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Relationship between Renewable Energy and Socio-economic Development: A Study in Patuakhali District

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Abstract

The major research purpose is to critically assess the relationship between the use of renewable energies and socio-economic development of the rural people in Bangladesh. The research objectives are focused to explore the socio-economic development of rural people resulting from the application of renewable energies; to assess how Grameen Shakti distributes renewable energy technologies to improve socio-economic conditions of rural people; and to explain under what conditions the renewable energy usage can actually bring positive socio-economic changes in rural areas. The problem statement is focused on why many villagers are not using solar energies even if it is cheaper to buy. The research is conducted by qualitative research method and both secondary and primary data collection techniques are employed. The study is focused on Bangladesh because the number of solar energy installment is increasing vastly and it has become very cheap to buy. The study is conducted in two villages of Dumki Upazila of Patuakhali district of Bangladesh because there are many climate migrants live in this area and most of renewable energy users in this area are from climate migrant backgrounds. The study consists of 8 qualitative interviews with households who use solar energy and 8 more qualitative interviews with households who do not use solar energy. Focus group discussion is also conducted as an interview session with Grameen Shakti employees. A telephone interview is also conducted with UNO (Upazila Nirbahi Officer) of Dumki Upazilla to get information about how local government can help to increase the accessibility of solar energy. It is found that there are visible differences between the users and non-users of solar energies in rural areas; such as the households who use solar energy achieve comparatively more socio-economic and environmental benefits than the non-users of solar energy. Distribution and accessibility of renewable energies, how the company reaches their clients, and how they company uses their funds for offering renewable energies are found as major conditions to define whether the use of renewable energy can develop socio-economic conditions or not. The changes in socio-economic development caused by the renewable energy use are attempted to relate with energy and sustainable development theory. The research also attempts to identify the limitations that hinder the accessibility of renewable energies in rural areas and some major further scopes of the study are discussed. An ambiguous finding of the research is that many villagers do not use solar energies even if it is cheaper to buy, so, there can be more studies conducted to analyze psychological and cultural barriers that do not inspire them to utilize renewable energies.

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List of Glossaries

ArcGIS	It is a geographic information system (GIS) application for working with maps and geographic information.
AVA	Association for Village Advancement
BDT	Bangladeshi Taka, which is the currency of Bangladesh. 85 BDT is equal to USD 1 as of 2017.
BGEF	Bright Green Energy Foundation
BRAC	Building Resources Across Communities
District	Bangladeshi districts are local administrative units. Totally, there are 64 districts in Bangladesh.
Division	The administration of Bangladesh is divided into eight major regions those are called division.
EVD	Eco-village development, is an approach introduced to change the people's livelihood by promoting education, income generation, women empowerment and promoting environment
FGD	Focus group discussion is a small but demographically diverse group of people whose reactions are studied especially in market or social research.
Grameen Bank	It is a Noble Peace Prize-winning microfinance organization and community development bank founded in Bangladesh
Grameen Shakti	It is a company that disseminates solar technologies and the use of other renewable energy sources in rural areas in Bangladesh, 'Grameen Shakti' is a Bengali term refers to rural power.
HKSKS	Hilful Fuzul Samaj Kallyan Sangstha
ICT	Information and communications technology
IDCOL	Infrastructure Development Company Limited, is a government owned non-bank financial institution that finances renewable infrastructure projects in Bangladesh.
IGA	Income generating activities
Imam	It is an Islamic position, mostly indicated to the praying leader of a mosque and Muslim community by Sunni Muslims.

INFORSE	International Network for Sustainable Energy, it is an international non-profit organization network to implement sustainable energy solutions.
Kerosene oil	It is known as paraffin, lamp oil and coal oil, it is basically a combustible hydrocarbon liquid derived from petroleum, widely used as a fuel in industry as well as in households.
Patakuri	A tiny NGO aimed at sustainable micro finance organization in Bangladesh.
Patuakhali district	It is a district in South-central Bangladesh and it is a part of the Barisal division of this country.
PCSD	Policy cohesion for sustainable development
PV	Photovoltaic
RAPSS	Remote Area Power Supply Systems
RDF	Resource Development Foundation
SEF	Sustainable Energy Finance
SHS	Solar Home System, are stand-alone photovoltaic systems that provide a cost-effective type of supplying power for lighting appliances to remote off-grid households.
SPP	Small Power Plants
SPV	Solar Photovoltaic, A photovoltaic system, also solar PV power systems or PV panel, is a power system designed to supply usable solar power by mean of photovoltaic.
SRIZONY	A National Socio-Economic Development Organization in Bangladesh.
TV	Television
Upazila	It indicates to sub-district, formerly called as *Thana*, it is a geographical region in Bangladesh used for administrative or other purposes.
Union	It refers to Union Councils or *Union Parishads* that are the smallest rural administrative and local government units in Bangladesh.
UNO	Union Nirbahi Officer, is the chief executive of an Upazila (sub-district) and a junior level officer of the Bangladesh Civil Service.
USD	United States Dollars, USD $1 is equal to 85 (BDT) Bangladeshi Taka that is the Bangladeshi currency as of 2017.

Chapter – 1: Introduction

1.1 Introduction

The importance of renewable energies in our society has become immense because of ensuring sustainable development. The present research is mainly focused on the relationship between renewable energies and socio-economic development, which is one of the main thrust of the study. The purpose of the study is to investigate how the use of renewable energies can affect to change the socio-economic conditions of the rural people in Bangladesh. The background of the research explains few aspects of green economy and why renewable energies are so popular in order to maintain green economy and save natural resources. It also discusses about the present scenario of renewable energies in Bangladesh, and how rural people are being benefitted by this. Research aim, objectives and hypotheses are developed in terms of dependent and independent variables of the research to explain how the findings of the study can be discussed.

1.2 Background of the Study

The popularity of 'green economy' is increasing all over the world because of the threat of insecurity of energy, and climate change issues. The concept of 'green economy' has emerged to reduce the dependency on fossil fuels, natural oil, and electricity so that we can save sufficient amount of natural resources for the next generations (Howard et al., 2013). The introduction of green economy has provided us an actual opportunity to utilize alternative sources of energy and power so that we can take steps to deal with the threat to global biosphere and climate change. It is worth mentioning that green economy has led us to believe that the investment on renewable energy can assist to increase the energy supply as an alternative source (Bäckstrand &, Lövbrand, 2007). Most of the developing nations are assisted by European and American investors for initiating renewable energy such as bio fuels, solar energy, hydro-electric power project, and wind energy projects (Shove & Gordon, 2014).

As a developing country, Bangladesh has been improvising the practice of renewable energies for last two decades (Bahauddin & SalahUdin, 2010). The initiatives of green economy involves

the use of natural resources such as sun, land and water in order to produce renewable energy, which can truly change scenario for Bangladesh in national and international energy market by saving energy resources and developing energy structures (Asaduzzaman et al., 2013). Generally, the cost of renewable energy technologies is cheaper than the cost of electricity so people from both rural and urban areas of Bangladesh are attracted to renewable energies. This can dramatically change the energy supply and energy demand patterns, which is considered to be a great influence on socio-economic transformation (Bawakyillenuo, 2012). There are many companies to offer solar panels with cash and loan so that poor people can buy the solar panels by paying the money with loan installments. Thus, even rural people find it flexible to utilize it, and suddenly Bangladesh has paced the use of renewable technologies (Bahauddin & SalahUdin, 2010). The usage of renewable energies includes solar photovoltaic (PV) panels[1] that help to utilize the abundant sunlight to produce a source of energy, which is commonly used in all over Bangladesh (Khandker et al., 2014). After installing a solar PV panels, it can function for 10-15 years that can benefit the users for long time. The traditional usages of energy in Bangladesh are cooking, lighting, heating, freezing and grinding, this also includes the use of charcoal or firewood burning and fossil fuels. Particularly in rural areas, people are more likely to use renewable energies because the purchasing cost is low, thus the rural people can afford to buy it (Khandker, Barnes & Samad, 2009). The study can be significant to address the research issue that how use of solar renewable energy affect on socio-economic conditions of the rural people in Bangladesh.

1.3 Problem Statement

The price of buying renewable energy has become cheaper these days in Bangladesh but still there are many villagers who are not willing to use them. So, the research is useful to investigate the issue that why people are reluctant to use renewable energy when it is affordable to buy and easy to use. The problem statement of the research is to analyze whether any psychological and cultural barriers working behind this factor or not, which actually does not inspire villagers to use renewable energy. The access to renewable energy needs to be expanded to the people who

[1] **Solar photovoltaic (PV) panels:** A photovoltaic system, also solar PV power systems or PV panel, is a power system designed to supply usable solar power by mean of photovoltaic

live in rural areas so that they can be involved under development process. But since the renewable energy policies do not emphasize on the impacts on socio-economic life of the rural people then it becomes major issue for the companies to reach the target clients. So, the problem issue of the research is to find out if there is any discrimination among the clients selected by the company because Grameen Shakti[2] may offer renewable energies only to the clients of Grameen Bank, thus it can be a reason that hampers the widespread access of renewable energies to every rural people. Policy implementation regarding renewable energies in Bangladesh would be flexible if we find out that Grameen Shakti provides renewable energy technologies to everyone without having any kind of discrimination. So, it is important to study that whether sufficient numbers of rural people are offered to get the access of renewable energy or not. It can be considered that socio-economic development of rural people can be caused by some other factors such as foreign remittance, so, it would be important to identify whether the changes in socio-economic conditions is truly coming from the impact of renewable energies or is there any other factors working behind it.

Energy and sustainable development theory and policy cohesion for sustainable development (PCSD) can be related to this research in order to assess how the implementation of relevant policies help to increase funds for the organizations and offer renewable technologies in affordable price, which is the major issue of the present research. The present study is significant to investigate that under what conditions, the application is renewable energies is effective for socio-economic development and under what conditions it is not. There are some major aspects covered by the study such as distribution and accessibility of renewable energies, how the company reaches their clients, and how they company uses their funds for offering renewable energies. All these aspects are mentioned as the conditions, which may define whether the use of renewable energies creates any positive impact of socio-economic conditions or not.

1.4 Rationale of the Research

The usage of renewable energy can promote the socio-economic conditions of the rural people in Bangladesh in terms of women empowerment, educational development, increased income

[2] **Grameen Shakti:** It is a company that disseminates solar technologies and the use of other renewable energy sources in rural areas in Bangladesh, 'Grameen Shakti' is a Bengali term refers to rural power.

opportunities and improved telecommunications sector (Bahauddin & SalahUdin, 2010). But the present research is unique than other studies because it can analyze under what conditions the renewable energy usage can be positive to achieve socio-economic benefits. The most important justification of the research is to understand how the usage of renewable energies is creating income generations for rural people to change their socio-economic conditions. It is necessary to increase the distribution and accessibility of renewable energies in rural areas in Bangladesh so that people can actually be a part of sustainable development process. Many companies and social enterprises are working to support renewable energies but still the widespread use of renewable energies is not visible in rural areas (Deb, Bhuiyan and Nasir, 2013). So, the present research is important to assess the process of reaching the clients of renewable energies because if the company does not reach the actual clients then it may not bring overall socio-economic development. According to Marro and Bertsch (2015), companies are creating thousands of job opportunities for rural people. The use of renewable energies also create income generating activities for women such as sewing activities, livestock farming, fish farming that brings the scope of ensuring women empowerment in the society (Bahauddin & SalahUdin, 2010).

The study can be very much significant to understand the impact of using renewable energies on socio-economic development and assess whether it has any environmental impact for rural people in Bangladesh. “Private Power Generation Policy in Bangladesh 1996” was introduced by the government in Bangladesh but more attempts on this policy were provided, and eventually in 2009, it was amended as “Renewable Energy Policy in Bangladesh” to focus on public-private partnership, local technological development and sustainable development (Reegle, 2015). So, the present research can be significant to investigate the role of Grameen Shakti to provide renewable energies to everyone with reasonable price without any sort of discrimination, which helps to implement the policies regarding renewable energies in Bangladesh. According to Geels and Turnheim (2012), the use of renewable energies is more useful for gaining economic benefits rather than achieving environmental benefits. But the impact of climate migration is also affecting reform efforts, economic forces and environmental issues that allow climate migrants to use renewable energies (Grubler, 2012). The research issue is also significant to identify how rural people are getting environmental benefits by using solar energies at home. The Companies may suffer to meet the demand of renewable energies that may hinders socio-economic development so this research can be important to find out how the companies manage to meet the

demand of renewable energies in rural areas. Solar energy is chosen for this research because the prevalence of use of solar energy bas been increasing in Bangladesh so this can be a significant aspect of the research to put more emphasis on solar energy popularity. The present study is also different from other studies because it investigates that under what conditions solar energy affect on socio-economic changes in rural areas.

1.5 Research Aim and Objectives

The theory of energy and sustainable development explained by Cleveland and Najam (2008) is useful to understand the linkage between renewable energy use and socio economic development. The authors attempt to study the impact of energy use in terms of the major three pillars of sustainable development such as social, economic and environmental aspects. This theory can assist to identify the impact of renewable energy use on the changes in socio-economic indicators. The relevancy of this theory is prominent because the research aim is also emphasized to investigate the relationship between renewable energy use and socio-economic development.

Aim of the research: The aim of the research is to critically assess the relationship between the use of renewable energies and socio-economic development of the rural people in Bangladesh.

Objectives

- To explore the socio-economic development of rural people resulting from the application of renewable energies;
- To assess how Grameen Shakti offers renewable technologies to improve socio-economic conditions of rural people;
- To explain under what conditions the solar energy use can actually cause positive socio-economic changes in rural areas; and
- To find out the limitations of increasing the availability of renewable energies in rural areas.

The aim of the research is emphasized on the critical relationship between renewable energy use and socio-economic development. It is considered that renewable energy usage is increasing because it is cost effective and easy to use that allows users to change their socio-economic conditions (Bahauddin & SalahUdin, 2010). Major changes in socio-economic conditions can be income generation, education health, entertainment, gender equity, increased work and business scopes, and extended working hours and clean and hygienic indoor environment. Grameen Shakti is a sister company of Grameen Bank established by Nobel Peace Prize winner Muhammad Yunus. Grameen Shakti is a social enterprise known as the largest provider of renewable energy technologies in Bangladesh, which has evolved as a social business trend to fulfill the energy demand of the rural people. As of December 2012, Grameen Shakti installed more than 1 million solar home systems (SHSs)[3] in rural areas in Bangladesh, along with 22,250 more SHSs installed each month. Grameen Shakti holds the lion's share of renewably energy market and we choose this company as a social enterprise because most of the renewable energies used in the chosen study are offered by them.

1.6 Research Hypothesis

There is some research hypotheses designed in terms of the major research issues. There are some independent and dependant variables that can be found from the hypothesis. The independent variables of the research are; increase of investors and funds, use of renewable energies, efficiency of the company in terms of reaching clients and increasing the use of renewable energies. On the other hand, the dependant variable of the research is socio-economic development. There are some indicators of socio-economic development as such as income generating activities, educational facilities, entertainment facilities, health and safety, gender equity etc.

[3] **SHSs:** Solar home systems, are stand-alone photovoltaic systems that provide a cost-effective type of supplying power for lighting appliances to remote off-grid households

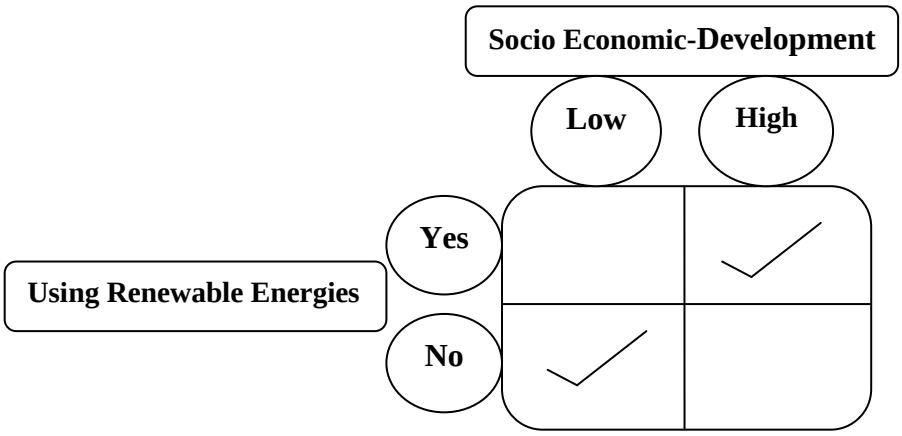


Figure 1.1: Research Hypothesis

Hypothesis: The use of renewable energies can positively influence the socio-economic development for rural people of Bangladesh.

According to Cleveland and Najam (2008), the nature of development in socio-economic and environmental aspects can always change. The authors have attempted to employ energy and sustainable theory to find out the impact of energy usage on socio-economic development by investigating the changes in socio-economic conditions of the people after using renewable technologies. So, the present research can be essential to identify under what conditions, the use of renewable energies can affect on socio-economic development and under what conditions it does not. Those conditions are identified in this research as major research questions such as how the company reach their clients, integration between local government and the company, and how the company utilized funds to increase the availability of renewable energies. So, for an effective investigation, we can try to analyze these conditions to understand how these conditions may help to ensure the impact of using renewable energies to gain socio-economic benefits.

