



A Cross-Sectional Study of Household Cooking Energy Selection in Urban and Rural Areas of Afghanistan

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The purpose of this study is assessing Afghanistan households' preferences for cooking fuel. Paper-based and online surveys with random selection were used to gather data from cities and villages of multiple provinces. In order to properly evaluate results, the survey questionnaire is divided into four parts. The participants' demographics, number of household members, type of fuel used for cooking in rural and urban areas, and amount of fuel consumed each month. The results are assessed using SPSS descriptive and means comparing analysis approach. The results show that highest urban cooking energy choice is natural-gas, chosen by 83% households. However, the most common rural energy choice is wood, used by 90% households. The use of wood and coal in villages is two and three times higher than cities, respectively. This confirms that the choice of energy source for cooking is directly influenced by the availability of energy sources and the people's lifestyle.

Keywords

Cooking Fuel Choice; Least Developed Countries; Energy Transition; Sustainable Development Goals

د افغانستان ښاري او کلیوالي سیمو کې د کور پخلي انرژۍ د انتخاب مقطعي مطالعه

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Abstract

دا څېړنه افغانستان کې د کور پخلي د سون توکو د انتخاب لپاره ترسره شوې. د کاغذ او آنلاین سروې په وسیله د څو ولایتونو د ښار او کلي څخه تصادفي نمونې اخیستل شوي. د سمې ارزونې لپاره، پوښتنلیک په څلورو برخو وېشل شوی، چې د گډونوالو ډیموگرافیک، د کور غړو شمېر، کلیوالي او ښاري سیمو کې د پخلي د سون توکو ډول او په یوه میاشت کې د مصرف اندازه شامل دي. وروسته د SPSS تشریحي او منځنۍ پرتلې تحلیل باندې ارزول شوي. د سروې پایلې ښيي چې ښاري سیمې د کور پخلي انرژۍ ترټولو لږ ۸۳٪ انتخاب طبیعي گاز دی. په کلیوالي سیمو کې د کور ترټولو لږ ۹۰٪ انتخاب لرگي دي. د سروې شویو کورنیو د سون توکو منځنۍ کارونه اندازه شوې او دا ښيي چې د پخلي لپاره د سون انتخاب په مستقیم ډول د انرژۍ سرچینو شتون او د خلکو د ژوند له سبکه اغېزمن کېږي.

تر ټولو کم پرمختللي هېوادونه؛ د انرژۍ لېږد؛ د پخلي د سون توکو انتخاب؛ د دوامدارې پراختیا اهداف

کلیدي کلیمې

Citation: Patmal, M. H., Oriakhail, Z., Faiq, A. B., & Mohsini, M. S. A Cross-Sectional Study of Household Cooking Energy Selection in Urban and Rural Areas of Afghanistan. *Journal of Natural Sciences – Kabul University*, 8(4), 275–288. <https://doi.org/10.62810/jns.v8i4.483>

Introduction

Cooking is an inseparable part of human life. However, non-clean cooking fuels such as wood, dung, coal, and oil can increase greenhouse gas emissions and air pollution and pose serious health risks. According to the IEA (International Energy Agency), around 760 million people globally did not have access to electricity as of 2022. The population without access to electricity is located in developing and underdeveloped countries. On the other hand, around 2.3 billion people worldwide lack access to clean cooking (*Access to Clean Cooking*, 2022). Limited access to grid electricity and the high cost of clean energy remain major issues in many developing nations. Usually, severe indoor harmful greenhouse gas emissions that frequently occur from a high reliance on solid fuels, primarily solid biofuels and coal, pose an alarming threat to the health of families around the globe. Several reports (Ezzati & Kammen, 2002; Kenneth Y. Chay and Michael Greenstone, 1999, 2003) have demonstrated the toxicity of solid fuel use, which could increase the risk of respiratory illnesses and infant deaths. On the contrary, using clean fuels for cooking—like biogas, electricity, natural gas, or LPG brings about beneficial impacts like decreased environmental pollutants, improved health outcomes for energy consumers, and improved conservation of resources (Bharadwaj et al., 2022; Carter et al., 2020; Gould & Urpelainen, 2018; Gupta & Pelli, 2020).

Ensuring clean, reliable, and affordable energy access for all people worldwide by 2030 is the United Nations Sustainable Development Goal SDG-7. However, the major barrier to achieving this goal is that around 80% of the population without clean energy access lives in rural areas (Foell et al., 2011). Studies on the trends and factors influencing the selection of cooking fuel are becoming more widespread (Alem et al., 2016; Heltberg, 2004; Hou & Tang, 2018; Paudel et al., 2018; Twumasi et al., 2020; Yasmin & Grundmann, 2020). Household income is one of the key socioeconomic factors influencing cooking fuel choice.

