LPG.

Surkhet district is located in inner terai in Karnali Province of Nepal. It is surrounded by Jajarkot, Dailekh and Achham districts to the north and Bardia and Kailali to the south, similarly, Salyan and Doti to the east and west respectively. The district covers 2,488.64 sq. km and has a population 4,17,776 according to preliminary report of census 2021. Total number of HHs is 87,312. Surkhet is the provincial capital of Karnali Province. The study included a cluster of households in the only Sub-Metropolitan city of Surkhet district. Brahman/Chhetri comprises 43%, of total population, Magar occupies 19 %, Kami 19% and 19% others.

Most of the households in Nepal can gain economic benefit from the electric cook stoves. The switching from LPG to electric cooking can be smoother and more efficient, if the consumers are made aware of the benefit. So, electric cook stoves could be a good, clean, efficient, viable, cheap source of fuel while also reducing the trade deficit and hence can promote fuel-switching exploring other perspective opportunities. This study analyses socio-economic benefits of electric cooking to LPG stoves for households in urban areas of Surkhet District.

II. OBJECTIVES OF THE STUDY

The overarching goal of this article is to analyse socio-economic analysis of alternative energy consumption in Nepal. The specific objectives are:

- To analyse economic benefit of replacing LPG use by electric cooking.
- To examine the social and environmental benefits of using electric cooktops.

III. LITERATURE REVIEW

Ensuring access to and use of clean cooking fuels for all is a key Sustainable Development Goal (SDG 7). The range of possibilities for cooking with clean and modern sources of energy is increasing rapidly on a global basis. Being highly popular source of fuel for household cooking,

LPG has contributed to protection of forest and reduction of climate-warming elements, and its supply has enabled access to clean and convenient fuel in Nepal (Parikh et al, 2020).

With the growing electrification rates, electric cooking is now popular in areas where there is reliable power supply. Nepal does not have its own LPG production and has to import from India. It is rich in hydroelectricity potential, hence, may benefit from electric cooking as cleaner household energy (Parikh et al, 2020).

Ecuador had launched the induction stove program in 2015, aimed to replace LPG-based cooktops with an electric system for 80% of all households by 2018 as it has growing hydroelectricity production (Gould et al., 2018). Several studies have shown that electric cooking is the most efficient fuel as it was almost half the cost of cooking with LPG (EECMU, 2021).

Nepal joined Sustainable Energy for All (SE4ALL) initiative in 2012 to meet the target of clean energy to all, Sustainable Development Goal 7, by 2030. This UN Secretary General led initiative was to ensure the promotion and development of sustainable, clean, affordable, efficient and viable source of energy. Nepal is committed to achieve the SE4ALL goal through the action plans formulated by the National Planning Commission. To materialize SE4ALL commitment, the Nepal government, in 2013, developed a national goal to provide Clean Cooking Solutions for all by 2017.

The Constitution of Nepal (2015), has the provisions to adopt policies of protection, promotion and use of natural resources to ensure appropriate, affordable and sustainable energy to its citizens. There are various relevant policies and strategies to support the promotion of clean and renewable-energy technologies. They are aimed to advocate for clean cooking, raising awareness towards it, and subsidy provision for promotion and set effective policy frameworks.

Growing interest in cleaner cooking fuels among policy makers, civil societies and development partners is subsequently creating new opportunities for the promotion of modern cooking fuels such as electricity as a source energy for cooking.

The Government of Nepal has incorporated Clean Cooking Solutions for all initiative in policy and program for fiscal year 2071–2072 BS (World Bank, 2016). The Government of Nepal is committed to ensure access to secure, affordable, reliable, sustainable and modern energy for all to achieve global Sustainable Energy for All and Sustainable Development Goals (SDGs) and has set the aims to provide clean cooking technologies to all households by 2030 (MoPE 2017).

The traditional biomass fuel has negative impacts on human health, economic cost, forest conservation, greenhouse gas emission, time consumption, and drudgery. Major sources of black carbon emission are use of solid fuels and other aerosol species for cooking and heating (Bond et al., 2004).

The provision of providing subsidized electric induction only ensures economic benefit of adopting induction cooking to the majority of households.

Future analysis of the economics of a transition to induction cooking could be improved through the collection of more precise data on LPG consumption, baseline electricity consumption, LPG prices, and the economic discount rate (Dahal, 2020). Convenience, speed, safety and operating cost are the driving tools towards the use of electricity as cooking fuel. Expansion of electricity grids and its wider coverage have ensured the reliability of its uninterrupted supply and its viability (The World Bank, 2020).