1.7 Research Questions

Traditional literatures about renewable energies in Bangladesh attempt to identify the changes in energy supply and energy demand patterns so there can be a gap of studying the changes of socio-economic dynamics that is affected by using renewable energy. So, the study is focused to understand the socio-economic impacts of using solar renewable energy in Bangladesh.

- How does the use of renewable energies change the food habit and health status of the people?
- What are the educational, recreational, and technological facilities gained by using renewable energies?
- How can renewable energy usage bring increased working hours and income generating activities?
- Does renewable energy use create any income generating opportunities for female members in the family?
- Can renewable energy usage influence on living environment, accommodation situation and social status of the households?
- How does Grameen Shakti contribute to increase the use of renewable energies in rural areas for socio-economic development?

The study is conducted by using qualitative research method to gather data from both users and non-users of renewable energies to compare and find out the socio economic impact of using renewable energies. Both the user and non-user households is chosen from similar kind of socio-economic demographic background to make sure that the socio-economic development is actually coming from the usage of renewable energies. It is also analyzed in research findings that how Grameen Shakti operates their business and supplies their renewable energy technologies to rural people by gathering data from their organization and employees.

1.8 Scope of the Research

The research is conducted in rural areas in Bangladesh to identify how the usage of renewable energies is creating impact on socio-economic development. At the same time, the assessment can be done with the people who do not use renewable energies to understand the differences between socio-economic changes caused by the use of renewable energy. It is attempted to select the respondents of both categories from similar types of socio-demographic backgrounds. The research is conducted in terms of the performance of Grameen Shakti, which is a company holding biggest market share of renewable energy market in Bangladesh. This organization offers different types of renewable energies to the people (Gshakti, 2016), but we tend to analyze

the conditions of clients who are only offered supported with solar energy by Grameen Shakti. Grameen Shakti is chosen for the research because it holds the largest market share so it has direct impact on the implementation process of policies relating renewable energies by increasing distribution and accessibility of renewable energies. For the considerations of time limit and other barriers the research cannot be conducted in vast area so we choose Patuakhali[4] district as the study area because of having many users of solar energy. This district is chosen because there are many climate migrants moving to this district who use solar energies so the number of renewable energy users is increasing vastly in this district. The concept of eco-village development is introduced by Grameen Shakti, which can be explored with in-depth analysis to explain the strategies and approaches of this company to offer renewable energies to rural people.

1.9 Structure of the Study

Chapter one: The first chapter explains the research aim, research objectives and hypothesis. Scope of the study, rationale of the research, and problem statement are useful segments of this chapter.

Chapter two: Major concepts of the research are defined in this chapter such as green economy, sustainable development, renewable energies, income generating activities (IGA), socio-economic development etc. There are many existing literatures relating to renewable energies and their impact on the livelihood of the rural people, which are mostly analyzed in this chapter, relevant theories and theoretical framework of the study is also explained in this chapter.

Chapter three: Research methodology is mainly focused in this chapter. Major research methods, research approaches, data collection techniques are described in this section. Data analysis methods, ethical considerations, and limitations of the study are some major portions of this chapter.

Chapter four: The fourth chapter contains the findings and analysis of the collected data. This is mainly the interpretation of the collected data to study how the socio-economic conditions of

[4] **Patuakhali district:** It is a district in South-central Bangladesh and it is a part of the Barisal division of this country

rural people can be changed by the usage of solar energy. The discussion of the findings and results is also attempted to relate research framework and relevant theories with the major research findings.

Chapter five: The last chapter is has discussed the concluding remarks of the research. Conclusion is explained in terms of the relation between research objectives and research findings.

1.10 Conclusion

The research background is discussed in terms of the concept of green economy, sustainable development and renewable energy use in Bangladesh. Rationale of the research explains the necessity of conducting the research while problem statement shows the existing issues that can be investigated by the study. Research aim, objectives and research hypotheses are also explained by the use of dependant and independent variables, some major conditions are mentioned to assess under what conditions, the use of renewable energies can affect on socio-economic development.

Chapter – 2: Literature Review, Conceptual and Theoretical Framework

2.1 Introduction

There are some useful concepts relating to the major research issues that need to be defined for the clarity of what we are going to investigate exactly. It is very important to clarify those concepts transparently with appropriate definition for the discussion of the results and findings. The review of existing literature helps to identify major aspects and advantages of using renewable energies in rural areas of Bangladesh. There are some important existing literatures discussed in this chapter to study the relationship between socio-economic development and renewable energies. Relevant theories relating to the research issue is also described so that we can develop an effective theoretical framework to conduct the research. The discussion of the findings and results of the study can be related with the relevant theories and review of the existing literature.

2.2 Defining Concepts

Defining concepts would be helpful to elaborate the major terms used in research objectives and research questions. This section can give us specific definition and meaning of the major terms that are frequently used in this research. The major concepts in this research that can be defined such as; green economy, sustainable development, renewable energies, income generating activities (IGA), socio-economic development, eco-village development and access to renewable energies.

2.2.1 Green Economy

The concept of green economy emerges from the protection of environment. It refers to the business activities of business entrepreneurs that can reduce environmental risk and protect the natural resource from distinction (Bäckstrand & Lövbrand, 2007). The aim of green economy is to ensure sustainable development for the next generation that allows maintaining socio-

economic and environmental development. The present research is highly essential to assess the socio-economic conditions of the customers who use renewable energies, which is a major component of green economy. According to Makower (2008), green economy has the emphasis on business companies to ensure the demand of the customers as well as to maintain positive intention to assure societal demand to reduce their environmental effects.

2.2.2 Renewable Energies

The research issue has a great emphasis to understand how the access of renewable energies can affect on socio-economic conditions of the people so we can clarify the definition of renewable energies and what kind of renewable energy we are referring by this research. Renewable energy actually indicates the energy that is produced by sunlight, rain, waves, tides, and wind etc. According to Maczulak (2009), the most common types of renewable energies are solar energy, biogas plant, wind energy, hydropower, and solar photovoltaic (SPV). In the present research, we can analyze socio-economic conditions of the customers who use only solar energy. So, renewable energies indicate many types of energies but the present research has focused on only solar energy. The use of solar energy has emphasized by this research rather than other renewable technologies because the number of solar energy users in rural areas are increasing every day. There might be a question that why we use the term users of renewable energies rather than users solar energy. The reason is because some people may not use solar energy but they can use other forms of renewable energies such as biogas plant and wind energy etc. So, for the selection of households for data comparison, we choose the term ‘users of renewable energy’ (solar energy only) and non-users of renewable energy (non-users of any kind of renewable energies). We may intend to make sure that the non-users are not using any kind of renewable energies including solar energy so that it helps us to compare the differences of socio-economic conditions between users and non-users of renewable energies.

2.2.3 Sustainable Development

The concept of sustainable development explains the prevention of over exploitation of natural resources so that it does not lead to tragedy of the commons (Cleveland & Najam, 2008). This is

development in a manner and use of natural resources where future generation is not affected by today's' over exploitation. Rogers, Jalal and Boyd (2008) describe that sustainable development is a process where the development does not come from a mono approach. The authors argue that when development happens from major three perspectives such as social, economic and environmental, then we can define it as sustainable development. The present research is focused on the impact of renewable energies on socio-economic development of the rural people so the concept of sustainable development conveys significant relation with the research issue.

2.2.4 Socio-Economic Development

Development means changes and socio-economic development refers to the positive changes in social and economic conditions. Socio-economic development is an interrelated concept because social development is dependent on the economic development. When a community is affected by economic development then the population is easily developed from social conditions. Szirmai (2015) explains that socio-economic development is mainly focused to measure the quality of life and standard of living the people. But it is necessary to identify some major indicators that are essential to understand socio-economic development.

Indicators of socio-economic development: There are some indicators that can help to measure the level of socio-economic development such as health, education, entertainment facilities, social status, gender equity, increased job opportunities, increased business opportunities, increased working hours, hygienic environment and protection from pollution etc (Szirmai, 2015; Bahauddin & SalahUdin, 2010). In the present research, these indicators are the major elements of measuring the changes in socio-economic conditions of the people who use renewable energy.

2.2.5 Eco-Village Development (EVD)

The approach of eco-village development is essential for sustainable development. Hasan (2015) explains that eco-village development is an approach introduced to change the people's livelihood by promoting education, income generation, women empowerment and promoting environment. Eco-village development is an important term for this research because all the

aspects of eco-village development such as income generation, promoting education and environment are relevant to socio-economic changes of rural people. The use of solar energy is the major focus in the present research as a useful type of renewable energies and eco-village development is also introduced by the emphasis of solar energy installation for rural people in Bangladesh.

2.2.6 Access to Renewable Energies

The access to renewable energies refers to the availability and the use of renewable energies by the customers. The present research is important to assess how compaany offer renewable energies to the clients and ensure the distribution and accessibility of the renewable technologies. The term generally refers to the use of renewable energies by the rural people, and it also indicates whether people are being offered to use the renewable energies or not (Deb, Bhuiyan & Nasir, 2013. The affordability of buying renewable energy with reasonable price and offering renewable energies to everyone are two major perspectives of understanding the distribution and accessibility of renewable energies.

2.2.7 Income Generating Activities (IGA)

Income generation is the term that is indicated to increased opportunities for farming, fishing, business, and entrepreneurs. It generally refers to the activities that can bring income opportunities for the people. Boadi (2006) describes that income generating activities can help to empower people economically by enhancing working hours and increased business opportunities. Income generating activities are also highly relevant with sustainable development and socio-economic changes so the concept is very important to the present research issue.

2.2.8 Gender Equity

Gender equity is a concept that elaborates the opportunities for both male and female equally. In social science, gender equity refers to the process of distributing resources, programs and power of decision making fairly to both male and female. The explanation of gender equity does not

allow any kind of discrimination in terms of sex and gender (Szirmai, 2015). Gender equity also addresses any form of differences in the facilities available to male and female. In the present study, gender equity refers to the opportunity to earn money by the female members, which is mentioned as women empowerment in the research findings. In rural areas, female members in the family can contribute to their family by sewing activities, livestock farming, and cottage industries etc (Grameen Shakti, 2006). All these income generating activities can be promoted by the use of renewable energies that allows women to sustain their position in decision making process in the family, which is a major aspect of gender equity and women empowerment.

2.3 Literature Review

The findings of Wadud, Zaman, Rabbee and Rahman (2013) argue that the modern world is moving very first in terms of the use of technological advancements. But the people should become more cautious about the sources of the natural resources, and how they can be utilized in a more effective way. The sources are limited and expensive so the introduction of renewable energies has emerged to reduce the dependency on the limited sources of natural resources (Wadud et al., 2013). The installation of vast numbers of renewable energies in Bangladesh has not only affected the supply and demand pattern of energy but also created an utmost competency for energy development. But the present research issue is also going to analyze how the application of renewable energies is creating opportunities to more income generating activities such as fishing. Fishing activities by fishermen can be promoted by using renewable energies and this can be mentioned as a knowledge gap that the present study has investigated.

Scheer (2013) discusses that having the immensely important exchange of fossil by renewable energies can disclose a future of a new momentum for a productive economy. Through the touch of renewable energy economic market, agriculture, and forestry will no longer stay new and lasting motors of the economy but modern and forward-looking enterprise with various sources of new job opportunities. Agricultural sector needs to be developed with business structures to fulfill the demand of international market conditions and using renewable energy is a key to that pathway (Scheer, 2013). The author argues use of renewable energies in different sectors of economy but the present research can help to investigate the role of renewable energy use in both economic and social aspects.

The impact of solar energy use has progressed women empowerment and education for the young generation (Bahauddin & SalahUdin, 2010). In the off grid areas, solar energy has made a big contribution for telecommunication sector. The scope for information technology improves students studying capacity. Bahauddin and SalahUdin, (2010) also discusses that solar energy use can reduce the use of smoke and soot from the kerosene lamps, which can actually lessen health risks for the rural people. The authors also elaborate how solar energy creates increased job and business opportunities, mobilizes social forces, improves rural economy and brings children and women development. But the present research can emphasize on how the distribution and accessibility of solar energies can be extended in rural areas furthermore. This is a research gap that can be met by the present study to explain why solar energy is not spreading as much as expected and how solar energies can be accessible for everyone in rural areas of Bangladesh.

Ma, Oxley, Gibson and Li (2010) explain that continous improvement of renewable energy economy in China is reliable on government support because renewable energy economy is not yet cost-competitive with the fossil energy economy. The authors also imply that during 1970s, China implemented programs under renewable energy projects in rural areas not because of dealing with shortage of fossil energy supply but to work on energy balance and environmental protection (Ma, Oxley, Gibson & Li, 2010). But as a developing country, Bangladesh can reduce the dependency on fossil energy and introduce more renewable energy in order to sustain environmental protection and economic development. The present study can help to analyze how renewable energy accessibility can be reach to everyone in rural areas.

Ullah, Hoque and Hasib (2012) discuss in their study that energy and power sector is the most efficient sector for a developing country like Bangladesh. But the recent success of establishing different kinds of renewable energy projects has dramatically changed the supply and demand scenario of energy market. But the mismanagement and inefficient governance has hindered the development activities in energy sector and created negative impacts on employment process resulting vulnerable impacts on people’s livelihood. The authors also argue that the renewable energy companies are attempting to improve the condition of rural people in Bangladesh. But it is also important to investigate how these companies are utilizing their funds to offer renewable

technologies in a cost effective way so that rural people can get access to renewable energies with affordable price.

According to Paul and Uhomoibhi (2012), economic development can be sustainable if we can ensure well-equipped high-value-added industries with well-equipped infrastructures. Solar energy's impact and ICTs (Information and Communication Technologies) are the key mechanism to shift away the dependency on low-value-added sectors such as forestry, framing and agriculture (Paul & Uhomoibhi, 2012). There are many studies conducted to understand how ICTs can contribute positively in the emerging economies but very few studies are found to identify various sectors where solar energy can affect in emerging and developing economies such as Bangladesh. So, the present research is very much essential to discuss how renewable energy usage can improve farming and agricultural activities to foster sustainable economic development in developing economies.

The study of Hassan, Mahmud, Rahman, Khan and Haque (2014) shows that the shortage of electricity has become a threat for the rural areas of Bangladesh so the renewable energy has become much more popular in rural areas rather than urban areas. By the application of renewable energies, Bangladesh can meet the actual demand of energy so that people from all over the country can get access to energy. The authors also mention that the installation of renewable energies can enable the people to have more income generation than before, which can actually influence financial growth (Hassan et al., 2014). The expansion of renewable energies is good in rural areas but still many people are not using these technologies. So, there is a necessity of assessing whether the costs of buying renewable energies are affordable or not, which can be mentioned as a research gap the present study has investigated.

The impact of solar renewable energies is highly effective for sustainable development. The study of Rahman, Saha, Khan, Habiba and Chowdhury (2013) explains that the progress of energy sector is very slow in Bangladesh and almost 70 percent of people having lack of access to energy use, and most of them live in rural areas. So, the importance of installing renewable energies is mostly emphasized in rural areas so that people from village areas can be included in the process of sustainable development. The authors imply that sustainable development can be brought by enhancing the positive impacts of using renewable energies, and the present research

is also essential to understand how socio-economic development can be fostered in rural areas in Bangladesh through the use of renewable energies.

According to Islam, Khan, Nasreen, Rabbi and Islam (2011), renewable energy can be essential to reduce poverty in rural areas. The income generating activities can be increased by the application of renewable energies. The authors also imply that the quality and standard of life can be promoted by the influence of renewable energies. The people in rural areas of Bangladesh are causing environmental degradation so it is necessary to utilize renewable energies and get the best use of natural resources to protect the environment (Islam et al., 2011). But the present study will not focus on the environmental degradation caused by rural people but focus on analyzing how the access of renewable energies can affect environmental protection such as clean and hygiene environment and protection from different kinds of pollution.

Grameen Shakti published a country status report of Bangladesh in 2006 as a contribution to INFORSE[5] South Asia, which explains that Bangladesh is a nation that often faces extreme barriers for development because of lowest per capita income. The report suggests that people living in rural areas of Bangladesh are suffering from different kinds of problems such as misuse of biomass, degradation of the environment and drying up water bodies. For both social and economic development of a nation, energy is one of the most influential keys to success. For many years, significant technological development has been influencing renewable energy development, particularly biogas energy and solar photovoltaic. According to Grameen Shakti (2006), the need of energy in rural areas is significant because of agricultural activities, transport, industries and farming. Different types of renewable energies are developed in Bangladesh to meet the energy needs that are shown in the table below.

[5] **INFORSE (International Network for Sustainable Energy):** It is an international non-profit organization (NGO) network to promote and implement sustainable energy solutions worldwide

Table 2.1: Types of Renewable Energies in Bangladesh

Solar Photovoltaic (SPV)	• School electrification • Rural market electrification • Solar home system • Cyclone shelter electrification • Hospital electrification • Micro enterprise • ICT training centre electrification
Solar Thermal	• Hot water system for commercial purpose • Hot water system for domestic use • Dryer for preservation of vegetables, fish and fruits
Biogas	• Biogas for poultry waste of electricity • Biogas for domestic use
Other types	**Hydropower** **Solar energy** **Wind energy** **Village Boom** **Thrive Energy**

Source: Adapted from Grameen Shakti, 2006, p. 2-3

Socio-economic impact: The report explains that renewable energy can create impact on income generating activities of rural people by increased working hours such as saw mill, tailoring shops, small industries, grocery shops etc. Education and home activities of the children can be improved by the impact of renewable energy. The increase of women's income opportunities is also noticeable by the extension of their working hours by poultry farming and sewing (Grameen Shakti, 2006). The report also indicates that it can increase new business opportunities such as increase of TV/radio repairing shops. More metal stores can be opened to supply sufficient amount of farming and agricultural instruments. Renewable energy can also enable the opportunity for rural people to get access of primary health care and improvement of small and cottage industries (Shove & Gordon, 2014). The report basically explains about the economic

impact of renewable energy in rural areas of Bangladesh but the changes in social condition of rural people are not discussed. It is very important to investigate whether renewable energy actually influences social conditions of the rural people or not, so, it can be mentioned as a knowledge gap that we can investigate in the present research.

Policy implementation and political perspectives: Private Power Generation Policy of Bangladesh was introduced by Government of Bangladesh in 1996 that emphasizes on the promotion of renewably energies. The major goals of this policy are; to meet the energy needs in various rural areas of the country, to ensure sustainable economic growth in rural areas, to assure useful operation of renewable energies, and to inspire public-private participation in the promotion of renewable energy. But for making this policy as a success, the Government needs to deal with some barriers such as source of financing can be limited and lack of proper management of the projects. The report mentions about the policy goals and barriers that may affect policy outcome but there can be a limitation of this policy that the policy goals do not directly emphasize on the socio-economic development of people resulting from the use of renewable energies.

According to Marro and Bertsch (2015), Infrastructure Development Company Limited (IDCOL)[6] has joined the Rural Electrification and Renewable Energy Development Project in Bangladesh that started in 2003 to establish a commercial framework for renewably energy development. The authors explain that Bangladesh is one of the most successful countries in the world to operate renewable energy programs. IDCOL loaned about $594 million for 3.5 million Solar Home System (SHS) installation as of 2014. This success has changed the livelihood of 16 million people who live in rural areas of Bangladesh.

[6] **IDCOL:** Infrastructure Development Company Limited is a government owned non-bank financial institution that finances renewable infrastructure projects in Bangladesh

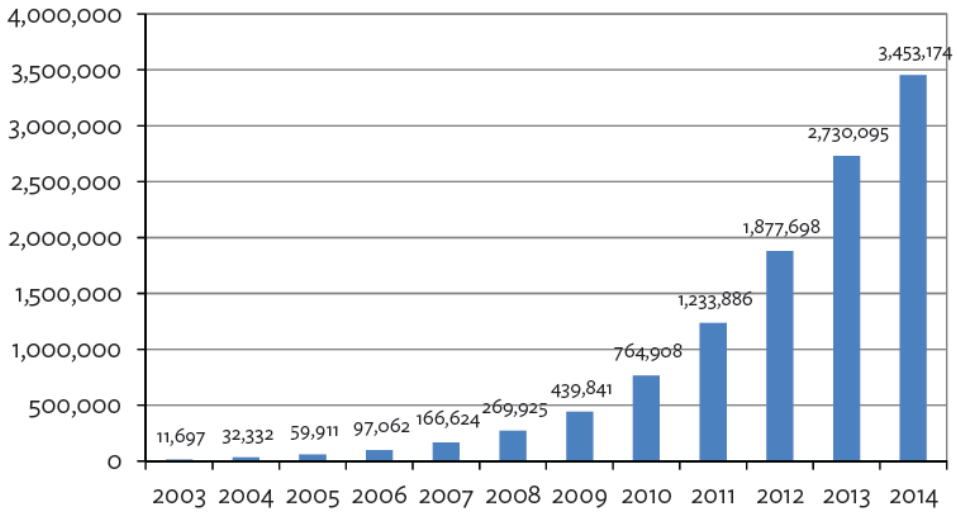
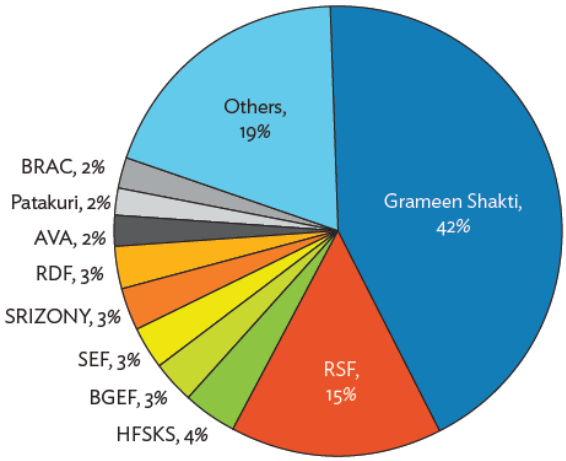


Figure 2.1: Solar Home System Installation Numbers, 2003-2014

Source: Marro and Bertsch, 2015, p. 3

The increased number of SHS shows that the renewable energy is becoming extremely popular in Bangladesh and people are getting the benefits of using it. The present research is efficient to assess how the increased number of solar home systems is changing the socio-economic conditions of the rural people.



BGEF = Bright Green Energy Foundation, HFSKS = Hilful Fuzul Samaj Kallyan Sangstha, RDF = Resource Development Foundation, RSF = Rural Services Foundation.
Source: IDCOL.

Figure 2.2: Distribution of Solar Home Systems by Participating Organization 2015

Source: Marro and Bertsch, 2015, p. 4

According to Marro and Bertsch (2015), the most dominant participating company that supplies SHS installation is Grameen Shakti that holds about 42 percent of the total market share. This company is a member of Grameen family of organizations that also involves Grameen Bank[7]. There are other companies that supplies SHS installation to rural people such as BRAC, Patakuri, AVA, RDF, SRIZONY, SEF, BGEF and HFSKS. The largest market share of Grameen Shakti and high efficiency of this company enables them to introduce the concept of eco-village development (EVD)[8], which has a large emphasis on the socio-economic changes of rural people. So, the present research can help to investigate how the company is offering renewable energies to clients, and how their concept of eco-village development (EVD) can affect to change the socio-economic condition of rural people.

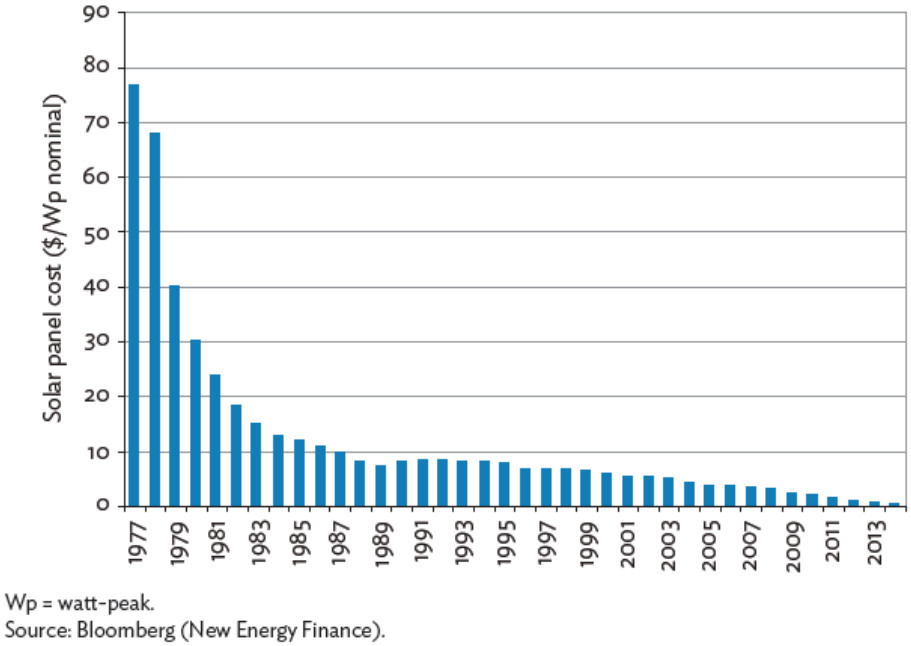


Figure 2.3: Solar Panel Price History, 1977-2013

Source: Marro and Bertsch, 2015, p. 11

According to Marro and Bertsch (2015), the global industry of renewable energy has been growing at 70 percent annually over the last 10 years. Surprisingly enough, in the recession

[7] **The Grameen Bank:** It is a Noble Peace Prize-winning microfinance organization and community development bank founded in Bangladesh

[8] **EVD:** Eco-village development is an approach introduced to change the people's livelihood by promoting education, income generation, women empowerment and promoting environment

during 2009-2010, the industry grew at 172 percent. Due to this reason, the price of solar panel has decreased, which becomes an opportunity for the clients to install solar panels in a cheap cost. But while buying solar panels at cheap costs, the quality of the product and service from the company can be decreased, which is not assessed by the authors. So, it is very important to investigate about the quality of products and service from the company along with the price and it can be assessed by the present research.

Making renewable energies affordable to the rural people helps to ensure socio-economic development, which is the pre-requisite to sustainable development. Lower lighting cost and services help to save the monthly budgets for household, and many micro, small and medium-sized business enterprises can be formed become of the access to renewable energy (Marro & Bertsch, 2015). Thus, income generating activities can be increased among rural people. The impact of renewable energy also affects on educational facilities, entertainment opportunities, health, and safety measures by protecting the family members from various kinds of diseases and pollution. So, it can also affect positively on the social condition of the rural people. Renewable energies are also environment friendly so it also creates positive impact on the local environment, thus the scope of sustainable development can be enhanced in rural areas of Bangladesh (Marro & Bertsch, 2015).

Since 1996, there have been several attempts of policy implementation in Bangladesh to initiate renewable energy technologies. The beginning of the journey started in 1996 through “Private Power Generation Policy of Bangladesh”. Later on, Government also introduced “Policy Guidelines for Small Power Plants (SPP) in the private sector in 1988. In 2007, “Guidelines for Policy Remote Area Power Supply Systems (RAPSS)” was also introduced and then “Policy Guidelines for Enhancement of Private Participation in the Power Sector” is initiated in 2008 (Reegle, 2015). Eventually, the Government came up with “Renewable Energy Policy of Bangladesh” in 2009 focusing on several aspects such as public-private partnership, sustainable energy supplies and local technological development. But the policy objectives only emphasize supply and development of renewable energies rather than socio-economic impact of using renewable energy. So, many of attempts have been made in this field of policy implementation so it is useful to investigate how the implementations of these policies help the companies to get funds and utilize them to provide renewable technologies to rural people in affordable price.

According to Kibria (2015), using renewable energies for rural people can help to bring some economic changes such as profits from selling energy and creating local employment opportunities. It is also explained by the author that health benefits are also achieved by rural people by the influence of using renewable energies through reducing harmful pollution associated with cow dung, fuel wood and kerosene for lighting and cooking. Educational and other familial activities are extended during night time and working hours can be increased, which can promote more income generating activities (Kibria, 2015). But still in many rural areas of Bangladesh, renewable energy use is not that popular as it was expected to be. So, it can be a research gap to be studied through the present research about how to spread more use of renewable energies by integrating with local government to ensure effective marketing activities.

The discussion of Biswas, Das, Baqee, Sadi and Farhad (2011) explains that the companies who support renewable energies to people are more likely effective to provide the information and offer new technologies (solar energy) to the clients. The usage of renewable energies is cost effective and it is easy to use, so many rural people are attracted to renewable energies. The authors also argue that renewable energies have direct impact on income generating activities for rural people and reduction of environmental problems such as indoor air pollution from fuel wood, cooking, and deforestation. The present research issue emphasizes on the role of using renewable energies to increase income generation for rural people, which is also explained by the findings of Biswas et al., (2011).

According to Ferroukhi, Khalid, Lopez-Pena and Renner (2015), the number of solar home system installation have increased very rapidly in Bangladesh during last ten years, to 3.6 million units as of March 2015. The authors also show that about 115,000 relevant employment opportunities are created in 2014 in Bangladesh because of renewable energy projects. There is also an opportunity for women getting employed by the companies so it can certainly affect on the income generating activities in rural areas, thus it creates direct effect on the socio-economic life of the people. But there is a research gap about how the companies can actually reach the clients to provide the benefits of renewable energies. It is a significant research issue to investigate how companies are offering renewable energies to the customers.

The study of Kürschner et al., (2009) describes that solar home system (SHS) are mainly installed by middle-class families in both urban and rural areas. The authors also attempt to

explain how foreign investors support partner organizations to utilize the funds in order to offer renewable energies to the clients, which is one of the major research issues in the present research. The quality of life and education are two major benefits of using renewable energies explained by the findings of Kürschner et al., (2009). Another useful advantage of using renewable energy is to increase working hours for women in farming and sewing activities, which gives them more opportunities to contribute financially for the household, thus gender equity is also maintained, which is a major indicator of socio-economic development. The authors explain that renewable energies can help the users by accessing information, improved communication and improved safety in some cases, which are also major indicators of socio-economic development.

According to Hackett (2012), the implication of renewable energies is not only useful for energy supply but also essential for socio-economic development. The focus of Grameen Shakti is enhanced toward women empowerment so that more income generating activities can be enhanced for women. Hackett (2012) also explains that rural development is the major benefit of using renewable energies. But while ensuring rural development, we also need to understand that increasing the number of investors that can spread the renewable projects in other rural areas of Bangladesh. Using renewable energies can also explore more income generating activities for women such as sewing activities, livestock farming fish farming, which is a major issue of the study. But there is a knowledge gap about how women are getting opportunities for income generation because of using solar energies, which can be studied by the present research.

The findings of Hossain and Tamin (2006) argue that the situation of Bangladesh is not in a very good position to increase funds for the assurance of sustainable development. The authors explain that decision makers need to be sincere about assessing the necessity of investors and funds to meet the demand of renewable energies. The lack of resources has become the major problem to approach sustainable development so policy makers need to play significant role to identify how foreign investors can be attracted to invest for sustainable development in Bangladesh (Hossain & Tamim, 2006). The research issue can analyze how the role of investors and funds can play significant role to reduce the costs of buying renewable energies for rural people in Bangladesh.

According to Asif and Barua (2011), Bangladesh is a country that always faces some environmental and energy challenges but the companies who support renewable energies are attempting to meet the supply and demand in energy market. The authors state that using renewable energy is cost effective so people from rural areas of Bangladesh are attracted to get access to renewable energies. The most common use of renewable energies in Bangladesh is solar home systems, biogas systems and improved cooking systems. All these three types of renewable energies are essential to affect on socio-economic changes but the major issue is to identify whether all the rural people are getting access to these technologies or not. It is necessary to study how the company is offering the renewable energies to the rural people so that we can understand sufficient number of rural people is getting access to these technologies.

The "Sustainability Energy for Development" report of Giz.de (2016) shows that energy need in rural areas of Bangladesh is self-effacing but we know that energy is an integral part to development. While thinking about community development, people need energies to extend the working and business hours, and children need light to increase their study hours in the evening. Community health centre can use refrigerators to increase health facilities, and mobile phone can bring better communication mode for the villagers (Giz.de, 2016). So, the access to renewable energies can enable the rural people to promote their quality of life and health conditions in order to be a part of sustainable development process.

Joshi and Rahman (2015) describe about the barriers that do not inspire the consumers to purchase renewable energies. The author explains about few cultural aspects that directly connect with the environmental concern of the consumers, which may not inspire the people to purchase renewable energies always. According to Sovacool (2009), the lack of information about the significance of using alternative or renewable energy may hamper the psychological encouragement of the people to use renewable energy. So, both cultural and psychological barriers can discourage the people to use renewable energy even if it is cheaper to buy.

For socio-economic development, a secure, affordable, reliable supply of energy is very much important, discussed by the findings of Deb, Bhuiyan and Nasir (2013). The prevalence of renewable energies is not only necessary to deal with energy crisis but also to change the socio-economic conditions of the people. So, it is a responsibility for the policy makers to identify strategies about how to approach renewable energies to rural people so that it can reduce energy

crisis and help to foster socio-economic development. The authors argue that there are social, economic and environmental problems relating to the installation of renewable energies but the companies need to play supportive role to make it easy to use for the customers. But the use of renewable energies may also bring mental satisfaction to the households that can encourage improving their socio-economic development, which is a research gap to be investigated by the present study.

2.4 Relevant Theories for the Research

According to Cleveland and Najam (2008), energy and sustainable development can be inter-related because all the three elements of sustainable development can be influenced by energy or renewable energy. The authors describe that environmental development is one of the most useful pillars of sustainable development and renewable energy can contribute as a major source of environmental safety. From the economic perspective, renewable energy is also considered as a key motor to macroeconomic growth, which means economic changes can be occurred through the influences of energy (Cleveland & Najam, 2008).

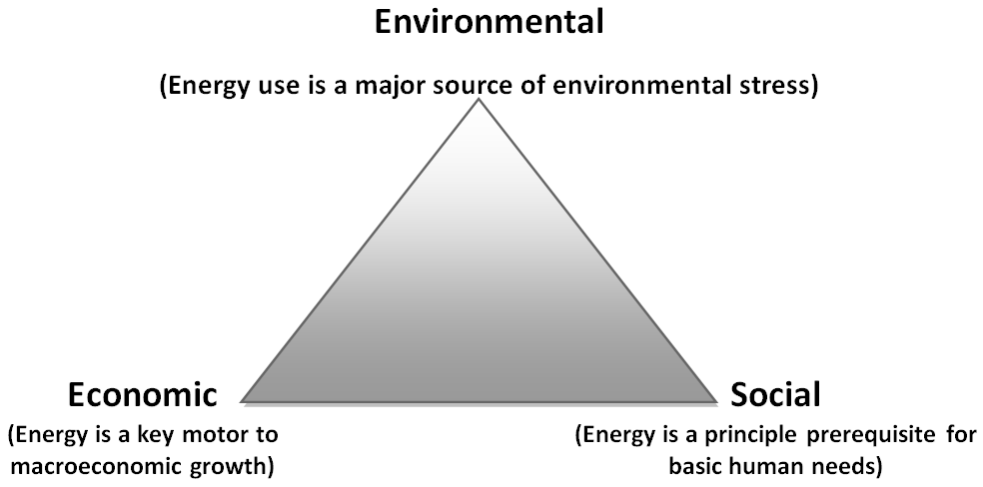


Figure 2.4: Energy and Sustainable Development Theory

Source: Cleveland and Najam, 2008

There is an inter-relationship among these three pillars of sustainable development because they may affect each other. The environmental benefits can ensure safe and hygienic living conditions

for the people and households that directly affect their health condition, which is a social benefit. On the other hand, economic benefits can bring the opportunity to better food and nutrition, education facilities, proper sanitation, which are also indicators of social development (Cleveland & Najam, 2008). The use of energy has also impact on social conditions because using energy or renewable energy is a principle prerequisite for basic human needs. So, the theory of energy and sustainable development can be related to the present research in order to study the socio-economic impact of renewable energy in rural areas of Bangladesh. The present research is significant to focus on these three pillars of sustainable development so the researcher is interested to investigate the socio-economic changes and environmental benefits that may take place by the access to renewable energy. Major indicators of socio-economic changes of using renewable energies are income generating activities (IGA), educational facilities, entertainment opportunities, health, and safety (Cleveland & Najam, 2008). The accessibility of renewable energies can enable rural people to create more business opportunities and extend the working hours, thus income generation can be increased for rural people. Children can study for longer period in the evening because of the light they can use from renewable energy, thus educational facilities are also promoted. Health care centre can use refrigerators and other medical instruments through renewable energy that also promote health and safety for rural people (Cleveland & Najam, 2008). Environmental benefits of using renewable energies are clean and hygiene home environment, and the protection from pollution relating to fuel wood and using kerosene.

Energy and sustainable development theory by Cleveland and Najam (2008) focuses on major three pillars of sustainable development; social development, economic development, and environmental development, which are affected by the use of renewable energy. The theory argues that renewable energy usage is the major key to economic growth, and the present study is also emphasized with the role of renewable energies in order to increase income generation in rural people in Bangladesh. But the present study is focused to understand under what conditions, the use of renewable energy can affect on socio-economic development and under what conductions it may not. Renewable energy is a prerequisite principle for basic human need and social development (Cleveland and Najam, 2008), and the research issue is also important to investigate how social conditions of rural people are changing by the impact of using renewable energies.

Scheer (2013) discusses about the role renewable energy and sustainable global future in terms of indicators that are quite similar to the elements of energy and sustainable development theory. It is also found that Bahauddin and SalahUdin (2010) also studied the impact of solar energy use on the livelihood of rural people in Bangladesh where they investigated the indicators such as health, women empowerment, education, income generating activities and telecommunication sector, which are also relavant with the energy and sustainable development theory. In the present research, we can also discuss the useful elements of sustainable development in terms of renewable energy use by inter-relating the theory of energy and sustainable development.

Policy cohesion for sustainable development (PCSD) is another relevant theory discussed by Knoll (2014), which is relevant to the research issue. This theory claims that necessary support can be given by developed countries to developing countries in terms of policy adoption and implementation regarding finance, science and technology (Knoll, 2014). Policy cohesion for sustainable development is a systematic process to combine governmental, environmental and socio-economic aspects in national and international spheres (Galeazzi et al., 2013; Engel et al., 2013). The present research issue is focused to investigate the relationship between renewable energy use and socio-economic development so the theory of policy cohesion for sustainable development can be necessary to understand how implementation of renewable energy policies helps the organizations to get funds and support renewable energies with affordable price.

Knoll (2014) explains that the concept of cohesion for sustainable development emerged in 1990s while international donors started to aid the developing nations. The major focus of this concept is to show the responsibility of developed countries to help developing countries introduce policies regarding migration, finance, science and technology. Engel et al. (2013) discuss that policy cohesion for sustainable development (PCSD) is a systematic process to integrate socio-economic, environmental and governance aspects in every spheres of national and international level. There is a dilemma of implementing policy cohesion for sustainable development with political agenda because it needs to be relevant with political interest (Galeazzi et al., 2013). The present research attempts to assess the impact of using renewable energies and how Grameen Shakti is offering renewable technologies with cheap price to the rural people. So, the relevance of PCSD theory can be useful to understand how policy

implementation can be essential to increase funds for the organizations who offer renewable technologies to the people.

2.5 Theoretical Framework of the Research

Energy and sustainable development theory can be related to the present research, and the indicators of socio-economic development can be emphasized by the theoretical framework.

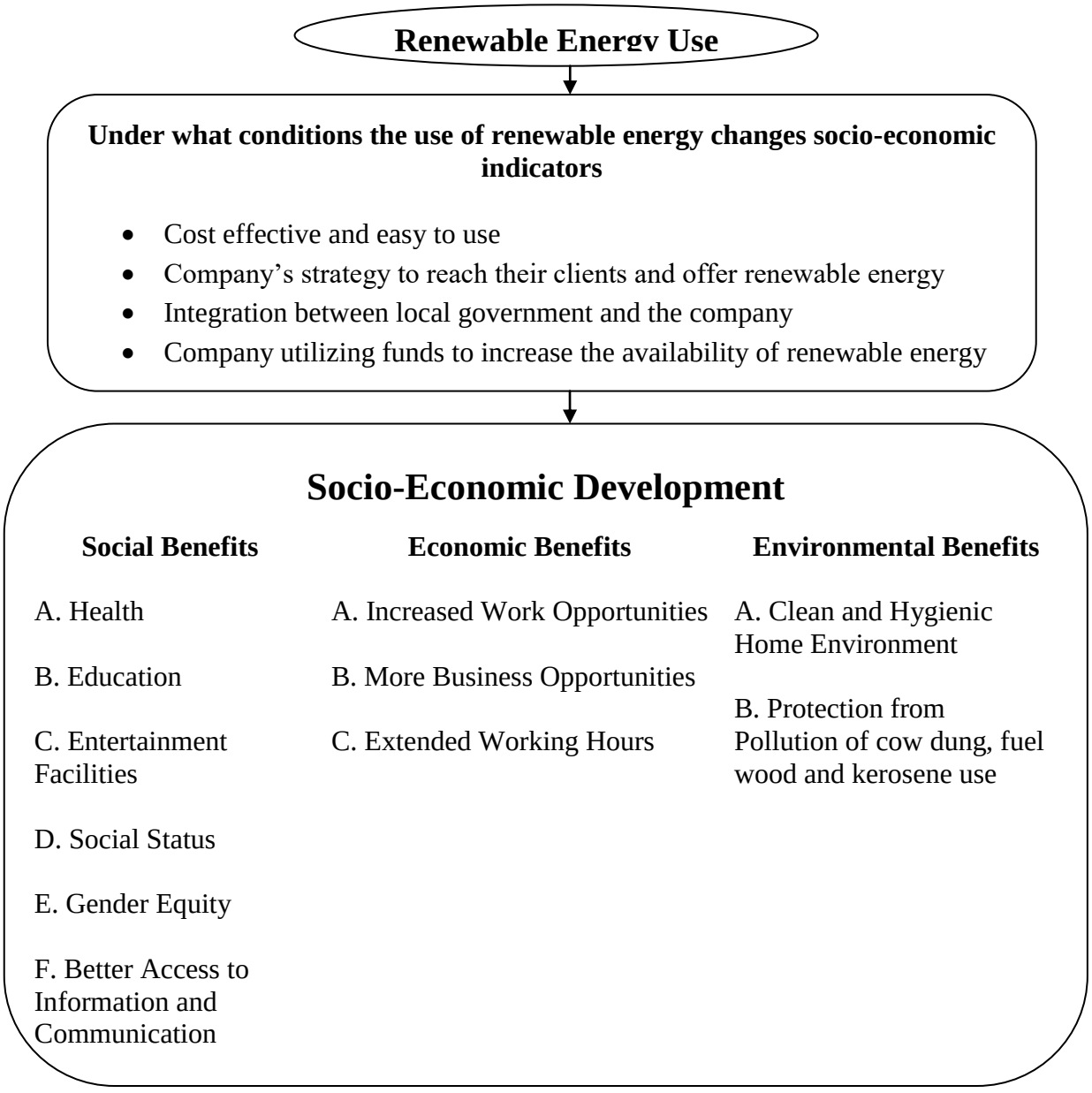


Figure 2.5: Theoretical Framework of the Research

Major indicators of socio-economic development and variables of renewable energy use are integrated to formulate the theoretical framework of the research. Cleveland and Najam (2008) utilize similar kind of theory to assess the impact of energy use on sustainable development. The authors attempt to study the nature of socio-economic changes after using energy technologies. The findings of Cleveland and Najam (2008) indicate that energy use does not only help to develop socio-economic conditions but also gives opportunity to achieve environmental benefits.

Renewable energy use has been increasing at a rapid pace in the last 10 years in Bangladesh. Increase of foreign investors and funds provided by IDCOL are the major reasons to reduce the price of buying renewable energies. These two reasons also help to increase the distribution and accessibility of renewable energies in Bangladesh. So, while accessing renewable energy (solar energy) and accessing new information, it has become easier to use for the customers and cost effective as well, which are the major reasons of spreading renewable energies in rural areas in Bangladesh. So, the theoretical framework shows that renewable energy use can affect on the indicators of socio-economic development of the users. There are some major indicators of social development given in the framework that can be affected by renewable energy use such as health, education, entertainment facilities, social status, gender equity, and better access to information and communication (Bahauddin & SalahUdin, 2010). Major indicators of economic development are increased job opportunities and increased business opportunities, and extended working hours. There some other factors that can also be affected by renewable energy use such as clean and hygienic home environment and protection from pollution of cow dung, fuel wood and kerosene use.

The framework attempts to covers all the indicators of socio-economic development of the people in rural areas in Bangladesh. The problem statement of the research argues why the use of renewable energy is not increasing vastly in rural areas while the framework shows that it is cost effective and easy to use that helps to gain the access to information and new technology. So, the study can be significant to understand whether the company is actually being successful to offer renewable energies to all the people in rural areas. The framework explains about increased work and business opportunities such as fish farming, livestock farming, and shop business. So, we can assess the advantages of increased income generating opportunities created by the use of renewable energies. It is also essential to understand how the impacts of renewable energy bring

environmental benefits in rural households. The impact of using renewable energies is also necessary to change the social indicators of the rural people, which can be explained by the research findings.

2.6 Operationalization of the Variables

The variables used in the research needs to be measurable in order to understand the changes in socio-economic conditions of the people impacted by the use of renewable energies. Operationalization of concepts can be essential in terms of systematized concepts with one or more indicators to explain the findings and discussion (Adcock & Collier, 2001). According to Layder (1998), in terms of logic and reasons, analytical and conceptual thinking can be involved within theoretical framework. So, the major variables of the present research can be discussed with the major indicators of theoretical framework of the research to understand the measurability of the variables of the study.

2.6.1 Independent Variables

There are some major independent variables in the research that helps to formulate the research hypothesis. Major independent variables are use of renewable energies, increase of investors and funds and efficiency of the company.

Increase of investors and funds: International aids and donors are the major investors to provide funds for introducing renewable energy projects in developing countries. The research issue attempts to investigate how Grameen Shakti is gathering funds from international investors and donors, and utilizes them to increase the availability of renewable technologies for the rural people in Bangladesh. If investors and funds are increased, this refers that the availability of the renewable energies can be increased (Islam et al., 2011). The necessity of international aids and donors is very much relevant to increase the availability, distribution, and accessibility of renewable energies. The investors and donors are the major sources of introducing renewable energy projects in developing countries (Marro & Bertsch, 2015). So, it is very important to assess how the funds are being utilized by the organization in order to increase the availability of renewable energies for the rural people in Bangladesh.

Efficiency of the company: It indicates to the performance of Grameen Shakti in terms of offering renewable energy technologies to the rural people (Grameen Shakti, 2006). The concept of eco-village development (EVD) is introduced by this organization to determine sufficient accessibility of renewable energies. So, by analyzing the concept of EVD in this organization, we can have useful discussions regarding what approaches and strategies are followed to ssupply renewable energies to the clients.

Use of renewable energies: It refers to the application of renewable energies by the rural people in Bangladesh. The concept of use of renewable energies can be determined by the availability and accessibility of the renewable energy technologies (Wadud et al., 2013). It is important to understand how rural people are offered renewable energies, and how they can ensure the accessibility to install and get the benefits of renewable energies, which are also emphasized in the research questions.

2.6.2 Dependant Variable

Major dependant variable in this research is socio-economic development. The indicators of theoretical framework can help to operationalize the concepts within this variable.

Socio-economic development: Socio-economic development is a major issue in this research that can be affected by the use of renewable energies. We can measure the changes of socio-economic conditions of rural people by assessing the status of health, education, income, social status, women empowerment, and income generating activities (Bahauddin & SalahUdin, 2010; Deb, Bhuiyan and Nasir, 2013). By analyzing these indicators we can attempt to determine the changes in socio-economic conditions of the people who are using renewable energies. The use of solar energy can bring more opportunities for fish farming, livestock farming and shop business that can influence on the socio-economic condition of the people.

2.7 Conclusion

The definitions of the major concepts are made to clarify the actual meaning of the useful terminologies used in this research. It is very important to define the relevant concepts such as green economy, socio-economic development, and income generating activities in order to relate the research findings with research purpose. The role of renewable energies in Bangladesh does not only affect on supply and demand scenario of energy market but also influences the socio-economic life of the people. The major research issue is to identify the relationship between renewable energy use and socio-economic development in Bangladesh. Existing literatures are reviewed in terms of the major research issues so that we can understand the theories and explanations made by other authors in the same field. Relevant theories are also discussed to formulate the theoretical framework of the research.

Chapter – 3: Research Methodology

3.1 Introduction

This chapter focuses on the selection of research methods and approaches. It attempts to justify why a particular method is chosen, and why this has been useful for the research. Research methods and approaches, data collection techniques, data analysis methods, study area and population, ethical considerations, and limitations of the study are discussed in this chapter. It is attempted to discuss the importance of particular research methods and data collection techniques in relevance to the major research objectives and questions.

3.2 Research Methods and Approaches

The application of qualitative research method can be essential to investigate the relationship between socio-economic development and use of renewable energies. We also choose to apply exploratory research approach to find out how socio-economic development is fostered by the use of renewable energies among rural people in Bangladesh.

3.2.1 Qualitative Research Method

According to Punch (2013), for the efficiency in social research, researchers can use two common methods such as qualitative method and quantitative method. It is considered that the application of qualitative research method is more noticeable in market study and business research but social research can also be effectively conducted by applying qualitative methods (Yin, 2013; Bazeley, 2007). The livelihood scenario of the target population can be investigated through social study accomplished by qualitative research method (Neuman & Kreuger, 2003). The present research is useful to analyze the socio-economic changes of rural households affected by renewable energies so the use of qualitative research method is essential in assessing the livelihood pattern of the target population. In-depth data analysis and observation are two major benefits of using qualitative research (Creswell, 2014). It is also emphasized that the tasks and activities of the research can be improved by the application of qualitative research method

(Easterby-Smith, Thorpe & Jackson, 2012; Musson, 2004). The data collection techniques of qualitative research methods are more efficient rather than the techniques of quantitative research method (Saunders et al., 2009). Qualitative research method is also necessary to for broader generalization of the collected data (Strauss & Corbin, 2008). The present research issue is important to understand the changes in socio-economic life of rural people by the influence of renewable energies and we can use qualitative data collection techniques and in-depth analysis of data for the research purpose. Qualitative nature of the data can assist the researcher to get information about the major research questions from different perspectives (Saunders et al., 2009; Dick, 2004). Qualitative research is useful to analyze various indicators of socio-economic development of rural people that are affected by the use of renewable energies. It can also bring the opportunity to get real life experiences about the people, and how they are utilizing renewable energies to change their socio-economic conditions. The usefulness of empirical justification in data analysis is important to relate findings of socio-economic changes of renewable energy users and theory of energy and sustainable development.

The households using renewable energies need to be observed with in-depth observation and quantitative research method may not be useful to ensure that. So, the selection of qualitative research method is more efficient in this research to understand the relationship between socio-economic development and renewable energies by studying with in-depth findings. It is generally controversial that many scholars believe quantitative research method is more efficient while measuring indicators of socio-economic development because it can help to gain analysis with numerical data and statistical presentation. But the researcher tends to employ qualitative research methods because it is necessary to find the depth of the data regarding how company is supplying renewable energies and how the households are getting benefits by using renewable energies. These issues are the major focus in this research and without qualitative method; it might not be possible to get in-depth analysis of these issues.

3.2.2 Research Approach

The major research question is focused to explore how socio-economic development can be fostered by the application of renewable energies so the usefulness of exploratory research investigation can be essential to explore under what conditions, the use of renewable energies

changes the socio-economic conditions of the households. Exploratory type of investigation is more useful in social research with the adaptation of qualitative research method (Creswell, 2014). The statement of the problem in this research argues that we may attempt to find out how the company is offering renewable technologies to the rural people and what strategy is being followed to support renewable energies. So, the role of exploratory research approach can be significant in this research to emphasize on the research problem and ensure efficient research findings to explore the relationship between renewable energies and socio-economic development. The research is executed by exploratory research approach to collect qualitative information about the strategy of the company to support renewable energy to rural people, and how the funds are collected and being used to offer renewable energies.

3.3 Study Area

The study is conducted in two villages of Muradia Union[9] in Dumki Upazila[10] of Patuakhali district[11] of Barisal division[12], Bangladesh; those are the chosen study area. The selected villages in Muradia union are called South Muradia and North Muradia, and both the villages are located in Muradia Union as indicated in the figure 3.1.

Dumki Upazila of Patuakhali district has an area of 92.46 sq kilometers, and it is surrounded by Bakerganj Upazila in north, Bauphal and Patuakhali Sadar Upazilas in south, Bauphal Upazila in east, and Mirzaganj Upazila in west. Main rivers in this Upazila are Rajaganj, Lohalia and Burishwar. In 2000, administration Dumki Upazila was established. Majority of the population are Muslim and there are people from other religions too such as Hindu, Buddhist and others. Dumki Upazila has 4 Unions and Muradia is one of them, and both South Muradia and North Muradia villages are located in Muradia Union. Muradia Union has area of 6,863 acres with total population of 15,786 where male population is 7,714 and female population is 8,072.

[9] **Union:** It refers to Union Councils or *Union Parishads* that are the smallest rural administrative and local government units in Bangladesh.
[10] **Upazila/Sub-district:** It indicates to sub-district, formerly called as *Thana,* it is a geographical region in Bangladesh used for administrative or other purposes.
[11] **District:** Bangladeshi districts are local administrative units. Totally, there are 64 districts in Bangladesh.
[12] **Division:** The administration of Bangladesh is divided into eight major regions those are called division.

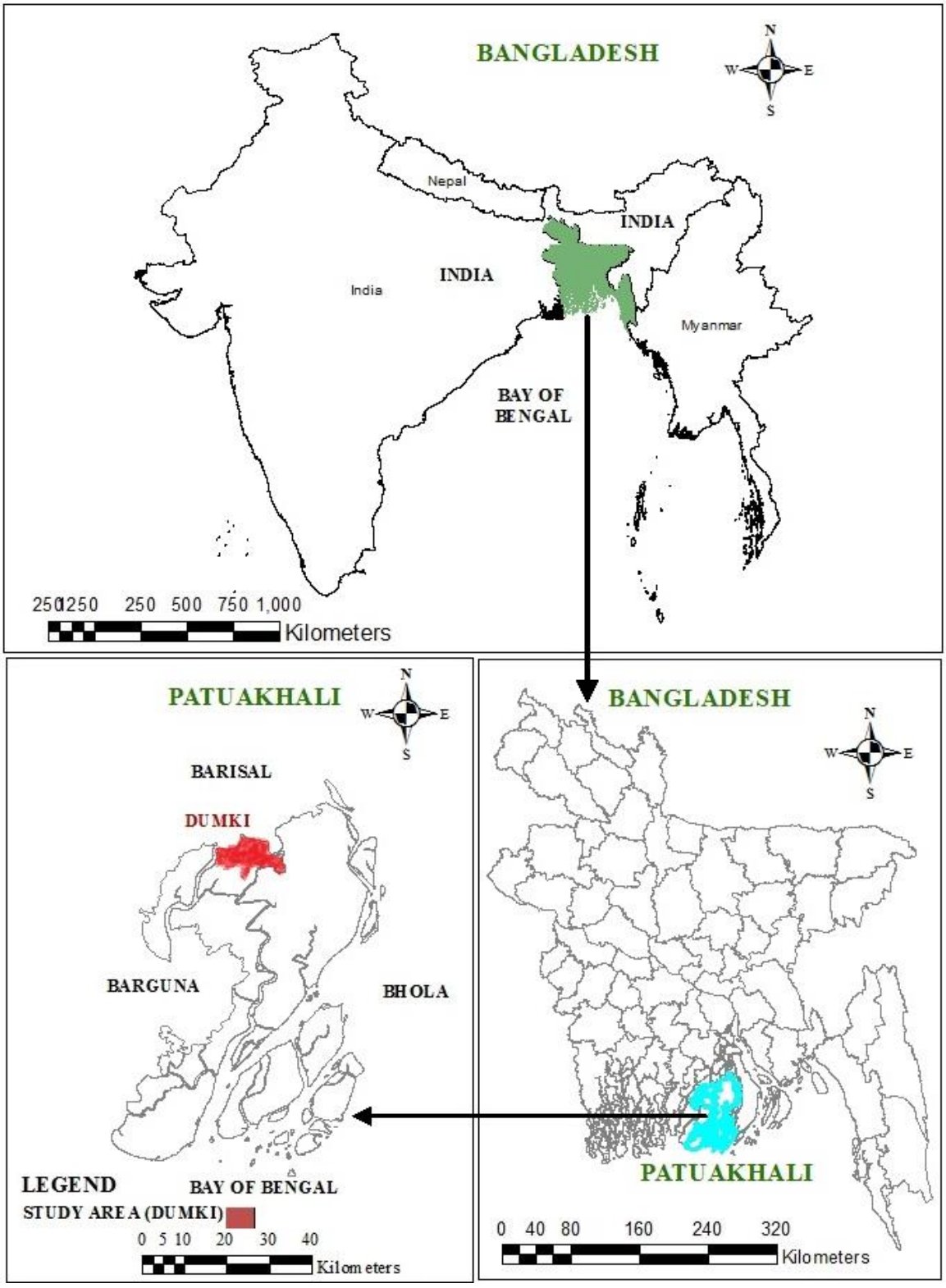


Figure 3.1: Study Area of the Research

Source: By Author

The literacy rate in Muradia Union is 66.92 percent. The Main sources of income in Muradia Union are agriculture, labor, industry, commerce, transport and communication, services, construction and religious services (Banglapedia, 2016). There are three major reasons of choosing these villages of Muradia Union in Dumki Upazila of Patuakhali district as study area. Firstly, the use of renewable energies in rural areas of this district is noticeably increasing, and many companies and social enterprises are supporting renewable energies in this district. Secondly, most of customers are not only using solar energy in house but also in business places, which gives us the opportunity to find out how solar energy is creating business and income opportunities. Thirdly, all Unions under Dumki Upazila are being attempted for rural electrification network and only 20.27 % of the rural population have access to electricity but rest of the rural population do not have access to electricity. Above all, many renewable energy users in this area are from climate migrant backgrounds, which also help to justify the reason of selecting this location as study area. So, most part of these two villages is excluded from electrification that gives us the opportunity to investigate the actual impact of using solar energy in rural areas. We choose households from two villages because it is difficult to find households with similar socio-demographic backgrounds from one village among of users and non-users of renewable energies.

3.4 Unit of Analysis

Population or the unit of analysis is indicated to what or who is being studied by the research. All the rural households living in Muradia Union at Dumki Upazila of Patuakhali district are considered to be the target population or unit of analysis of the research. The population of the study also mentions the rural households of this district who use renewable energies and who do not use renewable energies. The choice of proper unit of analysis may occur if the researcher can appropriately justify the primary research questions (Yin, 2013). The major research questions are designed to focus on the relationship between using renewable energies and socio-economic development so we can mention that the rural households from Muradia Union at Dumki Upazila of Patuakhali district are the unit of analysis in this research.

3.5 Sample Size and Sampling Technique

The techniques of sampling can affect on the validity and reliability of the research, and it can also be useful to gather necessary participants for data collection procedures (Saunders et al., 2009). If the researcher is willing to conduct a research with huge number of samples then it can be time consuming, so, in order to reduce the number of samples, we can use a sampling technique (Kothari, 2009, Maxwell et al., 2009). The application of non-probability sampling technique is useful to gather small number of samples for qualitative research (Patton, 2002). The present research can be conducted by applying qualitative research method so we do not require big number of samples. Purposive sampling method is one kind of non-probability sampling method that can be used to gather samples for research work (Neuman, 2005; Catherine, 2002). The study area covers two villages of Muradia Union at Dumki Upazila of Patuakhali district. Though in both villages, there are many households using renewable energies but we choose households from one village (South Muradia) who use renewable energies and households from another village (North Muradia) who do not use renewable energies, and it is important to mention that in both villages the users of renewable energies are visible. So, by applying purposive sampling method, we choose 8 households from each village to conduct in-depth qualitative interviews, so, the total number of sample size of the research are 16.

The socio-demographic characteristics of the chosen households are quite similar but only difference between the selected samples is that the samples of one village (South Muradia) use renewable energies, and samples of another village (North Muradia) do not use any renewable energies. Creswell (2014) explains that small size of sample is effective for social research to gather effective data through in-depth qualitative interviews, and it is not even time consuming when we have few samples for data collection. Additionally, a telephone interview is conducted with Union Nirbahi officer (UNO)[13], who is the representative of local government, and a focus group discussion is conducted with 5 employees of the Grameen Shakti's divisional office in Patuakhali district.

[13] **UNO:** Union Nirbahi Officer is the chief executive of an Upazila (sub-district) and a junior level officer of the Bangladesh Civil Service.

3.6 Data Collection Techniques

Both the primary and secondary data collection technique is applied in this research to understand the relationship between socio-economic development and usage of renewable energies. Raw findings of the research can be elaborated by the primary data but still the necessity of secondary data is immense in this research in order to relate primary findings and secondary literature. Secondary data is also useful for making comparison and inter-relation between research findings and relevant theories.

3.6.1 Primary Data Collection

Primary data collection technique is referred to the first hand data, which is gathered by the researcher's own effort (Creswell, 2014). Primary data is collected by qualitative interviews with the chosen rural people to assess how they are utilizing renewable energies, and how the indicators of socio-economic development are affected by the use of renewable energies. If we need to understand how the use of renewable energies affects socio-economic changes of the rural people then it is also important to gather data from the employees of this organization. So, we conduct focus group discussions (FGDs)[14] with the employees of the organization to understand how the funds and investors support this organization and how this company is assisting the rural people with the application of renewable energies. It is also useful to gather more primary data from the FGDs regarding the concept of eco-village development (EVD) to assess the strategy of supporting renewable energies by the organization. Primary data can be collected from four categories of respondents such as users of renewable energies, non-users of renewable energies, employees of the company, and representatives of local government. But before collecting data, four pilot studies are conducted from each of these four categories of respondents. The questions of the pilot studies are open ended to enable the respondents share information freely. There are some questions designed for primary data collection for qualitative interviews and FGDs, which are included in the appendix section.

[14] **FGD:** Focus group discussion is a small but demographically diverse group of people whose reactions are studied especially in market or social research

Table 3.1: Primary Data Collection Techniques

Number of Techniques	16 Qualitative Interviews	1 Focus Group Discussion	1 Telephone Interview
Number of Respondents	8 Households using solar energy 8 Households not using solar energy	5 Employees of Grameen Shakti	1 local government representative
Research Focus	Socio-economic changes by solar energy use	The process of the company to reach clients and offer solar energies	The role of local government to increase solar energy use

Qualitative Interviews: For collecting primary data in this study, qualitative interview is chosen as the major technique. Qualitative interviews are conducted with the participants to collect data regarding how they are offered by the company to use renewable energies. Qualitative interviews can be similar to in-depth interviews because it can be essential to gather in-depth data regarding the major research issues (Creswell, 2014). The application of qualitative interviews is very much important to achieve qualitative data about how the use of renewable energies can change the socio-economic conditions of the people. Qualitative interviews are normally conducted with semi-structured interview guidelines but it can also be time consuming. The researcher also conducts some additional interviews with key informants such as local government representative and employees of the company to understand how local government is helping the company to offer renewable energies to the rural people.

Focus Group Discussions (FGDs): Focus group discussions help to conduct a discussion with many people altogether to gather variety of data regarding same research issue (Creswell, 2014). It is conducted as a group meeting or group discussion where every participant has the opportunity to share their opinion. Focus group discussions are mainly conducted with a group of people who are using the same kind of services provided by the company (Saunders et al. 2009). But in the present study, we conduct a FGD with the employees of the company to get information about how it utilizes funds to offer renewable energies, how they reach their clients,

and how they integrate with local government, which are considered to be the major conditions to study whether renewable energies can change socio-economic conditions or not.

3.6.2 Secondary Data Collection

Secondary data collection is also necessary to review relevant literatures and documents that are useful to the research questions (Kumar, 2011). Necessary documents of Grameen Shakti, organizational magazines and annual paper are the major sources of secondary data collection in this research. There are some existing literatures that focus on the use of renewable energies in Bangladesh, are also reviewed with critical discussion. Some more secondary data collections sources are newspaper articles, books, journals, conference and seminar papers etc. Though the major research method is qualitative in this study but there are some quantitative data used in the secondary data in order to explain some previous research findings that are relevant to the research issue.

3.6.3 Observation

Observation is a prominent part of data collection technique because it gives the opportunity to the researcher to get additional data, which are not even shared by the participants (Creswell, 2014). Participant observation is employed in this study while collecting data from the people who use renewable energies to assess the household and living conditions. Observation can provide a systemic approach to the research to understand the nature, behavior, events and social settings of the present study. While communicating and sharing data between researcher and the participants, observation provides the scope to analyze the surrounding information, which are related to the research topic (Maxwell et al., 2009). For example, even if the respondents do not share about the benefits of using renewable energies properly then the researcher can observe the household conditions, entertainment facilities, food habits, living environment etc. So, observation can ensure the attainment of maximum level of data regarding the impact of renewable energy use in rural areas.

3.6.4 Data Collection Instruments

Therefore, we tend to apply qualitative research method to investigate the relationship between using renewable energies and socio-economic development, so, we choose semi-structured interview guidelines for collecting data from the respondents. Semi-structured interview guidelines is helpful to design questions in terms of major research questions and objectives so that relevant data can be collected to ensure effective findings and discussion (Sanders et al., 2009). Semi-structured interview guideline also creates opportunity to add or remove questions in accordance with the response of the respondents while conducting focus group discussion with the employees of Grameen Shakti as well as qualitative interviews with the respondents.

Semi-Structured Interview Guideline: Semi-structured interview guideline is a useful data collection tool for conducting qualitative social research. Semi-structured interview guideline is helpful to conduct qualitative interviews and focus group discussion because it provides liberty in terms of the response of the participants (Punch, 2013). Semi-structured interview guidelines are necessary in this study to design major questions by creating useful themes and sub-themes. The most important focus of the study is socio-economic development and this instrument gives the scope to categorize the questions in order to focus on every indicator of socio-economic development such as health, education and income generating opportunities etc.

3.7 Data Analysis Methods

According to Saunders, Lewis and Thornhill (2009), there are several steps of analyzing qualitative data such as transcribing data, using electronically textual data including scanned documents, using inductive approach, data summarizing, data categorizing, data unitizing, and data structuring using narrative. Among these steps, necessary stages are followed to analyze the qualitative data in this research to understand how the use of renewable energies is helping to change socio-economic condition of the rural people. Verbatim is also used to categorize the major themes of the research and analyzing the data with proper interpretation. While categorizing the data, we create major themes and sub-themes of the research questions to analyze the data. The role of thematic data analysis method is helpful to analyze the indicators of socio-economic development in terms of major themes and sub-themes. MS Office application is

used to explain the necessary facts regarding data interpretation. NVivo[15] application is applied to design and analyze the data in terms of major themes and sub-themes of the research. ArcGIS[16] application is used to formulate the map of the study area to show where the chosen area is located.

3.8 Ethical Considerations

Ethical issues are very important segments for conducting social research and designing a research methodology. There are some useful ethical issues of research activities argued by Saunders, Lewis and Thornhill (2009), which are followed for the present research.

- Consent of sharing information is taken from the participants of data collection process;
- Privacy and confidentiality is ensured while providing data for the research;
- It is also assured to have voluntary nature of participation by the respondents and giving the right to withdraw information;
- It is ensured that respondents is protected from both physical and mental injuries during data collection procedures; and
- We use pseudonyms of the respondents while analyzing and discussing the collected data. It is important to use pseudonyms to maintain the anonymity of the respondents in data collection procedures.

3.9 Assessment of Research Quality

The assessment of the research quality can be addressed by discussing validity and reliability of the research. Major types of validly measurement in the present study are also explained below.

3.9.1 Validity

Construct Validity: According to Yin (2013), construct validity is a procedure of establishing proper operational measure for the concepts that are being investigated. It is useful to choose

[15] **NVivo:** It is a qualitative data analysis computer software package produced by QSR International. It is designed to qualitative data analysis to analyze data in terms of text-based or multimedia information

[16] **ArcGIS:** It is a geographic information system (GIS) application for working with maps and geographic information.

specific types of changes that are to be investigated, and demonstrate that the selected measures of these changes that truly affecting the specific types of changes that have been selected (Yin, 2013). The present research issue focuses on the changes in socio-economic conditions of the rural people that are affected by the application renewable energies. Therefore, we intend to gather data from two different stakeholders such as people who use renewable energies and people who do not use renewable energies, so, it can be possible for the researcher to identify particular changes in socio-economic conditions that are affected by the application of renewable energies because the people who do not use renewable energies may not have similar kind of changes in their socio-economic life. Cleveland and Najam (2008) have used energy and sustainable development theory, where the authors operationalize the concepts of social, economic and environmental developments through major indicators such as health, education, food habit, income generation, increased working hours and housing environment. In the present study, we can also measure the changes in socio-economic conditions of the users of renewable energies by analyzing the similar indicators those are used by Cleveland and Najam (2008).

Internal Validity: Internal validity indicates to the causal relationship between different indicators or variables of the research (Yin, 2013). While doing exploratory research investigation, it can be possible to have internal validity. There are two kinds of causal relationships such as causal explanation and causal description. The causal description involves the investigation of changes in one variable affecting change in another variable. The present research is essential to explain the causal relationship between the use of renewable energies and socio-economic development to describe how the use of renewable energies can cause changes in socio-economic conditions of the rural people in Bangladesh. Cleveland and Najam (2008) establish the connection between the use of energy and socio-economic development by their theory of energy and sustainable development. The authors have discussed the causal relationship between energy use and sustainable development, and the present research can also focus on investigating the causal relationship between socio-economic development and renewable energy use to see how the households are actually changing their socio-economic conditions by the influence of using solar energy. It is also ensured that other factors such as foreign remittance did not affect the socio-economic development of the households so that we can actually find out that solar energy usage is the only reason that is causing socio-economic changes.

External Validity: The generalize ability of the research is addressed by external validity in terms of research, participants, times and location (Marczyk et al., 2005). External validity puts emphasis on the generalization of the study. The present study is conducted in two villages of Patuakhali district in Bangladesh so there can be a generalization of the holistic scenario of the chosen district in terms of showing the relationship between using renewable energies and socio-economic development. Therefore, it is a qualitative research, so, we do not choose large number of samples for gathering data, which maybe imply limits to generalization of the research. But the study focuses on different indicators of socio-economic development by the impact of renewable energy use, which is relevant to theory of energy and sustainable development indicating the analytical generalization of the research. The findings of the research bring more applicability to energy and sustainable development theory given by Cleveland and Najam (2008) because my study discusses the same phenomenon that are explained by the authors, which is the relationship between renewable energy use and socio-economic development. The primary findings generally indicates that solar energy use is positive for socio-economic development, and similar kind of results is found by Bahauddin and SalahUdin (2010), so, it can be mentioned that the raw findings are practical and globally accepted.

3.9.2 Reliability

The consistency and the dependency of the collected are mainly emphasized by the reliability of the research (Yin, 2013). Reliability of the data can help to identify the degree of understanding measurement error in the study. It is very important to ensure that the researcher and participants maintain honesty and integrity during the data collection process, where the researcher cannot show any bias or force the participants to share data. The respondents and the researcher need to understand the significance of the research so that they can maintain an actual and practical data collection process, which gives consistent and reliable data that shows actual relationship between the use of renewable energies and socio-economic development. The collected data from the qualitative interviews and pilot studies are consistent and stable regarding the impact of using solar energy on socio-economic changes, so, we can mention that data used in the research are reliable. The review of secondary literatures is also relevant with the data collected from focus group discussion with the employees of Grameen Shakti, which gives us the opportunity to

state that collected primary data is reliable and dependable. The data collected from the telephone interview with local government representative has relevancy with the data collected from focus group discussion that proves that the used data in the research is reliable.

3.10 Limitations of the Study

The research is important to identify how the investors and international aids support financial resource for increasing renewable energy projects in Bangladesh. So, we can attempt to discuss how these funds are collected and utilized for the increase of renewable energy technologies but the organization may not be willing to share this sort of sensitive data, which is mentioned as a limitation of the research. The research area is the rural areas of the chosen district where people are not educated enough to understand the significance of this research, which also creates a hindrance for data collection procedures. The study is focused on the role of the company to increase the use of renewable energies among rural people to change their socio-economic conditions in terms of the performance of Grameen Shakti. But if the organization does not cooperate well with the researcher, then it might become a complexity to get access to the relevant data to understand how the organizational strategy and approaches are directed to support their clients.

3.11 Conclusion

The implication of research design and methodology is useful in this research to have the outline and research plan by which the researcher can conduct and execute the research successfully. The selection of research design and appropriate methods is very important to collect and assess data relating to the major variables of the research. The research study is conducted by qualitative research method with the adaptation of exploratory research investigation. Both primary and secondary data collection methods are necessarily used in this research. Thematic method of data analysis is applied for effective interpretation of the data and efficient findings of the research. There are some major ethical issues that are followed during the data collection process and useful types of validity and reliability of the research are also described.

Chapter – 4: Findings and Analysis

4.1 Introduction

The findings and analysis is divided into two sections such as socio-economic changes by using renewable energy and conditions influencing the relationship between socio-economic development and renewable energy use. The qualitative interviews conducted with the households from both users and non-users of renewable energies are analyzed to find out the major socio-economic changes occurred after using solar energy. The findings from the focus group discussion are also discussed in order to understand the major conditions of using renewable energy that create positive impact on socio-economic changes.

4.2 Socio-economic Changes by using Renewable Energies

Total 16 qualitative interviews are conducted between users and non-users of solar energy. Eight qualitative interviews are conducted with households who use renewable energy and 8 more qualitative interviews are conducted with households who do not use renewable energies. The households from these two categories are chosen from two different villages of Muradia Union at Dumki Upazila of Patuakhali district because it is difficult to get households from these two categories from single village with similar kinds of socio-economic and demographic backgrounds.

4.2.1 Socio-demographic Background of the Households

We can imagine that households using solar energy is called category A (solar users) and households not using solar energy are called category B (solar non-users). The primary data explains that the households from both A and B category are having similar kind of occupations because most of them are involved similar types of occupation such as shopkeeper, businessman and fisherman.

Table 4.1: Background of the Households

Sample Category	Total Sample	Occupations	Family's Monthly Income	Educational Status	Family Member
A. Users of Renewable Energies	8 (100%)	1 Fisherman (13%) 5 Businessmen (62%) 2 Shopkeeper (25%)	$94–$164 in USD	4 Literate (50%) 2 Primary (25%) 2 SSC (25%)	3 to 6
B. Non-users of Renewable Energies	8 (100%)	4 Businessmen (50%) 2 Shopkeeper (25%) 2 Fishermen (25%)	$100–$141 in USD[17]	3 Literate (37%) 4 Primary (50%) 1 SSC (13%)	4 to 6

If we look at the family's monthly income of the households from both categories, we can see that category A (solar users) has range from $94 to $164 and category B (solar non-users) has range from $100 to $141. So, we can establish that the households from both categories are having fairly similar amounts of monthly income. In terms of educational status of the households, all the households from both categories are literate, primarily educated and SSC (secondary school certificate) completed, so, we can ascertain that educational status of the households of both categories are also quite similar. The number of family members in category A (solar users) ranges from 3 to 6, and number of family members in category B (solar non-users) ranges from 4 to 6, so, in terms of family members, households from both categories are similar. None of the family members among the selected households live or work in abroad for remittance so there can be no other factors except use of renewable energy to affect on the socio-economic conditions of their life. So, a comparative data interpretation can be applied between users and non-users of renewable energies to investigate the actual impact of using renewable energies in rural livelihood.

[17] **USD $:** United States Dollars, USD $1 is equal to 85 (BDT) Bangladeshi Taka that is the Bangladeshi currency as of 2017.

4.2.2 Cost, Longevity, and Place of using Renewable Energy

Primary data in this research show that solar energy is cost effective and easy to use. According to Marro and Bertsch (2015), per watt peak of renewable energy can be bought by only USD $2, which is around 170 BDT[18]. And all the households explain that they have bought solar energy with loan installment by Grameen Shakti and they have found the price affordable. They also state that the loan installment is reasonable and they find it cheaper to buy solar energy by this company. The lowest price of buying solar energy among the users is $105 and it goes up to $564 depending on the power, capacity, and quality of the products. The difference of the costs of buying solar energy depends on the watt capacity of solar energy and the numbers of solar energy because some users use it at only house and some user use it in both house and business place. Biswas, Das, Baqee, Sadi and Farhad (2011) explain that solar energy has become cost effective in Bangladesh and the primary data also indicate that buying solar energy is not expensive for the rural people.

One respondent from category A (solar users) says that *"Yes I use solar energy, and I am using solar energy at house for 15 years now. And I am using solar energy at my shop since 6 years now. I bought both of them from Grameen Shakti. For both the solar energies, I needed total 37000 Taka (USD $435) and I bought them through loan installments."*

Most of the households are using solar energy from 3 to 6 years. One user describe he has been using solar energy for 10 years and another user mentions he has been using solar energy for 15 years. The primary data has found that most of the users are using solar energy at house and business place, which maybe an influencing factor of socio-economic changes of the households.

4.2.3 Costs of using Kerosene Oil

The use of kerosene oil[19] is very common in rural areas in Bangladesh. According to the primary data, all the households who do not use solar energy have to use kerosene oil 3-5 liters monthly that cost them about USD $3 to $5 per month. The household who use solar energy, they also used to use same amount of kerosene oil monthly before.

[18] **BDT:** Bangladeshi Taka, which is the currency of Bangladesh. 85 BDT is equal to USD 1 as of 2017.
[19] **Kerosene oil:** It is known as paraffin, lamp oil and coal oil, it is basically a combustible hydrocarbon liquid derived from petroleum, widely used as a fuel in industry as well as in households

One respondent from category A (solar users) states that *"We used to require approximately 4 liters of kerosene monthly that would cost us about 350 Taka (USD $3.5) per month, but we do not need to spend that money to buy kerosene anymore."*

So, after starting to use solar energy, they do not need to use kerosene oil so it gives them an opportunity to save some amount of money. Health risks are also reduced because of not using kerosene oil within the house.

4.2.4 The Company helps to Install, Operate and Repair Renewable Energy

All the households describe that Grameen Shakti helps to install the solar energies at home and business places. The company also teaches them how to operate and maintain them properly. The respondents also mention that they also get repairing services from the company when face any problem with the solar energy technologies.

One respondent from category A (solar users) says that *"The Company helped me along in every step to install the solar energy at house and business place. They taught me how to operate the technologies and whenever I have some problem I just call them and they come over to provide services. The repairing services are very good from the company. I get repairing services through Sheba Contract."*

Sheba Contract: It is a contract to ensure repairing services for the solar energy users after the period of free repairing service is over. The customer who buy solar energy by one time cash payment and loan payment get free repairing services for 3 years. So, after 3 years, customers can sign for a contract (Sheba Contract) to get repairing services for each year by USD $6.

4.2.5 Changes in Food Habit

The environmental benefits of using solar energy are to maintain clean and hygienic home environment, and reduction of air pollution from the kerosene use. The data implies that the use of kerosene oil produces soot that can pollute the cooking environment in the kitchen that hampers the food habit of the households.

One respondent from category B (solar non-users) mentions that *"We cook our foods in kitchen but the soot from the kerosene use is not very good for our food and cooking environment."*

Islam, Khan, Nasreen, Rabbi and Islam (2011) discuss that environmental protection is one the major aspect of renewable energy development in Bangladesh. The primary data also explains that the households who do not use renewable energies are being affected by air pollution through the soot of kerosene lamps and it can harm their food habit and cooking environment.

Solar energy provides light at home, and it is also helpful to stay clean and hygienic, which is necessary for the food habit. The soot from kerosene lamps is not there anymore so it can reduce the scope of many kind of pollution in the food and cooking environment. The house does not get dirty anymore because of using solar energy which is also a benefit for food habit and cooking environment.

One respondent from category A (solar users) says *"I started fish farming by the help of solar energy light and now we can eat fish often so it develops our food habit."*

Few households have started fish farming and livestock farming after getting the access to lights by using solar energy, thus they have changed their food habits. The food habit has been improved after using solar energy because they do not need to use kerosene lamps anymore that help them to maintain hygienic food and cooking environment. Cleveland and Najam (2008) explain that improved food habit is one of the major benefits of using renewable energies. And the primary data also show that use of lights of solar energy is necessary within house to keep the eating and cooking place clean and hygienic, thus households are being able to maintain better food habit in the family.

4.2.6 Improved Health Status

Primary data explain that the family members of households not using solar energy often suffer from various diseases that mainly come from air pollution more than the users of solar energy. So, they have to visit to the nearest hospital or clinics to get treatment. Sometimes they also need to go the city areas to get better treatment that cost them more expenses. The primary data suggest that health risk is reduced for the families who use renewable energy because they do not

get affected by the soot from kerosene lamps and Bahauddin and SalahUdin (2010) also claim that using solar energy can help to reduce health risks and health related costs.

One respondent from category B (solar non-users) says that *"We suffer from diseases from time to time. And my brother and sisters also get cold sometimes then we have to take them to the hospitals or doctors."*

Kibria (2015) argues that soot from kerosene lamps is harmful for the environment within the house. Therefore, the soot from kerosene lamps can contaminate the air so there might be a possibility of increasing diseases coming from air pollution. But the households who use solar energy do not need to use kerosene anymore so they have reduced their health risks and possibility of suffering from several diseases that emerge from air pollution.

One respondent from category A (solar users) states that *"I think we get better food and cooking condition that is why we do not suffer from diseases like before. Nowadays, our children hardly suffer from diseases after we started using solar energy. There is no soot of kerosene that also helps us to stay away from many diseases so I think the use of solar energy has improved our health status."*

The households who use solar energy can keep the water safe and clean so it helps to reduce the occurrence of illness in the family. Rahman, Saha, Khan, Habiba and Chowdhury (2013) mention that after using solar energy it is also possible to provide nutritious food for the children because of the increased income, which shows that the health conditions are developed. The family members do not fall sick much nowadays because of having better food habit and improved home environment. The cost of going to the doctors and hospitals was very high but since they do not get sick much so it is also helping to increase their monthly savings.

4.2.7 Changes in Social Status

Few households mention that social status cannot be changed whether we use solar energies or not. But some respondents describe that it can educate their children then it might help to increase their social status. According to Grameen Shakti (2006), using solar energy helps the children to study extra hours at night that is an educational benefit. The primary data still

represents that few families tend to believe that using solar energy can help to increase their social status in the village.

One respondent from category A (solar users) describes that *"Our neighbors respect us more than before because they think we are improving a lot as a household because of having solar energy at house. People among my relatives also have the tendency to visit us often because we have better facilities through solar energy so I guess our social status has been improved than before."*

The collected data do not indicate any change of social status for the households who do not use solar energy in the village. Non-users of solar energy think that if people get rich or educated then they can get more social status in the village.

One respondent from category B (solar non-users) states that *"Maybe if my brother gets educated someday then we can get more social respect."*

The attitude of the neighbors and the relatives to respect them more and visit them often because of having solar energy is a new aspect in this research. Though it may sound a little bit controversial but few households have described that they feel like others are giving them more respect than before only because of having solar energy at house. According to Palma, Ness and Anderson (2017), the quality of food consumption among the people can be considered as a marker between different social classes. So, we can discuss that when the users of solar renewable energy can improve their food production and food consumption, it can definitely develop their social status in the community.

4.2.8 Scope for Educational and Recreational Facilities

The opportunity for education is improved because children can study for long hours at night. In the evening the children can also get more scope and time for recreational facilities at home because of having the lights. Solar energy also helps to charge up mobile phones; and using Radio at home gives more opportunities for recreations (Bahauddin & SalahUdin, 2010). But the most useful thing about using solar energy is to give the children opportunity to study longer period (around 3 or 4 hours more) at night. This is also inspiring the children to study more

because they can concentrate more on their education as they feel very good and comfortable to study under the light.

One respondent from category A (solar users) mentions that *"I have a nephew who goes to school and he can study for long time in the evening because of having light. We also have mobile phone at home and we do not need to go to the market to charge up the batteries of the phone because we can do that at home now. So, it also brings the opportunity for us to listen to the music and watch videos at mobile phone. So, I think the scope for recreational facilities is improved."*

Marro and Bertsch (2015) discuss that using solar energy does not only give the opportunity to study for long hours, but also provide different sources of entertainment in the households. Primary data show that using solar energy also helps the households to charge up the cell phone batteries at home. The non-users of solar energy need to go the market to charge up the phones and it also costs money.

One respondent from category B (solar non-users) says that *"Since we do not have solar energy, sometimes my brother suffers to study at night for not having any lights in the house."*

It suggests that the education maybe hampered during night when the households do not have enough lights to study. In many cases, parents do not let the children to study because using kerosene lamps also costs money, which discourage the children for education. Kibria (2015) explains that educational and entertainments facilities can be promoted when household use solar energy within their house, and the primary data also indicates that having solar energy at home can encourage the children to study with good concentration and bring more entertainment facilities.

4.2.9 Information and Technological Benefits

Using solar energy has made it easy for the people to utilize the mobile phone that helps them to get many information regarding health and education. Thus, it is believed that people get consciousness about so many aspects that they did not know before. So, the access to information and technological benefits has been promoted through the use solar energy. The

telecommunication sector has improved in rural areas particularly for the people who get access to renewable energy. Bahauddin and SalahUdin (2010) also discusses that solar energy use can be essential for rural people in Bangladesh to change their livelihood by improved telecommunication sector.

One respondent from category A (solar users) says that *"I use Television at my shop, which is a major recreational facility in my business place. Having this Television at my shop increases my sales and profit. I can also charge up my cell phones at my business place, I think it is a good technological benefits that I have."*

The use of solar energy brings the opportunity to have a Television at the business place that boosts up the income of the user. Watching news and other programs in the Television is also helpful to stay updated with the information about what is happening in the country. Kürschner et al., (2009) explains that people get lot of information about health, politics and business from the Television programs. So, it indicates that having a Television at a business place is useful for the people to become aware about different matters that improve the peoples' awareness.

One respondent from category B (solar non-users) states that *"We use a mobile phone at but we need to go to the market to charge up the phone batteries. But we can get information and hear some music sometimes through our mobile phone."*

The households, who do not use solar energy, need to go to market to charge up the cell phone batteries and it costs them extra money also. They also lack the opportunities to access information and technological facilities. The application of solar energy has brought the scope for technological advantages in rural areas by enhancing the telecommunication sector (Paul & Uhomoibhi, 2012; Biswas et al., 2011), and the primary data also refer that using solar energy is essential to ensure information and technological benefits for the people.

4.2.10 Increased Working Hours and Income Generating Activities

Solar energy helps to keep the business places open for longer time at night. Even there are many customers who feel comfortable to buy goods from the shops where solar energy lights are used. Solar energy is helping the shopkeepers to keep their shop open for long time during nights that

help to increase their income. In the village market, using solar energy does not only give the scope to keep the business open for at least more 3 hours at night but also help to attract more customers, which is a business advantage to increase profit. Hackett (2012) explains that solar energy is useful to extend income generating opportunities for the people and the primary data also indicate that people from rural areas are getting the scope to start new businesses such as fish farming, and small cottage industries because of using solar energy.

One respondent from category A (solar users) says that *"I have started my tea stall 2.5 years ago and solar energy is the major source of inspiration of my tea stall. I started my tea stall business after using solar energy. It is so difficult to run tea stalls by using kerosene lamps. So, I decided to open my tea stall with lights and a Television by using solar energy. Television attracts more customers to my shop so it increases the sale and profit for my business. So, the use of solar energy has large impact on my business and income generation."*

The encouragement of starting new business is source of inspiration given the use of solar energy. Primary data show that there are many income generating opportunities can be created because of having solar energy such as tailoring shop, tea stalls, small cottage industries, handicraft industries, fish farming and livestock farming. According to Shove and Gordon (2014), improvement of small and cottage industries are the prominent income generating opportunities created by the application of renewable energies. And the primary data also refer that numerous types of income generating activities are created by the use of solar energy along with increased working hours.

One respondent from category A (solar users) says that *"I got the opportunity to start fish farming after using solar energy. It is very important to put lights in the ponds for fish farming and which is now possible because of using solar energy. Having fish farming is profitable for my household and my wife can also help me in fish farming."*

Both fish farming and livestock farming has become much easier than before. Because of having lights, households can give more time to both fish farming and livestock farming that are financial benefit for the family. Ferroukhi, Khalid, Lopez-Pena and Renner (2015) argue that the application of solar energy can bring opportunities for the people to gain extra working hours and increased income generating opportunities. Primary data also indicates that households get at

least 2 or 3 extra hours of work in both fish farming and livestock farming. Bahauddin and SalahUdin (2010) explain that solar energy use is very important for increased working hours and increased income generation and the findings of primary data in this research also indicate that renewable energy use is creating impact on increased working hours and income generation.

But for the households who do not use solar energy, there is hardly any opportunity for increased working hours. The income generating activities are not even increased for the households who do not use solar energy.

One respondent from category B (solar non-users) says *"I do not use solar energy so I do not have the scope to keep my shop open for longer hours at night."*

So, it indicates that having a solar light is always helpful to run the business place for long time during night. But if the shopkeepers do not have enough lights to run their business, then they may have to shut down their shop very early during night.

One respondent from category B (solar non-users) describes that *"I have a tailoring shop in the village market. But I really do not have any increased working opportunities because when it is night I cannot work properly without lights. So, most of the time, I have to shut down the shop after the sun goes down. Candles and lamps are not very good for tailoring activities. At times, I wish to buy solar energy soon."*

For the tailoring activities, light is very much useful during night, so, the lack of having solar energy is hampering the business activities. Even the income generating activities are not extended for the households who do not use solar energy.

One respondent from category B (solar non-users) says that *"I am not sure what you exactly mean by increased working hours because it requires money and investment, which I do not have right now. But to work for more hours with my fish business, I really do not need solar energy because I can go for fishing anytime I want. Normally, I go for fishing in river and sea with a group of people and we share the profit altogether."*

The data indicates that some people are still not aware about how income generating activities can be promoted by using solar energy. For example, the statement from the respondent above shows that he is a fisherman but he does not know that there are two types of renewable energies

he can use for fishing activities. Primary data from FGD represents that Village Boom is a solar technology that costs only USD $14 to buy and it can be used as a hand light for fishing and other activities. This technology is also necessary for charging up the mobile phones. Thrive Energy is another solar technology that costs only USD $3.5 to buy and it can be used a table lamp for fishing, tailoring, studying cooking etc. So, the findings suggest that still not so many people are aware about how solar energy technologies can be useful for increased working hours and income generating activities. So, it can indicate the marketing activities of the company may have some limitations that do not spread the awareness properly among the rural people about the use of renewable energies.

4.2.11 Income Opportunities for Women

In many cases, the male members of the family stay outside of home with the business or work. So, female members of the family can help in other income generating activities such as fish farming, tailing work, sewing activities, and livestock farming.

One respondent from category A (solar users) mentions *"I stay busy with my business so my wife is the one who maintains everything about fish farming activities around the home. My wife also maintains the livestock farming that we have at our house. But we have been improving livestock farming a lot because sometimes we also use lights for livestock farming when it is necessary."*

Using lights by solar energy can keep the space more clean and hygienic for the livestock farming. Thus, female members of the families are supporting with monthly income and financial condition of the households. Hackett (2012) explains about the scope of gender equity as an indicator of socio-economic development. If women can support for family income then it gives them the access to decision making process in the family. The concept of gender equity and women empowerment in this research is to focus on how female members can have equal power to decision making process within the households. And the increased earning opportunities by using solar energies can actually lead the way to gender equity and women empowerment in rural areas.

One respondent from category A (solar users) describes that *"My wife gets some monthly income from the sewing machine activities. She is contributing in the monthly income a lot. She even works in the night under the lights through solar energy and that is how she is running her sewing activities these days."*

The data refer that female members in the families are also inspired to increase their income generating activities. Some households are also trying to expand their livestock farming because of the opportunity to use lights by solar energy. So, the contribution of female members is creating a major impact in monthly income and savings that can also help to bring gender equity in the families. Bahauddin and SalahUdin (2010) claim that using solar energy gives more opportunity for women to work and make financial contribution to the family, which provides scope for women empowerment. The findings of the primary data also shows that using renewable energy is helpful to bring more working hours and opportunities for women in rural areas.

But among the households who do not use solar energy, women do not get many opportunities for income generations. Even some households are having livestock farming but they cannot seem to extend their opportunities like the households with solar energies. For example, women who work with sewing machines cannot work for long hours at night if they do not have lights.

One respondent from category B (solar non-users) explains that *"My wife takes care of livestock farming during the day and she has sewing machine so she definitely gives a contribution to our monthly income. But therefore, we do not have lights at house so she cannot work during night."*

Though in few households, women are making contribution to the monthly income of the families but the lack of having solar energy does not give them the opportunity to extend their working hours around 3-4 hours. Hasan (2015) discusses the concept of eco-village development (EVD) where women empowerment is elaborated as an indicator of socio-economic development. But if the households do not use solar energy then female members cannot make sufficient contribution to the family income, which may hamper the process of women empowerment and gender equity.

4.2.12 Changes in Living and Accommodation Situation

Households with solar energy can keep their house clean and safe because they do not use kerosene anymore, thus air pollution has been reduced. They also mention that roof of their house used to get dirty so much because of kerosene use but it does not happen anymore. All of the households with solar energy have sanitary latrine and few of the households also use lights (Village Boom[20] or Thrive Energy[21]) within their latrines. The house environment has become much better than before because they can keep everything neat and clean within the house, and every family member feels joyous of having solar energy at house. The sense of mental satisfaction is a major advantage of using solar energy by the people that put smiles at their face and inspire them to improve their socio-economic condition.

One respondent from category A (solar users) says that *"We can keep our house clean and hygienic, it is also important that we keep the furniture and other objects neat and clean at home. My house is tin shed and we have sanitary latrine and we are able to keep it clean and hygienic. We have small hand-lights that are also run by solar energy and we can use it while accessing the toilet."*

The data refers that the housing and living conditions has improved after using solar energy because people do not need to use kerosene anymore. Even the water can be kept safe because of the stoppage of kerosene use, which helps to maintain good environment within the house. Ullah, Hoque and Hasib (2012) explain that the use of renewable energy has a direct impact on environment within the houses and the primary data also indicates that the living and housing conditions has been improved after using solar energy.

But among the households who do not use solar energy, has less opportunity to use lights within their latrines. At the same time, the use of kerosene oil is making them suffer while keeping the house neat and clean.

[20] **Village Boom:** It is a solar technology that costs only USD $14 to buy and it can be used as a hand light for fishing and other activities. This technology is also necessary for charging up the mobile phones

[21] **Thrive energy:** It is a solar technology that costs only USD $3.5 to buy and it can be used a table lamp for fishing, tailoring, studying cooking etc

One respondent from category B (solar non-users) mentions that *"We try to keep our house clean and hygienic. But it is not possible all the time because of the fog of kerosene usage makes everything dirty. Sometimes kerosene use stinks and it also spoils our food and water."*

Eco friendly technologies are always helpful to maintain safe and sound environment within the house. The kerosene oil for lamps produces soot in the house that often makes the roof dirty. The use of soot from kerosene oil is harmful for air, food and water, and it can seriously damage the health condition. Though most of the households try to keep their house neat and clean but the lack of lights from solar energy does not let them keep it clean always. Hassan, Mahmud, Rahman, Khan and Haque (2014) describe that clean and hygienic home environment is an environmental benefits achieved by the renewable energy users, and the primary data also indicates that having solar energy can help to reduce the pollution from cow dung, fuel wood and kerosene use in order to maintain clean and hygienic home environment. There is also another observation found that when eco-friendly technologies are used by households, it reduces the use of fire, which refers that it decreases the possibility of fire accidents and brings safer environment for the households.

4.2.13 Reasons of not using renewable Energy

Most of the families who do not use solar energies think that solar energies are expensive to buy. But the price of buying solar energies is reasonable so it indicates that many people still do not have the correct information about the price of solar energy. The lack of marketing activities by the companies may cause to this kind of unawareness about renewable energies. From the observational point of view, there may be a psychological barrier among the mindset of rural people that do not inspire them to use solar energies. Few respondents describe that do not know about the necessity of using renewable energy as an alternative source of energy to save natural resources. It shows that they do not have proper environmental concern as well that may not inspire them to utilize renewable energies. According to Sovacool (2009), having misconception and misinformation may not inspire the people to use alternative energy because they do not comprehend why renewable energy is needed, thus psychological barrier can hamper the peoples' mindset for not using renewable energies.

One respondent from category B (solar non-users) states that *"I just never thought about using solar energy. Maybe I will think about it but people say it is very expensive to buy so I never tried to buy it."*

The role of local government is to spread the message of solar energies by integrating with the companies so that people can actually get the information about the use and price of buying renewable energies. But the meetings between the company and local government can be increased in number to spread the message about renewable energies to the rural people so that the lack of information can be dealt with. Some households have intentions to use solar energies very soon because they think using solar energies can be useful for their family.

One respondent from category B (solar non-users) says that *"Maybe the use of solar energy can help to reduce the air pollution within house and we can get better health condition. Solar energy can be good for us to get increased working hours to increase our income so we can think about buying it soon in near future."*

The non-user households of solar energy indicate that if they could use solar energy, then it would be good for their business and work such as fishing, tea stall, and fish farming and tailoring shop, thus it could help to increase their income. It is also mentioned that solar energy can help them to get rid of the use of kerosene, which is harming the health conditions of their family members. Joshi and Rahman (2015) explain that consumers' environmental concern is a major factor for making the purchase of renewable energies. Rural people do not live in urban areas so they may not have sufficient concern for environmental protection since village areas are not much affected by air and water pollution like urban areas. So, it can be possible that culturally, rural people are not much aware about the need of using renewable energies.

4.3 Conditions influencing the Relationship between Socio-economic Development and Renewable Energy Use

The influence of using solar energy has created positive impact on socio-economic development for the rural people. But there are certain conditions or factors affecting the positive changes of socio-economic conditions by using solar energy those are explained by the findings of the focus

group discussion. The focus group discussion (FGD) is conducted with the employees of Grameen Shakti to collect necessary information.

4.3.1 Reaching to the Clients to Provide Renewable Energy

A. Strategies to offer renewable energies

Grameen Shakti mainly relies on marketing approaches to reach their clients. In rural areas, marking measures are taken to share the information about renewable energy to the villagers so that they can be informed about the use and benefits of renewable energies. It is also noticeable that local government representatives, local educated and valued persons such as school headmasters and Imam[22] in the mosques are helpful to spread the messages of renewable energy on behalf of Grameen Shakti. So, the marketing strategy is quite successful in this organization because they are also integrating with local government for their marketing activities. But the use of renewable energy is not increasing as much as it is expected in rural areas and the lack of integration with local government and insufficient marketing strategies may be two reasons behind this problem. The findings of qualitative interviews show that still many households do not know about the use and exact price of buying solar energy so it raises a question that whether the company is actually successful with marketing activities to spread the messages of renewable energies to everyone.

B. Conditions of being eligible to buy renewable energies

There are three conditions that can be considered while selecting a client for providing renewable energy technologies. Firstly, monthly income is reviewed to understand whether the client is capable of buying or affording the loan installments to purchase renewable energy. Secondly, the demand or need of the client is also assessed to realize the actual demand of the clients to use renewable energy, and lastly, the location of the house is also considered to identify that the solar energy can be installed at their houses properly in a specific place where the sunlight is available

[22] **Imam:** It is an Islamic position, mostly indicated to the praying leader of a mosque and Muslim community by Sunni Muslims

all the time. If the solar energies are installed in a place where sun light is not available then it may not bring positive outcome for the households to improve socio-economic condition.

C. Integration between the company and local government

One monthly meeting is maintained with UNO (Upazila Nirbahi Officer) by the company to communicate with the local government. A telephone interview is conducted with UNO and he explains that the company is always keen to stay connected with local government. It is also found that local government always encourages rural people to use more renewable energies. Local respected men such as school headmasters and Imam of mosques improves marketing activities of the company so that people can know that solar energy are not very expensive and they can get many positive impacts by using renewable energy. But if the people do not get proper information about solar energy by the company and local government then it might not inspire them to use solar energy, which may not be positive for their socio-economic development.

D. No discrimination in selecting customers

The company does not choose clients from any specific groups or communities, and accessibility to renewable energy is given to all the people within the country. Any person can become a client of Grameen Shakti if they have the need of using the renewable energy and meet the 3 criteria explained above. So, it shows that there is no discrimination in selecting the clients by this organization. It suggests that the company has been successfully offering the renewable energies to everyone in the society. Grameen Shakti is holds the biggest market share and the way it offers renewable energies to everyone, which actually helps to supply renewable energies to everyone in order to implement the policies regarding renewable energies in Bangladesh.

4.3.2 Role of Grameen Shakti on Renewable Energy Development

A. Ensuring sufficient extent of distribution and accessibility of renewable energies

It is possible by the company to provide sufficient numbers of renewable energy in rural areas. Though, it should be mentioned that there are other companies in the market who also provide renewable energies. In specific seasons or time of the year, the need of renewable energies can be increased but still Grameen Shakti is able to ensure the supply and distribution. Sometimes, they may need to bring the equipments from other branches of Grameen Shakti, so at times, the process may be delayed but still the company is effective to ensure adequate supply of renewable energies.

B. Cost of buying renewable energies is affordable

The company assesses three major aspects of the clients to understand whether the clients can afford the cost of buying renewable energy such as monthly income, business opportunities and installment perspective. The cost of buying solar energy is not very much expensive and they can also buy it through loan installment process with very low interest rate. Thus, Grameen Shakti has made it possible for the rural people to buy and get the accessibility of solar energies.

C. Impacts of Grameen Shakti to increase renewable energy use

The impact of this organization is very much important for the policy implementations. In Bangladesh, almost 50 percent of the renewable energy supply is given by this company, so, the company has been contributing largely for the development of renewable energy technologies. And the number of solar energy users is increasing every year by this company. Since, Grameen Shakti offers renewable energy technologies to everyone, and then it helps to increase the availability or renewable energies to help the implementation of policies regarding renewable energies in Bangladesh.

D. Utilizing the funds and resource to offer renewable energies

The expansion of renewable energy program is supported by the funds and subsidies given by IDCOL (Infrastructure Development Company Limited), which is the paramount government authority with financial support of World Bank. Grameen Shakti has to buy the products and equipments that are approved by IDCOL standards to ensure the quality of the products. Grameen Shakti does not only sell the products but also helps the clients to install, operate and repair the products whenever it is needed. The price of buying renewable energy has been decreasing in Bangladesh because of the aids and donation supported by the foreign investors and donations. But there might be a question to be asked that how much sustainable Bangladesh is in terms of renewable energy development without the funds and support from the foreign investors.

E. Eco-village development (EVD)

The approach of eco-village development is essential for sustainable development. Eco-village development is an approach introduced to change the people's livelihood by promoting education, income generation, women's employment and promoting environment. Eco-village development is an important term for this research because all the aspects of eco-village development such as income generation, promoting education and environment are relevant to socio-economic development of the rural people. According to Hasan (2015), the concept of eco-village development has the purpose to bring rural community development by integrating renewable energy use and sustainable development. The use of solar energy is the major focus in the present research as a useful type of renewable energies and eco-village development is also introduced by the emphasis of installation solar energies for rural people in Bangladesh. But from the perspective of eco-village development, there might be a question that how many opportunities women can get to have women empowerment and gender equity in rural areas of Bangladesh.

4.4 Discussion

The relationship between renewable energy use and socio-economic development is investigated in terms of major conditions such as distribution and accessibility of solar energy among the rural people in Bangladesh. The findings of the primary data suggest that Grameen Shakti offers renewable energy technologies to everyone without showing any sort of discrimination that allows distributing solar energies to the target people, and helps to implement the policies regarding renewable energies in Bangladesh. Primary data indicates the major conditions are existent such as (a) solar energy is cost effective and easy to use; (b) company's strategy is effective reach target people and offer solar energies; (c) integration between the company and local government is satisfactory and; (d) funds are utilized to increase the distribution and accessibility of renewable energies in rural areas. Thus, we can mention that under these conditions, solar energy use can create positive impact on socio-economic development of rural people. It is also ensured that no other factors such as foreign remittance is affecting on socio-economic development of the rural people so we can believe that the positive changes in socio-economic situation is actually coming from the use of renewable energy usage.

After we have discussed under what conditions solar energy use can actually create positive impacts on socio-economic development of rural people in Bangladesh, we find out the major indicators of socio-economic development that are changed for the households who are using solar energies. The comparative interpretation of the data indicates that the households that do not use solar energy cannot achieve as much as socio-economic development comparing to the households who use solar energy. So, the major benefits achieved by the solar energy users are reduced health risks, educational development, entertainment facilities, gender equity, and changes in social status, better telecommunication service, increased working hours and income opportunities, clean and hygienic environment and protection from pollution. Bahauddin and SalahUdin (2010) and also claim that these benefits are achieved by using solar energy in rural areas of Bangladesh, and all these indicators are also covered by the three major pillars of energy and sustainable development theory given by Cleveland and Najam (2008).

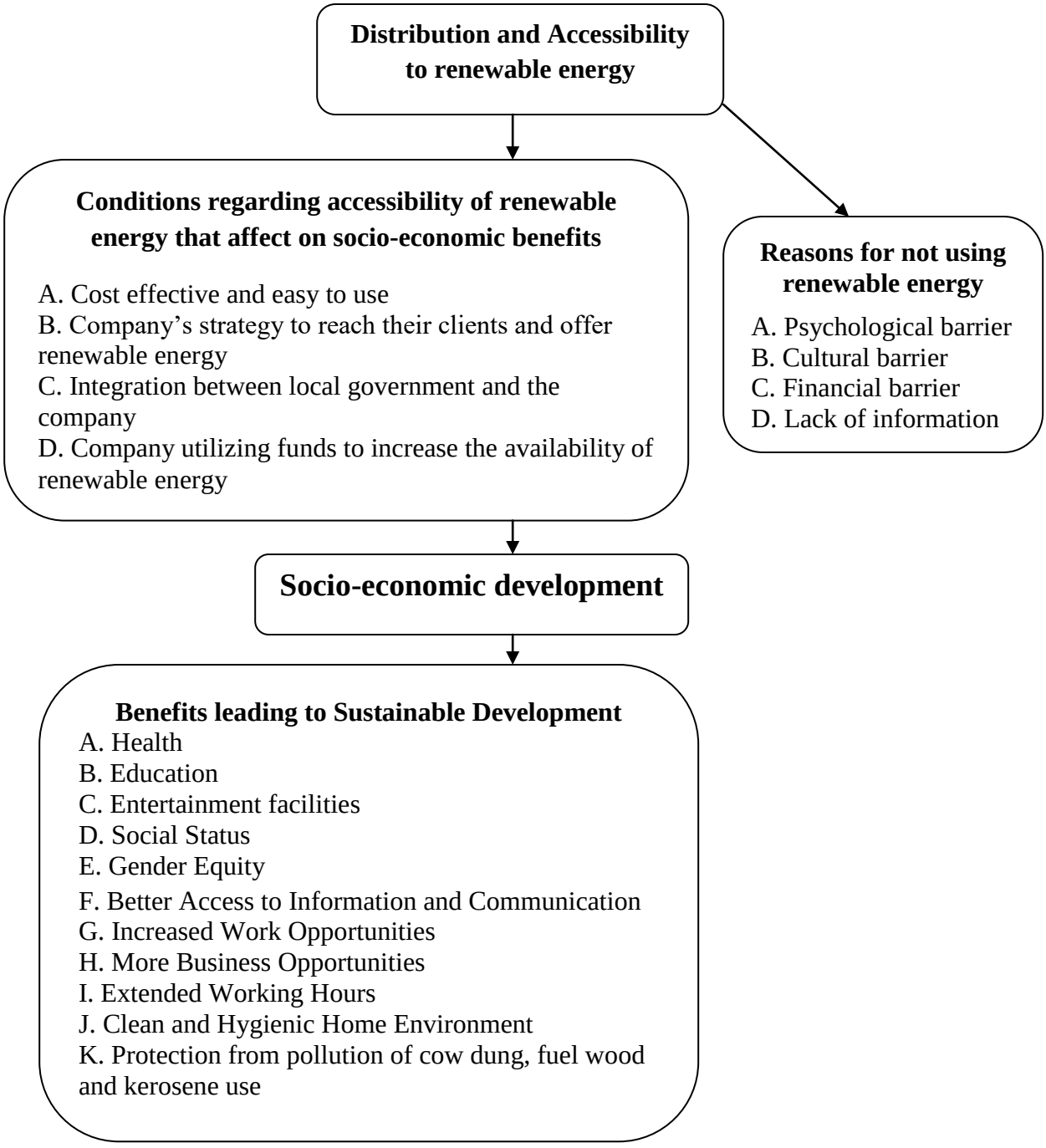


Figure 4.1: Relationship between Renewable Energy and Socio-economic Development

Source: Designed by the primary findings of the research

The major three pillars of energy and sustainable development theory are environmental, economic and social development; and solar energy users are benefited by all three aspects, which give relevancy between the primary findings and energy and sustainable development

theory. Policy cohesion for sustainable development (PCSD) theory argues to help the implementation of renewable energy policies that can help to offer renewable energies in affordable price (Knoll, 2014), and primary data suggest that Grameen Shakti offers their products to everyone with reasonable price, which gives the scope to implement policies regarding renewable energies in Bangladesh. Policy cohesion for sustainable development (PCSD) theory also emphasizes that developed countries assist developing nations for policy adoption regarding science and technology and we can also notice from the findings that Bangladesh to get funds and investment from foreign investment, which decreases of price of purchasing renewable energy technologies. Thus, rural people in this country can afford to buy renewable energy technologies and utilize them for their socio-economic development.

Since, we find that the cost of buying renewable energy is decreasing day by day but it still surprising that many villagers are reluctant to use solar energies. Despite of having good marketing strategy of the company, many villagers are misinformed and do not have proper information about the price and use of solar energies. Joshi and Rahman (2015) argue about the cultural barrier that may not encourage the people to purchase renewable energies. Even if the price is becoming cheaper day by day but still many marginal rural people can still find it expensive to buy, so, there might still be financial barrier behind this factor. Also it is observed in few cases that few people have psychological and cultural barriers that they do not bear the mindset of using renewable energies at their houses. According to Sovacool (2009), misinformed consumers may not understand the significance of using renewable energy that creates a psychological barrier for the people for not using renewable energies. Perhaps, one meeting with local government representative is not enough and the company may wish to have more meetings and integrate more with local government to improve their marketing strategy so that people can get more information about the necessity and benefits of renewable energy.

The application of solar energy in rural areas of Bangladesh has been creating positive changes in terms of socio-economic perspectives. The findings of the primary data explains that the people who do not use solar energy in rural areas, do not achieve advantages like the users of solar energy such as increased working hours, increased income generating opportunities, educational and recreational facilities, better food habit and cooking environment etc. But the major issue in these findings is actually to find out whether these changes truly coming from the

use of solar energy or not. From the observation of data collection and empirical discussion, we can identify that socio-economic development is a continuous process and it can be existent one way or another in a household whether they use solar energy or not. So, time is a large factor because one household who is investing more money and resources for more business opportunities though they do not use solar energies, they can improve their socio-economic conditions in time. So, this has been a critical aspect to investigate whether the changes in socio-economic conditions is actually coming from the use of solar energy or not. The researcher attempts to choose both the categories of households who use solar energy and who do not solar energy in terms of similar kind of socio-economic backgrounds so that the findings can actually show the differences between these two categories in terms of the effect of using solar energy. One of the major empirical contributions of the research is to analyze the duration of using solar energy. For example, one household is using solar energy for 3 years and another household using solar energy for 10 years, they may not have the similar kind of socio-economic changes. So, there might a more scope for investigation of intra-group variations in terms of analyzing the duration of using solar energy, and how it manipulates the socio-economic development of the households. There are many previous studies showing that solar energy does have positive impact on the rural livelihood but the findings in this research has brought two new aspects such as increase of social status, which is identified by the increase of food production and food consumption (Palma, Ness & Anderson, 2017) and the reduction of the possibility of fire accidents in the house.

The use of solar energy has not extended as quickly in Bangladesh as predicted and has not become as popular as one would have imagined. Since, the use of solar energy creates positive socio-economic changes in rural areas, and Grameen Shakti is having good marketing strategy to reach their clients so it is still contradictory that how people are still misinformed about solar energy costs and usage. Though the company attempts to integrate with local government to communicate with the rural people but still it is surprising that why the non-users of solar energy are not diminishing more rapidly. The findings of this study indicate that lack of awareness about the use and cost of solar energies is the factor that hinders many people to access solar energies but there might be more factors that do not encourage people to use solar energies, which could be a scope for further research investigation. Even if the marketing strategy of the company is good but still many people might not be reached by the marketing strategy and the practical

impact the marketing initiatives can be assessed to find out whether all the people are being communicated or not. Grameen Shakti assesses the clients to find out if the customers can actually afford to buy the renewable energies and the findings in this research discuss that large majority of potential users can afford solar energy then it brings a question to be raised that why would this company use much time and effort to assess all potential clients in this manner. The empirical observation can suggest that sometimes the company sells solar energy through loan installments so this is the reason that makes the company to assess the clients to see whether they would be able to pay the loan installment successfully or not.

Energy and sustainable development theory given by Cleveland and Najam (2008) explains that major three elements of sustainable development are economic factor, social factor, and environmental factor are fostered by the use of renewable energy. We can ascertain from the research findings that economic growth of the users of solar energy have better economic growth than the users of solar energy because of increased working hours and increased income generating opportunities. The use of solar energy has also direct impact on social and environmental changes of the households who use solar energy so it can be established that the theory of energy and sustainable development is found to be relevant with the findings of this research. Another theory used in this study is policy cohesion for sustainable development (PCSD) discussed by Knoll (2014) that explains the support given by international organizations and developed countries to finance and impalement renewable energy project in developing countries like Bangladesh. Grameen Shakti is supported by international donors that help to reduce the price of renewable energy technologies, which shows the relevancy of this theory in this research. But it also brings an issue to investigate that can Bangladesh sustain renewable energies if there are no donors or sponsor from international community because most of the renewable energy projects in Bangladesh are supported by international organizations and donors.

The framework of the research analyzes the impact of renewable energy on social, economic and environmental benefits. The research findings show that solar energy use has positive impact on health, education, entertainment, social status and gender equity so it refers that social benefits are obtained by the users of solar energy. Income generating opportunities and working and business hours are also increased for the users of solar energy, which are the major economic

benefits achieved by the use of solar energy. The household who use solar energy also gain few environmental benefits such as clean and hygienic home environment and protection from air pollution. The present study also analyzes under what conditions the use of renewable energies can change socio-economic indicators. It is found that the major conditions are; solar energy is cost effective and easy to use, company's strategy to reach clients is fair to offer renewable energy, the company integrates with local government for marketing strategy, and the company utilizes funds to increase the availability of renewable energy for rural people. All these conditions ensure that people can buy solar energy at affordable price and get the best use of it in order to improve their socio-economic conditions.

4.5 Conclusion

The findings of the primary data is explained in terms of major research questions to elaborate how Grameen Shakti is trying to reach people to offer renewable energies. The data suggest that there is a positive relationship between socio-economic development and solar energy use that leads to the opportunity for sustainable development. The contribution of this company is essential to ensure proper distribution and accessibility of renewable energy technologies in rural areas of Bangladesh. But there are some issues that cannot be conclusive in this research such as why still many villagers are not using solar energies even if the price is affordable. There can be some other barriers such as psychological or cultural barriers affecting behind this matter.

Chapter – 5: Conclusion

5.1 Conclusion

Grameen Shakti offers renewable energies to everyone in rural areas and there is no discrimination shown by this company. It is also explained by the discussion that the socio-economic development is mostly occurring for the solar energy users because of the use of solar energy rather than having impacts from other indicators. The accessibility of solar energy is still fairly limited because there are still many rural people who do not use solar energies. The marketing strategies of the company can be more productive and the integration with local government can be more influential in order to reach out more clients to offer solar energies. First research objective is emphasized to explore the socio-economic development of rural people resulting from the application of renewable energies, and the findings and discussion of the research show that user of solar energy achieves major socio-economic benefits such as health improvement, educational and recreational facilities, better access to communication and information, gender equity, improved food habit, increased working hours and increased income generating opportunities. The research also investigates how Grameen Shakti offers renewable technologies to the clients in order to maintain organizational strategy, which is another research objective. We have found that this company runs marketing strategy and integrates with local government to offer solar energies to the clients, and there is discrimination shown by this company while providing renewable energies to the people. The research also analyzes under what conditions solar energy use can be effective to improve socio-economic changes of the people. If the users can buy solar energies in affordable price, and the company offers solar energies to everyone in the rural areas then it can actually help the households to improve their socio-economic condition. The company also helps to install and operates the renewable energy technologies and integrates with local government so that it can be ensured that maximum number of people can get the accessibility to renewable energies.

There are some limitations found by the research such as lack of influential marketing strategy to make contact with more people to offer renewable energies. It is found that the marketing strategy is good enough to integrate with local government as well but still there are many non-users of solar energies who claim that they do not have the proper information about solar

energies. It is also a matter of question that the company integrates with local government but whether the representatives of local government actually contribute to reach the people in rural areas. The availability and access to solar energies is highly dependent on the role of local government and how they help the company to reach the people who are in need of solar energies. It can be possible for the companies to reduce the price of renewable energies more by the assistance of international donors so that more people can be attracted to use it. The research hypothesis explains that the use of renewable energies can positively influence socio-economic development for the rural people. The empirical discussion ascertains that the users of renewable energies have high level of socio-economic development and non-users of renewable energies have comparatively low level of socio-economic development so we can conclude that hypothesis of the research is found to be correct.

5.2 Further Scopes of the Study

Further research scopes can be made in terms of the present research findings and contributions. There are some further scopes of investigation that are found by the empirical discussion of the research.

- There might be psychological and cultural barriers among the rural people that do not encourage the villagers to use solar energies, which could be an interesting aspect to study in further research.
- The duration of using solar energy by the users of may vary, and it can be important to investigate whether the time or duration of using solar energies have any variation of socio-economic impact for the rural people.
- Not every household is using solar energy at both house and business places. It can be a significant research issue to study the difference between the users who use solar energy at home and who use at both home and business places.
- Bangladesh has been assisted by international organizations and donors to initiate the renewable energy projects but it could be an interesting idea to investigate that how Bangladesh will sustain renewal energies if there are no supports from international organizations.

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Appendix A

Semi-Structured Interview Guideline for Qualitative Interviews

(For the participants who use renewable energy)

[This information will be only used for research so privacy and confidentiality is ensured]

Title: Relationship between Renewable Energy and Socio-economic Development: A Study in Patuakhali District

A. Socio-demographic information

Serial No.	Name	Occupation	Age	Sex	Monthly Income	Educational Status	Marital Status
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Present Address:

Permanent Address:

B. Renewable energy use and socio-economic development

1. Do you use renewable energy? If yes then for how long have you been using it?

☐ Yes ☐ No

For how long have you been using it:.....

2. Where do you use renewable energy?

☐ Home ☐ Business ☐ Both

3. How did you buy the renewable energy?

☐ Loan ☐ Cash

Total Cost:.....(BDT)

4. