

# Factors Impacting on Electricity Access in The Least Developed Countries: Empirical Evidence from Afghanistan

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## Abstract

The purpose of the study is to empirically investigate the factors which impact on electricity access of the individuals in Afghanistan. This study hypothesizes that within the least developed countries (LDCs), access to electricity positively impacts the socio-economic status (financial standing and educational level) and health of individuals. In essence, this implies a potential link where enhanced electricity access may contribute to improved health and socio-economic conditions within the context of LDCs. Therefore, a binary regression model is estimated by using a survey database from a cross-sectional sample of 6,270 individuals regarding their access to electricity in 2016 and 2018 in Afghanistan. This survey data has been conducted by the Asia Foundation throughout Afghanistan and is nationally representative. Our findings reveal that there is a strong link between electricity access and the socio-economic status of individuals in the country. Regarding the financial status of individuals, the relation is positive (at  $p < 0.10$ ). In terms of the education level, a strong positive relation is found especially for high school attenders (at  $p < 0.01$ ). The findings revealed that electricity access can contribute to better health and socio-economic status in Afghanistan.

**Keywords:** Electricity Access, Least Developed Countries, Binary Regression Model, Afghanistan

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## 1. Introduction

Access to electricity affects all aspects of life. In particular, access to abundant, reliable, and cheap electricity is necessary for the unprecedented standard of living experienced by those residing in the developed world. Unfortunately, most countries in the developing world do not enjoy the same access to electricity that exists in high-income countries. According to Statista around 768 million people in the World suffered from a complete lack of access to electricity in 2021 (Statista, 2021).

A lack of access to electricity and other modern forms of energy posits the development challenge of providing adequate education, schooling, access to information, clean water, sanitation, medical care, food, shelter, and income. Similarly, poverty and low income is a major obstacle for sustainable development of not only developing countries but also the entire world. Nowadays, poverty is defined as low attainment of social condition, for example, education, health, and nutrition in addition to economic deprivation. One way to cope with this multidimensional aspect of poverty is to promote opportunity and one of the opportunities is access to modern energy such as electricity (Kanagawa & Nakata, 2008).

Electricity influences socioeconomic condition of countries in different ways. In particular, access to electricity and modern energy drastically impact the quality of life of individuals in different contexts. There has also been increasing attention on poverty reduction through electricity access improvement among international organizations in the energy field. For example, recently the International Energy Agency (IEA) has been focusing on the subject topic through the improvement of energy demand and supply situations in developing countries. According to the IEA some 2.4 billion people depend on traditional biomass such as wood, agricultural residues, and dung for their cooking and heating (Lim & Seow, 2012). It is estimated by 2030, one billion people will have no access to electricity and 2.4 billion people will rely on firewood and biomass for cooking (Mottaleb & Ali, 2017).

Though the issue of access to electricity has been somehow solved in a vast majority of the countries in the world, there are still many countries where people are still not connected to electricity and thus for rely on traditional sources of energy such as biomass and dung for cooking, heating and lighting which lead to a variety of problems including severe health implication for individuals. According to the literature review, no research has yet explored the subject within the context of the least developed countries. To fill this gap in literature, in this research it has been tried to find the impact of electricity access on individuals' health status by taking a cross-sectional sample of individuals from Afghanistan which can be a good representative of the least developed countries (LDCs) where people lack electric access.

The list of the LDCs is decided upon by the United Nations Economic and Social Council and, ultimately, by the General Assembly, on the basis of recommendations made by the Committee for Development Policy. The basic criteria for inclusion require that certain thresholds be met with regard to per capita GNI, a human assets index and an economic vulnerability index. Among the 46 Least Developed Countries globally (Nations, 2021), this research utilizes Afghanistan as a representative sample due to data availability. This selection aims to encompass the diverse geographical locations of the remaining LDCs.