Conventional fuels need to be replaced by cleaner fuels that is electricity. This fuel switching approach is opening new doors to modern cooking fuels such as electricity (Vaidya, 2020). Creating awareness and building

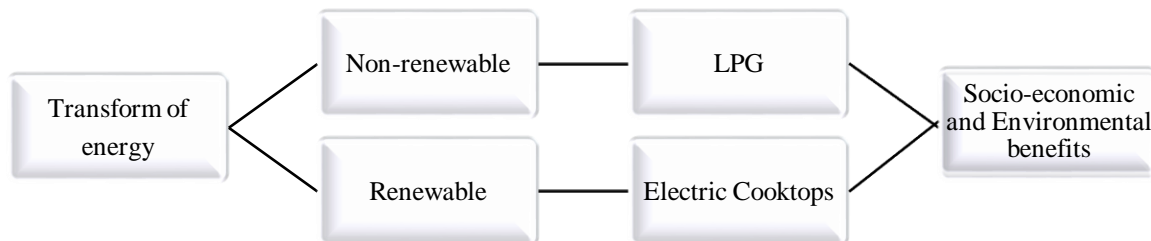
the capacity of households are twofold measures to sustain the transition in cooking practices (The World Bank, 2020).

Nepal Electricity Authority (NEA) achieved the highest generation of hydropower in the year 2019 (NEA, 2019). Many other hydropower projects are to be completed in the near future. Nepal is leading other developing countries in terms of providing electricity access to the people (Islar, Brogaard & Pedersen, 2017). Growing use of electricity, the cleaner energy, would help in reducing the trade deficit with India by decreasing fuel imports and providing electricity access to the citizen. Nepal mainly depends on India for petroleum products and LPG.

This study has the following research questions:

- RQ1: Is electric cooking cheap enough to replace LPG?
- RQ2: Does electric cooking impact the environment?

IV. CONCEPTUAL FRAMEWORK



V. METHODOLOGY

The research is both descriptive and analytical. The qualitative and quantitative data were collected through the questionnaire survey and cooking diary. The data were collected using KoBo Toolbox app. The collected data were downloaded in excel sheet from which analysis using charts and graphs was possible. The survey was conducted to collect information on the fuel consumption patterns of the households in Surkhet district. The district covers 2,488.64 sq. km and has a population of 4,17,776 and total number of HHs is 87,312 (CBS, 2011). 300 HHs as sample was selected by using Morgan table (confidence level 95% and P-value 0.5) from the 87,312 HHs of Surkhet district. Sampling is purposive in nature. The survey collected the information on electric cooking and non-electric (LPG) cooking events that the households experienced.

VI. RESULTS AND DISCUSSION

A. Users of LPG and Electric Cooktops for Household Use

Surkhet district is a valley, located in inner terai in Karnali Province of Nepal with geographical area of 2,488.64 sq. km. It is bordered by Jajarkot, Dailekh and Achham to the north, Bardia and Kailali to the south Salyan and Doti to the east and west respectively. According to preliminary report CBS, 2021, the valley is a home to 4,17,776 population. Out of total 87,312 HHs, 300 HHs were selected as sample using Morgan table. The goal of this study is to perform Socio-Economic Analysis of fuel-switching from LPG stoves to electric induction stoves. Table 1 presents the number of households adopted electric induction cooking and LPG. This study assumes that in the future, the households would switch to electric induction cooking, and this study would help them understand the financial, social and environmental benefits to fuel switch. Brahmin/Chhetri 43%, Magars 19%, Kami 19% and others 19%

Table 1: Pattern of Energy Use by Castes/Ethnicity

Energy/ fuel	Consumers Users (HHS) Category								Total	
	Brahman/Chhetri		Magars		Kami		Others			
	N	%	N	%	N	%	N	%	N	%
LPG	67	32.68	55	26.82	20	9.76	63	30.74	205	68.33
Electric Cooktops	52	54.74	22	23.16	5	5.26	16	16.84	95	31.67
Total	119	39.67	77	25.67	25	8.33	79	26.33	300	100

Source: Field Survey, 2022

Table 1 shows the number of households using electric cookings and LPG cooking. Out of total 300 households 68.33% use LPG and only 31.67% use electric cooktops for cooking. Among different categories of energy users, Brahmin and Chhetri 32.68% have been using LPG and 54.74% household have started electric cooktops. Likewise,

among Magar households only 23.16% have been using electric cooktops and majority i.e. 26.52% are using LPG. Similarly, Among Kami 5.26% and 9.76% households have been using electric cooktops and LPG respectively in urban area of Surkhet district.

