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The Amhara Region's Rural Electrification Projects: Effectiveness, Challenges, and Rural Transformation Implications

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Abstract

This study's major objective is to investigate how well rural electrification initiatives are working, what obstacles they face during implementation, and what effects they have on rural transformation in the Amhara region. There were both quantitative and qualitative research methods applied. The format of the data collection tool included closed-ended survey surveys. 386 people were included in the sample using a straightforward random sampling methodology. This conclusion showed that rural electrification projects are not being implement ted with high levels of effectiveness. The research also revealed that the high cost of wire materials used in rural electrification projects, the high connection fee for using it, the occasionally rising cost per unit of energy, and the complexity of bill payment methods are the main implementation obstacles for these programs. The study also demonstrates that household food security, productivity, and employment prospects have all improved as a result of rural electrification projects' impact on rural transformation initiatives (on the rural household economy). As a result, the research advises that the government should keep an eye on and assess the project's progress at all times and work with consultants, contractors, and project managers to address any problems that arise.

Keywords*: Rural electrification effectiveness, implementation, implications and challenges*

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Introduction

Household power, agricultural electricity, and electricity for small and medium-sized businesses are the three types of electricity used in rural areas. The usage of electric powered tools and equipment, such as refrigerators and freezers, can enable small and medium companies to create more goods and services and boost the quantity and quality of agricultural products in rural areas. Over 1.2 billion people worldwide did not have access to electricity in 2014, according to the IEA (2016) data, and practically all of them reside in developing nations. Africa is the region that is least electrified, with Sub-Saharan Africa having an access rate of little more than 35%. When we consider the rates of electricity in rural regions, which in developed countries reached 100% in 2014, these numbers become much more concerning. Although those who reside in rural areas are typically poorer than those who reside in cities, technological off-grid solutions need more initial investments. In the past, rural electrification was not regarded as a basic human requirement like food and water. Recent research sheds light on the different ways that rural electrification contributes to the improvement of rural society. Energy is a force that promotes economic, social, and health conditions and has an impact on all the sustainability pillars and dimensions.

Almost 85% of Ethiopia's population resides in rural areas, and the majority of rural cities and villages' homes lack access to electricity. Ethiopia has historically had very limited access to electricity, similar to most other sub-Saharan nations. The country's energy coverage was 17% in 2006 as per the WB (2015) report. Nonetheless, the Government of Ethiopia's ongoing efforts have led to a steady increase in rural electricity access over the previous few years, and it has already reached 57.17% (Behailu, 2018). By building infrastructure for electric power transmission, substations, and distribution, the universal electricity access program (UEAP), which was founded in 2005, aims to increase the country's initial 15% access to electricity. The World Bank (WB), African Development Bank (AfDB), Arab Bank for Economic Development in Africa (BADEA), Saudi Fund, OPEC Fund for International Development (OFID), and Kuwait Fund are among the development partners that provide funding for the various project units that make up the program office.

The program office is structured with a head office in Addis Abeba, eight regional offices there, and autonomous offices for Oromia, Mekele, Bahir Dar, Awassa, Assosa, Gambella, Jijiga, and Semera. In order to realize the strategic goals of GTP II, which include increasing electric coverage to 90%,

assisting Ethiopia in becoming a middle-income nation by 2025 (WB, 2015), and achieving the millennium goals, UEAP is now carrying out a significant number of projects.

Ethiopia has some of the least accessible electricity in all of Africa. Despite the geographic electrical network coverage reaching 60%, only 25% of the population has access to electricity (NPC, 2015/16). Large-scale renewable energy resources, including hydro, wind, geothermal, solar, and bio-energy, are abundant in the nation. The country has a gross hydro-energy potential of 45,000 MW, along with 1035 GW of wind, 7,000 MW of geothermal energy, and 5.2 kWh/m2 of solar energy, according to MoWIE (2015/16). Yet, the nation has only used a small portion of its potential for energy resources. Around 4228MW of the nation's electricity may be generated from hydropower, with the remaining 90% coming from wind, geothermal, and diesel power facilities (MoWIE, 2015/16).

Since energy is a crucial input for all economic sectors, improving access to enough, dependable, and inexpensive electricity is essential for the socioeconomic development and transformation of the Area. Increasing population and rapid urbanization have made it more difficult for people in the region to acquire power, in addition to rising electricity demand in already electrified urban areas brought on by a contemporary way of life and expanding industrialization. In order to improve the efficacy of rural electrification projects in the Amhara Region, this study tries to assess the important issues and challenges related to the cost of electricity and organizational related factors, procurement related factors, project manager and team related factors, and contractor related factors.

Problem Statement and Objective of the Study

In Ethiopia, the majority of people still live in rural areas, which are also the center for small and medium-sized businesses. Almost 90% of the population suffers from a lack of power. Communities have raised concerns regarding accountability and transparency and questioned the numerous procedures used in the identification and implementation of EEP projects, as well as in the monitoring and evaluation of programs and finances (Abdullah and Markandya, 2012)

For rural electrification schemes to expand successfully and sustainably, a number of institutional requirements must be met. These programs require special financing conditions, design and construction standards created to address the unique characteristics of rural power supply, and a program management practice that involves coordination and sequencing of the pertinent projects in order to minimize losses resulting from gaps between projects and programs. These challenges are

specifically brought on by low population density, low energy demand, and underdeveloped rural economies. Public institutions will benefit greatly from the successful use of strong and robust strategies.

Ethiopia's per capita electricity consumption is also very low, at around 100 kWh per year (MoWIE, 2015/16). According to the IEA (2011), access to electricity is defined as the household's annual consumption of at least 250 kWh of electricity in rural areas and 500 kWh in urban areas. Since 2005, the county has been implementing the UEAP and extending the national electricity grid to rural areas to increase access to electricity. However, the electricity access gap has still been enormous. The main focus of the UEAP has been expanding the electricity grid network to rural areas, though the household connectivity rate has been insignificant. In total, only 2.03 million households, mostly in major urban areas, had been connected to electricity services in the country at the end of GTP I. The country also planned a more ambitious target of reaching 7 million household electricity connections and enhancing the electricity network coverage to 90% at the end of 2020 (NPC, 2015/16).

A study conducted by Kefyalew (2015) concluded that there is project failure in UEAP due to the quality of deployed manpower, the project payment category, and the size of the project. The Ethiopian government allocates and spends a substantial amount of budget for rural electrification with an aim to promote social and economic development in rural areas and attain a more equitable distribution of developmental benefits, but the project's performance is much less than what was planned and expected. GTP II of Ethiopia UEAP was tasked with increasing access to electricity in rural towns and villages of all regions from 54 percent at the beginning of 2009 E.C. to 90 percent coverage access to electricity by electrifying 10 cities and 205 towns. Evidently, in the 2008 Ethiopian fiscal year alone, it was planned to electrify 2042 rural towns and villages (Strategic Plan of EEU/UEAP and GTP II Plan), but only 398 towns were completed, which was 19.4% of the Strategic Plan.

However, achieving universal electricity access requires comprehensive policy and strategy and very strong institutional capacity. Moreover, the electricity sector is considered one of the most capital-intensive sectors, so it requires substantial public and private investment. The Ethiopian electricity sector has been dominated and characterized by public sector investment and management. There are limited studies investigating the major challenges and factors (organizational related factors, procurement related factors, project manager and team related factors, contractor related factors) that

affect the effectiveness of rural electrification projects for rural transformation in the Ethiopian context in general and in the Amhara Region in particular.

The general objective of the study is to analyze the effectiveness, implementation challenges, and implications of rural electrification projects for rural transformation in the Amhara Region. Based on this research issue, this study answers the following research questions: What is the level of effectiveness of the implementation of rural electrification projects in the Amhara region? What are the challenges in implementing rural electrification projects in Amhara Region? What are the implications of the effectiveness of rural electrification projects on rural transformation efforts (on rural household economies) in the Amhara Region?

Review of Related Literature

Many literary contexts have defined access to electricity. Traditional definitions of access to electricity, emphasize power connection. The quantity of energy services that this link can offer, as well as its sufficiency and dependability, are not sufficiently covered by this definition. Electricity's capacity to reduce poverty is dependent on how much and for what purposes it is utilized, thus the quantity and quality of the service are essential factors to consider. The number of persons who have access to electricity at home is how the IEA (2002) defines electricity access at the household level. It includes both on-grid and off-grid electricity that is sold for a profit. However, to be meaningful for human and social development, access to electricity must be measured by the quality and range of usage of electricity via appliances to improve quality of life and workplace productivity.

The amount of power consumed is another way to quantify electrification. In order to qualify, a household of five must use at least 500 kWh of power annually in urban areas and 250 kWh in rural regions (IEA, 2011). In Ethiopia, locations where the grid network is expanded are often considered to have access to electricity, but actual household electrical connectivity has been quite low, especially in rural areas. According to estimates, Ethiopia's per-person electricity usage is only 100KWh, which is low compared to the sub-Saharan African average of 521KWh (MoWIE, 2015/16).

Energy access is defined as "the ability to access energy that is adequate, available when needed, reliable, of good quality, convenient, inexpensive, legal, healthy, and safe for all required energy services" as opposed to the traditional binary count definition. That is, the new definition, which also considers other factors like price and dependability, does not always equate having an electricity

connection with having access to power. Tier 0 (no access) to Tier 5 represent the different levels of energy access (the highest level of access). The power consumption levels used to determine the tier assumptions range from 4.5 KWh per year for tier 1, which is mostly used for lighting and phone charging, to more than 3000 KWh per year, which is a very high level of consumption that is correlated with higher income. The advancement of human welfare and quality of life is hampered by lack of access to energy. Access to electricity facilitates significant advancements in the fields of education, health care, access to water, vital communications, and information, as well as financial services and chances for income production, directly or indirectly. Lack of adequate power supply (shortfalls in generation and supply) lowers manufacturing and commercial productivity and slows overall economic growth (WB, 2014).

According to Schillebeeckx et al (2013), the capital cost and periodic payments are what determine how affordable a rural electrification program. They also point out that a small grid in Bolivia was able to double its connections by spreading the connection fees over 5 years, whereas Malawi's electricity company only achieved a 2% rural electrification rate after demanding full upfront payment of the 30 years' worth of line extension costs. In Thailand, materials used in the production of power were standardized and produced locally, which cut down on the expenses of procurement and transportation (Pellegrin & Tasciotti, 2012). Due to house wiring, connection costs, and electricity tariffs, the poor have trouble accessing energy. Cook (2013) contends that the problems with the poor's access to electricity have been solved by requiring service providers to first provide access, then lower connection costs through tariff design or direct subsidies incorporated into payment plans that benefit the poor, and finally increase the variety of service providers to give customers a choice. Cook added that knowledge of the issues that pose obstacles is insufficient and that progress is slow.

As part of the reforms, Thailand started a program to restructure its tariffs, which resulted in a gradual increase in electricity prices between 1990 and 2000. Rural consumers' (those in lower socioeconomic brackets) rates went up from an average of 5 to 8.5 USc/kWh. Yet, it didn't seem that the increase had any effect on household income or energy use per person (AIT, 2004). Charges were hiked in Vietnam to meet the criteria for the financing from the Asian Development Bank for an electricity project. Yet, protections for rural consumers were implemented in contrast to those for urban customers. As a result, rural area tariffs barely changed from 3.2 USc/kWh in 1996 to 3.5 USc/kWh in 2002. Rural consumers' per capita consumption increased by 17% yearly between 1992 and 1998, compared to 14% for urban

consumers. The ratio between household income and energy prices increased from 1.08% in 1993 to 3.0% in 1998 (AIT, 2004).

The nature and operations of every organization have a direct bearing on its success factors. The system's monthly generation tracking and a clear method to accept customer complaints if the system is not performing as intended are the bare minimums for effective monitoring and verification. If a private provider was selected, then down time and system operational status must be reviewed according to the original design and contract requirements, including unmet demand increases. Academics in the same nation where the CREM was implemented in some situations can enhance the overall technical system performance and ongoing local competence development, for example, in the Boca de Lura community in Panama. A database on issues and failures can help improve services and dependability and target future research projects (Dutt and MacGill ,2013).

To ensure financial viability, there must be an adequate customer base and organizational support to set an inexpensive connection and monthly energy service cost. Also, in order to achieve beneficial socioeconomic effects, it is essential to reach the greatest number of people with lower incomes (Hyvari, 2006). Successful project execution is significantly and favorably influenced by top management commitment, adequate project money and budget to completion, right organizational structure, and organizational culture (Hwang, 2013). Researchers have noted the significance of procurement factors, which are measured using three characteristics: the procurement method (choice of the organization for the project's design and construction), the tendering method (procedures adopted for the selection of the project team, in particular the main contractor), and the procurement outcome (Gunduz, 2015). According to Schillebeeckx et al (2013), the capital cost and periodic payments determine how affordable a rural electrification program is. They also note that in Bolivia, a small grid doubled its connections by spreading the connection fees over 5 years, whereas Malawi Electricity Company only achieved a 2% rural electrification rate after demanding full upfront payment of the 30 years' worth of line extension costs. In Thailand, materials used in the production of power were standardized and produced locally, which cut down on the expenses of procurement and transportation (Pellegrin & Tasciotti, 2012).

Research Methods

According to Creswell (1994), quantitative research is the phenomenon of gathering numerical data that can be analyzed mathematically. Since the developed hypotheses should be examined with the relationship between a variety of variables, using numerical techniques is appropriate to test the strength of relationships.