Afghanistan relies mostly on imported electricity from Central Asian countries. Though Afghanistan's supply of electrical power has improved in recent years, ongoing challenges in this sector contribute to inequalities across the country and are a barrier to the nation's economic growth both at national and individual level. These challenges arise from weak sector governance, financial instability, and a growing Afghan population, all of which make it difficult to meet the increased power demands year after year. The positive impact of per capita electricity consumption on macro-level growth has been the focus point of most researches in this regard. However, little has been done at the microeconomic level especially in developing countries (Jamasb, 2005).

Afghanistan is a country that faces many development challenges. Low incomes, poor health, and low education levels are problems that affect the majority of Afghanistan's households. Being on top of the list of the poorest and LDCs, it is also facing shortage of modern energy resources especially electricity. In Afghanistan despite the efforts *Da Afghanistan Breshna Sherkat* (DABS) and other interested organizations have made so far it has yet to provide a considerable portion of households with electricity in both rural and urban areas of the country. The major problems can be viewed from several angles; lack of electricity access is endemic in Afghanistan regardless of income while on the other hand, electricity access in Afghanistan is greatly hindered by financial incapacitation of utilities to meet supply as well as inability of households to pay (Ahmadzai & McKinna, 2018).

Despite all the problems this study has, it is still opening a new chapter for discussion and researches in the subject context. Recently, multi-dimensional aspect of poverty, for example, economy, education, and health, has been increasingly focused on, and access to modern energy such as electricity is one possible solution. The aim of this study is to reveal relations between access to electricity and advancement in socio-economic and health status of individuals in the LDCs mainly those living Afghanistan.

This study consists of five sections. In the first section of the study it has been tried to touch upon relevant introduction. Section two presents literature review. Next section describes data, empirical model and research methodology used in the analysis. Section four presents the empirical analysis and findings. The last section consists conclusion and discussion.

## 2. Literature Review

It could be argued that a deficiency in electricity and energy access contributes to most problems facing the poor in the LDCs. According to most studies that have been conducted in the context, access to electricity is a key factor affecting socio-economic and health status of families and individuals (Kanagawa & Nakata, 2008). Some of the studies conducted on the subject topic are summed in this study, based on which it has been tried to extract relevant variables for econometric analysis.

According to most researches access to electricity is affecting access to education and educational status of individuals. A lack of access to electricity and modern energy sources can impact education (Banerjee et al., 2014; Squires, 2015; Zhang et al., 2019). Without electricity, youngsters may not be able to extend the day to do school work. Schools that do not have access to electricity are not able to tap into modern technology, such as computers, which severely limits access to information.

Unpredictable electricity makes it difficult to power health centers and refrigerate medicines, greatly affecting the quality of health services available. Energy poverty affects health outcomes at the household level as well. Without electricity, households must turn to biofuels to cook their food and provide light and warmth for their homes. Not only is the collection of biofuels costly in time and danger of injury, but the indoor burning of biofuels is one of the greatest health concerns facing the LDCs in the World. Indoor burning of biofuels is linked to a variety of health problems especially respiratory infections. According to surveys of different organizations more people die from indoor air pollution than the use of drugs, alcohol, and tobacco, and malaria combined. These health risks are by-and-large imposed on women and children, who traditionally spend much of their day gathering fuel and burning it indoors. Lack of access to electricity and modern energy may influence health outcomes in developing countries in several ways (Adair-Rohani et al., 2013; Irwin et al., 2020; Opoku et al., 2020; Der, 2020; Ajide et al., 2023).

A predominant aspect of how a lack of access to electricity and modern energy may affect quality of life is through income, via labor productivity (Rao, 2013; Bridge et al., 2016; Lenz et al., 2017; Sarkodie & Adams, 2020a; 2020b; Tatli & Barak, 2021). In the absence of modern electricity, it is almost impossible to enhance communications; Individuals cannot make use of computers for acquiring information get access to cell phones and job announcement websites and channels that could lead to higher incomes. Without widespread, affordable electricity, it may be difficult for households to break the cycle of poverty.

There are a large number of literatures for the descriptive and experimental studies. In contrast, there are a limited number of researches categorized as the empirical study. In particular, few researches estimate socio-economic effects of results of analyses. Given that nowadays poverty is regarded as a lack of socio-economic welfare, it is unavoidable to consider socio-economic impacts of transition or improvement of electricity and energy sources consumed in the LDCs (Lesage & Van de Graaf, 2016).

Afghanistan being one of the poorest and underdeveloped countries in the World is facing a variety of problems on different socio-economic fronts. Despite the pouring of hundreds of millions of aid money of the international community, poverty is still a major problem in the country. There are still people in Afghanistan who are not able to feed themselves and are desperately looking for survival due to low living conditions and economic problems. The country's infrastructure is in extremely bad situation. Rampant poverty, low access to health care services, low access to education and ravaged infrastructure are the main characteristics the country is well known for.

Experiences from different countries show access to electricity and modern energy can impact socio-economic and health status of individuals. Although, investment in modern energy especially electricity has largely improved in the country there are still individuals in the country that have no access to electricity. This study is purely aimed at exploring the fact if investment and access to electricity is a relatively better therapy and can impact socio-economic and health status of individuals in Afghanistan. It will shade light on the fact if access to electricity has any impact on the socio-economic status of individuals in the country.

### 3. Data and Methodology

Applying a sub set of approximately 20,000 households in a Survey of the Afghan People which was conducted over sixteen years between 2004 and 2019, a cross-sectional sample of approximately 6,270 individuals, in both urban and rural areas of the country with different levels of electricity supply is used to estimate the subject relation. The study focused on data from 2016 and 2018 due to the inclusion of specific inquiries about individual electricity access in the survey during these years. The survey is conducted by the Asia Foundation throughout Afghanistan and is nationally representative.

In order to find the subject relationship and to analyze the socio-economic impacts of access to electricity in this study, binary regression model is conducted by using STATA 2017 program. The estimated model used in the study for analyzing the socio-economic impact of electricity is given in equation 1 as following:

$$E_i = \alpha_0 + \alpha_1 Y_i + \beta_1 Z_i + \delta R_i + e_i \quad (1)$$

In the above model  $Y_i$  is household total income and  $E_i$  is household access to electricity. For this model  $Y_i$  is continuous, while  $E_i$  is a dichotomous variable equal to one if the household has access to electricity, and zero otherwise.  $Z_i$  shows an individual's admission to the hospital during the last twelve months. It takes 1 if the individual did not admit to the hospital, and zero otherwise.  $R_i$  stands for the categorical variable of education, while  $e_i$  is the error term. Table 1 includes the list of variables used in this study.

**Table 1.** List of the variables

Variable Name	Variable Description
Electricity Access	It is the dependent variable. It takes 0 if the individual does not have access to electricity, and 1 otherwise.
Income	<i>It is a continuous independent variable which taking numbers from 0 to infinite.</i>
Education Level	It is independent variable and is of categorical nature. It takes 0 if the individual has not formal education, 1 if the individual's education level is primary school, 2 if its secondary, 3 if it is high school and 4 if the individual is a university graduate.
Visit to Hospital	<i>Hospitalization is also of binary nature taking 1 if the individual is not admitted to the hospital in the last 12 months and 0 otherwise.</i>

**Source:** Variables are extracted from the Asia Foundation Survey of the people of Afghanistan in 2019

In order to know better about the characteristics of the data set used in this study some of the descriptive statistics is summed up as below. Table 2 shows the number of individuals by year who have been asked in survey regarding their access to electricity.

**Table 2:** Distribution of participants in the survey by year

Year	Freq.	Percent	Cum.
2016	3,003	47.89	47.89
<b>2018</b>	<b>3,267</b>	<b>52.11</b>	<b>100</b>
Total	6,270	100	

As the table above shows 47.89 percent of the participants are asked in 2016 and the remaining 3,267 persons which count for 52.11 percent of the participants have been asked in 2018. It shows that by year there is not any difference regarding the number of participants and the data set is balanced. Also, table 3 below shows the distribution of participants by education level.

**Table 3:** Distribution of participants in the survey by education level

Education Level	Freq.	Percent	Cum.
No Formal	3,429	54.97	54.97
<b>Primary</b>	<b>1,085</b>	<b>17.39</b>	<b>72.36</b>
Secondary	426	6.83	79.19
<b>High School</b>	<b>1,165</b>	<b>18.68</b>	<b>97.87</b>
University	133	2.13	100
<b>Total</b>	<b>6,238</b>	<b>100</b>	

As the table 3 shows most of the participants of the survey have no formal education which accounts for 54.97 percent of the total number. Also, high school and primary education respectively with 18.68 and 17.39 percent are the second and third categories in the data set. University graduates account for only 2.13 percent of the data set which is a strong indication of the reliability of the data set used in this study. Table 4 below shows the distribution of individuals by access to electricity.

**Table 4:** Distribution of participants in the survey by access to electricity

Do you have access to electricity	Freq.	Percent	Cum.
No	890	14.19	14.19
<b>Yes</b>	<b>5,380</b>	<b>85.81</b>	<b>100</b>
Total	6,270	100	

As the table 4 suggests, while 890 persons of the total participants which accounts for 14.19 percent of the total data set does not have access to electricity, a total of 5,380 persons accounting for 85.81 percent of the total data set have reported to have access to electricity which is a clear indication of the betterment of electricity access in distribution over the past two decades in the country. Table 5 displays distribution of participants by admission to hospital in the data set.

**Table 5:** Distribution of participants in the survey by hospitalization

Admission to Hospital	Freq.	Percent	Cum.
No	2,554	78.54	78.54
<b>Yes</b>	<b>698</b>	<b>21.46</b>	<b>100</b>
Total	3,252	100	

As the table 5 shows a large portion of the participants of the survey have refused to answer whether they have been admitted to a hospital in the past twelve months or not. Among those who have opted to reply the answer of a total of 2,554 individuals which accounts for 78.54 percent of the respondents is positive which is a clear indication of the deteriorating health status of individuals in the country.

#### 4. Empirical Analysis and Findings

As mentioned in the methodology, the estimated model used for fining the individual level impact of access to electricity, binary logistic regression has been conducted. Independent variables used in this study are of both continuous and categorical nature. Binary logistic regression shows the probability of membership of independent variables in a target group. In fact, it's a kind of comparison of membership between the base and other categories in the target group if the independent variable is of categorical nature. Result of the binary regression estimation is displayed in Table 6.

As table 6 shows, there is a strong relation between individuals' status and their access to electricity. In the case of income, though its relevant coefficient is positive but it's not statistically significant at the five percent interval. In terms of education, although most of the coefficients are not statistically significant, in the case of high school graduates there

is a statistically significant relation. It could be as a result of the lighting and impact of news and motivation they receive different outlets. In the case of admission and visit to hospital, just as it shown in table 6, those who have access to electricity are less likely to report admission to the hospital compared to the ones do not have access to electricity. It could as a result of the access to a clean resource for lighting and cooking which reduce the probability to illnesses especially respiratory problems in individuals.

**Table 6:** Binary logistic regression results

Electricity	Coef.	St.Err.	t-value	p-value	[95% Interval]	Sig
Income	0.000	9.01e-06	1.78	0.075	-1.60e-06	0.00 *
<b>Education Level</b>						
Primary	-0.068	0.158	-0.43	0.668	-0.377	0.24 *
<b>Secondary</b>	<b>0.226</b>	<b>0.266</b>	<b>0.85</b>	<b>0.396</b>	<b>-0.295</b>	<b>0.74</b>
High School	0.503	0.183	2.74	0.006	0.142	0.86 ***
<b>University</b>	<b>0.290</b>	<b>0.435</b>	<b>0.67</b>	<b>0.505</b>	<b>-0.562</b>	<b>1.14</b>
Visit to Hospital						
<b>No</b>	<b>-0.498</b>	<b>0.134</b>	<b>-3.69</b>	<b>0.000</b>	<b>-0.762</b>	<b>-0.23 ***</b>
N	3,249					
Pseudo r2	0.0157					
Chi2	0.0000					
AIC	1965.323					
BIC	2007.926					
Prob > chi2	0.000					