People with lower incomes are more likely to use fuelwood, dung, and residue, whereas wealthy people are more likely to use LPG and electricity (Behera et al., 2015). In addition to quantity, financial status also affects the type of fuel used, with a preference for clean fuels (Daioglou et al.,

2012). A household's decision regarding cooking fuel is influenced by a variety of elements, including educational background, gender, tradition, and other considerations. Research (Farsi et al., 2006; Narasimha Rao & Reddy, 2007; Rahut et al., 2017) has shown that households led by women utilize convenient and clean energy sources, as women handle the majority of cooking in developing countries. Some studies have also revealed that gender has no bearing on an individual's energy preference (Ejigie, 2007; Ouedraogo, 2006).

As different geographies have different sources of energy with various levels of their availability, it is necessary to survey each of these communities to identify the main factors of choosing the energy in order to facilitate the transition to clean, convenient, and efficient energy use and reach the global goals of sustainable development. Afghanistan is a country that is heavily dependent on the imported powers from neighboring countries. While imported electricity and domestic production are not enough, there are frequent power outages during the day; therefore, families use alternative and available energy sources for cooking and air conditioning purposes (Patmal & Shirani, 2021; Rahmany & Patmal, 2021). Up to the time of submitting this article, the authors of this article did not find any articles on the choice of cooking fuel in Afghanistan. This itself represents a great gap that still exists, which requires more studies in the field to identify the major factors in choosing energy for cooking and to facilitate the transition to cooking with clean energy. Therefore, the current research will try mostly to fill the mentioned gap. This article attempts to contribute to filling the research gap by providing answers to the following questions:

1. What are the main factors affecting cooking fuel choice in Afghanistan?
2. How the life in rural and urban areas of Afghanistan affect the cooking fuel choice?
3. How much is the cooking fuel average usage per family in rural and urban areas of Afghanistan?

The results of this research will be very useful and effective for the policymakers in preparing and implementing relevant policies in achieving the goals of sustainable development. Thus, this research has been

conducted in the rural and urban areas of the central and surrounding provinces of Afghanistan for the analysis of major factors. Materials and methods of the study are described in section II, and the results of the study for the identification of the factors affecting cooking energy selection of the households are presented in section III. The article is concluded in section IV.

Methodology

The research method is structured into three parts: the questionnaire design, the data collection procedure and tools, and the data analysis.

Design

The questionnaire is designed to better reflect the energy selection choice for cooking purposes in rural and urban households. It is arranged in four categories to find proper answers for our research questions, which include:

1. The residential information of the participants
2. The number of households individuals
3. Fuel selection for cooking in rural and urban areas
4. Fuel amount used for cooking per month

Data Collection Procedure and Tools

This study is conducted by surveying households in Kabul and a few other provinces, mainly in Nangarhar, Logar, Kunduz, and Takhar provinces. The data collection for the study is completed by Nov 2024. Afterward, using an online and paper-based survey and random sampling method, the data has been collected. The online and paper-based survey was distributed in villages and cities of the mentioned provinces, where a total of 458 participants participated in the survey. The paper-based survey is distributed specifically in remote areas, where most of the people do not have access to the internet. The random sampling is selected as it is a better choice for survey data generalizability and statistical validity, its cost effective, quick, and closer to the actual situation as every person has an equal chance of being selected.

Data analysis

The descriptive and comparing means and proportional statistics analysis is performed through SPSS 30 software. Each part of the questionnaire provides specific information for perfect analysis. The residential information is required to differentiate the participants from various rural and urban perspectives. Meanwhile, it will assist us in providing information on the fuel consumers for cooking in rural and urban areas. The other categories would help to evaluate the fuel selection and consumption per family member in rural and urban areas. The last two parts of the questionnaire, the cooking fuel selection in rural and urban areas, and the amount of cooking fuel per month, directly deal with the research question. The provincial division data was collected through two questions. The participants were asked to select which province they are living in and whether they are living in the village or city of the province. The number of family members affects the fuel consumption of the family. So, the participants were asked to provide information about their family members, whether they are below 5 members, 5 to 10 members, or more than 10 members. Furthermore, a question with multiple responses that include wood, gas, oil, coal, dung, grid electricity, and solar power. All this data would properly provide enough information about the most used fuels for cooking in rural and urban areas of the city and villages of different provinces.

Additionally, it is thoroughly asked of each participant to provide sufficient data regarding their usage of fuels for cooking. From all the above common fuels, it's asked to provide the data on local units of measurement for each fuel type. This question accurately reveals the amount of each fuel type consumed per month.

This article studies the respondents' choice for the usage of fuel for cooking and observes some interdependencies. The interdependencies of the demographic aspects, like province, city, village, and family members, with the choice of fuel for cooking are depicted through graphical waveforms.

Results and analysis

The results and analysis of this cross-sectional study are examined from the dimensions mentioned in the methodology.

Provincial division of participants

A total of 458 people participated in the survey online and offline. The online form was chosen for ease of data collection, but since online contact with people in remote areas is limited, the printed survey questionnaires are distributed in order to collect data from remote areas as well. As mentioned earlier, in this survey, the city of Kabul and its neighboring provinces with different cold or hot weather have been considered. Since the living environment and energy resources of urban and rural areas are different, 199 families from villages and 259 families from cities participated in this survey. Table I shows the number of surveyed families in terms of rural and urban areas of the surveyed provinces.

Table 1: City and village-based participants.

Province	Rural		Urban	
	Frequency	Percent	Frequency	Percent
Kabul	61	13.3	86	18.8
Kunduz	33	7.2	19	4.1
Logar	13	2.8	48	10.5
Nangrahar	36	7.9	71	15.5
Takhar	32	7.0	19	4.1
Others	24	5.2	16	3.5
Total	199	43.4	259	56.6

Where Laghman, Kapisa, Parwan, and Panjshir provinces are considered together in the name of "Others" in all analyses due to their smaller number of respondents.

Number of household's individuals

Participants' responses regarding the number of people living in a household are depicted in Fig. 1. It shows that in the cities, the highest percentage of households have 5 to 10 people living in one house, and the lowest percentage of households have fewer than 5 people living in one house. In the same way, the participants of the village answered that the highest percentage of families has between 5 and 10 people living in one house. Although the percentage of households with more than 10 people is higher than in the cities, the lowest percentage is in households with

fewer than 5 people living in them. From the surveyed households, the average number of people in a house was calculated to be 8.26, which means that, on average, more than eight people live in each household.

