Impact of Rural Electrification on Poverty Reduction:
A Case Study In Bench-Sheko Zone, South-West Ethiopia

A thesis Submitted to the School Graduate Studies of Business and Economics College, Jimma University as a Partial Fulfillment of the Award of the Degree of Master of Sciences degree in development Economics

By: ***TESHALE SISAY NIGATU***

JIMMA UNIVERSITY

BUSINESS AND ECONOMICS COLLEGE

DEPARTMENT OF ECOOMICS

M.Sc PROGRAM
JULY 2020

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Under the Guidance of

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and

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DECLARATION

I hereby declare that this thesis entitled "Impact of Rural Electrification on Poverty Reduction: A Case Study in Bench-Sheko Zone, South-West Ethiopia", has been Carried out by me under the guidance and supervision of Dr. Leta Sera and Mr. Sisay Tolla.

The thesis is original and has not been submitted for the award of degree of diploma any university or instructions.

Researcher's Name	Date	Signature
Teshale Sisay Nigatu	_________	______________

CERTIFICATE

This is to certify that the thesis entities "Impact of Rural Electrification on Poverty Reduction: A Case Study In Bench-Sheko Zone, South-West Ethiopia", *Submitted to Jimma University for the award of the Degree of Master of Science (M. Sc) and is a record of Valuable research work carried out by Mr. Teshale Sisay Nigatu, under our guidance and supervision*

Therefore, we hereby declare that no part of this thesis has been submitted to any other university or institutions for the award of any degree of diploma.

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ACKNOWLEDGEMENT

First, I dedicate this work to the almighty for seeing me through my years of University education. His Grace and mercy have brought me this far and I am grateful.

Next, I would like to express my felt gratitude to my advisor Dr. Leta Sera and co-advisor Mr. Sisay Tola who give me with innovative ideas and instructional assistance to do fruit full accomplishment of the study as well as who had devoted their precious time while providing genuine invaluable guidance.

My special thanks go to Behailu Tsegaye (bt) I have no word to express you simply God bless your all.

Little brother Yohannse Sisay, you are no1, Habtsh, Mola, Menge, Wonde, Gech, Agest, Geni, and Chuchu thank you all of you for your financial, technical, and moral support to finish my study. Long Live.

My thanks also pass to Tedi and Azmi, who support me on my study in all, God bless you!

For your great collaboration Melese, Chere, Giovanna R. and Zebo to support me in material, moral and any works of the study thank you.

Lastly, I would like to say my deepest thanks for my mother Yeshi Mengistu, Long Live EMYE.

Contents

LIST OF FIGURES

LIST OF TABELS

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ACRONYMS AND ABBREVIATIONS

ADB	African Development Bank
ADB	Asian Development Bank
BADEA	Bank of Arab for Economic Development in Africa
CIA	Conditional Independence Assumption
CSA	Central Statistics Authority
ESMAP	Energy Sector Management Assistance Programme
GoE	Government of Ethiopian
HDI	Human Development Index
HICE	Household Income Consumption & Expenditure
MDGs	Millennium Development Goals
MoFEC	Ministry of finance and economic collaboration
NBA	National Bank of Ethiopia
RE	Rural Electrification
UEAP	Universal Electricity Access Program
UNDP	United Nation Development program
WB	World Bank

ABSTRACT

One way of alleviating poverty is to promote modern energy access, in particularly, electricity. In any country lack of electricity is one of the major impediments to growth and economic development of rural economies. However, in the Ethiopian context there is a very limited empirical study that has examined the causal relationship between the massively accomplish rural electrification endeavors and poverty reduction. Advocates of RE suggested that it increase the wellbeing of the society but some critics that it creates unequal social tension. The objectives to determine impact of RE on households' welfare: income, and education, the socio-economic development of both on-farm and off-farm commercial activities and the level of poverty in the area. This study has shown that the impact of electricity on reduction of poverty is positive and significant. BY using PSM and OLS the impact of electricity access on household on farm income is found to be insignificant and having the wrong sign. But, the result of the study revealed as rural electrification affected educational attainment and off-farm income positively and significantly. By using ATT nearest neighboring off farming income on the electrified area 70.2% more than on unelectrified kebele and 35 minutes more study time in electrified than unelectrified. Due to its important and contribution all types of electrification used to reduce poverty. The study addresses that this kind of study is essential to push the government body to connect rural areas for the sustainable economic development.

KEY WORD: Household Income, Impact, Poverty Reduction, Rural Electrification

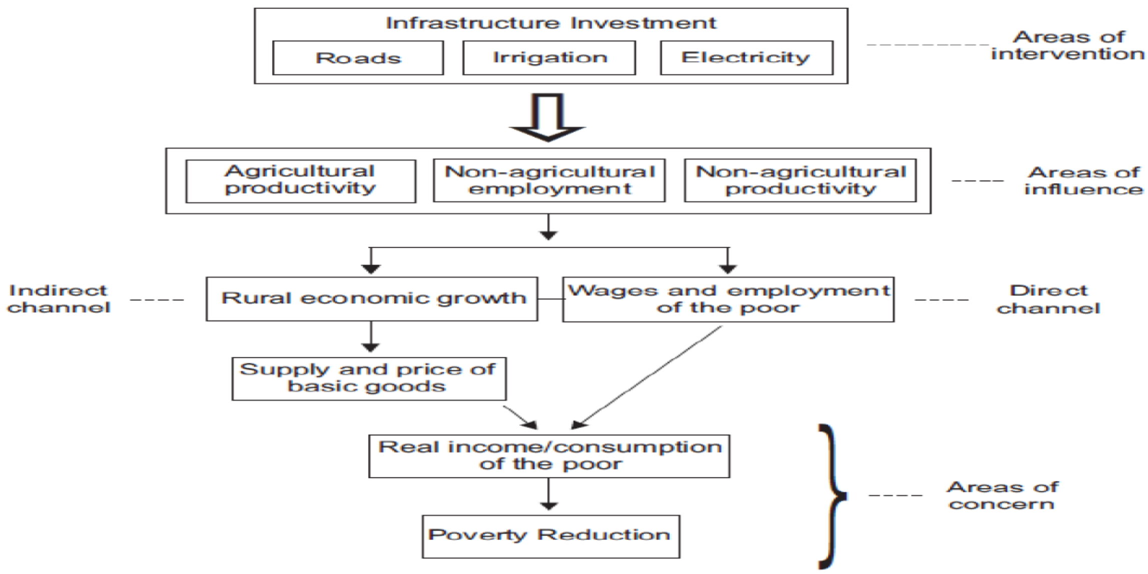
CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Poverty is the main difficulties for sustainable development for developing countries. One way of reducing poverty is to supply access to modern energy, in particularly, electricity. Poverty reduction necessitates economic growth which appeared with good governance and sound macroeconomic management, results in socially inclusive and sustainable development (ADB, 2002). Today in globalized world, access to electricity is a need that almost taken as a basic human right. In many developing countries national electrification programs are given priority and the level of electrification generally is seen as one of the key indicators of development. Significant change on access to the poor to health and education, employment, credit, water and sanitation, and produce for markets is needed. Furthermore, the exposed of the poor to natural disaster and economic disturbance must be decreased to augment their welfare and promote higher-risk in investment and in human capital and higher-return activities. Government reforms policy and in physical infrastructure investment will significantly change to give to the following of socially inclusive development of urban –rural (ADB, 2003).

According to IEA (2019), 13% of the world population have no electricity access. In 2015, in the history of electricity production for the first time the population without access to electricity fell below one billion. In 2019, 840 million people worldwide have no electricity access. From that, in Africa at least 600 million people lack its access. In Sub-Saharan Africa, from five people three have no electricity access of which, 83% live in rural and remote areas. According to CSA (2019) in Ethiopia 60% of the total population lack access to electricity, of which more than 85% live in rural and remote areas.



(***Source***: ADB, 2003)

Figure 1. ***Analytical Framework between Infrastructure and Poverty Reduction***

There is limited empirical evidence available addressing the nexus indicated by figure 1 above. Econometric examines find the above links depict do not discover in detail. Even so, they give applicable appraisal of the links more useful, implying their quantitative and statistical significance. Typically, these measures are described as elasticity indicate a variable that responsiveness to be a determinant. Whereas differences in econometric model definition, specification and data, judgement mistake across countries in result interpretation, they do advance useful approving into the connection between poverty reduction and physical infrastructure.

Few econometric results are found regarding the impacts of electricity and upon poverty reduction and they are mainly in Asian countries. Kwon (2000) estimated that growth elasticity with respect to poverty incidence in the province of Indonesia 0.33 and 0.09 for good-electricity provinces and for bad electricity provinces respectively. For every 1% growth in provincial GDP, poverty incidence falls by 0.33% and 0.09%, respectively. Provincial electricity also starts to improve directly employment of the poor and their wages, such that within five years a 1 percent increase in electricity investment is associated with a 0.3 percent decrease in poverty incidence.

There is relatively better empirical evidence showing that irrigation contributes significantly to on farm productivity and wages, income inequality and poverty reduction. Inequalities of Income indicate that the poor benefit more than the non-poor. For example, A dollar wealth of output in irrigated farms creates a total value of employment by 4.75 dollars. Also, in Bihar, India farm income in irrigated areas is 77% higher than that of unirrigated areas (Bhattarai et al., 2002). It is considered that there is a significant benefit of electricity to the growth of non-farm activities in some districts of rural China dominant to reducing poverty, an estimated elasticity of 0.42 (Fan et al. 2002). Investment in electricity has a noisome effect on poverty, it shows that for every 10,000 Chinese yuan spent for the development of electricity, 2.3 persons are bring out of poverty.

On the impact of rural electrification there is very limited empirical evidence particularly in the Ethiopian context. The Ethiopian economy which has showed 9.3% average annual growth during 2013/14-2017/18 fiscal years, recorded 7.7% in 2017/18 fiscal year (NBE, 2018) with the relatively similar rate of growth in further successive years. Growth in the sector of commercial and industrial has been even growing faster. This, in addition to expansion in rural electrification through UEAP (the Universal Electricity Access Program), has caused fast growth in demand of electricity needed. The demand is hoped to raise in the future rapidly because of additional economic expansion and to operate electrification for universal. In order to enhance the wellbeing or the quality life and to encourage Ethiopians to diversify economic activities, the Government of Ethiopia embarked in a rural electrification initiative in 2005/2006 this project was followed by more ambitious electrification programs. Through UEAP program thousands of small and medium size towns have had or will gain access to electricity that will benefit the population as well as the formal and informal enterprises established in these towns.

In 2008 in Addis Ababa and southern Ethiopia region survey data of small-scale handlooms (Ayele et al. 2009) shows that in southern Ethiopia region for electrified firms in productivity per worker is about 40% higher than that of non-electrified firms. This effect of productivity is succeeding in larger part because in city there is access to electricity, firms share workspace and producers work longer hours with electric lights at lower rental cost. Workers in non-electrified rural village and electrified rural villages worked 7.2 hours and 10.7 hours per day respectively.

Our current dependency on fossil fuel is not sustainable and dangerous to the planet, that is why we must change the way we produce and consume energy. By implementing these new energy solutions as fast as possible is essential to counter climate change, because it is one of the biggest threats to our own survival.

Facts shows 13% of the world population still lacks access to modern electricity, 3 billion people depend on wood, charcoal, coal, or animal waste for cooking and heating. Energy is the dominant contributor to climate change. It accounts for around 60% of the total greenhouse gas emissions.

The study provides the impact of rural electrification on poverty reduction in bench-sheko zone, south-west Ethiopia.

1.2 STATEMENT OF THE PROBLEM

In developing countries electrification in rural and remote areas has been the cornerstone of rural energy strategies. It is an argument and a cause of controversy among development analysts. The advocates of electrification in rural area believe that it has major significant effect on industrial and agricultural productivity, decrease migration of rural-urban, creates more employment opportunities and significantly increases the overall quality of life in rural areas. Critics claim that rural electrification may not have the hoped-for impact on economic and social life and in its unequal effect could contribute to social tension.

The United Nations has found out that there is positive relationship between human development index (HDI) of many countries and per capital energy consumption. There is empirical evidence also to show that human development and access to modern energy are closely linked. (IEA, UNDP, 2005).

In Ethiopia, the government through the Ministry of Water, Irrigation and Energy formed the Rural Electrification under national electrification program as a slogan of ‘lighting to all’. Authority which is funded by the government of Ethiopia and donors. The mandate of the authority is to implement rural electrification. The program focuses on giving development assistance for the supply of electricity services to encourage economic productivity and improve the society of life in rural areas. Currently, these projects do not start with an estimate of the needs of the people they are meant to serve. On the target populations they frequently fail to evaluate specific impacts resulting from these services. The rural electricity evaluation program at present time are confirmed to measure qualified variables only such as number of households electrified. They are not planed and designed to measure social and economic development effects. This fragmental understanding of the program effect on members of the target population hinders development of the initiatives that answer to rural needs and have positive reasonable and sustainable impact on socio-economic development.

Such kind of research is important in the reason that most successful rural electrification projects have solved problems when it is necessarily developed in implementation. The idea to enhance and benefit from the quality of rural electricity projects fully realized are depend on long term sustainability. The importance of rural electrification without long-term sustainability cannot be fully realized. The funding components of donors need justification and the development assistance is linked to project outcomes, hence need to develop local capacities to conduct evaluations.

Most of the studies in rural electrification are qualitative in nature. Literature has not used any special index to capture the effects of rural electrification. Abdalla (2005), Abdullah and Markandya (2007) Attempts to separate the effect of other social amenities from electrification. In assessing the social and economic impact has been a challenge to many researchers. As such the trust of exhibit rural electrification is a main factor of socio-economic progress in rural area remains questionable.

This research is purposeful to identify the contribution of electric power in poverty reduction and the importance of rural electrification to the rural communities of South-west Ethiopia, with a special focus on Bench-Sheko zone. The zone has less infrastructure relative to other zone, but electricity availability is relative to better access from other infrastructure.

1.3 OBJECTIVES OF THE STUDY

1.3.1 GENERAL OBJECTIVE

i. The general objective of the study is to estimate the impact of Rural electrification on poverty reduction mainly income and educational outcomes.

1.3.2 SPECIFIC OBJECTIVES

i. To determine impact of the Program on the key dimensions of households' wellbeing.

ii. To assess the impact of the Program on the socio-economic development.

iii. To determine the level of poverty in the area.

iv. To put forward logically sound recommendations based on scientifically rigorous impact evaluation.

1.4 HYPOTHESIS

H0= rural electrification has no impact on the consumption of the rural households.

H0= rural electrification has no impact on the level of poverty in the study area.

H0 = rural electrification has no impact on farm and off farm income of the rural households.

H0 = rural electrification has no impact on educational outcomes of the rural households.

1.5 SIGNIFICANCE OF THE STUDY

To know the effect of rural electrification in Bench-Sheko Zone specifically, South bench and Sheko Woredas. In this regard, findings, outcomes and the recommendations of this study will be important to the rural society and government to address rural electrification.

The findings of this research will also give and help as a source of initial reference and it may serve a steppingstone for those researchers who want to make in detail and further study on the area of the impact and its objectives of rural electrification. Finally, it will give the researcher the opportunity to gain deep knowledge on the outcomes of influencing factors.

1.6 SCOPE OF THE STUDY

This study was conducted in Bench sheko zone found in south-west of Ethiopia. Currently, it is the newly established zone. The study covers the electrified sample rural in Bench Sheko zone in 2020. The Corporation has electrified 6,317 rural towns all over Ethiopia. While the electrified towns/villages in SNNR were 866 and 112 (Southern region UEAP office, 2013). Since the study was specific to Southern Nations Nationalities and Peoples Region (SNNPR) in Bench-Sheko zone, specifically two Woredas out of the 10 namely, south bench and Sheko Woreda. Both have 38 and 24 kebeles respectively, out of this kebeles. Except the town of the woredas the rest have no electrification but Zemika have. So, two of them (Zemika and Gorika) are select for this the study to meet the general and specific objectives of the study. Zemika electrified in 2014 and Gorika not electrified still.

1.7 LIMITATIONS OF THE STUDY

Due to the sensitivity of some questions in the questionnaire, some of the limitations encountered include the unwillingness of some respondents to respond to some questions. To overcome this problem, the researcher collaborates to work with kebele leaders, and the research team was also part of it.

Some questionnaires were translated into Amharic language a challenge that some of the translators could not translate the technical terms into the local language. However, the researcher included leaders to assistants who hailed from the community who made correct interpretations of the questions to the respondents.

1.8 ORGANIZATION OF THE STUDY

This thesis is structured as follows: Chapter one contains introduction. A review of the literature related to the Rural Electrification is presented in Chapter two. Chapter three provides research design and methodology. Results and discussion are described in chapter four. Finally, Chapter five presents summery, conclusion, and recommendation.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

INTRODUCTION

By the definition rural electrification is the process of giving and supplying electrical power to rural and remote areas.

According to new research studies, more than 840 million people in the world are without access to electricity. Most of them are in living in rural and remote areas of the developing world, where the speed of supplying electrification remains slow (Barnes, 2012). Rural electrification approaches are one of the important parts of the infrastructure development of a country, whereas the infrastructural economic plans for developing countries have not given attention it more priority. In various developing and developed countries, electrification in rural area has been successful in enthusiastic development. The supply of Electricity is one of the primary inputs for social and economic development since its supply is crucial for improving and enhancing living standards, fostering social activities and supporting development (United Nations, 2005).

2.1 THEORETICAL LITRATURE

2.1.1 ELECTRICITY, ECONOMIC GROWTH AND POVERTY REDUCTION

The increased need for infrastructure investments in rural and remote areas and other key public service that are essential for making growth and poverty reducing in rural areas has been emphasize by different stakeholders. Singh and Ali (2001) have remake that expenditure on government on rural electricity, roads and telecommunications can have a considerable impact on reducing poverty in rural. It is estimated that almost one billion people today live in energy poverty, without access the importance of electricity. Electrification in Rural areas has been increased important in recent years due to the heave interest in infrastructure development in relation to the central part. RE can play an improving well-being and reducing poverty (Singh and Ali, 2001; Fishbein, 2003; World Bank, 2008).

In the last two decades, in the development circle reduction on poverty has been a major important policy effort. Accordingly, international development agencies have publicly understood poverty as a central issue, and poverty by putting as one of the millennium developments goals. This is an unquestionable recognition that infrastructure has a determine relationship to the level or stage of development of a country. By different studies the purpose of modern energy in poverty reduction has been documented. Ondari (2010). It is true that in the developing country, no country has ever achieved 8% – 10 % annually growth that is done without modern energy to reduce poverty. In Kenya as a part of agenda of the national development, poverty the highest levels in rural areas highlight the essential of investing in basic infrastructure like electricity. (Otieno and Awange, 2006).

Electricity an intermediate good and as consumption service has been connected to growth in income and therefore, a causal relationship exists between infrastructure and income (Cook, 2012). RE can promise a shining future in the long term for many communities of the rural and providing electricity to poor households the benefits can be high. Research study result have given evidence showing the positive relationship between gross domestic production (GDP) and consumption of electricity. This correlation has been showed by the relationship existing between the rate of electrification in a country and the percent of households who are living above the poverty line of $2 per day (Kirubi, 2006; Tuntivate, 2011).

Electricity is an essential infrastructure for development of rural businesses and significant economic growth through the right circumstances. The evidence in the existence of many studies in research, over in the last two decades the economic and social benefits of RE have been researched. Barnes (2012) established that in households electrified or with electricity have increased luck of utilizing activities that needs higher levels of lighting as contrary to households without electricity or not electrified. As a result, a study in research conducted that businesses found in developing countries of rural areas can benefit from rural electrification program such as micro-small commercial shops, home businesses, tea and coffee processing, grain mills, brick kilns, sawmills and other small and medium- scale enterprises Singh (2009).

In the book "*Rural Electrification and Rural Development*" Cook (2012) determine that the impact of RE on small businesses should be factor out by the attitude and the behavior of the local community, the ability of rural entrepreneurs and give free charge of the programs. The researcher further features that electricity is an essential and important input that can encourage and support in the small industries development and some other supplementary conditions such as access to good rural markets and adequate credit. The feeling is further supported whose opinion that subsequently the above admiring stipulation are not uniformly distributed in all rural areas, the expected growth of business enterprises in rural areas providing with electricity can be slow (Otieno and Awange, 2006).

World Bank, (2008). Study showed in Philippines discovered that in areas with access of electricity small home businesses were more active. Compared to rural areas provided with access of electricity to that of rural areas without access of electricity have worse record of development of business.