The mixed quantitative and qualitative research design used in this study enables the analysis and development of inferences through the collection of numerical data, measurement of variables, prediction, and use of statistical processes. Compared to either a qualitative or quantitative research approach alone, mixed method research offers a more comprehensive grasp of the study problem. In order to improve overall understanding of the perceived critical issues that determine the understanding of respondents toward the difficulties of effectiveness of rural electrification projects in the Amhara Region, it contributes to this study to gather appropriate data and test the theoretical frameworks.

Research Design

The research design, according to Kothari (2003), is a thorough plan for data collecting in an empirical research endeavor. It lays up the framework for data collection, measurement, and analysis. It is a collection of steps and techniques that explains study variables. As a result, the design defines what the investigator accomplished from examining the hypothesis and using conclusions in the data analysis. This study attempts to influence the causal connection between problems and their effects, and it acts as a bridge between theoretical and empirical research.

The success of rural electrification projects and factors (organizational related factors, procurement related factors, project management and team related factors, and contractor related factors) in the study area were examined using a field survey research design. To achieve the study's goal, the researcher used primary data, which offers a good method of evaluating sample information and a suitable data to draw conclusions about generalizing a sample of replies to the full community. Hence, utilizing self-administered closed-ended structured questionnaires and key informants' interviews, primary data was mostly gathered from respondents who are currently employed by the company. The investigator uses field survey-research to gather the data in order to determine whether the respondents consistently provide the same answers. For the purpose of the study, the researcher chose houses in the

project area using a basic random sampling method; however, for project managers, engineers, supervisors, consultants, and contractors, the researcher employed a census sampling strategy.

Thus, Yamane (1967) asserted that the sample size of the study is calculated using the sample size determination formula as follows. Therefore, the sample size is 356 households and the questionnaires will be distributed for these women.

$$n = \frac{N}{1+Ne^2} = \frac{3218}{1+3218(.05)^2} = 356$$

According to Cronbach (1951), the most frequently used practical estimate of different item scales' reliability represents the standard of all possible split-half reliabilities for a construct. It is proposed the coefficient Alpha (called Cranach Alpha Value) that indicates the higher the coefficients, the better the measuring instrument on which its value ranges from 0 to 1. However, a satisfactory value should be higher than 0.6 on the scale to be reliable or acceptable. According to this study, as shown in Table 1 below, the minimum Cronbach Alpha value is 0.719 and the maximum is 0.815 for each variant of the posttest. The average coefficient of Cronbach's alpha for all items is 0.781, which is good and acceptable. The result indicates that having rationally high alphas suggests that the relationship between the factors and the effectiveness of electrification projects is generally reliable.

Table 1
Summary of The Pre and Posttest Reliability

Variables	Pre-test		
	No. of Items	No. of samples	Cronbach's alpha
Organizational related Factors	5	41	.773
procurement related factors	5	41	.727
project manager and team related factors	5	41	.719
contractor related factors	4	41	.723
effectiveness of electrification projects	5	41	.815

Source: - Field Survey 2021

From the total sample size, 32 respondents were invited for interviews, 41 were given for pilot testing, and the remaining 313 respondents were given the chance to complete questionnaires. Of the 297 respondents who completed the questionnaires correctly and returned them, the questionnaires were used for analysis, yielding a response rate of 94.89%.

Descriptive Analysis:

As shown in the above Table 2, the descriptive statistics and comparisons between Electrification Projects users and Electrification Projects non-users indicate that 149 (50.17%) are males and 148 (49.83%) are females, of which 52.8% of the respondents are male users and 47.2 % are female users of Electrification Projects. It has shown to be significant differences between electrification projects users and non-users. A Chi-square test revealed that the gender difference was significant at the 5% significance level.

Table 2

Gender Status of Electrification Projects Users and Non-Users

Gender status	Electrification projects users		Electrification projects non-users		Total		X^2-test	P-value
	Number	%	Number	%	Number	%		
Males	86	52.8	63	47.0	149	50.17	3.873	0.009
Females	76	47.2	72	53.0	148	49.83		
Total	162	100	135	100	297	100		

Source: Field survey 2021

Table 3

Demographic Characteristics of the Respondents

Categories		Electrification projects users		Electrification projects non-users		Total		X^2-test	P-value
		Number	%	Number	%	Number	%		
Age of Households	< 24 years	2	0.8	4	2.4	6	2.02	1.031	.794
	25-44 years	93	57.6	89	56.1	182	60.94		
	45-64 years	61	37.6	65	40.2	126	42.08		
	>64 years	6	4.0	3	2.3	9	3.03		
Total		162	100	135	100	297	100		
Family size	Single	3	1.8	2	1.5	5	1.6	14.958	0.085
	2 Households	26	16.1	33	24.2	59	19.8		
	3 Households	45	27.8	46	34.1	91	30.6		
	4 Households	63	38.9	52	38.6	115	38.7		
	>4 Households	21	12.9	2	1.5	23	7.7		
Total		162	100	135	100	297	100		
Education level	No formal edu	136	84.0	119	87.9	255	85.8	12.157	0.032
	1-12 Complete	18	10.4	15	11.4	33	11.1		
	Diploma & above	9	5.6	1	0.8	8	3.4		
Total		162	100	135	100	297	100		