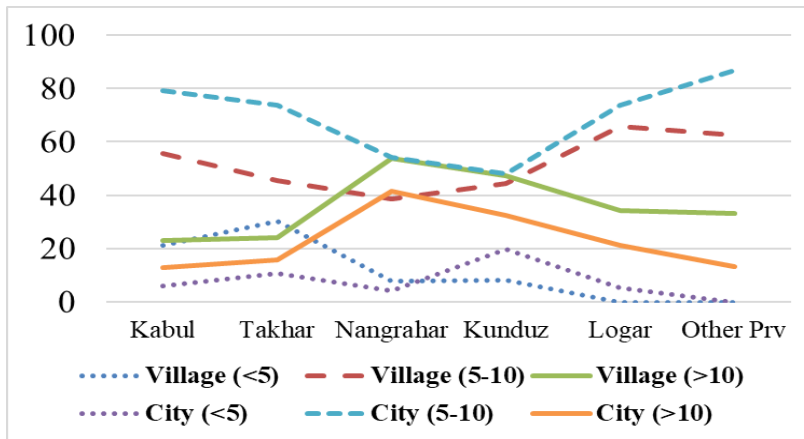


Fig. 1: City and village-based household individuals

Fuel selection for cooking in rural and urban areas

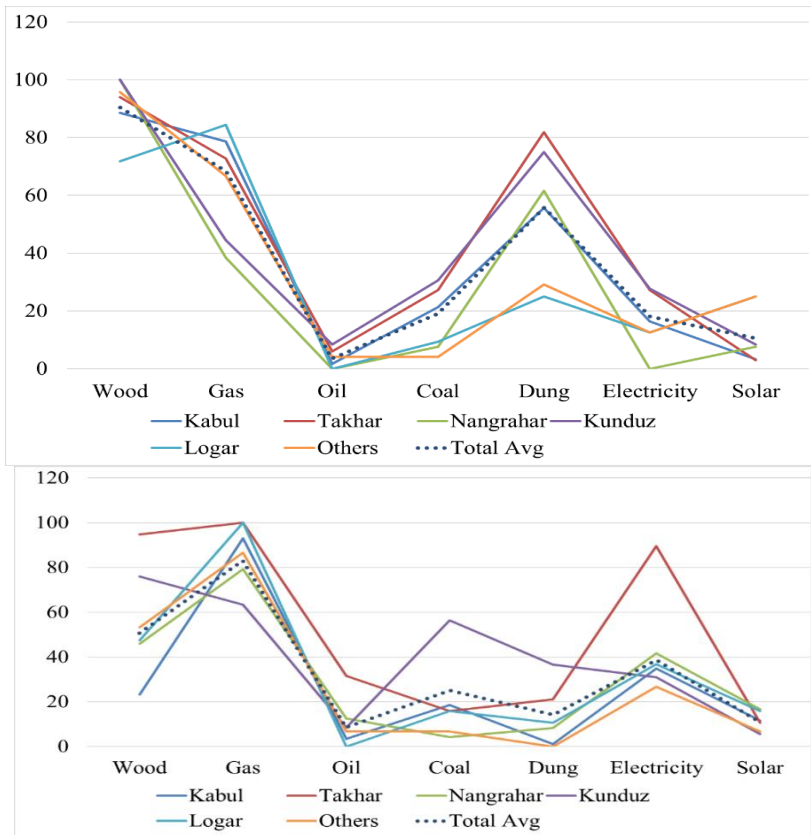
The fuel selection of urban and rural areas is evaluated in Table 2, which shows the rural and urban participants' means of their selection for each of the fuel choices. The results of the respondents declare that natural gas, which is selected by 83% of the participants, is the highest energy choice for cooking in urban areas, and the lowest choice is oil, which is selected by only 8% of the participants. The wood is selected as the second high choice with a 39% of the respondents' choice, but coal, dung, and oil are the least selected sources of energy in urban areas. The table shows that in rural areas, the highest choice of energy for cooking purposes is wood, with a mean of 90% selection. The next choice is gas and dung, with 68% and 49% respectively.

Table 2: Energy choice for cooking purpose

Rural		Wood	Gas	Oil	Coal	Dung	Electricity	Solar
0	Mean	0.51	0.83	0.08	0.25	0.14	0.39	0.11
	Std. Dev.	0.501	0.376	0.279	0.434	0.351	0.488	0.311
	Mean	0.90	0.68	0.04	0.19	0.49	0.18	0.11
1	Std. Dev.	0.295	0.466	0.185	0.394	0.501	0.386	0.308
	Total Mean	0.68	0.77	0.06	0.22	0.29	0.30	0.11

Std. Dev. 0.467 0.424 0.244 0.418 0.455 0.457 0.309

a)



b)

Fig. 2: Energy usage choice for cooking purposes in provinces: a) Rural areas, b) Urban areas

The energy usage choice for cooking purposes in Afghanistan with a provincial perspective is shown in Fig. 2. The level of using different energies in urban and rural areas is depicted for each province. The average of all surveyed provinces is drawn by a dotted line.

In the figures above, only the choice of energy for cooking by urban and rural households is shown. However, the average amount of each energy in a month for cooking purposes has been provided by the respondents. Their results are drawn in the next parts separately for each of the energy sources.

Fuel amount used for cooking per month

The research results show that the amount of wood used in rural areas for cooking purposes is almost twice as much as in urban areas, which can be seen in Table 3. The average amount of wood consumption of a family in villages is approximately 313 kilograms, while this consumption in urban families is 155 kilograms on average.

Table 3: Average fuel consumption of families per month for cooking purpose

Province		Wood_kg	Gas_kg	Oil_Liter	Coal_kg	Dung_kg
Kabul	Mean	216.643	17.296	3.02	55.452	17.90
	Std.	720.1776	15.9537	15.440	237.4659	48.109
	Deviation					
Kunduz	Mean	227.271	9.757	4.44	104.477	100.55
	Std.	381.9324	11.7745	14.687	230.6249	145.995
	Deviation					
Logar	Mean	402.225	16.392	5.40	35.137	64.51
	Std.	1667.525	14.5204	22.035	119.9637	172.463
	Deviation					
Nangrahar	Mean	92.377	14.197	1.57	8.836	34.77
	Std.	127.4168	14.6911	4.873	35.8279	92.619
	Deviation					
Takhar	Mean	185.365	7.231	1.88	15.346	119.27
	Std.	387.2593	6.9356	5.480	29.9253	299.562
	Deviation					
Others Provinces	Mean	263.550	12.513	3.25	14.175	69.65
	Std.	501.6357	10.4914	8.421	57.0995	230.670
	Deviation					
Urban	Mean	155.351	14.819	4.29	58.851	30.57
	Std.	512.1184	12.9681	16.523	174.0796	95.517
	Deviation					
Rural	Mean	312.854	11.693	2.03	39.116	99.86
	Std.	956.1722	14.8667	9.243	194.9925	213.427
	Deviation					
Total	Mean	223.786	13.461	3.31	50.276	60.68
	Std.	741.8126	13.8962	13.879	183.5140	161.458
	Deviation					