Electrification in rural area has the potential of improving the wellbeing of rural community in different ways. The energy demand everywhere in developing countries is very fast growing anywhere there is raised need for energy to help different services like small-scale and domestic services (Abdullah and Markandyab, 2012; Barnes, 2012). Several developing countries have taken over several institutional initiatives and policy in order to provide electricity access to rural communities. However, in developing countries rural electrification programs have confronted major hinder that are linked with low population densities in rural areas. It has resulted in capital for electricity companies and high operating costs and, as a result of poor consumers low consumption of electricity (Singh and Ali, 2001), obstacle on the arranged running and planning of the electricity by politicians always agree on providing component and interference by individual farmers and local communities in giving way for the maintenance and construction of electricity lines (Barnes, 2012). Accordingly, in developing countries electricity services quality suggested for rural areas frequently reduction of those provided to urban areas. This is evidence that interruption and fluctuating power quality in the form and number of brown outs and black outs, (World Bank, 2003).

Even though in developing countries in relative to the delivery of electricity to its rural population are still lagging far behind but numerous of the developing economies have successfully provided access to electricity to their rural society. For example, in Costa Rica more than 90% of rural population have access to supply of electricity of which, more than 95% of the rural population gets supply of electricity from government energy agencies and cooperative (United Nations, 2005). Alike, in Tunisia more than 95% of the households in rural area have electricity supply access (World Bank, 2008).

The government of Kenya has developed electrification in rural area the country using via grid and off grid supply (renewable energy bases such as wind, biogas or diesel station and the solar. The Rural Electrification Authority (REA) that was established in 2003 has been played an important part in the delivery of the electricity to rural populations (Abdullah and Markandyab, 2012). Due to their important role the government endures to connect electricity to most public organizations in the rural areas in achieving rapid growth such as public secondary school and health center and trading centers (Ondari, 2010). Reverse to former conjecture that the upcoming of electrification in rural areas of Kenya is not hopeful (Otieno and Awange, 2006), it can be defiantly showed that it has given greater attention to commitment to increase from the government to expand the process.

2.1.2 ELECTERCITY, EDUCATION, AND HEALTH

Education

The impact of rural electrification, if any, on the propensity to stay in school of a child shows that RE indirectly benefit to enhance the propensity to stay in school of child via raise in the mother's education and knowledge. This might be an increase in reading and studying hours due to light after dawn or at night.

Health

Health through access to media improved health and increased knowledge and fertility outcomes. Rural Electrification is important benefits that lowers costs and the quality of health services by significantly strengthening the cold chain for vaccines and making longer opening hours—though it does not raise the scope to which such services are obtainable. Electrification was also started to decrease worker absenteeism in both health clinics and schools and by improving living conditions and morale. But, on this case studied are few, so it required further analysis.

Benefits of Rural Electrification: Education, Health, Status, and Income

Users of electrification in the household had fast engaged an advantage of supply of grid connection. On which individually had on average 2 lights per room.TV, radio, and Refrigerator ownership rates differ between one for every two households and one per household, and some households have their owned satellite dishes. In Tunisian nationally, in 1994, 92% of Tunisian had televisions, (of which 70% were color) and 72% households owned their refrigerators. The beneficiaries were aware of that RE could bring the benefits. Opportunities in economic raised for women in the village and at the home are supposed as one of the electrification outcomes.

Electric on lighting at night makes events simple and possible, and many girls say that they prefer to stay in the village and get a living using a knitting or weaving, a sewing machine, rather than going to work as maids in the city. Sewing workshops (apparently a result of the raised fashion awareness) and Hairdressers figure commanding among the new goings-on in economic related to electrification. Through different state development program equipment is frequently gave to households. Refrigeration is essential valued for providing the capacity to preserve food and medicine and save money by rationalizing shopping. Rural electrification for health staff and beneficiaries attributed at least a part of the decrease in the birth rate in their areas too, which makes a difference the effectiveness in increased of family planning and other benefits of health program. Health clinics and centers report being able to increase the range of their services and equipment : for instance, videos and televisions are used to present program on public health benefits and in some waiting rooms disease prevention; medical equipment and tools can be sterilized; and anti-tetanus shots for pregnant women and vaccines for babies are more widely offered. According to one clinic a nurse suggested, the availability of refrigeration for medicines and vaccines has contributed to a remarkable decrease in childhood diseases, poisoning and diarrhea (Chaieb, 2001).

2.1.3 Impact of Rural Electrification on Microenterprise and Employment Creation

Enterprise which is productive believed to be among through the importance of electrification, few research studies on the methodology using an impact evaluation have tried to quantify these benefits. For instance, in Bangladesh the USAID evaluation on rural electrification (Barkat and others 2002) finds those enterprise activities that electricity utilize and contribute to the total income from these to electrification. Therefore, not to consider the substitution of possibility of either one action for another or source of energy and so overrating the advantage. The Independent Evaluation Group (IEG) (2004) studied three different kinds of effects measured important to realizing higher economic benefits:

(i) complementary infrastructure—such as transport, roads, bank, markets, and adult literacy
(ii) stock of tools and equipment of micro-enterprises and
(iii) operational hours.

The empirical evidence involving to each of these points is discussed as follows.

i. complementary infrastructures

Infrastructure, which is complementary such as transport, roads, building, equipment, markets, information and training frequently not provided electricity access — are essential and important to attain economic benefits from electrification (Cecelski 2004). IEG (2004) examined two questions:

1) is overall infrastructure, such as roads access for markets, offered in electrified or access to electricity communities?
2) are business-specific facilities more accessible?

The first question is obviously showing a matter of correlation in percentage of household’s communities working at a micro-enterprise as their secondary or primary occupation. Here below are his findings on the same: Differences significantly in having access to road, transport, and even market between having electrified and non-electrified communities are not a big issue. Economics of larger the grid to areas of rural is least excessive for communities closer to a road. Therefore, communities near to a road are expected to be get electrified first, and other facilities and usually infrastructure enlarge over time.

Ii Hours of operation

In Ghana the household on Electrification status was significantly and positively related to earning and equipment, but not hours worked; it was positively related to hours worked and revenue earnings in the Philippines and to revenue earnings in Laos. Electrification in Ghana has a small but significant effect on the revenue earnings of the microenterprise. The possible networks are rise in number of hours worked per day by the household members and use of electrical equipment (IEG, 2004).

2.1.4 The direct and indirect economic benefits of rural electrification

The direct economic benefits from rural electrification resulting in a rise in consumer surplus occur as supply of electricity to the user lowers the cost of energy. Such benefits incline to help the well-off, because connection charges and tariffs for the poorest are often so high. The form of electrification helps the non-poor, but as electrification coverage increases the distribution becomes more equal. In general, rural electrification does not drive development in industrial, but it can increase development of businesses at home. Such home businesses mostly rise their hours once electricity becomes accessible and employ family labor. Electrification increase to the incomes of some households, thus gives a small, but not negligible. Though, the evidence base on this point remains high (Dinkelman, 2010).

Electricity in rural area may also change employment opportunities by exciting the rise of new firms that create jobs outside the home. All separately from this, within households electricity may directly create jobs for the market by empowering the production of new goods and services: for instance, for larger groups food making and storage becomes easier; working small appliances to offer market services becomes possible (e.g. hair dryers, cell phone charging stations and local craft production). Electrification in this ground, on household could influence an increase work in market and the former unrealized demand for labor, even without the growth of firms.

From the above analysis, it can be concluded that modern energy services supply, mainly electricity, has had only an essential impact on small industries creation. Foley (1990), Rogerson (1997), sees that the raised higher living standards and economic activities due to electricity access in certain areas. Then, it can be concluded that electricity service access is from among the influences needed in developing the decisions of local entrepreneurs to invest in a different of productive enterprise. But many local entrepreneurs have little utilization of electricity services for production due to lack of tangible information about effect of electricity services on development of micro-enterprises. In rural areas the electricity supply can have negative impacts on some people, mostly to the weakest people who may be displaced; for them there may be no other source of livelihoods Meadows, K. et al., (2003).

2.1.5 BASIC CONCEPT ON SOCIO-ECONOMIC IMPACTS OF RURAL ELECTRIFICATION

It is globally accepted that electrification increases the welfare stimulates at a broader level of the economy and at the household level. The first and the immediate benefit of electrification comes through better-quality lighting, which encourage longer hours of reading and studying which in turn contributes to improved educational achievements and another household work that done regularly. And lighting can important to benefit many other household tasks at home, for instance sewing by women, social gatherings after dark, and many others. It also uses for communication devices such as television and radios which give to information access by rural households and can give to family members for entertainment.

In addition to this, economic activities of household's have very great benefit from electricity both from outside and inside home. For example, irrigation pumps can be increased crop productivity, longer hours in the evening businesses can be works, machinery and electric tools can tell efficiency and production growth for industrial enterprises, and so on (Khandker 1996; Filmer and Pritchett 1998; Roddis 2000; World Bank 2002; Barnes, Peskin and Fitzgerald 2003; Kulkarni and Barnes 2004; Agarwal 2005; Cabraal and Barnes 2006). Due to its large benefits, electrification which is along with access to other sources of modern energy, can be identifies as an important for satisfying the new global goal by 2030 (UNDP 2015).

The World Bank assessments on electrification is an essential for development and has maintained in many developing countries electrification projects. Most of projects of electrification in many developing countries financed by the Bank and frequently increase coverage of grid electrification with specific objectives in mind, for instance, enhancing welfare of the household (education, income, etc.), creating institutional mechanisms, providing inputs to power sector reform, creating guidelines for tariffs, subsidies, and others. From the many objectives, the most essential is making a positive effect on the living of rural people. Though, without appropriate valuation of such kind of projects is impossible to determine if, and to what scope, these objectives are attained. It is well documented that it improves farm productivity using electric for pumps irrigation. Off-farm productivity in both home business and small commercial also may rise due to the capability to keep working to stay open after shadowy. This improve farm productivity may be changed as result of having electric lighting throughout the evening hours or more efficient electric apparatuses and machinery.

2.1.5.1 SOCIAL EFFECTS OF RURAL ELECTRIFICATION

Most scholars agree that RE has positive relation on education and health. Barnes (2004) in Costa Rica reports shows that after rural area electrification there is a significant social improvement took place in the number of educational institutions with lighting and night classes increased and significantly, the number of health centers increased due to new hospitals were built up.

India shows over the past decade experienced rapid growth in economic, with an increase the size of middle class which is larger than the population of the United States of America. In 2000, the rate of population increased over 6 per cent, which required energy growth of a rate of 9 per cent. In the past two decay years alone, a 208% growth in India's energy consumption has increased by urbanization. Under these conditions and sustainable manner, it is imperative that India's need meets its growing energy necessities in a self-reliant. However, giving more than 1 billion people with a constant energy supply is very difficult, especially for country in developing in facing rising prices of gas. Comprehensive growth starts with giving access to energy to the most disadvantaged and remote communities. In India more than 18,000 villages live without access to electricity and 404.5 million people do not have electricity access.

According to the IEA. From their utility companies, numerous who do get face constant electricity insensibility and uncertainties of a steady supply of energy. The major problems are unpredictable levels of voltage and depend on supply of power, leading to power cuts due to old transmission and the inadequate energy supply. with the trust of power supply rural areas face serious problems. Climatic conditions in India's make it a very suitable place to depend on renewable energy, 45,000 megavolts megawatts (MWV) of possible wind capacity and with very high solar irradiation levels, renewable energy business growth has much potential.

The Indian economy also relays heavily on agricultural production which is the livelihood for most of the population is farming. To make a significant impact renewable energy for rural agricultural purposes is necessary. India is an agricultural country, yet the rural poor and the farmers remain not earned. The importance of renewable energy in Indian rural communities are huge, renewable energy not only greenhouse gas mitigation and expands energy generation and, but also contributes to in increased agricultural yield and improvements in local environment, employment opportunity, security of drinking water, health and hygiene, control drought, energy conservation and social welfare.

Accessing solar power and wind farms in villages gives for the rural people an overall better of wellbeing, efficient agriculture and development in the form of infrastructure. Thus, the broad developmental goals of the rural electrification program, such as sustainable development, poverty alleviation and employment generation should be integrated while desiring direct support under multilateral and bilateral cooperation. The government of India, the villagers themselves, the international community, NGOs and private businesses all have a significant role to play in creating this better life and must work together in order to do so.

After the independence of Bangladesh (1971) in 1975, under a scheme called 'Total Electrification Program' the first main initiative to wide-ranging grid electricity in areas of rural was considered. By 1978 this program proposed further grid connectivity to development of the fundamental delivery facilities for effective power supply of rural areas. For a rural electrification project in Bangladesh at around the same time, creating an institutional structure was measured, which would develop the organizational requirements, technical, social and economic and financial analysis. Moreover, at the call of the Bangladesh Government RE Project Committee, a conclusion was taken for the founding of a new national agency under the Power Ministry to develop and administer a rural electrification program. So, on 29 October, 1977 Rural Electrification Board (REB) was established and started working on 1 January, 1978 with following ultimate objectives; to provide sustainable, reliable and affordable electricity to rural people, benefit and improve the living condition of rural people, to help and improve the economic condition of rural people by giving electricity for small industries and agriculture, to ensure consumer participation in policy-making and expand electrification to the whole rural of Bangladesh.

Rural Electrification Board (REB) program performs through rural electric associations called *Palli Bidyut Samity* (PBS) locally organized. The objective of *Palli Bidyut Samity* (PBS) is created based on the model of Rural Electric Cooperatives in USA, which ownership of consumers and operates with cooperatives. A PBS is a self-governed organization, and it possess, manages and works a rural electrification supply system within its area of administration registered with REB. Its member is its consumer, who join and share on its policymaking in its governing body through elected representatives. REB's key part is to give PBS with help in initial organizational activities, management and operational activities, training, and providing link between PBS and the bulk suppliers of power like Bangladesh Power Development Board (PDB), Dhaka Electric Supply Authority (DESA), procurement of funds and other concerned Non-Government and Government agencies. One PBS area coverage is usually 5-10 *thanas* (sub-locations) with a geographic area of 600-700 sq. miles.

In 1980 the first PBS was established to perform in Dhaka. Throughout Bangladesh (REB 2007) a total of 70 PBSs is working in about 46,000 villages in 61 sites and more than 7 million rural customers serving. Subsequently, the organization of REB, RE has increased significantly. Which preliminary from less than 10% connectivity in 1977 to about 61% villages have got electricity by 2007. Every year about 800,000 new rural customers get electricity under REB's program, which is important and impressive for a poor country like Bangladesh. The Rural Electrification Board (REB) consumers are basically domestic electricity users (85 percent), although commercial customers and industrial are also helped, including those requiring connection for irrigation pumps. By the year 2020 REB cover 75,000 villages of Bangladesh. The rural electrification program in Bangladesh is many times considered as one of the most successful government programs.

2.1.5.2 ECONOMIC EFFECTS OF RURAL ELECTRIFICATION

Empirical studies and instinctive attractiveness climax the purpose of energy in economic development. The IEA has emphasized the high correlation between development and energy access (Silva and Nakata, 2009). All over the world over 2 billion people live without electricity access and they remain to stay below the poverty line (UNDP cited in Haayika, 2006). In comparison of this, RE has been a government priority for two decades so much, so that in 2009 Philippines has finally attained 100% electrification of the 41,980 barangays or villages. To finish this, the Philippines government has had to organize a lot of bilateral and multilateral support besides program from the major IPPs operating. The government of Philippines has spent US$ 1 billion or pp (Philippine peso) 49.3 billion or pp 2 million for each village from 2001 to 2009 of that amounts, pp11.68 billion from subsidies and 37.64 billion came from credit it is according to the National Electrification Authority (Anonuevo, 2009).

Historically, from the existing network distribution a large majority of the new villages were connected via line extensions. On this approach, became hard to reach last mile connections. Likewise, as the lines extended became longer and longer, quality became difficult and challenging. Subsidies increasing and losses limited scope what could be realized. Under this metric, the number of actual household connections and utilization were ignored, whereas only the reality of initial point within the village was recorded. Like the variance distinguished in the impactful growth on GDP, complete electrification of the village did not impact on poverty reduction. In 2003, commissioned of ADB study to discovered and find out why some “New and Renewable Energy” (NRE) projects failed to meet their requested objectives. Between the areas that need consideration include lack mobilization of stakeholder, institutional problems (inappropriate management practices), financial problems (high tariffs for consumers or high initial and maintenance costs), technical problems (use of obsolete technologies and lack of spare parts for operation and maintenance) and beneficiary participation.

Asian Development Bank (ADB) notes that in the long-term it is important to ensure installed NRE systems are sustainable. It is also essential opportunities to develop renewable energy-based livelihood. Sample of these undertakings could be mini-ice plants for cold storage of fish and rice mills. Operation and market access, provision of training and skills for maintenance are also essential parts of these projects. For Philippines in 2009, the WB approved a US$40 MM credit through Development Bank for the Rural Power Project (RPP) for the purpose of reducing poverty and improving the well-being of 10,000 households in poorest areas of the country, mainly in Mindanao, and in rural areas in hard-to-reach and isolated. The RPP will upgrade these distributors to become financially viable and operationally efficient, emphasize rural electric cooperatives, target households, use more public-private sector partnerships. At this point, one may ask if maybe this is the crucial to illegal provision of electricity with poverty reduction. Certainly, it would give sustainability of the projects financed by these loans. Also, areas with high poverty can be recognized and attention on it. It would also be suitable to think again the nature of the problem at hand.

The Population of Zimbabwe is approximately 13 million and an area of 398 000 sq km. This country was under the Colonial rule from 1890 to 1980 when it succeeds independence. In the early 1980’s the extended all to electrify rural growth points and service centers started. RE Masterplan Study of 1995 (ADB-funded), was confirm and approved by Cabinet in 1997. In 2002 the new Electricity Act passed initiated the privatization utility of electricity and setting up of Rural Electrification Agency with own board having majority of Provincial Administrators. Rural Electrification Agency embarked on the distribution of RE Program, funded by tax on electricity tariffs (in last 5 years rose 1%-6%) and additional government provisions. The approach in Zimbabwe to rural grid extension was aimed on unelectrified rural centers. These are rural centers where infrastructure that the local government develops such as health services and agriculture extension, police stations are located. Government houses and premises are connected free. Household connections for rural public are not subsidized. Rural electrification has continued but at a very slow pace.

Lim (1984) argues that the poor economic returns of rural electrification in Malaysia could improve when other socio-economic inputs to rural development were also provided. In USA, rural electrification in the 1930's was expected to improve the economic competitiveness of farm families, but unfortunately it was not enough (Yang, 2003). Fluitman (1983) mentions that the costs understated and the benefits of extending the grid tend to be overestimated. His study did not find much evidence to suggest that electricity, which could be used for productive purposes, had any major beneficial effect on income generation or employment of poor in the rural areas. On the contrary, with the "partial and existing empirical evidence", he says that, there is some indication of net job losses and more unpleasant income distribution as a result of electrification on rural areas.

This, it is further stated, is not to suggest that rural electrification should not be developed but that there is a need for a more careful and sensible planning and evaluation of such programs. If most of the people cannot afford to use it, RE may not gap the income difference. Only as income increases, the type of fuel used also shifts towards electricity. A survey conducted in South Africa indicates that the energy transition theory is mostly driven by income rather than the access to electricity (David, 1998). Fuel switching towards electricity, the study found out, was evident in a substantial way in wealthier households and electricity substituted other fuels in only a few households. In the middle- and low-income households, electricity existed to be more of an additional energy source rather than a replacement for other fuels. Barnes (2004) suggests additional intervention to assist the rural people obtain the benefits by helping them consume more energy. He tries to explore ways and means by which the viability of rural electrification could be improved. Costs of wiring, lack of credit were some reasons why households in electrified villages still un-electrified. He suggests introducing credit and loan promotion schemes includes as part of the rural electrification project. Other areas to enhance the impact is to introduce social infrastructure and community street lighting, electrifying public buildings, functions like vocational training, adult literacy campaigns.

Zomers (2003) point out those criteria for making decision as to whether a rural electrification project should be implemented have changed or not. He says that growing environmental issue are also playing key roles in decision of rural electrification. Fluitman (1983) concluded that the costs understated and the environmental and the economic benefits of rural electrification can be overestimated.

There are other issues that are directly not known in common socio-economic impact studies. Davidson and Mwakasonda (2004) say that “strong institutions are the backbone of an effective and efficient energy sector”. They address that countries similar in social and political setup may still require different policies to create the right enabling environment. Foley (1992), unlike most papers on Rural Electrification, narrate some of the important institutional concerns and options to carry out rural electrification works. Several alternative other than having the rural electrification program implemented under the central utility’s direct control are suggested with examples of their usage in different countries. The strength and weaknesses of each of the different institutional setups are described. He described that the institutional aspects of rural electrification programs need as much attention as the technical aspects for successful implementation.

2.2 EMPERICAL LITRATURE

2.2.1 Rural electrification studies in the world

In developing countries some of the recent difficult efforts to determine attribution of rural electrification on development outcomes include Chakravorty et al., (2014), Dinkelman (2011), Lipscomb et. al., (2013), and Rud (2012). The first study examined impact of RE on income, on female employment and wages the second study, the third on Human Development Index, income, and poverty, and on industrial outputs is the last study. All these studies tried to separate the causal impact of rural electrification and used the method of an instrumental variable to address the selection bias rising from the non-random placement projects of the electrification. Previous literature reasoned that the relationship between developmental and infrastructure outcomes could be confused meanwhile the project placement could target developing or socio-politically vital areas.

Chakravorty et al., (2014) in India district-level density of transmission cables used as the instrument for household’s electrification status and due to high-quality access to electricity reported a significant rise on non-agricultural income. For expansion of electricity network across regions used accessibility of groundwater as an instrument, Rud (2012) in India found that delivery of electricity is linked with positive gains in manufacturing output. Dinkelman (2011) studied using land slope as the instrument for program placement as the labor market effects of electricity delivery in rural areas of South Africa. Her results indicated a rise in female employment, increase in male’s wages and decrease in female’s wages. Moreover, Lipscomb et.

al. (2013) in Brazil distinguished positive impact of electrification on investment in education, Human Development Indicators, salaries, and employment. Additional study shown in Nicaragua by Grogan and Sadanand (2013) reported higher propensity of off farm for women employment, but not for men. They use previous population density as an instrument for current electricity access.

The handful of studies between on the impact of rural electrification on developmental outcomes. For instance, in a recent study by Dasso and Fernandez (2015), the authors found no impact on earnings in the double-difference model, but reported a positive effect on earnings for the women in the tune of about 35%, but they did not find any effect on men's earnings in the fixed effect models in Peru. Also, by using the instrumental variable (IV) method estimates of the impact of electrification on income of the household in Chakravorty et al., (2014) between 86.7 percent and 89.8 percent ranged.

In Viet Nam and Bangladesh two other studies were conducted that gave the effect of electrification on income and education (Khandker et al., 2012 and Khandker et al., 2013). In Bangladesh using instrumental variable method, Khandker et al. (2012) due to electrification found that the household per capita expenditure raised by 11.3% and overall total income increases by 21.2%. In addition, as a result of electrification boys and girls study time also raised by 22 and 12 minutes a day. Similarly, in Vietnam Khandker et al. (2013) estimated the effects of electrification using household fixed effect model. They show that electrification of the household had positive effects on total and nonfarm incomes. in Vietnam as a result of electricity access at household level, increase by 28 percent and 27.5 percent, total and nonfarm income respectively. Household rural electrification also impacted children educational attainment. Electricity access at household level raised school enrollments by 9% points for girls and 6.3 % points for boys. By 0.11 years boys' schooling raised, while the impact on girls' schooling was statistically insignificant.

In India RE was also found to rise household per capita income and expenditure, labor supply of men and women, schooling of boys as well as girls, (Khandker et al., 2014). This study used instrumental variable (IV) method and the instrument used was households' own socioeconomic characteristics and interaction of proportion of households in the community which is electrified. The IV is reliable with the literature on demonstration effect and peer pressure that highlight the status of neighbor's activity on own decisions. Rural electrification also helps to reduce poverty and improved labor supply of men and women in India. Van de Walle et al. (2017) used instrumental variable and double-difference method to evaluate the effect of household and village electrification rate on income, consumption, education and labor supply in India. In rural India over 1982-1999 they found that household electrification had significant gains on labor supply, schooling and consumption. According to the instrumental variable (IV) method, rural electrification produced a consumption gain of 8.8 percent (0.5 percent per annum), which shows a gain of Rs. 300.3 per person per year. For girls were found Positive impact but not for boys. Some evidence there was dynamic effect of household's village connectivity without electricity themselves. Rural electrification were unaffected wage rates and the gains in labor earnings were mainly comes from extra work done by men.

The results from these studies clearly shows that empirical evidence on the effect of electricity provision is mixed. The sign and magnitude of the effects depend on location of the study, the outcomes analyzed and empirical methodology. Assumed a limited number of difficult effects of RE programs evaluations so far in a handful of countries, more efforts are needed to gather evidence in a causal framework. Use of electricity for improved human welfare and depending on the prevailing enabling environment for the access Moreover, the impacts may vary by the context of the country.

Studies have shown that in electrified homes (with access to electricity), consumption of energy constitutes, on average, 4 percent budget of the household, whereas, in non-electrified homes (without access to electricity), 15 percent budget of the household is spent on energy (MRC 1998). Further studies show that, electricity is the most cost-effective energy source for cooking besides, self-collected wood at no financial cost. The somewhat few with the access programs for the rural areas, low cost of electricity, has resulted in a much higher proportion of households cooking using electricity in South Africa than in several other African countries. Though, when seeing simultaneous space heating and cooking, wood and coal burning stoves arise to be more cost effective than electricity in the higher regions of the country (Graham and Dutkiewicz 1998).

Electricity helps a varied population, which includes domestic and commercial users, industrial, and each is services unit supply and under different costs. For a different kind of reasons, use of electricity is subsidized among the different groups and there are subsidy differentials for the different kinds of users. The KPLC schedules for tariff useful five tariff rates classes: 1. large consumers and industrial consumers. 2. medium commercial and industrial consumers. 3. ordinary domestic consumers and small commercial. 4. to ordinary consumers interruptible off-peak supplies and 5. street lighting. The industrial and commercial consumers are the main electricity users for economic production and consume 75.5 percent of the total of the distributed electricity, whereas the rest of the residential users or domestic class consume only 23 percent (KPLC, 2006). The domestic class is often considered less essential, because of low contribution to the economic output and their low consumption rates. There has been maintain in decreasing the costs for both grid and off-grid services, but the major barrier are monthly consumption costs for low-income households and the initial connection fees (Townsend, 2000). It is necessary to compare household income with connection cost to assess the need for affordability connection to electricity services. Affordability define the actual ability of a household to pay for goods and services and it can be distinguished between consumption and the affordability for access (Estache et al., 2002), which the study is a key determinant.

Income and Expenditure

RE can lead to improved employment and income opportunities, availability of wage goods and farm and nonfarm productivity, thereby increasing mean consumption and income. However, as the UNDP explained, RE is not enough condition for growth of income. Complementary infrastructure such as transport, roads, buildings, markets, equipment, and information and training frequently not provided in tandem with electricity are necessary from electrification to attain economic benefits. In general, RE does not initiative industrial development, but it can spur growth of nonfarm and home businesses activities. Such increase their hours once electricity becomes available and businesses mostly employ family labor. As create by the World Bank IEG study electrification thus offers a small increase to the incomes of some households. However, the evidence for this point remains inadequate.

Due to monsoons, agricultural output fluctuates in many developing countries, which farmers depend on for irrigation. RE can increase agricultural output by encouraging farmers to use irrigation high-yielding farm practices, equipment and tools. World Bank an evaluation helped RE projects in India and Bangladesh create that RE improves reducing poverty incidence, the use of irrigation. Another study, in India using data from 85 selected districts of 13 states to survey the role of rural infrastructure in agricultural investment, initiate that electricity encourages investment in irrigation infrastructure. It also carried out that the electricity availability, along with improved agricultural output, inspires the growth of grain mills. Though, the issue of whether electricity profitability through increased hours of operation and use of equipment and tools and increases productivity was not explored.

In Bangladesh USAID estimation of RE found that the household's average annual income with electricity access (electrified) is 64.5 percent higher than that of households without electricity access (unelectrified) villages, and 126.1 percent higher than households without electricity in electrified villages. The overall average annual expenditure in the households which is electrified is more than the corresponding figure for the unelectrified households in electrified villages and for households in unelectrified villages. The study also found a positive impact on agricultural production, irrigation, commercial activities and business turnover.

The World Bank IEG study, focusing on cross-sectional data from Philippines, Peru, Ghana, and Lao People's Democratic Republic found that electricity access rises (i) profit coupled with improved community infrastructure; (ii) hours that household members put into businesses; and (iii)) use of electrical equipment and tools, thereby increasing productivity. Also, it showed that areas with electricity access have more home businesses, which is more profitable due to operate for longer hours. On the other hand, electricity has an insignificant effect on income and agricultural output. Animal manure as fertilizer appears to be the only factor affecting agricultural production, of the 702 farm households surveyed. However, as mentioned before, in other developing countries, electricity does play an essential role in improving income and agricultural output.

In Bangladesh and Viet Nam, two other recent World Bank studies that examined the impact of RE on per capita expenditure, total income, farm income, and nonfarm income. Both studies provided reliable evidence in support of the positive impacts of RE on expenditure and income. They undertook the issue of causality by employing robust econometric techniques, to address endogeneity concerns, such as PSM, difference-in-differences, and instrumental variables.

In rural Bangladesh using a cross-sectional study conducted in 2005 of some 20,000 households, the first study observed at the impact of RE on household welfare. It found that rural electrification has positive impacts on per capita expenditure, total income, farm income, and nonfarm income. Standard PSM showed that electrification increases by 15.4% per capita expenditure and by 30.0% total income. Further disaggregated analysis found that by 72.9% increased farm income and by 90.3% increased nonfarm income. Instrumental variable estimates were qualitatively similar, but the magnitude of impacts was more modest. It showed that total income raises, farm income increased, and nonfarm income increased, by 12.2%, 52.1% and 22.9%, respectively. This study also found varied impacts on poor and rich households and concluded that physical capital makes a change in the distribution of electrification importance since rich households benefit more than poor ones.

In Viet Nam the other study estimated the impacts of RE using a difference-in-difference method. To date, this is the first study that joint with difference-in-difference and propensity score matching to estimate the impacts of rural electrification on socioeconomic. Most studies depend on cross-sectional surveys, comparing households with access and without access to electricity, which hurt from endogeneity and selection bias issues. Through functioning panel estimation, this study analyzed the impact of RE on per capita expenditure, total income, farm income, and nonfarm income. It estimated three different models (i) simple difference-in-differences: (ii) difference-in-differences with fixed effect, and finally (iii) difference-indifferences with fixed effect and PSM. A positive and significant impact was found only on total income, but amazingly, no effect was found on per capita expenditure in the simple difference-indifference model. An insignificantly negative impact on farm income and a positive impact on nonfarm income an additional disaggregated analysis of total income confirmed. Due to access of electricity electrified households have 36.2% higher total income and 70.0% higher nonfarm income than unelectrified households.

To improve the simple difference-in-differences method, the study estimated a fixed-effect model by spreading the difference-in-difference method by adding household and commune level covariates as additional dependent variables. RE effects from the more difficult fixed-effect model were different from the simple difference-in-difference effects. Farm income rises by 30% and is statistically significant, according to this model; however, no impacts on nonfarm income are found. In fact, RE has a negative impact on nonfarm income. One possible reason could be the use of electric pumps that may have dramatically improve farm productivity. Due to electrification total income rises by 25 percent, and, in contrast to the simple difference-in-difference model, per capita expenditure rises by almost 10 percent.

Furthermore, by using a PSM method the study enhanced the fixed-effect model. First, its matched households with similar characteristics and then used fixed effect with difference-in-difference for samples of matched households. Suggesting that matching did not improve the model results from this model were not different from the earlier model with fixed effect plus difference-in-difference. Total income is 25 percent higher and farm income is higher by 30 percent. Amazingly, no significant impacts were found on per capita expenditure and nonfarm income for electrified households. The study also observed if the well-being effects varied with respect to length of introduction to electricity. It found that for per capita expenditure and farm income, early connectors gain more than late connectors. There was no differential impact between the two groups on total income, nonfarm income, and schooling outcomes. Taken together, these results proposed that the economic effects of RE on per capita expenditure and income are unclear. Only a few studies have demonstrated a positive impact on per capita expenditure and total income, while impacts on farm income and nonfarm income continue an open research question.

Education

RE may affect education by (i) improving the school's quality, either increasing teacher quantity and quality or through the provision of electricity-dependent equipment; and (ii) better allocation of time at home, with raised study time, though the accessibility of TV may reduce that time.

In developing countries rural schools often absence basic infrastructure and equipment, such as classrooms, textbooks, furniture, drinking water, and toilets and, but electricity may not affect this directly. It may address these constraints if there is an overall development of the electrified village for various reasons indirectly, such as effective use of government funds, allocation of more government funds, and social awareness due to media exposure. Further, in developing countries primary schools are characterized by high teacher absenteeism, due to weak teacher incentives or which may be due to many teachers failing to take up jobs in rural and remote villages. The World Bank IEG study provided evidence that the accessibility of electricity makes more attractive to teachers in rural positions. Electricity, due to high-quality bright light may also have an impact on education through increased study time at home. Children's productivity and efficiency rise when they study under a bright light compared to wick lamp or a dim flickering candle.

The World Bank IEG study, used a Cox proportional hazards model, based on health and demographic survey data from nine countries, to estimate the impact of RE on children's dropout rates, where the hazard is dropping out of school. The study described that RE improves the propensity of children to stay in school indirectly. However, due to illumination after dawning, it could not confirm that this effect is mediated through a rise in studying and reading hours.

Though the impacts are more pronounced for boys, some evidence suggests that RE leads to a rise in the years of schooling for school-aged children. In Bangladesh the World Bank study studied the impact of RE on study time and on years of completed schooling. It found that boys' completed years of schooling rise by 0.09 to 0.27 years, for girls, the study found a positive impact on years of completed schooling, and the estimates varied from 0.12 to 0.36 grades, depending on estimation methods. They also investigated depending on estimation methods the impact of RE on study time, and results suggested that boys' study time rises by 4.9 to 18.2 minutes per day, while girls' study time rises by 8.9 to 17.0 minutes per day. Generally, the impacts on study times and completed years of schooling were positive and highly significant in Bangladesh.

In Viet Nam the similar study examined the impact of RE on completed years of schooling and school enrollment. It found an insignificant impact for girls, but a significantly positive impact on boys' completed years of schooling. The impact on boys increased from 0.52 to 0.67 years completed years of schooling. In electrified households' girls vary from 0.14 to 0.39 years completed years of schooling, but these impacts were insignificant. In Bangladesh and Viet Nam, it should be noted that impact on girls' completed years of schooling is similar, while in the case of boys, the effect in Viet Nam is greater than the effect in Bangladesh. The study also found that in electrified households school enrollment is about 11% and 10% higher for boys and girls, respectively in Viet Nam.

The ESMAP study found that children with access to electricity (electrified which is 8.5 years) households have almost 2 years more schooling than children without access to electricity (in unelectrified which is 6.7 years) households (8.5 versus 6.7 years). Though, this estimate did not control for other individual, household, and community factors it was based on single difference. The study also showed that the accessibility of electricity in a household after controlling for factors such as, education, age of the head of household and housing index, has no significant effect on children's and adult propensity to study and to read and. However, after individuals chose to read or study, electricity increases the time that adults spent reading by 27 minutes and the time that children spend studying by 77 minutes. Used the Heckman procedure the ESMAP study to estimate the impact of RE on children's reading studying. It found that electricity has a negative impact on children's propensity to study or to read, which, in turn, by more time spent watching television and on other forms of entertainment is supposed to be caused. However, electricity rises the time spent studying or reading for children by 48 minutes per day and adults by 15 minutes per day, conditional on the decision to study. Lastly, the World Bank IEG study found that even after controlling for community and parental factors, electricity has a positive impact on education in rural areas.

In overall, after electrification there is a rise in educational activities. Study time at school is prolonged either by holding night classes or by providing longer library services. In Bhutan, for example, more students in electrified villages are studying for longer durations. Further, nonformal education at night is available to accommodate villagers. Presence of television in the prolonged evenings, and the capability to join nonformal education facilitate school enrollment and higher literacy rates. In addition, RE shifts enabling children to attend to school during the daytime, thus some household tasks to the nighttime. In rural Bangladesh improved literacy rates, though, are attributed not only to RE but also to an associated mass education program. After their regular household tasks or farming activities, poor workers are encouraged to attend night school.

2.2.2 Rural electrification studies in Africa

In Sub Saharan Africa the last few years have evidenced a renewed interest in development of infrastructure., it is now estimated that the continent’s low infrastructure development is accountable for a 2% deficit in economic growth per country, following years due to macroeconomic structural adjustment programs. Mainly the essential are the growing concerns with the continent’s low power generation and supply capacities.

The World Bank (2009) calls for $930 billion to be invested over 10 years in the continent’s infrastructure, of which almost half should be dedicated to the energy sector in the region in its new report on infrastructure development. In fact, in the 1980s with the same status in Sub-Saharan Africa’s electricity generation capacity per inhabitant is now one-tenth of that in East and South Asia. And only 40 % its electricity coverage. Within the power sector, developing countries they attained 50% where over the past 30 years the electrification rates have stagnated at less than 10 %, although specifically RE remains low in Sub-Saharan Africa. General, and despite the essential potential energetic of the region, there are about 226 million people in Africans living in rural areas without electricity access.

Thus, the World Bank (2009) recommends that one-fourth or 25 percent investments of the energy sector which is almost about $10 billion per year from $930 billion be allocated for rural areas to distribute and generate electricity. And while far off the declared objective, African governments and several international donors such as the African Development Bank, the World Bank, the European Union, and the United Nations Development Program, along with many bilateral aid agencies have increased their emphasis toward encouraging rural electrification.

RE the support of public sectors and donors to puts on three supplementary groups of explanations.

First, RE is supposed to benefit to poverty reduction. In the medium and short run, through increase productivity and create employment opportunities for growth of local economic which allowed by a dependable source of power access can benefit the poor indirectly and directly. Further, in terms of education and health human capital development enabled by access to electricity can help boost to social well-being constraints and the poor's economic. In the longer run, the local development process by that enabling the environmental sustainability, RE can decrease environmental pressures. Overall, while RE is not the Millennium Development Goals (MDGs) a specific target, in rural areas many supposed to consider that it is an essential condition to their achievement.

Second, in the domain by the ordinarily low private sector engagement, despite potential rents from natural monopoly situations the involvement of public sectors and donors in encourage RE is justified. In fact, to RE programs tells their essential costs and limited returns in the short and medium run one major difficulties, for example in contrast with cellphone development. Indeed, initially the rural populations have low electric consumption level, along with tariff policies intend to equalize the price of a kilowatt-hour between urban and rural areas for a given level of service, imply limited returns, and investments for off-grid schemes and grid extension to reach scattered communities and remote areas are frequently important. Generally, it persists that RE usually needs large subsidies, if successful electrification programs are often those that have managed to control costs low and recover part of the investment.

Lastly, development of rural electrification, answers to political incentives for governments, as for most it is public infrastructure. Electricity is usually seen as the key to the modern world, apart from its potential causal impact on poverty reduction and local growth. Without it, in developed countries people and societies are being deprived of many facilities often considered as basic, and governments deliberate it their duty to encourage rural electrification across the territory to improve economic and social cohesion. It is remarkable that rural electrification in today's developed countries was frequently based on temporary political will rather than reality returns assessment of its socioeconomic. In addition, and despite decades of investments in the sector, most project documents base their expected impact estimates on a priori beliefs, and little is known about the effective impact of rural electrification on households' welfare (Barnes and Halpern 2000). The essential donor subsidies and level of government for rural electrification at a time of inadequate resources and challenging investment needs therefore calls for deeper researches. The dependence of public investment on international aid makes these vulnerable to paradigm shifts that have characterized the past decades, this is particularly the case in Sub-Saharan Africa where, due to absent of robust evidence. In fact, particularly in terms of low connection rates and weak productive use of rural electricity, most of what is known today was known some time ago. Additional, although recent studies provide promising examples of robust evaluations, actual impacts of rural electrification on their beneficiaries remain largely unknown due to attribution difficulties.

Unstable Support to RE in Sub-Saharan Africa

One can distinguish three stages with respect to RE policies over the past 30 years.