Source: Field survey 2021

95.7% (284) of households are between the ages of 25 and 64, with 51.8% (154) participating in electrification projects. But the chi-square results indicate there is no significant difference in age group category in the study area. The above Table 3 also presents the proportion of Electrification Projects users' households and Electrification Projects nonuser households, with an insignificant difference. All two groups have almost the same family size. The majority consists of 115 (38.7%) 4 Households, 91 (30.6%) 3 Households, and 23 (7.7%) 2 Households. The significant level of the chi square indicates no significant difference between user and non-user households of electrification projects and family size.

The findings of the study show that there are significant differences between electrification project users and non-users in terms of educational status (no formal education for 84.0% of users), and only 16.0% of users are from grades 1–12 who complete electrification projects. The Chi-square test showed that the difference in relation to educational level was found to be significant at the 5 percent level.

Table 4 shows that 162 (54.5%) of the total respondents of 297 are users of electrification projects, and the remaining 135 (45.5%) are electrification projects non-users under the study.

Table 4
Electrification Projects Status of Respondents

Categories	Frequency	Percent
Electrification projects users	162	54.5
Electrification projects non-users	135	45.5
Total	297	100.0

Source: Field survey 2021

Table 5 shows what users of electrification projects investment they use as a result of their village's electrification projects. As indicated in the above table, 57 (35%) of the total 162 users benefited from lighting, 54 (33.3%) used TV or satellite dish, radio, 12 (7.4%) had refrigerator service, 23 (12.8%) had mobile phone charging, and 18 (11.4%) had an electric hot plate.

Table 5

Accesses Got Through Electrification Projects

Categories	Frequency	Percent
Lighting	57	35.0
TV/ satellite dish, radio	54	33.3
Fridge	12	7.4
Mobile phone charging	23	12.8
electric hot plate	18	11.4
Total	162	100.0

Source – field survey 2021

Effectiveness of Rural Electrification implementation

Table 6 below shows the effectiveness of the implementation. 59.78% of the total respondents disagreed with the adequate awareness of community participation; 58.69% of the respondents also disagreed that the completion of the project on a pre-planned budget; furthermore, 64.13% of the respondents believed that the completion of the project on a pre-planned schedule was not completed; 60.87% of the respondents disagreed that the completion of the project was not of the required quality; and 61.13% did not believe that the completion of the project meets stakeholders satisfaction.

Table 6

The Effectiveness of Rural Electrification

No	**Items**	**1(S. Dis-agree)**		**2(Disagree)**		**3(Undecided)**		**4(Agree)**		**5(S. agree)**		**Mean**	**Std. Deviation**
		F	%	F	%	F	%	F	%	F	%		
1	There is adequate awareness of community participation	74	25	103	34.78	29	9.78	48	16.3	42	14.13	2.65	0.924
2	There is completion of the project on pre-planned budget	81	27.17	94	31.52	45	15.22	45	15.22	32	10.87	2.91	0.873
3	There is completion of the project on pre-planned time schedule	90	30.43	100	33.7	23	7.61	55	18.48	29	9.78	2.58	1.015
4	There is completion of the project with quality	84	28.26	97	32.61	26	8.7	48	16.3	42	14.13	2.65	1.01
5	The completion of the project meets stakeholders' satisfaction	94	31.78	87	29.35	35	11.87	42	14.13	38	12.79	2.9	0.918
The Average Mean and Standard Deviation												**2.74**	**.732**

Source – Field Survey 2020

Rural Electrification Project Implementation Challenges

The challenges that hinder the managers require them to rethink some of their fundamental assumptions about how to achieve the goals of their organizations, about what they consider productive actions, and about the real purpose of cost management.