\*\*\* p<0.01, \*\* p<0.05, \* p<0.10

## 5. Conclusion and Discussion

An understanding of the interrelationship between a household's access to electricity and socio-economic status is beneficial for a number of reasons. Policies aimed at reducing poverty would benefit from more than simple anecdotes about the benefits of electricity. Quantitative results showing the specific magnitudes of differences between households with and without electricity would be extremely informative for policy makers in the context of Afghanistan and other LDCs with similar conditions. Lately there has been growing interest in the field of electricity and energy poverty. Electricity and its socio-economic impacts have drawn the attention of researchers in different fields especially energy economics. Electricity access is an important driver of economic development. In reality, in the LDCs households face chronic electricity supply interruptions, which can last up to twelve (12) hours a day which may result in different socio-economic problems for households and individuals.

The findings of the study unearth a compelling narrative surrounding the impact of electricity access on socio-economic indicators, particularly in Afghanistan and comparable LDCs. The demonstrated correlation between access to electricity and reduced hospital visits among individuals signifies a tangible link between electricity availability and improved health outcomes. This insight underscores the significance of electricity not just as a utility but as a determinant of public health, highlighting the urgency for widespread access.

Moreover, the observed disparities between households with and without electricity accentuate the pronounced socio-economic inequalities perpetuated by limited access. The stark contrast in disease prevalence between those with and without electricity underscores the pivotal role of this resource in mitigating health risks and enhancing overall well-being. These findings underscore the pressing need for policies aimed at expanding electricity access to bridge socio-economic gaps and improve public health.

Furthermore, the study's revelation regarding the economic benefits associated with electricity access, especially in terms of reduced healthcare expenses, paints a compelling picture for policymakers. It presents a clear incentive for investing in electricity infrastructure as a means to uplift household economies, reduce healthcare burdens, and potentially redirect resources to other developmental avenues.

In the context of the LDCs mainly Afghanistan, this could be the first study to estimate the socio-economic impacts of electricity access. This study is providing policymakers in the LDCs especially Afghanistan with useful information regarding access to electricity in terms of its impact on the socio-economic status of households in the country and is giving them assurance that focusing on electricity supply is a relatively better option and solution when it comes to the issue of strengthening household economy in the mentioned category of countries mainly Afghanistan. It enables a more realistic assessment of the benefits of access to electricity, it will inform trade-offs between infrastructure improvement and investment in energy especially electricity.

The study explores the profound socio-economic impacts of electricity access, specifically in the context of Afghanistan and analogous low-income countries (LDCs). By showcasing these quantitative results, the study illuminates the precise disparities between households with and without electricity, a dimension often lacking in existing literature. Furthermore, it draws attention to the vital link between electricity access, improved health outcomes, and economic development. These findings hold substantial weight in policy discussions and underline the necessity of addressing chronic electricity supply interruptions, which this study unravels as a substantial challenge. Additionally, the call to prioritize expanding electricity access in Afghanistan aligns with the research's implications, as it underscores the unexploited potential for electricity generation in the country. Finally, the suggestion to explore panel data from similar countries for further research is well taken, as it could offer even more comprehensive insights into this critical topic.

The study's unique contribution to literature lies in its empirical exploration of the socio-economic impacts of electricity access in Afghanistan and comparable low-income countries (LDCs). By providing robust quantitative results, the research addresses an existing gap in the literature by shedding light on the precise magnitude of disparities between households with and without electricity. Furthermore, it highlights the pivotal role of electricity in health and economic development, which is often understated in prior research. The recommendation to focus on policy implications and interventions to mitigate chronic electricity supply interruptions aligns seamlessly with the study's core findings. This study underscores that expanding electricity access is a tangible solution to bolster household economies in these regions, a point that resonates with the call to action for policymakers. Additionally, the proposal to explore panel data from comparable countries for future research holds promise in offering more comprehensive and robust results.

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