Period 1: Infrastructures for Development

Under-development was understood primarily as a lack of equipment to support growth, and infrastructures investments policies were given a central part in development until the early 1980s. Rising investments growth were urban centers in part intend to limit migrations to already saturated in rural areas. In this context, rural electrification was an essential part of the solution. It was supposed that rural electrification would give to limiting rural to urban migration, by bringing in modernity and a suitable source of energy to support economic activities (agriculture and non-agriculture). It was also predictable that households would shift away from fuel woods and thus limit the related deforestation for which forecasts were then catastrophic (Arnold and others 2006). Finally, rural electrification thereby contributing to increasing productivity and future revenues and was intended to contribute to long term growth via its effects on human capital development (Tendler 1979).

With these forecasted benefits, rural electrification programs in the period were given strong support and with the lack of data to support them. Besides, if initial investments were high, consumption rates increased, and marginal costs were believed to decrease as fast as connection. Its “political returns” were also believed to be significant, electricity being a synonym for modernity.

Period 2: Structural Adjustments

In the 1980s and the early 1990s, in Sub-Saharan Africa infrastructure programs were no longer seen as the priority. Not only they did not generate the expected growth in return infrastructure but did development in the earlier period give to the unsustainable debt burden of most countries.

the structural adjustment plans and the crisis of the 1980s that followed led to a reconsideration of the relative effect of these programs.

The rural electrification programs this concerned particularly, given their disappointing results and high costs in the rare cases where these were assessed effectively (Rambaud-Measson 1990). Mainly disappointing were the observed low connection rates, and the rare productive use of the electricity provided, and despite improved access (De Gromard 1992). In fact, electrical consumption was mostly related to radios or televisions and house illumination, one observed that only 25 to 50 percent of households in electrified villages were connected; and for those who were connected. As the impact of wood fuels on deforestation was much lower than initially thought (apart from peri-urban areas), and connected households did not decrease their use of wood as a result of having electricity, in particular for activities such as heating and cooking, environmental benefits were also deemed limited. Further, with electricity the importance in terms of education and health remained largely unknown, and migration from rural to urban did not seem to reduce in villages. Lastly, it was observed that rural electrification concerned basically wealthier households, for whom the large subsidies involved in rural electrification programs were not justified.

Generally, the favorable cost–benefit analyses achieved in the previous period seemed overrated, on the benefits side that remained unknown or limited (Pearce and Webb 1987). At the same time the underlying rationale for rural electrification itself was asked, with numerous micro-microstudies arguing that it is the growth of income that creates the demand for electricity and not the reverse (Foley 1992). At the least rural electrification could thus contribute to an increasing of growth but did not establish an essential condition to its start.

International Labor Organization as noted in a report rural electrification programs were thus judged rather negatively over the period (Fluitman 1983), “A major impression one retains from a review of the pertinent literature and statistics is that the benefits of rural electrification, including the social benefits, tend to be over-estimated and the costs under-stated. Multi-million-dollar schemes, it appears, are repeatedly based on conventional wisdom fueled by extraneous motives rather than arithmetic. The role of subsidies is therefore debatable, particularly in countries yet unable to satisfy needs more basic than electricity. In our view, the time may have come to substitute the benefit of hindsight for the benefit of the doubt.”

Period 3: Poverty Reduction

In its various dimensions the late 1990s saw an improved focus of development policies toward fighting poverty. And with the implementation of the MDGs in 2000, the essential of energy as a necessary condition is now emphasized to fight poverty, improve education and health, provision women empowerment, prevent natural resources degradation, etc. (IEA 2002). For Jeffrey Sachs, "Without increased investment in the energy sector, the MDGs will not be achieved in the poorest countries" (Modi and others 2005). Therefore, several rural electrification project documents now use the MDGs as their main justification, though with little data to support these claims (World Bank 2008), and some international initiatives have arisen, looking for to catalyze funding for the sector.

Since the 1980s to avoid failures observed in terms of limited productive use and low connection rates, choices are also measured to encourage services without which access of energy will not lead to significant progress. Therefore, electrification must be thought as an input among others in combined projects linking access to productive equipment (via grants, credit-bail or loans) or training on electricity usage (Peters, Harsdorff, and Ziegler 2009). In addition, low connection rates problem, mainly among the poor, indicates reconsidering the use of targeted subsidies, other technologies lowering barriers to connection, or prepaid meters.

On aid effectiveness following the Paris declaration, according to different intervention modalities, the past few years have also seen a growing number of effect studies meant to measure and compare the impacts of projects on their beneficiaries. Such studies are relatively extensive in the field of education and public health but remain rare in general in the field of infrastructure and quasi-inexistent for RE. In the recent rise of rural electrification programs proposals, the possibility to measure their effect on targeted populations and to study the conditions under which these can finally be improved. Often leading to uncompleted projects and lack of maintenance, in turn these studies may contribute to limiting the type of policy changes described above that can be particularly pervasive in the field of infrastructure (Estache and Fay 2007).

2.2.3 Ethiopian Government Rural Electrification

The grid based RE program, that is the UEAP, in rural areas aims at growing electricity access services from its baseline access level of 17 percent to 50 percent in five years. Estimated UEAP budget is US$1 billion, financed partly by government contribution and partly through external donors and bank loans (World Bank, 2006). The Ethiopian government finances up to 2 billion birr in 2008/9 budget year. The UEAP will primarily be using cheap and abundant hydropower resources with an extension of the main interconnected grid system. Alongside the RE expansion program will be an aggressive program of increasing hydropower-based generation capacity. A total of 7,542 rural villages and towns were identified as not having access to electricity services while 785 rural villages were already connected by the start of the RE expansion program.

The UEAP started operation in 2005/6, connecting 179 towns the first year, 784 towns the second year, and 1206 towns the third year, of which 455 were completed while connection of 751 towns was under way. The UEAP had managed to connect 2169 rural villages by the time this study was in progress, bringing the number of electricity connected rural villages to a total of 2954. A 36 percent increase in access to electricity services was achieved in three years. By July 2011, the UEAP connected 5,866 rural towns and villages, providing electricity access to 46 percent of rural villages in the country

The Ethiopian government has instituted substantial changes over the last five years in generally revitalizing the energy sector, particularly power sector development. Policies have focused on more specific areas of power generation and rural electrification, and on using the latter as a tool to reduce poverty. Progress in RE expansion has so far been remarkable, with over 5800 rural villages being connected to electricity services from the grid in five years, starting in 2005/06, raising the access level of rural towns to above 46 percent by the end of the first phase of the project.

Randomized Household-level Encouragement

Ethiopia’s Universal Electricity Access Program starting in 2005 with a budget of close to a billion dollars for its first five years has set out to electrify most rural towns and villages. Where RE rates are close to 1 percent in a country, it is expected that improved access to a reliable source of power will improve households’ welfare by creating scope for new income-generating activities, improving conditions for education, access to information and expanding communications, and other such channels.

Households are responsible for paying the costs of connecting their house to the main line, which typically amounts to between $50 and $100 within each selected town or village. These costs are likely to be prohibitive for many households, in a country where 80 percent of the population lives on less than two dollars a day, limiting the expected impact of RE on growth. Ethiopia’s power utility has traditionally proposed low interest loans to its clients, to facilitate the connection of poorer households thereby smoothing connection costs over three to five years. It seems, mainly among the poorest households, which are reluctant to engage in long-term financial commitments however, that take-up of such loans is quite limited.

Bernard and Torero (2009) for various levels of household income set out in their study to test the relative efficiency of connection subsidies. In fact, so-called "smart subsidies" have frequently been encouraged in RE projects, but they have seldom been realized and to our knowledge have never been tested. In 10 village communities electrified over the year 2008 the study depends on the random allocation of vouchers covering 10 to 20 percent of a household's connection cost. Enables comparison of household connection rates over time, between voucher recipients and nonrecipients, a baseline survey conducted before electrification, and a comparison survey conducted a year later. Enabling the identification of the electrification's impact on such outcomes as men, women, and students' time allocation, the random nature of the voucher distribution further allows their use as instrumental variables for household connection decisions.

Impact of RE on Poverty Reduction Evidence from Northern Ethiopia

Effect of Electricity on Household Welfare

Girma T, et.al. (2015) This study takes the levels of household income and consumption spending as proxies of the levels of household welfare. So, first what do is that present the levels of means household income and consumption spending in each village. Ashegoda (which is not electrified) has the highest level of income while the lowest income is that of Romanat (which is electrified). Therefore, if we were to judge wellbeing just by income, we would say Ashegoda is relatively well-off while Romanat is the poorest. But since the literature sufficiently shows that income is not a good measure of wellbeing, we also wanted to see the levels of consumption spending. Interestingly what we find is that Romanat has the highest level of consumption while Ashegoda has the second lowest (after Sherafo) – also note that mean income in Sherafoos the second largest. The effect of electricity on consumption spending is positive and quite large. The same story holds when we break down the consumption spending into food and nonfood. But in relation to income we see that the effect appears to be counter to expectation. This can be explained by the possibility of a significant difference in terms of other factors like having irrigation and fertile land that affect the level of income in a significant manner. At last we also tried to see the effect of electricity on level of education which can be taken as a component of wellbeing and a determinant of it also.

Having access to electricity has a visible effect on the level of schooling. This holds good since electricity enables households to have more spare time as some of the labor demanding works can be simplified with electricity. Not only that but also having access to electricity may lead to good access to information which will influence their decision on whether to go to school positively.

Impact of Electricity on Poverty

In order to see how electricity impacts up on poverty we estimated a regression of determinants of poverty on the probability of becoming non poor. We take the one dollar per day measure of poverty as a basis to classify households in to poor and non-poor. In this study we gathered income and spending data of households for three consecutive months of the year 2012. So, using this data we find that the poverty line will be $900 of income for the three months. Taking an exchange rate of 18 Birr for one dollar we find that the poverty line is 16,200 Birr of income for the three months.

Result shows that the poor section of the sample is very large (75%) while the non-poor section is quite small. What is surprising is the difference in mean income that we found. The non-poor section of the sample is found to have a mean income which is more than four times (426.8%) that of the poor ones. Coming to the regression section, first we tried to see the effect of electricity by regressing the probability of becoming non poor on a set of variables that affect it including access to electricity as one of the determinants.

2.2 CONCEPTUAL FRAMEWORK

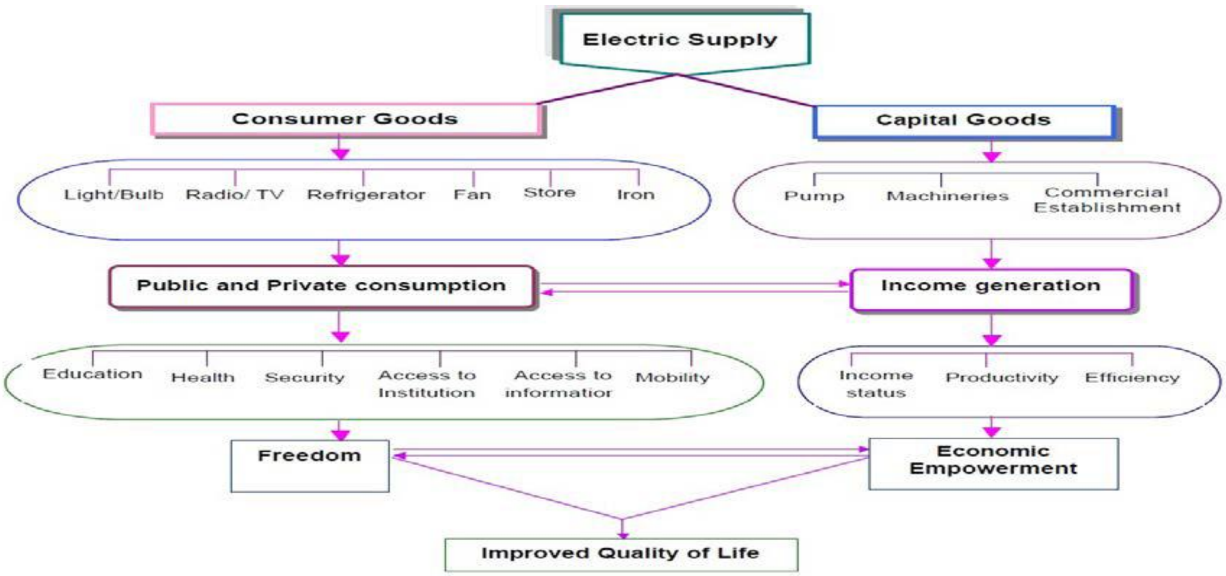
In trying to understand the phenomenon in the rural areas, there are various models which can be very applicable in the case of this study. For the purpose of this study, two models come into play. They seek to answer the philosophical as well as the orientation of the development and provision of infrastructure in the rural areas. For these areas to be seen to be participating in the national economic development, they ought to be involved. Rational Choice theory is assuming that it is an economic theory that individuals always make logical and prudent decisions that give them with the greatest satisfaction or benefit and that are in the best self- interest. Most typical theories of economics are founded rational choice theory. While minimizing that which can hurt the individual, rational choice theorists believe that most human decisions are based on maximizing a person’s own benefits. As it can help explain and predict future consumer spending decisions, small business owners should consider adapting the theory of rational choice into their business model.

It is the paradigm in the currently dominant school of microeconomics Rational choice theory is a framework for understanding and often formally modeling economic and social behavior. Rationality in micro economic models and analysis is broadly used as an assumption of the behavior of individuals which appears in almost all economics dealing with decision- making.

Rational choice theory is different from the colloquial uses of the word described in rationality. In a thoughtful clear- headed manner or knowing and doing what's healthy in the long term, for most people rationality means sane. Rational choice theory uses a narrower and specific definition of rationality, basically to mean that an individual act as maximizes personal advantage if balancing costs against benefits to arrive at action. The costs are only extrinsic to the individual rather than being intrinsic in rational choice theory.

Rational choice theory about individual's preferences for actions makes two assumptions: in all actions completeness that can be ranked in an order of preference and transitivity. It assumed that if action A is preferred to B, and action B is preferred to C, and action C is preferred to D. A preference of individual's can also take procedures: when an individual prefers strict preference occurs A, B, C or D. Indifference occurs when an individual does not prefer A to B or B to A though in some models. Other assumptions an individual include has perfect or full information about exactly what will occur because of any choice made. An individual has the reasoning or cognitive ability and time to weigh every choice against every other choice.

Figure 2 conceptual framework between rural electric supply and household welfare



CHAPTER THREE

RESEARCH DESIGN AND METHODOLOGY

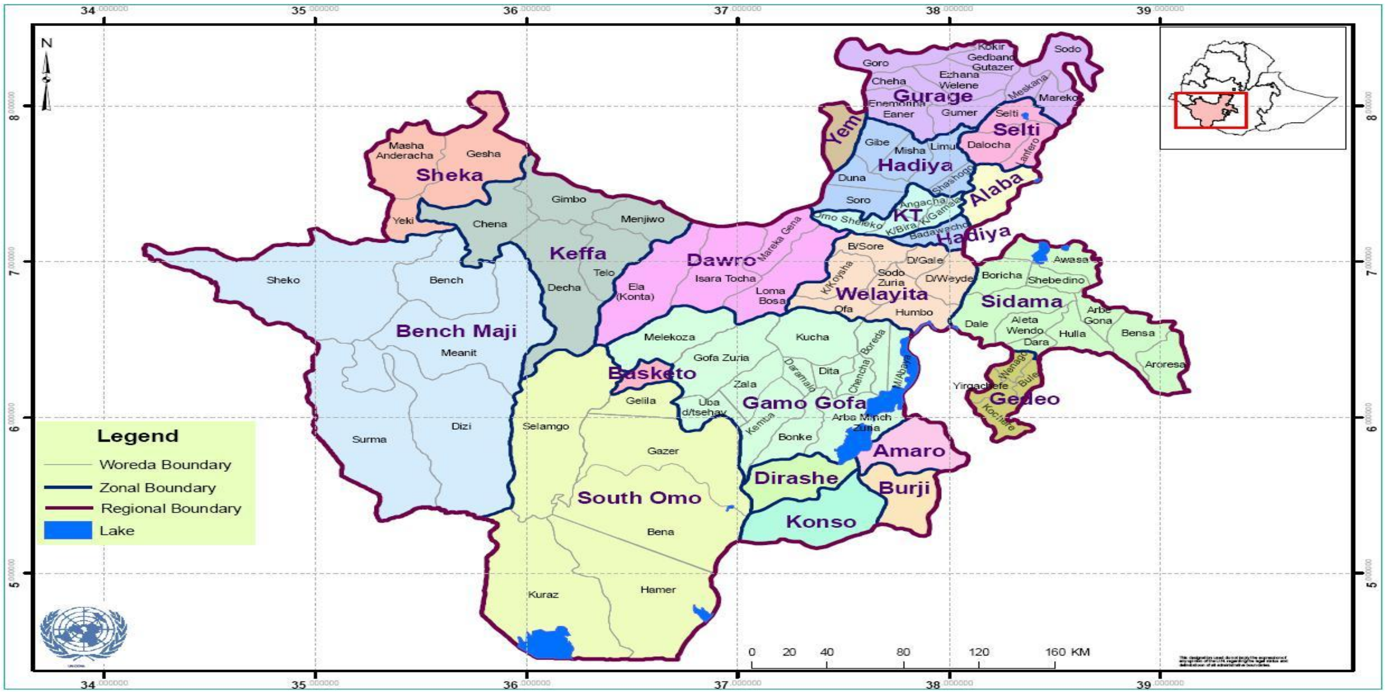
3.1 INTRODUCTION

One of the most important to achieve multi-phase and challenging tasks is Methodology. The first phase in developing the research methodology for this study was the definition of impact indicators and identification of testable hypotheses linking the Rural Electrification program (REP) and project interventions with implicit and explicit goals established and followed to articulate the study design. There are technical issues discussed which include, among others, the contexts and objectives of Rural Electrification Program (REP) and the proposed study, implicit and explicit goals of REP, testable hypotheses, impact indicators, sample and universe, and field implementation, in addition to this the proposed study timeliness and relevance.

3.2 DESCRIPTION OF THE STUDY AREA

According to the 2017 housing and population census projection report, the total number of the zone populations was 1721591 of which males accounts 49.15 % and the rest 50.85% are accounts for females. From the total population 8.22 % of the population is living in urban areas whereas 91.78% is living in the rural areas. Throughout Ethiopia both in the urban and rural areas an electrification program is also formulating and implement. This program in relation to, a great effort is undertaking to increase and expand the electric power both in the urban and in the rural areas. This study taken from two different kebeles, that are locate in two woredas namely South-bench and Sheko woreda. The kebeles are Zemika in South-bench woreda and Gorika from Sheko woreda. Both kebeles were similar with culture, cash crops areas, on ecology and environment, forest areas. Zemika have 1276 households of them 193 are connected to electricity. Those connected share for their neighbors and Gorika 368 households not connected (2017, CSA).

Figure 3 Map of the study area

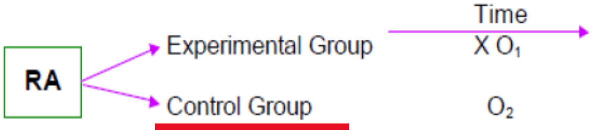


Source Southern Nation Nationality Peoples Region Administration

3.3 DATA SOURCE

Households were the targeted units of generating primary data. The researcher used a detail questionnaire to get data from households during 2020 on rural electrification, factors that may influence electricity use and its level of contribution for households' wellbeing. Observation and interviews were also taking from the study area. Quantitative data information collected through semi-structure questionnaires, qualitative data information was obtained through key informant interviews from the two major categories of households (Experimental and control) and focus group discussions (FGDs).

From the objectives as indicated in the above in this study, lack of initial or baseline measurement(pre-test) observation necessitate implementation of only Post-test (control group operations research design), which described as follows:



Where

RA = Random Assignment of the experimental group and the control group cases

X = experimental/ Program intervention of rural electrification

O1 = Observation for households' measurement with access of electricity

O2 = Observational for households' measurement without access of electricity

The rural electric service expansion study is intended to evaluate effect on via `with or without' scenario of electricity to gauge the effect of Rural Electrification Program (REP). Beside to the observational households measurements which is O1 and O2, it was decided to collect retrospective information on some specific indicators like property, ownership and assets for households which suffer less memory revoke problems, the pre-test and actual study of the household survey instruments in the proceeding of designing.

On the level of household, two types of observation measurement the study proposed:

O1 = for households Observation measurement with electricity

O2 = for households Observation measurement without electricity.