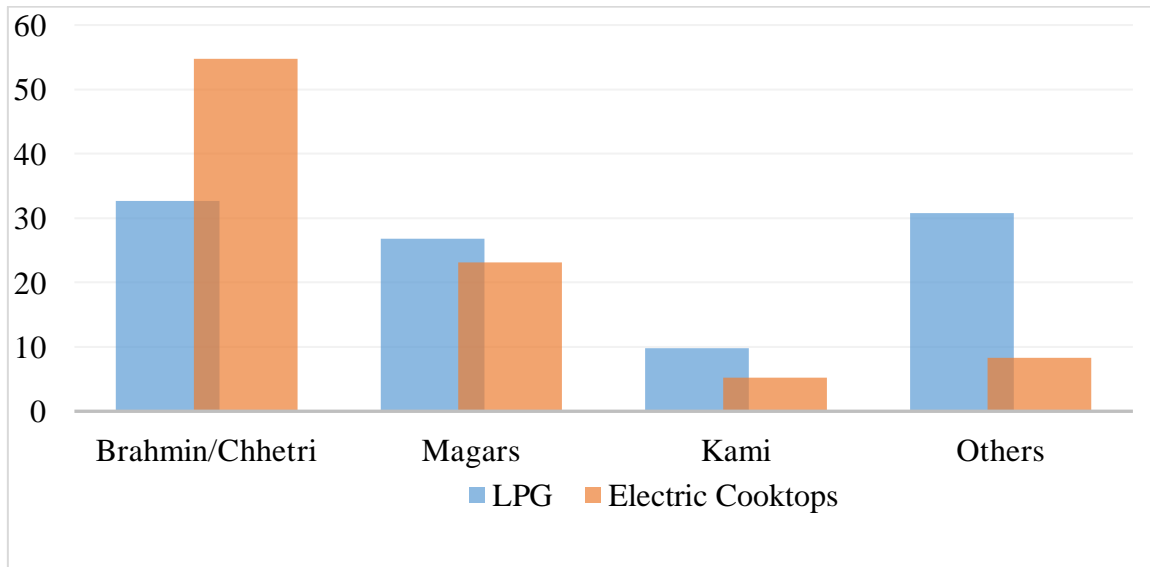


Fig. 1: Energy Users by Different Cluster

Source: Field Survey, 2022

Surkhet is provincial capital of Karnali Province. There is only one Sub-Metropolitan city, one urban municipality and seven rural municipalities. Brahmin/Chhetri occupies

the majority of population Brahmin/Chhetri 43%, Magars 19%, Kami 19% and others 19%.

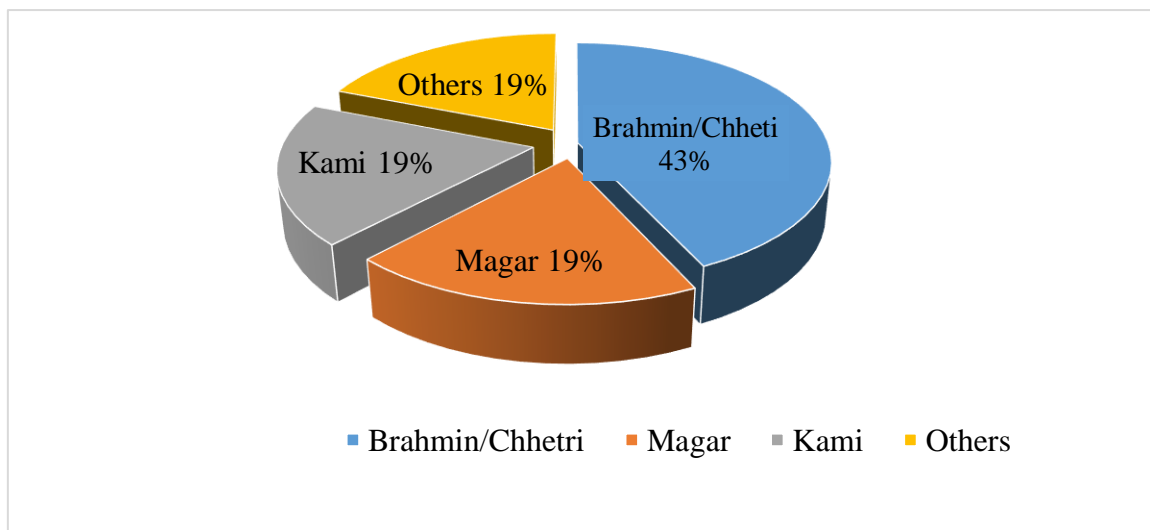


Fig. 2: Population Composition in Surkhet District

The results show that about one-half of urban households in the study have been using electric cooktops in Surkhet. They would be benefitted economically from the adoption of electric cooktops if the LPG is not subsidised.

B. Economic benefit of Electric Cooking in place of LPG

The results show that 90 units of electricity saves around a cylinder of LPG in households cooking. If valued in terms of money, the time saving on electric cooktops provides benefit than LPG use. There are other benefits of electric

cooktops in terms of convenience, affordability, safety, viability, economical, good health and clean environment. So, the demand for electric cooktops is increasing day by day. In case of use of LPG only for cooking purpose, a family requires around 1 cylinders per month that costs around NRS. 1900 (including delivery charge) per month. Relatively, electric cooking use is much economic i.e. NRS 855 than LPG use (Table 2). In case of induction use the cost saving is much higher than LPG.

Table 2: Fuel cost for Cooking a Comparative Analysis

Fuel	Quantity	Price (Rs)	Monthly expenditure (in Rs.)
LPG	14.2 kg (net/cylinder)	1900 (including delivery charge)	1900
Induction cooktop	90 unit	9.50/unit	855

Source: IOE 2019

Liquefied Petroleum Gas has a specific calorific value of 46.1 megajoules per kilogram. Every cylinder with 14.2 kg of cooking gas gives 181.9 kilowatt-hours of energy from electricity. In terms of heat transfer efficiency from the burner to pot, the LPG stove has just 40 percent efficiency only when compared to 84 percent efficiency with induction. If efficiency factor is considered one cylinder of LPG is equivalent to 86.59 kilowatt-hours (86.59 units) electricity consumption from an induction cooktop. If converted on money, the use of an electric induction cook stoves is much cheaper than the LPG in term of running cost in Nepal.

Socio-economic analysis of using electric cooktops and LPG helps to motivate to replacing LPG stoves with induction electric cooktops in urban households of Surket district Nepal.

VII. ELECTRICITY ACCESS SCENARIO OF NEPAL

Nepal's electrification trend is growing at an alarming rate and has become world's fastest electrifying country. The global average of increasing access to electricity is 0.8%, where Nepal is far ahead with 4.3% annually. Economic Survey 2019/20 presented the fact that, 90% of Nepalese population had access to electricity by mid-March 2020 (NPC, 2020).

In Nepal, 71.7% of the total households are connected to the national grid and 23% are depending on off-grid source. Only 5.2% households are out of electricity access, and the majority of which are living in the most remote areas (World Bank, 2019).

At present, Nepal has installed capacity if electricity is around 1200 MW. The government has set the target of 15000 MW to be achieved by 2030. Currently, there are 172 projects with total capacity of 4642 MW in different stages of construction under the issued license. It proves that Nepal is well prepared for electric cooking to fulfill its commitment of one house one electric stove (GoN, 2018).

VIII. CONCLUSION

On the ground of this study, it performs socio-economic analysis of replacing LPG stoves by electric cooktops. The results show that almost one-third (31.67%) of urban households in the study area have been using electric cooktops. If the subsidy on the LPG is removed, the households would be benefitted economically from the adoption of electric cooktops. Expansion of electricity grids and its wider coverage would ensure the reliability of its uninterrupted supply and its viability. The provision of providing subsidized electric induction ensures economic benefit of adopting induction cooking to the majority of households. The use of electric cooktop is much cheaper

(around 50 %) than the LPG in term of running cost. Electric cooking is smokeless and does not produce indoor air pollution, reducing carbon dioxide emissions and hence minimize respiratory diseases. Electric cook stoves could be a good, clean source of fuel while also reducing the trade deficit and maintains balance of payment. There are other benefits of electric cooktops in terms of convenience, affordability, safety, viability, economical, good health and clean environment. Socio-economic analysis of LPG and electric cooktops motivate to replacing LPG stoves with induction electric cooktops in urban households of Surkhet district Nepal.

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