Table 7

Challenges of Rural Electrification Project Implementation

No	Items	1(S. Dis-agree)		2(Disagree)		3(Undecided)		4(Agree)		5(S. agree)		Mean	Std. Deviation
		F	%	F	%	F	%	F	%	F	%		
1	There is high cost of wiring materials	21	13.18	26	15.91	31	19.09	44	27.27	40	24.55	3.85	.861
2	There is high connection fee	31	19.09	22	13.64	23	14.09	54	33.18	32	20	3.51	1.094
3	Unit cost of energy is increasing from time to time	29	17.73	22	13.64	20	12.26	48	29.55	43	26.82	3.66	.980
4	Mode of paying electricity bills is complex	18	10.91	19	11.82	29	18.18	41	25.45	54	33.64	3.66	1.037
5	There is high labor payment to wiring electrician	18	10.91	24	14.54	29	17.72	46	28.63	46	28.2	3.99	.866
The Average Mean and Standard Deviation												**3.73**	**.914**

Source – field survey 2021

These items were designed to assess the overall level of challenges of implementing a rural electrification project from the perspective of the 162 household users in the study area, as shown in Table 7. Five challenge items were used to understand the level of effect. As indicated from Table 9 above, the majority of 51.82 percent of the respondents believed that there was a high cost of wiring materials in the rural electrification projects. In the same way, about 53.18 percent of respondents also agreed that there is a high connection fee for using it. In addition, 56.37 percent of respondents agreed that the unit cost of energy is increasing over time. 59.08% of the respondents believed that the mode of paying electricity bills is complex. In the same way, 56.83 percent of the respondents agreed that there is a high labor payment for wiring electricians. Thus, we can understand that the overall effect of the challenges of rural electrification under the study is high, with an average mean value of 3.73.

Implication of electrification projects on the livelihood of rural households

Table 8 below presents the mean annual income level of households at 42,300 birr and 18,360 birrs for electrification projects users' and electrification projects non-users', respectively. The annual income mean of Electrification Project users' households is greater than that of Electrification Project non-user households. The T-test is significant at the 5 percent level, which shows the significance difference

between two groups. This implies that electrification projects had a positive impact on household income improvement. This result is found that electrification project user households earned more money than non-user households. Therefore, in Electrification projects, household users had more chances to ensure food security.

Table 8

Annual Income Level of The Respondents

Annual Income level	**Electrification projects users**	**Electrification projects non-users**	**T-test**	**P- Value**
Mean	42,300	18,360		
Std. deviation	31,350	12,430	23.842	0.003
Minimum	17,350	8,120		
Maximum	96,130	62,900		

Source – field survey 2021

The above table 9 indicates 171(57.58%) and 126 (42.42%) of the households have improved food security and have not improved household food security respectively. As it shows from Electrification projects users' households, 126 (77.6%) have improved food security and the remaining 36(22.4 %) households have not improved food security. On the other hand, only 38 (28.15%) of Electrification projects non-user households have improved food security. This shows that from the opposite of Electrification projects users, the majority of Electrification projects non-user households 90 (66.67%) have not improved food security.

Table 9

Status of Households Food Security, Productivity & Job Opportunity

Impacts of electrification projects	Categories	Electrification projects users		Electrification projects non-users		Total		X^2-test	P-value
		Number	%	Number	%	Number	%		
Improved household food security	Yes	126	77.6	45	33.33	171	57.58	11.652	.031
	No	36	22.4	90	66.67	126	42.42		
Total		**162**	**100**	**135**	**100**	**297**	**100**		
Increased the productivity	Yes	117	72.22	38	28.15	155	52.19		
	No	45	27.78	97	71.85	142	47.81		
Total		**162**	**100**	**135**	**100**	**297**	**100**		
Create job opportunity for non- employment	Yes	136	83.95	33	24.44	169	56.90		
	No	26	16.05	102	75.56	128	43.10		
Total		**162**	**100**	**135**	**100**	**297**	**100**		

Source – field survey 2021

The findings show that in the study area, households who use electrification projects are more likely to have improved food security than households who do not use electrification projects. The Chi-square test results are significant at the 5% level of significance, which displays there is a high significant difference in access to improved food security between electrification project user households and electrification project non-user households in the study area.

It also shows that of the total respondents of 297, 155 (52.19%) and 142 (47.81%) of the households have increased their productivity and have not increased their productivity, respectively. From the Electrification Project user households of 162, 117 (72.22%) have increased their productivity, and the remaining 45 (27.78%) have not increased their productivity. It also indicates that of the 136 electrification projects in the study area, the majority (83.95%) have created job opportunities for non-employees.

Table 10 indicates that of the total users of electrification projects, the majority, 124 (76.5%) of the respondents, said that electrification projects had a positive improvement for their children's education under the study; the remaining 38 (23.5%) of the households did not get improvements for their children's education under the study area

Table 10

Implication of Electrification Projects on Children's Education

Has the electrification of your household resulted in any improvements for your children's education?	Frequency	Percent
Yes	124	76.5
No	38	23.5
Total	162	100.0

Source – field survey 2021

Analysis of Multiple Regression

The researchers designed to fit a predictive model to the data and use that model to forecast values of the dependent variable from one or more independent variables. The analysis of multiple regressions was directed at analyzing the mutual effect of factors or index (organizational-related factors,

procurement-related factors, project manager- and team-related factors, and contractor-related factors) on the effectiveness of electrification projects.

Table 11

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Dur bin-Wat son
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.852[a]	.725	.721	.37166	.725	192.535	4	292	.000	1.986

a. Predictors: (Constant), CONTCHAL, ORGCHAL, PROJMTE, PROCHAL

b. Dependent Variable: EFFELR

Source - Own Survey 2021

It shows that the combined effect of the factors observed on the effectiveness of electrification projects. The adjusted R squared was found to be .721 which means that 72.1% of variation in the effectiveness of electrification projects can be explained by the four factors of (organizational related factors, procurement related factors, project manager and team related factors, and contractor related factors). That means, of the major factors affecting of the effectiveness of electrification projects. The adjusted R squared was found to be .721 which means that 72.1% of variation in the effectiveness of electrification projects, 72.1 % can be recognized to the four factors under the study and the remaining 27.9 % of factors are not explained in this study.

Table 12

ANOA for Regression

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	106.381	4	26.595	192.535	.000[b]
	Residual	40.335	292	.138		
	Total	146.716	296			
a. Dependent Variable: EFFELR, Index for electrification effectiveness						
b. Predictors: (Constant), CONTCHAL, ORGCHAL, PROJMTE, PROCHAL						

Source - Own Survey 2021

N.B: CONTCHAL for contractor related factor, ORGCHAL for organizational-related factors, PROCHAL for procurement-related factors, PROJMTE for project manager and team-related factors

The model tests whether the complete regression model is a good fit for the data. Table 12 above represents the report of ANOVA on the general significance of the model. The result of the model gives a significant result $F(5, 292) = 192.535$, $p < .01$ by which it indicates that the factors under the study can significantly influence the effectiveness of electrification projects. Therefore, the combined effects of factors of (organizational related factors, procurement related factors, project manager and team related factors, and contractor related factors) significantly predict the effectiveness of electrification projects under the study.

Table 13

Coefficients of The Four Factors

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.032	.173		.184	.854
	Organizational Factors (ORGCHAL)	.160	.045	.137	3.551	.000
	Procurement factors (PROCHAL)	.082	.067	.064	1.230	.220
	Contractor related factors (CONTCHAL)	.449	.061	.376	7.407	.000
	Project managers & team factors (PROJMTE)	.771	.048	.676	16.119	.000

a. Dependent Variable: EFFELR

Source - Own Survey 2021

When the study's beta value is positive, it may be inferred that the predictor factors and the success of electrification projects have a positive link; when the coefficient is negative, it denotes a negative association (Field, 2009). While one factor, procurement related factors, is not significant at less than 5% level of significance in the study area, the other three factors—organizational related factors, project manager and team related factors, and contractor related factors—have positive coefficient values and indicate a positive influence on the effectiveness of electrification projects under study. This outcome supports prior research by Pelegrini et al., (2013), and Sanghvi and Barnes (2011).

Analysis of Qualitative data and Discussions

The majority of the responses from the interview indicated that adequate awareness of community participation in the electrification projects is low, the project on the pre-planned budget is not completed on time, within the pre-planned costs, and to the expected quality, and the completion of the project does not meet much stakeholder satisfaction. Furthermore, the results of the interviews revealed that the implementation of rural electrification projects has encountered challenges that limit their effectiveness, such as the high cost of wiring materials, the high connection fee, the fluctuating unit cost of energy, the complex mode of paying electricity bills, and the high labor payment to wiring electricians. Finally, the responses of those interviewed concluded that the implications of rural electrification projects on rural transformation efforts (on the rural household economy) were that by improving household food security, it facilitated increasing their economic productivity and also created job opportunities for their children who were not employed. This result confirms the previous findings of Sanghvi and Barnes (2011), Hwang and Janicia (2013), and Pelegrini and Tasciotti (2012).

The focus group discussion also confirmed that there is a high cost of wiring materials in the rural electrification projects. In the same way, they agreed that there was a high connection fee for using it. In addition, they agreed that the unit cost of energy is increasing over time. The group disagreed with the adequate awareness of community participation, the completion of the project on a pre-planned budget, the completion of the project on a pre-planned time schedule that was not completed, the completion of the project with the required quality, and they did not believe that the completion of the project meets stakeholder satisfaction in the study. The discussion forwarded the fact that users of electrification projects use investments as a result of the electrification projects in their village. They used lighting, a TV or satellite dish, a radio, fridge service, mobile phone charging, and an electric hot plate.

Conclusions and Recommendations

The findings of this study show that the level of effectiveness of implementation of rural electrification projects is low in creating adequate awareness of community participation, in completing the project on a pre-planned budget, on a pre-planned time schedule, with the required quality, and in completing the project to meet stakeholders' satisfaction under the study. The finding indicated that the major implementation challenges that hinder their effectiveness were that there was a high cost of wiring materials in the rural electrification projects, there was a high connection fee for using it, the unit cost of energy was increasing over time, the mode of paying electricity bills was complex, and there was a

high labor payment to wiring electricians in the study area. The study found that the effectiveness of rural electrification projects on rural transformation efforts (on rural household economy) has implications for improving household food security, facilitating increased economic productivity, and creating job opportunities for non-working children.

Based on the findings and the results of this finding indicated in Chapter 4, the investigator suggested the following recommendations: The local government in the area of the projects should create adequate awareness of community participation by increasing training about the use of electricity and involving them in each work activity, which helps the completion of the project on a pre-planned budget, on a pre-planned schedule, and with the required quality. The owner of the projects, especially Ethiopia Electric Company Amhara Region, should monitor and evaluate the project implementation at all stages, from project feasibility studies to completion, and carry out a thorough feasibility study of the projects both in technical and financial aspects to solve the existing challenges with contractors, consultants, and project managers. Even though the electrification projects have positive implications on the rural household economy by improving food security, productivity, and job opportunities, they need proper communication and coordination channels between users and the various stakeholders to create alignment with the project objectives and avoid misunderstandings in the execution of the projects.

References

Abdullah S. and Markandya A. (2012), Rural electrification programmes in Kenya: Policy conclusion from a valuation study, January 2009Energy for Sustainable Development 16(25/09), DOI: 10.1016/j.esd.2011.10.007

Asian Institute of Technology (AIT) (2004). Institutional Reforms and their Impact of Rural Electrification: South and Southeast Asia. Global Network on Energy for Sustainable Development (GNESD), Roskilde, Denmark.

Cook P. (2013), Rural electrification and rural development: Rural Electrification through Decentralised Off-grid Systems in Developing Countries, Springer-Verlag, London (2013), pp. 13-38

Gunduz M., Yahaya, A. M. A. (2015). Analysis of project success factors. Technological and Economic Development of Economy 3-4.

Dutt, P.K. and MacGill, I., 'Addressing some issues relating to hybrid mini grid failures in Fiji', Global Humanitarian Technology Conference: South Asia Satellite (GHTC-SAS), 2013. IEEE, 106-111

Hwang, B. G., and E-Sin Janicia Lim, S. J. (2013). Critical success factors for key project players. Journal of Construction Engineering and Management 3-4.

Hyvari, Irja. (2006). Success of projects in different organizational conditions. Project Management Institute 6-7.

IEA. (2002, 2011, 2013,2016). World energy outlook. International Energy Agency. Paris.

Kefyalew, Mergiya. (2015). Causes of failure of projects under universal electricity access program of Ethiopian electric power: The case of projects financed by Ethiopian government. MBA Thesis, Addis Ababa University, Department of Management.

Kothari, C.R. (2004) Research Methodology: Methods and Techniques. 2nd Edition, New Age International Publishers, New Delhi.

MoWIE (2015/16), Report, Ethiopian Ministry of Water, Irrigation and Energy (MoWIE)

NBC (2016), Growth and Transformation Plan II (GTP II): (2015/16-2019/20), National Planning Commission, Addis Ababa, Ethiopia

Pelegrini, L. and Tasciotti, L. (2012). Rural electrification now and then: comparing contemporary challenges in developing countries to USA's experience in retrospect. Forum for Development Studies, (Erasmus University of Rotterdam, International Institute of Social Studies) 40 (1): 153.

Sanghvi, A., & Barnes, D. (2011). Rural electrification: Lessons learned. World Bank Findings: Operational Quality and Knowledge Services, Africa Region Infrastructure. World Bank, Washington, DC.

Schillebeeckx, Priti Parikh, Rahul Bansal, Gerard George (2013), An integrated framework for rural electrification: Adopting a user-centric approach to business model development, https://www.sciencedirect.com/science/article/abs/pii/S0301421512005009

Behailu Ayele Woldesemaite (2018), Factors Affecting the Successful Implementation of Rural Electrification Projects in Ethiopia, https://core.ac.uk/reader/199938910

WB (2015). Implementation completion and result report on the second electricity access (rural) expansion project. Addis Ababa: World Bank.