All categories of customers (consumers) were considered, in order to capture all the dimensions of impact of REP. Beside to the households, observation household's measurement was made on irrigation plot owners and pump owners, industry, and commercial units with access of electricity through RE (experimental) and without access of electricity (control). The survey technique includes both quantitative and qualitative methods.

3.4 SAMPLING TECHNIQUE AND SAMPLE SIZE

In this study probabilistic sampling strategy was adopted to ensure desired level of confidence with probability proportionate to size (PPS) as stated the number of villages electrified, instead of purposive selection. In the study area Zemika have eight village of which five are electrified. The total number of households got electrified was 193. Gorika which is not electrified have three village which have 386 households. The sample size is calculated using the formula developed by Cochran and corrected for a finite population. As for this objective, the following statistical formula was used:

$$n = \frac{NZ^2PQ}{(N-1)\,C^2 + Z^2PQ}$$

Where,

N = Size of the population

Z= Standard normal variate

P = a dichotomous probability

C = Precision level

Q = 1 – P

n = Sample Size

An estimated conservative value of P=50% (Choice of P=50% leads to a better approximation to normality which is needed for the above formulation) is used with a confidence level of 95% and precision level 10%. The Choice of precision level = 10% is allowable in social science studies in order to minimize costs relate to trade-off between Type I and Type II errors. The two kebeles strata are as follows N=1644, n=90 for propensity score matching the researcher divided in to two parts equally on this sample this is due to access of electricity is small in number regarding the number of households so, the two strata were as follows:

Table 1: Sample sizes with electrification status and households (Quantitative data)

Electrification status	Households
Village with electricity (experimental)	45
Village without electricity (control)	45
Total	90

To balance quantitative information, collected through semi-structure questionnaires, qualitative information was obtained through focus group discussions (FGDs) and key informant interviews from the two major categories of households (Experimental and control). Estimating the impact of infrastructure projects is a major methodological challenge because of absence of counterfactual state, (Heckman and Robb, 1985). For instance, in this study, the researcher can observe households either with electricity access or without electricity access but in both situations cannot observe outcomes for the same households. It is better to conduct a randomized experiment to solve missing data problem.

3.5 METHOD OF ANALYSIS

The collected data were analyzed using appropriate quantitative techniques to uncover causality, establish stronger evidence ensuring robustness. Appropriate micro-econometric techniques that account for endogeneity, unobserved heterogeneity, attrition, initial conditions and state dependence was employed. Besides, non-parametric technique for example, PSM was used in place of the nature of the data, i.e. nonexperimental data, to evaluate the impact of electric power access on household's economy and education.

More briefly the researcher employed mix of different statistical analysis techniques: descriptive techniques, difference tests and econometric models to address each research question of the project.

3.5.1 DESCRIPTIVE APPROACH

To give an overall portrait of the data and get birds eye-view of the interrelationship among reproductive health, population dynamics, economic growth and household welfare, the researcher present descriptive statistics like mean, median, standard deviations, frequencies and percentages among others. Besides, the researcher analyzes the qualitative data descriptively.

Mean/Median Difference Test

To undertake over all comparative analysis, the researcher test means, and median difference of household welfare indicators and other indicators supposed to be affected by access to electricity. The researcher tests statistical difference in household per capita consumption expenditure between households in treatment and control areas.

3.5.2 ECONOMERIC MODEL

Different econometric models can estimate the causal effect of rural electrification on poverty reduction. Using HH survey data collected, the researcher specified as model of household welfare in (1) factors that affect household welfare or that control for other regressors. In order to investigate the causal or partial correlation of each factor on a response variable, the researcher used the following sets of models that address each research question of the project.

$$\ln C = \alpha + \beta H_i + \delta E_i + \psi X + \gamma electric + \varepsilon_i \quad \text{--}(1)$$

Where;

ln *C* is household consumption expenditure in the natural log of per capita,

H_i is for household's human capital, which is vector of regressors accounting,

$\boldsymbol{E_i}$ is representing for labor market opportunities and participations which is vector of variables,
X is for other factors that affect household welfare in vector of regressors controlling,
electric is variables indicators of measuring electricity access or variables of electrification infrastructure.

$\boldsymbol{\alpha}$ is constant which is the intercept; $\boldsymbol{\beta}$ is vector of parameters to be estimated measuring the effect of human capital, $\boldsymbol{\delta}$ is vector of parameters of labor opportunities, and $\boldsymbol{\psi}$ is vector of parameters of other control variables.

$\boldsymbol{\gamma}$ is parameter of our main interest that measures the effect of electrification infrastructure on household welfare.

$\boldsymbol{\varepsilon_i}$ is a disturbance term.

The researcher specifies as a model of household welfare that the effect of rural electrification considers in (1) above.

In circumstance, including them as regressors the researcher controls the effect of other factors that affect household welfare. That is welfare of the household's measured in terms of per capita consumption expenditure is affect by the household's physical and human capital and access to *electric* power and other village characteristics. During estimations, to capture household poverty the researcher uses several sets of indicators such as poverty indices, per capita consumption expenditure (head count and poverty gap). The literature sufficiently shows that income is not a good measure of wellbeing so that the researcher wants to see the levels of consumption spending. Food and non-food items the researcher break down the consumption.

The researcher also tries to estimate the electrification impact on poverty by using logit or probit regression the model of which can be specify as under.

$$Y_i = \beta_0 + \beta_1 X_i + \gamma E + \varepsilon \text{ -- } (2)$$

Where

a) Yi = 1 when the household is non poor

b) Yi = 0 when the household is poor

c) Xi = all determinants of the probability of becoming non poor but electricity

d) E = electricity access = 1 for households with electricity access, and =0 for households without electricity access

The main target of this study is to estimate the above equation and see the coefficient γ**.**

In order to see how electricity, impact up on poverty the researcher estimate a regression of determinants of poverty on the probability of becoming non-poor. The researcher in this study uses poverty line of Household Income Consumption & Expenditure (HICE) survey of 2015/16 as a basis.

Method of measuring poverty and poverty line **Measurement and aggregation of poverty:**

CSA 2017 report in the conduct of poverty analysis consumption rather than income is used. Welfare of the household's consumption to be an indicator, for differences in the calorie requirement of different household members it must be adjusted (for age and gender of adult members). By dividing real household consumption expenditure by an adult equivalent scale computed based on the nutritional requirement of each family member this adjustment could be made.

Considers both the food and non-food requirements the total poverty here refers to an aggregate measure of poverty. Now, it is value noting that how poverty lines are recognized. The cost of basic needs method is the most widely used method of estimating poverty line because the indicators will be the threshold consistent with real expenditure across time, and more representative, space and socio- economic groups. First, by choosing a bundle of food typically consumed the food poverty line is determined by the poor. In such a way that the bundle meets the predetermined level of minimum caloric requirement (2200 kilocalorie) the quantity of the bundle of food is determined. If the objective is to get a consistent poverty line across regions and socio- economic groups, this bundle is valued at national average prices or at local prices. To the food poverty line, then a specific allowance for the non-food goods consistent with the spending pattern of the poor is added. the food poverty line is divided by the food share of the poorest quartile or quintile, to account for the non-food expenditure.

The percentage of the poor below the poverty line (headcount index), the aggregate poverty gap (poverty gap index), and the distribution of income among the poor (poverty severity index) are the most widely used poverty indices. The poverty measure itself is a statistical purpose that the chosen poverty line into one aggregate number for the population or a population subgroup and translates the comparison of the indicator of household well-being. The three measures described below are the ones most commonly used from many alternative measures exist.

Incidence of poverty or headcount index: Head count index is the share of the population whose consumption or income is below the poverty line. The share of the population that cannot have enough money to buy a basic basket of goods.

Depth of poverty or poverty gap index: Poverty gap index offers information concerning how faraway the households are from the poverty line. Across the whole population this measure captures the mean aggregate consumption or income deficit relative to the poverty line. It estimates the total resources needed to bring all the poor to the level of the poverty line, in other words it is obtained by adding up all the shortfalls of the poor (if the non-poor have a shortfall of zero) and dividing the total by the population.

Poverty severity or squared poverty gap: Poverty severity index measures not only the inequality among the poor, but also the distance separating the poor from the poverty line (the poverty gap), that is, further away from the poverty line a higher weight is placed on those households.

In developing countries poverty reports use all the three poverty indices. This report uses also all the three poverty indices specifically headcount poverty, the poverty gap, and the severity of poverty. The important complements of the incidence of poverty are the measures of depth and severity of poverty. Low poverty gap (when numerous members are just below the poverty line) but it might be the case that some groups have a high poverty incidence, while a high poverty gap for those who are poor (when relatively few members are below the poverty line but with extremely low levels of consumption or income) but other groups have a low poverty incidence.

The methods that defined above were first applied in the context of the 1995/96 Poverty Analysis Report in Ethiopia. Food consumption with an allowance for essential nonfood items this was based on the cost of 2,200 kcal per day per adult. Since 1995/96 in the country are 648 and 1075 birr at national average prices, used the food and total poverty lines respectively. The per adult consumption expenditure has been updated by deflating all food and nonfood consumption items by spatial price indices (disaggregated at the regional level relative to national average prices) and temporal price indices (relative to 1995/96 constant prices), to use these poverty lines and compute poverty indices.

First the nominal values of per adult food and non-food consumption items were deflated by the spatial price indices (disaggregated at regional level relative to national average prices) and temporal price indices (relative to 1995/96 constant prices) to arrive at real per adult consumption to calculate the 1999/00 and 2004/05 poverty indices. Second expenditure in order to calculate head count, poverty gap and squared poverty gap indices, the 1,075 Birr poverty line is applied to real per adult household consumption.

Setting poverty line: Using the consumption groups (basket of goods) defined in 1995/96 the poverty line based on the 2010/11 Household Income and Consumption Expenditure Survey was set. At 2010/11 national average prices in order to obtain food poverty line of 2010/11 these baskets of goods which provides 2200 kilo calories are valued. Then this food poverty line is separated by the food share of the poorest 25 per cent of the population to arrive at the absolute poverty line for year 2010/11. For 2010/11 are determined to be Birr 1985 and 3781, the food and absolute poverty lines respectively.

The poverty line figures set for the year 2010/11, the 2015/16 poverty line was set by applying the GDP deflator provided by the MoFEC (2011-2016). The absolute poverty line for 2015/16 is Birr 7184 per year per adult person and the food poverty line is computed to be Birr 3772 Birr per year per adult person.

To aggregate consumption poverty indices these poverty lines and the real per adult consumption expenditure are used. The real per adult consumption is obtained by first per adult consumption expenditure has been updated by deflating all food and non-food consumption items by spatial price indices (disaggregated at the reporting level relative to national average prices) and temporal price indices to bring them to December 2010 constant prices. These adjustments result into real per adult food and non-food consumption expenditure measured at December 2015 national average prices. Second, dividing the nominal consumption expenditure by nutritional calorie based adult equivalence family size to arrive at per adult consumption expenditure. The calorie based adult equivalent scale used varies by age and gender (MOFED 2008,). The real per capita consumption expenditure is got by dividing consumption expenditure by family size rather than adult equivalent family size. As shown in Table 3.2, the per capita consumption expenditure is higher in urban than in rural areas.

Table 2 Total (absolute) and food poverty line in Birr (average price)

	1995/96	2010/11	2015/16
Kilocalorie per day per adult	2200	2200	2200
Food poverty line (Birr)	648	1985	3772
Absolute poverty line (Birr)	1075	3781	7184

Source: Computed using HICE survey 1995/96, 2010/11 and 2015/16 and MoFEC (2015)

PROPENSITY SCORE MATCHING (PSM) TECHNIQUE

Households without any consideration has electricity access with and without for a simple comparison just gives a snapshot of the outcomes to what causes them. Households may differ essentially in initial characteristics and their access to electricity. To estimate the importance may be because of the differences in household instead of having electricity. By using a matching technique, the researcher notices this problem in part. The identification of a counterfactual is the central part of any matching technique lies, which identifies households with intervention to compare with households with the same characteristics but without intervention. Fundamentally this is a scenarios simulation of electricity access with and without. Based on observe properties this technique encloses first by matching households has with and without electricity access. This is attainable to see the difference of average outcome values between these two groups (just like the single difference method) after this matching is done. From this comparison process households that cannot be scored matched are drop out.

The most used matching technique which goes further than directly matching observable characteristics is Propensity score matching (PSM). The probability of treatment or electrification as a function of household characteristics from a logit or probit model, the PSM technique calculates for both treated (electrified) and untreated (unelectrified) samples. To calculate for households both access with and without electricity, this probability of adopting electricity is called propensity score. The outcomes of treated units which is electrified are then comparing with those of untreated units which is unelectrified. Rosenbaum and Rubin (1983) show that if random within cells treatment is define by *X,* it is also random within cells defined by the values of the propensity score p(x). So, if the propensity score is $p(x_i)$ identified, the effect of the treatment which they call it ATT (Average effect of Treatment on the Treated).

$$
\begin{aligned}
\tau &\equiv E\{Y_{1i} - Y_{0i} \mid D_i = 1\} \\
&= E\{E\{Y_{1i} - Y_{0i} \mid D_i = 1, p(X_i)\}\} \\
&= E\{E\{Y_{1i} \mid D_i = 1, p(X_i)\} - E\{Y_{0i} \mid D_i = 0, p(X_i)\} \mid D_i = 1\}
\end{aligned}
$$

Where

$(p\ (Xi) \mid D_i = 1)$ the outer expectation is over the distribution and

Y_{1i} (treatment) and Y_{0i} (no treatment) are the outcomes in the two counterfactual situations.

Propensity score matching (PSM) method is that matching process may drop out a significant number of observations from the original sample non-randomly, making the working sample misleading is one of the disadvantages of PSM. The researcher can take care of this problem that will discuss two alternative uses of PSM. First, in place of the actual treatment variable, the estimated propensity score matching, the outcome variable can be added in an ordinary least square (OLS) regression:

$$\mathbf{Y_{ij} = \alpha + \beta X_{ij} + \delta P_{ij} + \mu_{ij} + \varepsilon_{ij}}$$

where,

Y_{ij} is the household's welfare outcome within i-th household and j-th kebele,

X_{ij} is the households' vectors,

P_{ij} is the p-score (which the household's probability of implementing electricity) which indicating household's access to electricity can replaces the actual electrification variable,

β, δ, μ are estimated parameters,

μ is unobserved factors of household outcome at household-level, and

ε_{ij} is an unobserved random error

This procedure can remove any omitted variable bias that would have resulted using a simple OLS regression (Ravallion, 2005; Imbens, 2004). A disadvantage of this method is it assumes a functional form which standard PSM technique does not. A second way is to use in the OLS regression of the outcome variable a weight variable constructed from the propensity score: the weight is defined as $1/\sqrt{p}$ for treated household and $1/\sqrt{(1-p)}$ for control households. The resulting equation looks like:

$$\mathbf{Y_{ij} = \alpha + \beta X_{ij} + \delta E_{ij} + \mu_{ij} + \varepsilon_{ij}}$$

where, E_{ij} is indicating the actual treatment variable of the household's electricity access and using a weight variable calculated this equation is estimated. A study by Hirano, Imbens, and Ridder (2003) shows results in fully efficient estimates by using p-score to calculate weight balances the covariates. The researcher implements all three approaches of PSM for comparison and to check the robustness of the results.

Empirical framework

To estimate the plausibly causal effect of RE on household income and schooling this study uses propensity score matching (PSM). In a seminal work with observed data sets, Rosenbaum and Rubin (1983) proposed PSM as a method to reduce the bias in the estimation of treatment effects. In recent years, in the evaluation of development interventions matching methods have become increasingly popular and widely used (Becker and Ichino, 2002, Ravallion, 2008; Rauniyar et al., 2010; Kumar and Vollmer,2013).

To generate groups of treated and control households that have similar characteristics so that comparisons can be made within these matched groups is the basic premise in the matching technique. Direct matching becomes infeasible and propensity score p(X) (a single-index variable) can be used, in the event of many observed characteristics (Rosenbaum and Rubin 1983). The estimated probability of receiving treatment given the background covariates is Propensity score p(X). Treated households are matched with the comparison households based on propensity score and the difference in the mean outcomes of treated and control groups is attributed to the RE program in this study. In the propensity score model the identifying assumption is that selection into treatment is based on time-invariant observed characteristics and these observables are adequately captured. Based on unobserved characteristics the method further assumes no selection bias (Dehejia and Wahba, 2002; Smith and Todd, 2005).

The Average treatment effect on the treated (ATT)

Let Y1i is the outcome variables for treated household and Y0i is the outcome variables for control households, and $D \in \{0, 1\}$ is the treatment status indicator. The propensity score p(X) is given observed characteristics the conditional probability of receiving treatment:

$$p(X) \equiv Pr(D = 1 \mid X) = E(D \mid X) \text{ ------------------------------------ } (1)$$

where X is the vector of multidimensional observed characteristics.

The Average Treatment Effect on the Treated (ATT) can be stated as given the propensity score p(X):

$$ATT \equiv E\{Y1i - Y0i \mid Di = 1\}$$

$$= E[E\{Y1i - Y0i \mid Di = 1, p(Xi)\}]$$

$$= E[E\{Y1i \mid Di = 1, p(Xi)\} - E\{Y0i \mid Di = 0, p(Xi)\} \mid Di = 1] \text{ ----------------------- } (2)$$

Equation (2) gives conditional independence assumption (CIA) and under the overlap the average programme impact. Conditional Independence Assumption (CIA) assumes that independent of treatment the outcomes are conditional on X, and can be written as $Y1, Y0 \perp D \mid X$, while, there are both treated and control units overlap assumption implies that for each X, i.e. $0 < Pr [D=1j X] < 1$.

Matching Algorithms

Four widely used matching methods to probe the robustness of the results this study uses: nearest-neighbor (NN) matching with replacement, kernel, local-linear, caliper matching., which takes the average of the closest five matched control units as the counterfactual for each treated unit, we used nearest five neighbors. However, if the closest neighbor is far away, this approach faces the risk of bad quality. This is known as caliper matching; this was avoided by imposing a tolerance level on the maximum propensity score distance (caliper). Applying this option means that as a matching partner for a treated individual that were within the caliper (propensity range), an individual from the comparison group was chosen. Furthermore, we employed kernel and local-linear matching, to probe the robustness of our results. Thereby minimizes the variance of the matching estimates, the advantage of kernel matching is that it is more efficient since this method uses all untreated units. In different matching algorithms, we applied bootstrap method to estimate the standard errors. To reduce the bias, the selection of bandwidth parameter is important in matching methods. The bandwidth choice introduces a bias-variance tradeoff (Caliendo and Kopeinig, 2008). Smaller bandwidth implies higher variance and lower bias, while larger bandwidth implies lower variance and higher bias. In the study the choice of bandwidth is based on the prior literature on impact evaluation (IEG, 2008). We estimate ATT with bandwidth of 0.1 and 0.2 in the local linear and kernel matching method, Given the tradeoff between the bias and variance.

In the study of this research it used nearest neighbor matching because it works as expected when working with small number of futures (parameters), it is uncomplicated and easy to apply nature and it is fairly easy to add new data to algorithm.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 INTRODUCTION

To ending poverty worldwide despite substantial efforts targeted, in 2011 world bank report indicates close to 1 billion people still lived on less than $1.25 a day (World Bank, 2015). There has been a growing interest in understanding the role of RE programs in poverty reduction and improving welfare in recent years. Achieving the United Nations commitment to end poverty and provide universal energy access, providing access to electricity remains one of the critical binding constraints in spurring rural development and (UNDP, 2015). By increasing employment opportunities and access to improved public services the electricity access is expected to reduce rural poverty.

Through several channels access to electrification can potentially affect economic development but the most evident link is through improved productivity at the household and individual levels. Clean lighting source is the main direct benefit of electricity, but through the improved production process and reduced cost of production, it can also positively contribute to farm and non-farm productivity (Rud, 2012; Chakravorty, Emerick, and Ravago, 2016). Electricity access could also mechanization of agricultural practices, adoption of new technology, and facilitate the start of new businesses. Among other benefits, electricity access higher educational attainment (Lipscomb, Mobarak, and Barham, 2013); contributes to health improvements as households switch away from kerosene and coal to electricity (Barron and Torero, 2015); gender empowerment and better food security (Dinkelman, 2011; IEG, 2008). When households switch away from firewood collection to clean source of energy through time savings electrification may also enhance labor supply (Dinkelman, 2011).