The results of the survey under the choice of energy for cooking, which was mentioned earlier, the energy of oil was the least chosen by families, both in rural and in urban areas. This energy usage is, on average, 3.3 liters in urban areas and around 2 liters in rural areas per month, which is very low compared to other energies. On average, a family consumes about 59 kg in urban areas and about 39 kg in rural areas in a month. The results of the study show that urban families, compared to rural families, have a

higher energy choice of electricity. The gas, on the other hand, is a widely selected energy choice for families besides other energies, with an average usage of 13 kg per month. The average amount of dung monthly use is about 100 kilograms for a family in rural areas, but the urban use is about 31 kilograms due to the lack of livestock farming in cities.

Discussion

Afghanistan's distinct geographic location and complicated topography are the main causes of its wide variety of energy sources and climate zones. Several factors affect the fuel selection choice; the first factor is the availability and access to the energy source in those specific areas. The fuel selection of Table 2 declared that natural gas is the most highly selected choice for cooking in urban areas, and oil is the least selected. The reason is that access to gas energy is higher and easier in the country. Although the selection of this energy is higher in urban than in rural areas, it is easier to access in cities compared to villages. Some households use wood, but coal, dung, and oil are rarely selected in urban areas. Household financial condition is another factor affecting the energy selection choice. The low-income people in the villages with no access to grid electricity have the lowest level of use of clean energy, such as electricity and solar. Instead, households in rural areas mostly use wood, gas, and dung. The dung is a widespread energy choice for cooking, especially in rural areas as in Table 3 of Afghanistan, as most of the people of Afghanistan are engaged in agriculture and livestock (Azizi, 2024; Bank, 2014).

Coal energy, due to its availability in the country, is mostly used in the winter season for heating and cooking purposes. The city of Kunduz has the most use of this energy; most likely, this use is more due to its proximity to the cities of Samangan and Baghlan, where there are coal mines. The reason why the average coal usage in urban areas is higher than in rural areas is that most of the families in urban areas use coal for heating and cooking simultaneously. The results of the study show that urban families, compared to rural families, have a higher energy choice of electricity.

Conclusion

The purpose of this study is to examine Afghan households' choices for cooking fuel. Paper-based and online surveys with random selection were used to gather data from cities and villages across multiple provinces. In order to properly evaluate the results, the survey questionnaire is divided into four components. Important portions of the questionnaire include the participants' demographics, the number of household members, the type of fuel used for cooking in rural and urban areas, and the amount of fuel consumed each month. The descriptive and means-comparing analysis strategy in SPSS is used to evaluate the gathered data. This approach entails creating and quantifying frequency tables and utilizing various graphs to show the elements and their effects. According to the survey results, 83% of households in urban areas use natural gas as their primary energy source for cooking. Wood is the most popular energy source for cooking in rural areas, accounting for 90% of household energy choices. On average, rural families use 313 kilograms of wood, 39 kg of coal, and 100 kg of manure each month. On average, urban families consume 30 kg of manure, 59 kg of coal, and 155 kg of wood per month. This suggests that whereas households in urban regions prefer to use more convenient and clean energy sources, households in rural areas use more unclean energy sources. This confirms that the choice of energy source for home cooking is directly influenced by living styles and access to energy sources. The study's findings also revealed the fuels that are most frequently utilized for cooking in both urban and rural locations, which will assist the appropriate governmental bodies in supplying these resources for public use as needed. Additionally, relevant authorities may develop and put into action plans and regulations that would facilitate the quick and easy transition of these particular fuels to the use of renewable energy.

Even though Afghanistan is among the countries that have the highest number of sunny days in the world, poor household economic conditions, low public knowledge, and inadequate education may be the reasons why this energy is the least preferred option. The concerned public and private sectors should invest in, plan, and carry out projects pertaining to the use of clean and renewable energy in order to increase the use of clean energy

and minimize its negative effects on the environment. Additionally, using high-efficiency cooking stoves can be quite successful.

Declaration of conflicting interest

The authors state that none of the tasks described in this study could have been influenced by any known conflicting financial interests or interpersonal interactions.

Acknowledgements

This work is conducted without external financial support.

Author Contributions

Mohammad Hamed Patmal: Conceptualization, Methodology, Data curation, Software, Writing, Original draft preparation, Zahidullah Oriakhail: Methodology, Reviewing and Editing, Abdul Basir Faiq: Data curation and Software, Shoaib Mohsini: Reviewing and Editing.

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