The data conducted on mid of February to mid of March 2020. The season selected because of boost time for both consumption and getting more income. Any agricultural products sold at the time especially coffee (the selling price of coffee was 21 birr per kg). On the electrified kebele more female got temporary job which was picking black cherry coffee (1Quntal for 150 birr). On the consumption side electric utility, payments of credit like fertilizer and seed. Both have fewer infrastructures (road), densely forest area and the respondents live with cupper sheet house. The surveyed data presented below:

4.2 Descriptions of Study Area and Sample Respondents

This study takes two woredas from Bench-Sheko zone. Zemika kebele from South-Bench woreda and Gorika kebele from Sheko woreda. As shown in below table from these Kebeles the study takes a total of 90 households of whom 11 are female headed which accounts 12.2% while the remaining 79 or 87.8% are male headed households. In terms of access to electricity 45 have electricity connection in Zemika kebele and get electrified in 2015 while the remaining 45 are without electricity access in Gorika kebele.

Table 3 The household head Gender

Gender	Male	female
Zemika	39	6
Gorika	40	5

Source own survey 2020

When we see the age structure the households by the following table the sample situation is given.

Table 4 The household head the age structure

Age group	Number of hh head
21-35	48
36-50	40
51-65	2
>65	0
Total	90

Source own survey 2020

The above table clearly shows that the respondent households are predominantly young headed households. It accounts 53.3% which is more than half. The area not recorded pension age which more than 65 years. There is a potential to do any job in the area due to higher working age. It is also good for investor specially on electrified area to build industries getting cheap labor force in the area.

When it comes to the levels of schooling of household heads the result of this survey is given in the following table. The table shows that predominantly the households are headed by literate households. 65.56 % of the household head are get primary and above educational level. This is also additional benefit for the investor and businessmen to agree contractual and permanent documental to engage.

Table 5 Levels of schooling of household heads

Education	frequency	percent
Certificate	6	6.67%
Secondary	26	28.89%
primary	27	30%
illiterate	31	34.44%
Total	90	100%

Source own survey 2020

In the household regarding the size of the person, study reveals that number of people in the household or the average household size was 5.4 which include the household head. This average indicates there are high fertility rate and larger family size in two kebeles.

The main occupation of the household headed in the study area shows 85.5% are farmer and the rest 14.5% are trades. As observed the area on the electrified kebele engaged more on trade than unelectrified. It accounts 70% from the trade value. This shows new business comes by electric for example beauty salon, bars and milling.

On average the land holding of the study area was 2.37ha which is good to use modern technology to increase productivity. By using pumping irrigation produce market base production more than twice a year.

Here it is more advantageous for the market because the distance far from the zonal city was 5.25km.

Consumption of the household

The consumption pattern of the study area described below table 8 indicated that more mean consumption on treated than controlled groups and statistically significant.

Table 6 consumption of the household

Variable	Obs	mean	Std. Err	Std. Dev	t	df	p
treated	45	4995	296.95	1991.99	7.15	88	0.0000
control	45	2678	129.95	871.22			

Source own survey of 2020 **(t tests are given in appendix)**

On farming income of the household

Table 9 shown that their electricity not used for agriculture productivity purpose even there was difference in mean value, but it was not larger and statically insignificant.

Table 7 On farming income of the household

Variable	Obs	mean	Std. Err	Std. Dev	t	df	p
treated	45	60102	4845.95	32507.68	0.9629	88	0.1691
control	45	54135	3861.66	25904.83			

Source own survey of 2020 **(t tests are given in appendix)**

Off-farming income of the household

In table 10 below showed that in electrified kebele due to this access there was additional incomes came through it. For example, beauty salon, small shops, and two coffee industries create employment and increase income.

Table 8 off-farming income of the household

Variable	Obs	mean	Std. Err	Std. Dev	t	df	p
treated	45	11924	2084.56	13983.71	3.9686	88	0.0001
control	45	2100	773.87	5191.33			

Source own survey of 2020 **(t tests are given in appendix)**

4.3 ECONOMERIC ANALYSIS

4.3.1 Model 1: - Multiple Linear Regression on consumption

The dependent variable is consumption (the natural log of per capita consumption expenditure of the household) that are trying to predict while the independent variables that are using to predict consumption are on farming income(in log), off farming income(in log), gender, marital, age, education, family size, number of literate, landholding, treat(which is access to electricity), distance and occupation. The independent variables are having on the dependent variable *Y*, the multipliers or coefficients that describe the size of the effect, and the constant term when all the independent variables are equal to zero the value consumption is predicted.

Table 9 Estimated Consumption Function

Variables	Coef.	Std. Err.	t	P
Log on farming	1.50244	0.2563507	5.86	0.000
Log off farming	0.1007764	0.0765494	1.32	0.192
gender	-0.0413739	0.1558043	-0.27	0.791
marital	-0.0669867	0.0514545	-1.30	0.197
age	0.0016522	0.0038112	0.43	0.666
education	0.0032364	0.0300111	0.11	0.914
Family size	-0.0542455	0.0358879	-1.51	0.135
No. of literate	0.0390262	0.359769	1.08	0.281
Land holding	0.0254298	0.0514081	0.49	0.622
treat	0.4238225	0.0719204	5.89	0.000
distance	0.0383072	0.0314784	1.22	0.227
occupation	0.4106178	0.118217	3.47	0.001
constant	0.0656875	1.194864	0.05	0.956

Estimated equation;

lnC = 0.656875 + 1.50244logonfarm + 0.1007764logofffarm – 0.413739gender - 0.669867marital + 0.0016522age + 0.0032364education – 0.054298familysize + 0.0390262nooflitrate + 0.0254298landholding + 0.42382255treat + 0.0383072distance + 0.4106178occupation

Accordingly, the prediction equation of the percentage change on consumption increased by 50% when there is a single unit change in on farm income, percentage change on consumption increased by 42%, when there is a unit increase treat, percentage change on consumption increased by 41%, when there is a unit increase occupation.

lnC = 0.656875 + 1.50244logonfarm + 0.1007764logofffarm – 0.413739gender –

(0.2563507) (0.0765494) (0.1558043)

0.669867marital + 0.0016522age + 0.0032364education – 0.054298familysize +

(0.0514545) (0.0038112) (0.0300111) (0.0358879)

0.0390262nooflitrate + 0.0254298landholding + 0.42382255treat + 0.0383072distance +

(0.0359769) (0.0514081) (0.0719204) (0.0314784)

0.4106178occupation

(0.0118217)

For treat (rural electrification):

Hypothesis Testing

H_0: coefficient of treat (β_1) = 0

H_0: coefficient of treat (β_1) $\neq$ 0

Test Statistic

$$t = \frac{\hat{\beta}_1 - \beta_1}{se(\hat{\beta}_1)} = 5.89$$

When the t-calculated falls below the t- tabulated, or it falls within the confidence interval region, $pr(-t_{\frac{\alpha}{2}} \leq \frac{\hat{\beta}_2 - \beta_2}{se(\hat{\beta}_2)} \leq t_{\frac{\alpha}{2}}) = 1 - \alpha$, we accept the null hypothesis. But, if the t-calculated falls above the t- tabulated, or it falls outside the confidence interval region, we reject hull hypothesis.

Therefore, as the tabulated-t value is less than the calculated-t value, the regression result tells that rural electrification at 5% level of significance, it is statistically significant and has effect on consumption.

R-squared:

The 'percent of variance explained ‘is typically read as the R-squared. It is the overall fit of the model can be measured. Just another measure of goodness of fit is the adjusted R-squared is that penalizes that for using extra independent variables slightly - essentially, the adjusted R-squared adjusts the degrees of freedom that use up adding these independent variables.

Said differently, R-squared is the value of 0.8755, which means that the variables in the model approximately 87.55% of the variability of consumption is accounted for. In this case in the model, the adjusted R-squared indicates that about 85.61% of the variability of consumption is accounted for; even in the model after considering the number of predictor variables. But that cannot judge the high R-squared the high goodness of fit by simply observing the value. Rather that need to test using F-test.

F-test

And, that cannot also use the normal t test the slope coefficients are zero simultaneously to test the joint hypothesis. Rather use F-test in this regard. It is most often used when comparing statistical models that have been fit to a data set, in order to identify the model that best fits the population from which the data were sampled. An **F-test** is any statistical test in which the test statistic has an F-distribution under the null hypothesis. When the models have been fit to the data using least square the Exact *F-tests* mainly arise. Other than the constant term *all the independent variables taken together*; the *F-ratio* provide a test of the significance.

H_0: $\beta_1 = \beta_2 = \beta_3 = 0$

H_0: $\beta_1 = \beta_2 = \beta_3 \neq 0$

F-test can be calculated

$F = \frac{ESS / k - 1}{RSS / n - k}$ = 45.15, as compared to the tabulated F-test which is $F_{(K-1,\ n-K)} = F_{(12\ ,77)} = 1.98$

We accept the null hypothesis, when the F-calculated falls below the F- tabulated value. But we reject hull hypothesis when the F-calculated value falls above the F- tabulated. Therefore, for this research we reject the null hypothesis. And, obtaining the p value, F value as much as 45.15 or which is greater than zero, at 5% level of significance leading to rejection of the hypothesis that together on farming income(in log), off farming income(in log), gender, marital, age, education, family size, number of literate, landholding, treat(which is access to electricity), distance and occupation does have effect on consumption. Therefore, the above model explains the overall significance of goodness of the fit.

4.3.2 Model 2: - Probit estimation of poverty

Poverty line

A poverty line is often defined as a predetermined or well-defined standard of income or value of consumption, which is deemed to represent the minimum required for a productive and active life or even survival (Okunmadewa, 1999). This is a predetermined and well-defined standard of income or value of consumption. Though by different studies several methods have been used total households' income and two-thirds of mean household per capita expenditure, such a specific amount of dollar per day, annual household per capita expenditure. In this study used the poverty line was based on the two-thirds of the per capita expenditure of the households. For distribution analysis as it tends to be stable and data are more reliable, household consumption is often preferred to household income. First, depending on farm production and prices income varies from season to season and from year to year. Secondly, it is not the amount of income per se that matters but the amount spent on consumption and lastly most individuals are often reluctant to declare their true income. So, an analysis of poverty limited to income of the household may overestimate (if the household saves much of the income earned without spending on consumption items that would translate to improved welfare) or underestimate (if the household borrows to augment consumption). In many studies on poverty the approach using per capita expenditure has been used (Okunmadewa, 2002).

In which a household was defined as poor relative to others in the same society a relative approach was used. One third was taken as the line for extreme poverty while two third of the MPCHE was used as the moderate poverty line.

The categories were given as of poverty line:

- Extremely (absolute poverty) poor: Those spending <1/3 of MPCHE
- Moderately (intermediate poverty) poor: Those spending <2/3 of MPCHE
- Non poor (out of poverty): Those spending >2/3 of MPCHE.

To calculate the poverty line used the following formula

$$\text{Per capita expenditure for consumption (PCE)} = \frac{\text{Total expenditure}}{\text{Household size}}$$

MPCHE= Total household expenditure /Total number of respondents

Where, MPCHE = Mean per capita household expenditure.

MPCHE= 345276/90

= 3836.4

Non- poverty line = (2/3) * 3836.4

=2557.6

Here, non- poor >=2557.6 monthly consumption and below or < 2557.6 become poor. The data survey held on mid of February to mid of March 2020. This is the time of boost income getting with selling of agriculture products and higher consumption time. The current exchange rate of 1dollar is 33 birr, so the amount in dollar was $77.5 it is more than the world estimation which is $2 per day and $60 per month.

The next thing we do is try to see whether the levels of income and consumption spending are affected by electricity access or not. The result of this endeavor is given by the following table

Table 10: poverty line distribution

	poor	Non poor
With access	2	43
Without access	23	22

Source own survey of 2020

From electric access area 95.5% of the household survey above the poverty line and the rest are below it. On the other comparison areas which without access area 51.1% households are below the poverty line and the rest 48.9% are above the poverty line. It shows that electrified area households wealthier than without electrified area.

Table 11: Electricity and Household Welfare

Access to electricity	No of household	Mean consumption spending	Mean food consumption	Mean non-food consumption	Mean income
With access	45	4994	1811	3183	5919
Without access	45	2675	1054	1621	4686

Source own survey of 2020 **(t tests are given in appendix)**

The results as summarized in the above table show that the effect of electricity on consumption spending is positive and quite large. The same story holds when we break down the consumption spending into food and non- food. But in relation to income we see that the effect appears to be counter to expectation. This can be explained by the possibility of a significant difference in terms of other factors like having irrigation and fertile land that affect the level of income in a significant manner.

Table 12: Probit estimation of poverty

Variable	Coef.	Std. Err.	z	p
consumption	0.0030892	0.0012103	2.55	0.011
gender	-1.499101	2.747073	-0.55	0.585
marital	-1.327096	0.939286	-1.41	0.158
age	-0.0958563	0.1053257	-0.91	0.363
education	-0.8969344	0.9375925	-0.96	0.339
Family size	-0.5046081	0.5465355	-0.92	0.356
Land holding	1.545176	1.0527	1.47	0.142
treat	4.495856	2.148713	2.09	0.036
constant	-2.199961	4.367567	-0.50	0.614

Chi-square or the likelihood-ration is defined as $2(L_1-L_0)$ where L_1 is the log likelihood for the full model with constant and predictors and L_0 represents the log likelihood for the "constant-only" model. And, chi-square or the likelihood-ratio is equal to 90.22. Which indicates that the model is statistically significant besides, the p-value associated the chi-square with 8 degrees of freedom is 0.000. -8.0657861 is the Log likelihood. Including the constant and all the predictors that was computed using the maximum-likelihood logit model this is also the values of the log likelihood for the model.

The z-statistic testing the Z column contains the logistic coefficient. **z = (coefficient)/ (Std. Err)** in the case of the probit command. For this stata, z (treat) = 2.09. Stata uses for the probit coefficient the same z-test value computed. The probability, p>/1/ column holds the two-tail p-value for the z-test. For both the probit coefficients stata uses testing the hypothesis the same p-value computed, H0: b = 0.

Significant effects are suggested when confidence intervals do not contain 1.0. The last column contains the 95% confidence intervals for the coefficients. The only interval that would be considered significant at the .05 level is for consumption and treat in this research.

PROBIT MODEL GOODNESS-OF-FIT TEST:

Typed without options, the **lfit** command, test for the estimated model displays the Pearson goodness-of-fit Hosmer-Lemeshow's goodness-of-fit test with the group option **lfit** produces.

The Pearson chi-square value with 81 degrees of freedom is given.

Table 13 Lemeshow Goodness-of-fit test

```
. lfit

Probit model for poverty, goodness-of-fit test

       number of observations =         90
 number of covariate patterns =         90
             Pearson chi2(81) =         15.56
                  Prob > chi2 =          1.0000
```

For the goodness-of-fit test the p-value suggests that the model fits well reasonably. However, the Pearson test is not appropriate for these data since the number of observations is equal to the number of covariate patterns. In this situation for grouped data the Hosmer and Lemeshow goodness-of-fit test is preferred. The data be formed into 10 nearly equal-size groups for the Hosmer and Lemeshow test of goodness-of-fit the **group** option requested that. With 6 degrees of freedom the value of the Hosmer and Lemeshow chi-square is given.

Table 14: Goodness-of-fit test ofHosmer and Lemeshow

```
. lfit, group(10)

Probit model for poverty, goodness-of-fit test

  (Table collapsed on quantiles of estimated probabilities)
  (There are only 8 distinct quantiles because of ties)

       number of observations =         90
             number of groups =          8
      Hosmer-Lemeshow chi2(6) =          0.27
                  Prob > chi2 =          0.9996
```

For the Hosmer and Lemeshow goodness-of-fit the p-value test is 0.9996 which our model could suggest problems concerning the fit.

4.3.3 Model 3: - Propensity score matching

Using a probit model the propensity score (p-score) model is estimated. Variables that are likely to affect electrification and outcomes are included in the propensity score model. Also, in the estimation of propensity scores variables that are unaffected by the treatment were also included. In addition to household-level variables, village-level variables also include because in the rural electrification program they are likely to affect the participation.

Below table shows before matching mean the summery of the total out comes and variables, with and without electrification and their difference described in matching variables and descriptive statistics of outcomes except study time the rest variable had not great difference in their mean value.

Table 15: Matching variables and Descriptive statistics of mean outcomes

Variables	Total Sample mean (1)	Household electrified mean (2)	Household unelectrified mean (3)	Difference in mean (2) - (3) (4)
PANEL A				
Economic outcomes				
Annual on farm income (log)	4.69	4.71	4.67	0.04
Annual non-farm income (log)	3.27	3.70	2.84	0.06
Educational outcomes				
Study time at home (minutes per day)	90	120	90	30
PANAL B				
Matching variables				
Household size	5.4	5.57	5.22	0.35
Gender of household head (Male = 1)	0.88	0.87	0.89	-0.02
Age of head of household	35.31	35.69	34.93	0.76
Whether household head is				

literate (yes = 1)	1.09	1.04	1.13	-0.09
household head Marital status	1.48	1.48	1.42	0.06
Land amount (ha)	2.37	2.41	2.34	0.07
Distance to the zone city (Mizan-Aman)	5.25	5.22	5.28	-0.06

Source own survey of 2020

Both the outcomes guided the selection of explanatory variables and the decision to have access to electricity affecting the CIA and the requirements. Pre-intervention data should have been used to estimate the p-score model in an ideal scenario. Due to lack of pre-intervention data led us to use post-intervention variables by the electrification intervention that are likely to affect the electrification status and is not affected. These variables were gender, marital status, household size; and total number of literate members in the household; literacy of the household head; cultivable land area and distance from the village to Mizan-Aman headquarter.

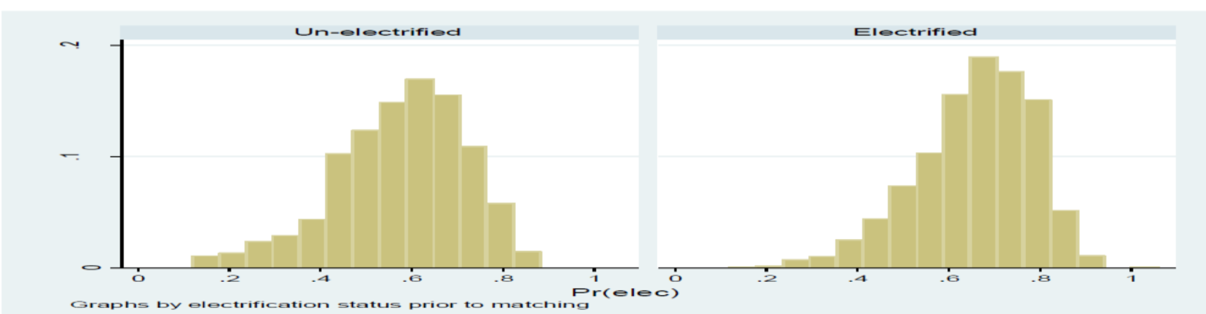
Table 15 shows the probit model of individual coefficients. Occupation and the number of literates in the household do play a significant part in explaining the electrification access but gender, marital status, family size, age, literacy of the head of the household and distance do not play a significant role in explaining the electrification access. On the probability of electrification as expected, gender, marital status, age, education, family size, family size sq, landholding sq, and distance to zone headquarters has a negative effect. On the other hand, Age sq, landholding and occupation has a positive effect on the probability of obtaining a grid connection. Except number of literate and occupation the rest of the coefficients are statistically insignificant. Due to the empirical specifications include many correlated variables and the purpose of the estimation is to calculate the propensity score and not to model an underlying selection mechanism, this is not problematic.

Table 16: probit estimation of household's electricity access

Characteristics of the Household	coefficient	Standard error
Household human capital		
Gender of the household head	-0.502	1.169
Marital status of head of the household	-0.084	0.397
Age of head of the household	-0.015	0.199
Age square	0.000	0.002
Educational background of head of the household	-0.132	0.232
Family size	-0.003	1.00
Family size square	0.028	0.085
In the family number of literates	0.807	0.285
Occupation of head of the household	1.466	0.716
Household physical asset		
Landholding of head of the household	0.9927	0.736
Landholding square	-0.146	0.129
Village level variable		
Distance from zonal city	-0.377	0.716

Figure 4.1 for electrified and nonelectrified households depicts the distribution of propensity scores. Distribution suggests that non-electrified households have a higher probability mass at lower levels of the propensity score (lower than 0.5), while electrified households have slightly higher probability mass at higher levels of the propensity scores (greater than 0.5). This indicates electrified households are slightly different from un-electrified households this is based on the set of observed characteristics included in propensity scores estimation. Thus, compared to multivariate regressions there should be a potential gain from using matching estimators.

Figure 4 For electrified and non-electrified households Distribution of propensity scores



Common support: Only those treatment observations and comparison whose propensity scores fall within the region of common support were included in order to obtain credible matching estimates. Treatment observations whose propensity score is higher than the maximum or less than the minimum propensity score of comparison observations were dropped from the sample

While implementing the common support criteria. In this sample survey the maximum of the untreated p score was 0.8586 and 0.1449 on the minimum value of the treated.

Results in the elimination of 6 electrified households (13.3% of the total electrified sample), and 4% from un-electrified households imposing the common support criterion. 8 were off-support and had also to be dropped from the analysis and remaining 82 households.

Table 17: Estimation of p-score

```
. sum mypscore
```

Variable	Obs	Mean	Std. Dev.	Min	Max
mypscore	90	.5023069	.2162426	.0265711	.988223

Balance test: A ‘balancing test’ of the characteristics of the matched samples was performed to assess the quality of the matching. All the Xs should be “*balanced*” across the treated and matched untreated groups, if CIA is valid. In the matching literature the analysis implemented three balancing tests commonly employed (Caliendo and Kopeinig, 2008). *First*, for the difference in covariate means between comparison samples and the matched treatment and we examined t-tests. *Second*, standardized difference before and after matching was analyzed as proposed by Rosenbaum and Rubin (1983). There should be a reduction in the standardized bias, if the covariates are balanced. *Third*, since systematic differences in the distribution of covariates between the treated and matched untreated groups are wiped out pseudo-R-squared of the propensity score model after matching should be low. Results from Table 4.13 suggest that all covariates are balanced post matching and there are no significant differences in means for most of the variables.

Table 18: Mean of the variables in post-matching

Characteristics of Household	Household electrified	Household unelectrified		
Household size	5.46	5.23		
Household size square	31.25	28.81		
Gender of head of the household	0.85	0.88		
Age of head of the household	35.9	35.23		
Age sq. of head of the household	1359.9	1310.58		
Marital status of head of the household	1.51	1.44		
Educational status of head of the household	1.08	1.09		
Number of literates in the household	3.2	2.83		
Occupation of the household head	1.13	1.09		
Land holding of head of the household	2.46	2.43		
Land holding sq. of head of the household	7.24	7.01		
Distance from zonal city	5.71	5.24		

The three outcome variables that determined our model were on farm income in the log, off farm income in the log and study time in minute multiple regression in OLS after adjusted the p score as followed

i. Yearly on farm income on log form

Table 19: OLS estimation of yearly on farm income

variables	Coef.	Std. Err	t	p
Log off farming	0.0281708	0.0147805	1.92	0.061
gender	-0.0668683	0.0546636	-1.22	0.226
marital	-0.0183652	0.0187259	-0.98	0.330
age	-0.0176433	0.0088911	-1.98	0.051
Age sq	0.000255	0.0001188	2.15	0.036
education	0.0015932	0.0101306	0.16	0.876
Family size	0.0054382	0.445864	0.12	0.903
No. of literate	0.02235	0.0131762	1.70	0.094
Family size sq.	-0.0022611	0.0036981	-0.61	0.543
Land holding	0.3329885	0.0372997	8.93	0.000
Land holding sq.	-0.0290609	0.0064361	-4.52	0.000
distance	0.0107441	0.0098703	1.09	0.280
occupation	-0.1791749	0.0404689	-4.43	0.000
E	-0.0088024	0.0220028	-0.40	0.690
constant	4.510442	0.2414877	18.68	0.000

From the above Stata table value on farm income did not statistically significant. Electrification have no impact on on-farm income, this is due to the area were not use modern technology to increase their productivity by using electric. From the focal group discussion and interviews no one can use irrigation via pump. Many reasons arise here but the adoption of technology was one.

ii yearly off farm income on log form

Table 20:OLS estimation of yearly off farm income

variables	Coef.	Std. Err	t	p
Log on farming	1.825638	0.9578673	1.91	0.061
gender	0.0771041	0.4448418	0.17	0.863
marital	0.0260252	0.1517926	0.17	0.864
age	0.0171349	0.073619	0.23	0.817
Age sq	-0.0002868	0.0009884	-0.29	0.773
education	-0.0296778	0.081488	-0.36	0.717
Family size	-0.1533036	0.3584817	-0.43	0.670
No. of literate	0.1730934	0.1062411	1.63	0.108
Family size sq.	0.006281	0.0298435	0.21	0.834
Land holding	-0.4878687	0.4402963	-1.11	0.272
Land holding sq.	0.0364747	0.0590043	0.62	0.539
distance	0.0172378	0.0801299	0.22	0.830
occupation	1.573152	0.3166231	4.97	0.000
E	0.5093714	0.1660617	3.07	0.003
constant	-7.201219	4.762687	-1.51	0.135

Here also taken from Stata value that regressed showed that off farm income statistically significant and electrification had an effect to change off farm income. On the area observed and on group discussion the electrified kebele got two wide industries to create job opportunity for the village. The industries directly came after electrification. Both are coffee processing and serve dry and washed coffee. It created more than 120 permanent and 1000 temporary on the peak time of harvesting and washing to pick the black cherry coffee. This increased the income of the area on great amount compare to unelectrified area. On the other hand, bars, night serve small shop at large are greater in the kebele.

iii study time at night in minute

The below Stata table showed that it also statically significant and electrification influenced study time. It is true that even if both area study taken place the difference comes not only more time to stay it is also health condition. Their health specially their eyes affected by Smokey in unelectrified area.

Table 21: OLS estimation of the study time

variables	Coef.	Std. Err	t	p
gender	13.36337	20.2054	0.66	0.511
marital	5.834085	6.894624	0.85	0.401
age	-0.6375483	3.344489	-0.19	0.849
Age sq	0.0097389	0.449115	0.22	0.829
education	-2.490838	3.704145	-0.67	0.504
Family size	2.385186	16.30135	0.15	0.884
No. of literate	0.4652365	4.919199	0.09	0.925
Family size sq.	0.074546	1.355684	0.05	0.956
Land holding	13.30585	20.17683	0.66	0.512
Land holding sq.	-2.720665	2.687098	-1.01	0.315
distance	-10.1514	3.640065	-2.79	0.007
occupation	-22.97484	16.81985	-1.37	0.177
E	-21.11767	8.053196	-2.62	0.011
Log on farming	15.28774	44.6617	0.34	0.733
Log off farming	33.74616	5.547882	6.08	0.000
constant	-17.92031	219.9392	-0.08	0.935

Table 21 shows the results from ordinary least square method to generalize the impact on income outcome and educational outcome lets summarized on the below table with access to electricity. All the columns include household control as well as village controls. Except on farm-income, results show that electricity access had significantly positive impacts on all the outcomes. Non-farm income was compared to non-electrified households 53% higher in electrified household (column 2). Electrification had substantial impacts on education outcomes that the estimates columns 3 suggest. Children were able to spend more time studying at home due to electricity access: the difference is about 1.4 minutes. Not only having study time more at night with electric light to study but also better health condition for the electrified. Kerosene, smoky, brightness and this led to blindness problem happen in the long run in unelectrified areas.

Table 22: OLS -impact on household income and Children's schooling

	Log on farm income	Log off farm income	Study time
Access to electricity	0.128	0.531***	0.014***
	(0.236)	(0.072)	(0.002)
Household controls	Yes	Yes	Yes
Village controls	yes	yes	yes

*** indicated 1%, 5%, 10% significance level

Table 22 results that have dealt with all the observables affecting programme assignment and outcomes contains the PSM. Findings suggest that household with electricity access have higher levels of off farm income and better educational outcomes. Analysis reveals that electrification only had a significant impact on off farm income. Off-farm income compared to non-electrified households was 70% higher in electrified and at 1% level of significance this difference was statistically significant.

Table 23: ATT effects on economic outcomes and educational outcomes

	Nearest neighbor
Economic outcome	
Log On farm income	0.032
	(0.030)
Log off farm income	0.702***
	(0.078)
Educational outcome	
Study time in minute	34.94***
	(4.17)

*** denote significance at the 1% level

In electrified households on farm-income was higher, but insignificant at the conventional level of significance and the impact was imprecisely estimated. The impacts on farm-income may be muted or even negative as a result of electrification if people switch out of agriculture into non-agricultural activities. Intuitively, the impacts of rural electrification on farm-income can be mixed. On the other hand, due to increased mechanization of agricultural practices, use of capital-intensive technology, and improvements in agricultural productivity, farm-income may go up for farmers that continue to be engaged in agriculture. However, mechanization on small-scale subsistence farming on scattered and fragmented land is quite difficult and unsustainable, these channels may not have led to significant impacts on farm-income. Furthermore, electricity access may affect non-farm through home-based small businesses, increased productivity, and start of new micro-enterprise undertaking. We are unable to provide empirical evidence on any of these channels in this study due to data limitation. During focus group discussions (FGDs) Interestingly, many participants claimed that electrification had increased their income potential by facilitating microenterprise businesses, and after they received electricity their income from picking black cherry in coffee washing and drying industries had more than doubled. Several FGDs participants also reported that improved non-farm income was associated with other micro-enterprise activities.

To findings in the previous literature our estimates are comparable. For example, in Bangladesh previous studies on impact evaluation of RE found that electricity access increased nonfarm income by 56% to 90% (Khandekar et al., 2012) and in Viet Nam by 70% (Khandekar et al., 2013). Improvements among electrified households both studies failed to identify the channel through which non-farm income witnessed.

In India another study conducted estimated the impact of electricity quality on household income to be in the order of 86% to 90% (Chakravorty et. al., 2014). Further indicates a sizable effect of electrification on non-farm income a back of the envelope calculation. For example, in 1995 the electrification rate was 20% and if we optimistically assume that between 1995-2009 electrification rate has increased by 30%, then due to increased access to electricity a 62% increase in nonfarm income would imply that non-farm income increased by 18.6 percent over this period.

Implying an increase of about 56% since the average study time in the sampled households is 90 minutes per day, the estimates suggest that access to electricity significantly improves children's study time at home increases by 1-35 minutes per day. Due to electricity found in this study have various explanations the positive educational outcomes. Several hypotheses consistent with the results emerge in our analysis, although it is difficult to conclusively pin down the pathways. Each has a part in the overall results, these hypotheses are not mutually exclusive. Due to availability of high-quality bright light as a result of electricity, the most compelling explanation is the increased evening study time at home for children. When they study under a bright light from electric bulbs compared to a dim flickering candles or kerosene lamp, children experience less strain on their eyes and their efficiency and productivity increase. As they faced no other option than to study under kerosene lamps because of prohibitive costs to the households, children from poorer families benefit the most from electricity.

Frequent absenteeism from such postings is a major problem in many developing countries and the failure of teachers to take up posts in remote locations. By making rural positions more attractive to teacher's electrification can be instrumental in coping with such shortage of teachers and can improve teaching quality and continued education (IEG, 2008). Participants of the focused group discussions stated that they did not need to commute daily from their original residences because teachers preferred to stay in electrified villages. In electrified villages higher accommodation costs support this assertion. Experienced teachers in electrified villages compared to nonelectrified ones more importantly, villages can recruit and retain better-qualified. Further, teachers can prepare their teaching lesson plans at night and they are happy to stay in electrified villages. Other reported benefits from electricity access include improved student performance in vocational schools and flexibility in teaching in evening hours, use of mass media to supplement normal classroom teaching, increased awareness and knowledge (IEG, 2008).

CHAPTER FIVE

SUMMERY, CONCLUSION AND RECOMMENDATION

5.1 SUMMERY

Around 1billion people live without access to electricity worldwide. Which has detrimental effects on education, health, income, and overall wellbeing, this is one facet of energy poverty. Today in globalized world, access to electricity is a need that almost taken as a basic human right. In many developing countries national electrification programs are given priority and the level of electrification generally is seen as one of the key indicators of development.

In developing countries electrification in rural and remote areas has been the cornerstone of rural energy strategies. It is an argument and a cause of controversy among development analysts. The advocates of electrification in rural area believe that it has major significant effect on industrial and agricultural productivity, decrease migration of rural-urban, creates more employment opportunities and significantly increases the overall quality of life in rural areas. Critics claim that rural electrification may not have the hoped-for impact on economic and social life and in its unequal effect could contribute to social tension.

The objective of the study is to estimate the impact of RE on poverty reduction. To determine this the key dimensions of households' wellbeing on income and education and the level of poverty in the area analyzed. In addition to this the socio-economic development of both on-farm and off-farm commercial activities can be measured. It hypothesized that RE has no impact on the consumption, the level of poverty, on the income and on education outcomes.

BY using PSM and OLS the impact of electricity access on household on farm income is found to be insignificant and having the wrong sign. Off farming on the electrified area 70.2% more than on unelectrified kebele and by using ATT nearest neighboring 35 minutes more study time in electrified than unelectrified.

The effect is also found to have come through increased consumption spending which means there is an improvement in wellbeing and through increased years of schooling which show that the impact is not one shot rather kind of sustainable.

Not only the grid contributes electricity but also solar. For using of solar the government should free from any tax to address those have rich household to able purchase within unelectrified areas.

5.2 CONCLUSION

This study has shown the impact of rural electrification on poverty reduction is positive and significant. The effect is also found to have come through increased consumption spending which means there is an improvement in wellbeing and through increased years of schooling which show that the impact is not one shot rather kind of sustainable. The rural electrification benefits well-off households more than as compared to it does poor households has been analyzed. The impacts are often higher than that for poor households due to for rich households that adopt electricity.

Based on matching method results suggest that electricity access improved off farm income and educational outcomes. Off farming incomes increased through electrification. Children in electrified households gain an additional spend more time studying in the evening. This study showed that taken together rural electrification has played an important role in improving the quality of life of households in rural areas.

Rural electrification important for investment to attract agro-processing industries. It creates employment opportunity for the rural households either permanent or temporary job.

5.3 RECOMMENDATION

The commitment of the government to connect rural villages to the national grid and enable them to have access to electricity using various means like solar energy should continue vigorously since it is having the desired impact. Not only the grid contributes electricity but also solar. For using of solar the government should free from any tax to address those have rich household to able purchase within unelectrified areas.

This study has key policy implications based on the findings. In the area the use of electricity for income-generating activities has been very limited, but the potential to increase household income is quite high. While rural electrification may not be enough condition for expanding income opportunities, but it is necessary. Including access to roads, market development, irrigation systems, skills development, and services, this requires substantial investments in complementary infrastructure. The demand for electricity is likely to remain below lifeline block in the area in short- to medium-term for most of the households, under the current scenario. In the local economy integrated infrastructure development can create substantial multiplier effects, thus promoting and stimulating growth. RE program needs to be associated with mechanisms to provide credit for electricity using technologies (power tools, mills, sewing machines, lamps), in order to spur rural development.

In determining the economic value of the rural electrification project, the Government should be proactive. A thorough economic analysis does not yield much to the investment in the rural areas. From the findings, communities and households are only using electricity for mainly lighting and seem not aware of the enormous benefits they would accrue to having electricity. Perhaps, the government should enlighten the communities on what more they can do with electricity.

There is need for the government to speed up the rural electrification. This will make communities to feel that they are developed, since communities feel that they are more empowered with electricity connectivity, even if the lives do not necessarily change, security is improved, and increased land lease value which also spurs investor confidence.

The impact electricity access on household on farm income having the theoretically wrong sign and is found to be insignificant. In addition to this some other theoretically important variables are found to be having the wrong sign or became insignificant or both. This shows that there is a need to carry out further research on this topic so that there can be a firm ground to enhance the gains from electricity expansion.

Lastly, the study addresses that this kind of study is essential to push the government body to connect rural areas for the sustainable economic development.

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APENDEX

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Research Questionnaire

Name of the Researcher: Teshale Sisay

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Phone No: +251-961-869-682

Dear respondent,

The questionnaire is prepared to be filled by peoples of Bench Sheko Zone, Debub bench and sheko Woredas. The objective of the questionnaire is to assess the impact of rural electrification in the woreda selected Kebeles. The study will be undertaken for educational purpose only. Your responses are confidential. Thank you in advance for your collaboration to fill the questionnaire honestly and sincerely with the sacrifice of your leisure and work time.

General directions: Do not write your names or any identifying information on the questionnaire, if it is needed you can give more than one answer and write your own opinion for open-ended questions. This questionnaire will be filled and return to the researcher as fast as possible. Give response for all the questions. Your responses are very important for the researcher to accomplish the study.

Thank you for your collaboration!

- Please put a tick mark (√) in the appropriate box in each of the following questions.

Part I: - General information of household respondents

1. Sex of household head?

A. Male ☐ B. Female ☐

2. Age of the household head ___________ years
3. Marital status:

   A. Single ☐ B. Married ☐ C. Divorced ☐ D. Widowed ☐
4. What is your education level?

   A. Illiterate ☐ B. primary ☐ C. secondary ☐ D. certificate and above ☐
5. How many families do you have _____________?
6. The number of children on the household.

   A. one ☐ B. two ☐ C. three ☐ D. four ☐ E. five and above ☐
7. What is the occupation of household head?

   A. merchant ☐ B. employee ☐ C. self-employee ☐ D. farmer ☐
8. For how long did you live in the kebeles?

   A. 1 year and below ☐ B. 1—5 years ☐ C. 5—10 years ☐ D. 10—15 years ☐

   E. above 15 years ☐

B. **Part II: - Information related to research questions /objectives**

1. When was electricity connected to your main house?

   A. Less than 1-year ☐ B.1- 2 years ago ☐ C. 2- 3 year ago ☐ D. over 4 years ago ☐

2. How much land do you hold? --------------------in ha

3. Is the land yours?

A. Yes B. no

4. How much is the yearly income of the household?

Agricultural products		Non-agricultural products	
Item	amount	item	amount

5. How much do you spend monthly for consumption?

Food consumption monthly spending		Non-food consumption monthly spending	
Item	amount	Item	amount

6. Is there household member engage on off farm activities within the past 5 year?

A. Yes B. No

7. If Q no 8 answer is Yes. On which off farm activities---------------------------------------
----

8. Do you want to engage on off farm activities?

A. Yes B. no

9. If Q.no 8 Yes on which activities--
----

10. How many of the children attain schooling? -----------------------in number

11. How many hours does your children spend on study time at night -----------?

12. Does the household head a member of idir?

A Yes B no

13. Do you use loan from micro finance?

A Yes B NO

14. Does electricity create job opportunity for the area

A/ yes B/ No

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INTERVIEW QUESTION

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INTERVIEW QUESTION

1. On this kebele what benefits rural electrification?---

   ----
2. Is there industries comes after electrification and what benefits?------------------------------
   ----
   ----
3. What kind of off farm activities happens on the area after electrification?-------------------
   ----
   ----
4. Mention what makes importance of electrification on your kebele---------------------------
   ----

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FOCUSED GROUPE DISCUSSION

Name of the Researcher: Teshale Sisay

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FOCUSED GROUPE DISCUSSION

1. Discuss the importance of rural electrification on the kebele-------------------------------
   ----

   -
2. Discuss the industries benefits the area--

   -
3. Is there the disadvantage of rural electrification on the kebele?----------------------------
   ----

ጂማ ዩኒቨርስቲ

ቢዝነስ እና ኢኮኖሚክስ ኮሌጅ

ኢኮኖሚክስ ዲፓርትመንት

ዴቨሎፐመንት ኢኮኖሚክስ ማስተርስ ፐሮግራም

የምርምር ቃለ-መጠይቅ

ስም ተሻለ ሲሳይ

ኢ-ሜይል teshalesisay12@gmail.com

ስልክ ቁጥር 0961869682

ውድ የጥያቄው መላሾች

ይህ የተዘጋጀው ቃለ-መጠይቅ የሚሞላው በቤንች- ሸኮ ዞን በደቡብ ቤንች ወረዳ እና ሸኮ ወረዳ ነዋሪዎች ነው፡፡የቃለ-መጠይቁ ዓላማ የገጠር መብራት ተደራሽነት ያመጣው ተጽኖ በተመረጠው አከባቢ ማጥናት ነው፡፡ ይህ ጥናት የሚውለው ለትምህርር (ለማስተርስ ትምህርት መመረቂያ) ብቻ ነው፡፡ምላሽዎ ትክክለኛና ተአማኒነት ያለው ይሁን፡፡ ከስራዎ እና ከጊዜዎ ቀንሰው ስለ ተባበሩንና በተአማኒነት ቃለ-መጠየቁን ስለሞሉልን ከልብ እናመሰግናለን፡፡

አጠቃላይ ትዕዛዝ ስምዎን እና አንዳንድ ከቃለ-መጠይቁ ውጭ የሆኑ ሃሳቦችን እንዳይሞሉ፡፡ የተጠየቁትን ጥያቄዎች እና ሃሳቦች የራሶን ምላሽ ይስጡ፡፡ምላሽዎ ለጥናቱ ና ለመመረቂያ ጽሁፌ ጠቃሚ ነው፡፡

ስለተባበሩኝ አመሰግናለሁ

ሀ. ክፍል አንድ; የመላሾች አጠቃላይ የቤተሰብ ሁኔታ

1. የአባወራ/እማወራ ጾታ?
   ሀ/ ወንድ ☐ ለ/ ሴት ☐
2. የአባወራ/እማወራ እድሜ? -------------------- ዓመት ነው
3. የጋብቻ ሁኔታ
   ሀ/ ያላገባ ☐ ለ/ ያገባ ☐ ሐ/ አግብቶ የፈታ/ች ☐ መ/ ባላ የሞተባት/ሚስቱ የሞተችበት ☐
4. የትምህርት ደረጃ
   ሀ/ ያልተማረ ☐ ለ/ የመጀመሪያ ደረጃ ☐ ሐ/ ሁለተኛ ደረጃ ☐ መ/ ሰርተፊኬት እና ከዛ በላይ ☐
5. የቤተሰብ ብዛት ስንት ነው? ------------------- ነው
6. በቤተሰቡ የህጻናት ብዛት ስንት ነው? ------------------ነው
7. የቤተሰቡ አባወራ/እማወራ የስራ ዓይነት ምንድንው?
   ሀ/ ንግድ ☐ ለ/ ተቀጣሪ ☐ ሐ/ የግል ስራ ☐ መ/ ገበሬ ☐
8. ለምን ያህል ጊዜ በዚህ ቀበሌ ኖሩ?
   ሀ/ ለ1ዓመት እና ከዛ በታች ☐ ለ/ ለ1-5 ዓመት ☐ ሐ/ ከ5-10 ዓመት ☐ መ/ ከ10-15 ዓመት ☐
   ሠ/ ከ15 ዓመት በላይ ☐

ለ. ክፍል ሁለት; ምርምሩን ዓላማ ያደረጉ ጥያቄዎች

1. ምን ያህል ጊዜ ሆነ የገጠር መብራት ተደራሽነት ወደ ቤትዎ ከተገናኘለወት?

ሀ/ ከ1 ዓመት ያነሰ ☐ ለ/ ከ1-2 ዓመት ☐ ሐ/ ከ2-3 ዓመት ☐ መ/ ከ3-4 ዓመት ☐
ሠ/ ከ4 ዓመት በላይ ☐

2. ምን ያህል የመሬት ይዞታ አለወት? ------------------ሄክታር
3. የመሬት ይዞታዎ የራስዎ ነው?

   ሀ/ አዎ ☐ ለ/ አይደለም ☐
4. ዓመታዊ ገቢዎ ምን ያህል ነው?

ከግብርና ውጤት		ከግብርና ውጤት ውጭ	
ዓይነት	የገንዘብ መጠን በብር	ዓይነት	የገንዘብ መጠን በብር

5. ወራዊ የፍጆታ ወጭዎ ምን ያህል ነው?

ለምግብ ነክ ፍጆታ ወራዊ ወጪ		ምግብ ነክ ላልሆኑ ፍጆታ ወራዊ ወጪ	
ዓይነት	የገንዘብ መጠን በብር	ዓይነት	የገንዘብ መጠን በብር

6. በዚህ 5 ዓመት ውስጥ ከቤተሰቡ አባላት መካከል ከግብርና ወጭ ስራ የሚሰራ አለ?

   ሀ/ አዎ ☐ ለ/ የለም ☐
7. የጥያቄ ቁጥር 6. ምላሽዎ አዎ ከሆነ በምን ዘርፍ? ....
8. ከግብርና ዘርፍ ውጭ ባሉት የስራ ዘርፍ መሳተፍ ይፈልጋሉ?

   ሀ/ አዎ ☐ ለ/ አልፈልግም ☐
9. የጥያቄ ቁጥር 7. ምላሽዎ አዎ ከሆነ በምን ዘርፍ..
10. ምን ያህል የቤተሰቡ ታዳጊ ህጻናት ትምህርት ይከታተላሉ................................... በቁጥር
11. ትምህርት ከሚከታተሉት ታዳጊ ህጻናት በምሽት ምን ያህል ሰዓት/ ደቂቃ ያጠናሉ..
12. የቤተሰቡ አባወራ/እማወራ በአከባቢው የሚገኝ የዕድር አባል ነዎት?

    ሀ/ አዎ ☐ ለ/ አይደለውም ☐
13. ከማይክሮ ፋይናንስ ብድር ተጠቃሚ ነዎት?

    ሀ/ አዎ ☐ ለ/ አይደለውም ☐

14 የገጠር መብራት ተደራሽነት ለአከባቢው ነዋሪ የስራ ዕድል ፈጥራል?

ሀ/ አዎ ☐ ለ/ አልፈጠረም ☐

ጂማ ዩኒቨርስቲ

ቢዝነስ እና ኢኮኖሚክስ ኮሌጅ

ኢኮኖሚክስ ዲፓርትመንት

ዴቨሎፐመንት ኢኮኖሚክስ ማስተርስ ፕሮግራም

የምርምር ውይይት

ስም ተሻለ ሲሳይ

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ስልክ ቁጥር 0961869682

ለውይይት ስራችውንና ጊዜአችውን ሰውታችው ስለተገኛችው አመሰግናለው፡፡

1. ለዚህ ቀበሌ የገጠር መብራት ተደራስሽነት ምን ጠቀሜታ አመጣ?
   ....
2. የገጠር መብራት ተደራሽነት ከተጀመረ በኣላ ኢንዱስትሪ እንዲመጣ አድርጉዋል ምንስ ጠቀሜታ አመጣ?
   ....
3. የገጠር መብራት ተደራሽነት ከተጀመረ በኣላ ለአከባቢው ከግብርና ዘርፍ ውጭ ሌላ መስክ እንዲስፋፉ ምን አስተዋጽኦ አደረገ?
   ....
4. መብራት ለአከባቢው ያመጣውን ጥቅም ግለጹ?
   ....

ጂማ ዩኒቨርስቲ

ቢዝነስ እና ኢኮኖሚክስ ኮሌጅ

ኢኮኖሚክስ ዲፓርትመንት

ዴቨሎፕመንት ኢኮኖሚክስ ማስተርስ ፕሮግራም

ትኩረት ከሚሹ አካላት ጋር ውይይት

ስም ተሻለ ሲሳይ

ኢ-ሜይል teshalesisay12@gmail.com

ስልክ ቁጥር 0961869682

ለውይይት ስራችውንና ጊዜአችውን ሰውታችው ስለተገኛችው አመሰግናለው:

1. የገጠር መብራት ተደራሽነት ምን ጠቀሜታ አመጣ?

   ....
   ....
   ....
   ....

2. ኢንዱስትሪው ለአከባቢው ምን ጠቀሜታ አመጣ?

   ....
   ....
   ....
   ....
   ....

3. የገጠር መብራት ያመጣው መጥፎ ተጽኖ በአከባቢው አለ?

   ....
   ....
   ....

.

Stata Commands that I used for may research

Appendix

Descriptive

tab gender

tab marital

tab age

tab education

tab familysize

tab nooflitrate

tab landholding

tab distance

consumption

Use STATA command: reg lnconsumption logonfarming logofffarming gender marital age education familysize noof literate landholding treat distance occupation

poverty

tab poverty

Probit poverty consumption gender marital age education familysize noof literate landholding treat

lift

lift, group (10)

propensity score matching

sum

tab treat

probit treat gender marital age agesq education familysize familysizesq noof literate occupation landholding landholdingsq distance

predict mypscore

sum mypscore

psgraph, treated (treat) pscore(mypscore)

pscore(newpscore) comsup

sum

reg logonfarming logofffarming gender marital age agesq education familysize familysizesq noof literate landholding landholdingsq treat distance occupation e

reg logofffarming logonfarming gender marital age agesq education familysize familysizesq noof literate landholding landholdingsq treat distance occupation e

reg studytime logofffarming logonfarming gender marital age agesq education familysize familysizesq noof literate landholding landholdingsq treat distance occupation e

reg treat logonfarm

reg treat logofffarm

reg treat studytime

attnd treat logonfarm

attnd treat logofffarm

attnd treat studytime

```
. ttest consumption1 == consumption2, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
consum~1 |      45    4995.022    296.9488    1991.993    4396.561    5593.483
consum~2 |      45    2677.778    129.9529    871.7508    2415.875    2939.681
---------+--------------------------------------------------------------------
combined |      90      3836.4    202.6195    1922.217    3433.799    4239.001
---------+--------------------------------------------------------------------
    diff |            2317.244    324.1394                1673.085    2961.403
------------------------------------------------------------------------------
    diff = mean(consumption1) - mean(consumption2)                t =   7.1489
Ho: diff = 0                                     degrees of freedom =       88

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

```
. ttest onfarming1 == onfarming2, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
onfarm~1 |      45       60102    4845.958    32507.68    50335.61    69868.39
onfarm~2 |      45    54135.56    3861.664    25904.83    46352.88    61918.23
---------+--------------------------------------------------------------------
combined |      90    57118.78    3096.947    29380.22    50965.21    63272.35
---------+--------------------------------------------------------------------
    diff |            5966.444    6196.431                -6347.66    18280.55
------------------------------------------------------------------------------
    diff = mean(onfarming1) - mean(onfarming2)                    t =   0.9629
Ho: diff = 0                                     degrees of freedom =       88

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.8309         Pr(|T| > |t|) = 0.3382          Pr(T > t) = 0.1691
```

```
. ttest offfarming1 == offfarming2, unpaired

Two-sample t test with equal variances
```

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
offfar~1	45	10924.44	2084.568	13983.71	6723.273	15125.62
offfar~2	45	2100	773.8791	5191.339	540.3491	3659.651
combined	90	6512.222	1200.387	11387.87	4127.079	8897.365
diff		8824.444	2223.582		4405.543	13243.35

```
    diff = mean(offfarming1) - mean(offfarming2)                  t =   3.9686
Ho: diff = 0                                     degrees of freedom =       88

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.9999         Pr(|T| > |t|) = 0.0001          Pr(T > t) = 0.0001
```

```
. reg lnconsumption logonfarming logofffarming gender marital age education fami
> lysize nooflitrate landholding treat distance occupation
```

Source	SS	df	MS
Model	17.4731185	12	1.4560932
Residual	2.48487601	77	.032271117
Total	19.9579945	89	.224247129

```
Number of obs =      90
F( 12,     77) =  45.12
Prob > F      =  0.0000
R-squared     =  0.8755
Adj R-squared =  0.8561
Root MSE      =  .17964
```

lnconsumption	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logonfarming	1.50244	.2563507	5.86	0.000	.991981	2.0129
logofffarming	.1007764	.0765494	1.32	0.192	-.051653	.2532058
gender	-.0413739	.1558043	-0.27	0.791	-.3516199	.2688722
marital	-.0669867	.0514545	-1.30	0.197	-.1694456	.0354723
age	.0016522	.0038112	0.43	0.666	-.0059369	.0092414
education	.0032364	.0300111	0.11	0.914	-.0565232	.0629961
familysize	-.0542455	.0358879	-1.51	0.135	-.1257074	.0172164
nooflitrate	.0390262	.0359769	1.08	0.281	-.032613	.1106655
landholding	.0254298	.0514081	0.49	0.622	-.0769368	.1277964
treat	.4238225	.0719204	5.89	0.000	.2806106	.5670343
distance	.0383072	.0314784	1.22	0.227	-.0243743	.1009887
occupation	.4106178	.118217	3.47	0.001	.1752177	.6460179
_cons	.0656875	1.194864	0.05	0.956	-2.31359	2.444965

```
. probit poverty consumption gender marital age education familysize landholding treat

Iteration 0:   log likelihood = -53.175802
Iteration 1:   log likelihood = -23.569971
Iteration 2:   log likelihood = -12.056275
Iteration 3:   log likelihood =  -8.614379
Iteration 4:   log likelihood = -8.0902489
Iteration 5:   log likelihood = -8.0659679
Iteration 6:   log likelihood = -8.0657861
Iteration 7:   log likelihood = -8.0657861

Probit regression                                 Number of obs   =         90
                                                  LR chi2(8)      =      90.22
                                                  Prob > chi2     =     0.0000
Log likelihood = -8.0657861                       Pseudo R2       =     0.8483
```

poverty	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
consumption	.0030892	.0012103	2.55	0.011	.000717	.0054614
gender	-1.499101	2.747073	-0.55	0.585	-6.883265	3.885064
marital	-1.327096	.939286	-1.41	0.158	-3.168063	.5138705
age	-.0958563	.1053257	-0.91	0.363	-.3022908	.1105783
education	-.8969344	.9375925	-0.96	0.339	-2.734582	.9407132
familysize	-.5046081	.5465355	-0.92	0.356	-1.575798	.5665818
landholding	1.545176	1.0527	1.47	0.142	-.5180784	3.608431
treat	4.495856	2.148713	2.09	0.036	.2844554	8.707257
_cons	-2.199961	4.367567	-0.50	0.614	-10.76024	6.360314

```
. reg logonfarming logofffarming gender marital age agesq education familysize nooflitrate famsizesq landholding landholsq distanc
> e occupation e
```

Source	SS	df	MS
Model	4.37869032	14	.312763595
Residual	.20115105	67	.003002254
Total	4.57984137	81	.056541252

```
Number of obs =     82
F( 14,    67) = 104.18
Prob > F      = 0.0000
R-squared     = 0.9561
Adj R-squared = 0.9469
Root MSE      = .05479
```

logonfarming	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
logofffarming	.0281708	.0147805	1.91	0.061	-.0013312	.0576728
gender	-.0668683	.0546636	-1.22	0.226	-.1759774	.0422407
marital	-.0183652	.0187259	-0.98	0.330	-.0557423	.0190118
age	-.0176433	.0088911	-1.98	0.051	-.03539	.0001034
agesq	.000255	.0001188	2.15	0.036	.0000178	.0004922
education	.0015932	.0101306	0.16	0.876	-.0186276	.0218139
familysize	.0054382	.0445864	0.12	0.903	-.0835567	.0944331
nooflitrate	.02235	.0131762	1.70	0.094	-.0039499	.0486499
famsizesq	-.0022611	.0036981	-0.61	0.543	-.0096425	.0051203
landholding	.3329885	.0372997	8.93	0.000	.2585379	.407439
landholsq	-.0290609	.0064361	-4.52	0.000	-.0419074	-.0162144
distance	.0107441	.0098703	1.09	0.280	-.0089571	.0304453
occupation	-.1791749	.0404689	-4.43	0.000	-.2599512	-.0983986
e	-.0088024	.0220028	-0.40	0.690	-.0527201	.0351154
_cons	4.510442	.2414877	18.68	0.000	4.028431	4.992454

```
. reg logofffarming logonfarming gender marital age agesq education familysize nooflitrate famsizesq landholding landholsq distanc
> e occupation e

      Source |       SS       df       MS              Number of obs =      82
-------------+------------------------------           F( 14,    67) =    6.05
       Model |  16.4886985    14  1.17776418           Prob > F      =  0.0000
    Residual |  13.0358167    67  .194564428           R-squared     =  0.5585
-------------+------------------------------           Adj R-squared =  0.4662
       Total |  29.5245152    81  .364500188           Root MSE      =  .44109

------------------------------------------------------------------------------
logofffarm~g |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
logonfarming |   1.825638   .9578673     1.91   0.061    -.0862728    3.737549
      gender |   .0771041   .4448418     0.17   0.863    -.8108039     .965012
     marital |   .0260252   .1517926     0.17   0.864    -.2769541    .3290046
         age |   .0171349    .073619     0.23   0.817    -.1298091     .164079
       agesq |  -.0002868   .0009884    -0.29   0.773    -.0022596     .001686
   education |  -.0296778    .081488    -0.36   0.717    -.1923286     .132973
  familysize |  -.1533036   .3584817    -0.43   0.670     -.868836    .5622289
 nooflitrate |   .1730934   .1062411     1.63   0.108    -.0389647    .3851516
   famsizesq |    .006281   .0298435     0.21   0.834    -.0532869     .065849
 landholding |  -.4878687   .4402963    -1.11   0.272    -1.366704    .3909664
   landholsq |   .0364747   .0590043     0.62   0.539    -.0812985    .1542478
    distance |   .0172378   .0801299     0.22   0.830    -.1427021    .1771778
  occupation |   1.573152   .3166231     4.97   0.000     .9411701    2.205135
           e |   .5093714   .1660617     3.07   0.003     .1779107     .840832
       _cons |  -7.201219   4.762687    -1.51   0.135    -16.70758    2.305145
------------------------------------------------------------------------------
```

```
. reg studingtime gender marital age agesq education familysize nooflitrate famsizesq landholding landholsq distance occupation e
> logonfarming logofffarming

      Source |       SS       df       MS              Number of obs =      82
-------------+------------------------------           F( 15,    66) =    3.60
       Model |  21671.6048    15  1444.77365           Prob > F      =  0.0002
    Residual |  26481.1391    66   401.22938           R-squared     =  0.4501
-------------+------------------------------           Adj R-squared =  0.3251
       Total |  48152.7439    81   594.47832           Root MSE      =  20.031

------------------------------------------------------------------------------
 studingtime |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      gender |   13.36337   20.20541     0.66   0.511    -26.97802    53.70476
     marital |   5.834085   6.894624     0.85   0.401    -7.931477    19.59965
         age |  -.6375483   3.344489    -0.19   0.849    -7.315036     6.03994
       agesq |   .0097389   .0449115     0.22   0.829    -.0799298    .0994076
   education |  -2.490838   3.704145    -0.67   0.504    -9.886403    4.904726
  familysize |   2.385186   16.30135     0.15   0.884    -30.16151    34.93188
 nooflitrate |   .4652365   4.919199     0.09   0.925     -9.35626    10.28673
   famsizesq |    .074546   1.355684     0.05   0.956    -2.632164    2.781256
 landholding |   13.30585   20.17683     0.66   0.512    -26.97848    53.59019
   landholsq |  -2.720665   2.687098    -1.01   0.315     -8.08563      2.6443
    distance |   -10.1514   3.640065    -2.79   0.007    -17.41902   -2.883772
  occupation |  -22.97484   16.81985    -1.37   0.177    -56.55675    10.60708
           e |  -21.11767   8.053196    -2.62   0.011    -37.19639   -5.038943
logonfarming |   15.28774    44.6617     0.34   0.733    -73.88221    104.4577
logofffarming |  33.74616   5.547882     6.08   0.000     22.66945    44.82286
       _cons |  -17.92031   219.9392    -0.08   0.935     -457.043    421.2024
------------------------------------------------------------------------------
```

```
. ttest foodconsumption1 == foodconsumption2, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
foodco~1 |      45    1811.778    114.8003    770.1042    1580.413    2043.143
foodco~2 |      45    1054.444    49.33452     330.946    955.0173    1153.872
---------+--------------------------------------------------------------------
combined |      90    1433.111    73.96285    701.6732    1286.149    1580.074
---------+--------------------------------------------------------------------
    diff |            757.3333     124.952                509.0174    1005.649
------------------------------------------------------------------------------
    diff = mean(foodconsumption1) - mean(foodconsumption2)        t =   6.0610
Ho: diff = 0                                     degrees of freedom =       88

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

```
. ttest nonfoodconsumption1 == nonfoodconsumption2, unpaired

Two-sample t test with equal variances
```

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
nonfoo~1	45	3183.244	189.0129	1267.937	2802.314	3564.175
nonfoo~2	45	1623.333	84.35136	565.8461	1453.334	1793.332
combined	90	2403.289	132.0041	1252.301	2141	2665.578
diff		1559.911	206.9807		1148.58	1971.242

```
    diff = mean(nonfoodconsump~1) - mean(nonfoodconsump~2)         t =   7.5365
Ho: diff = 0                                     degrees of freedom =       88

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```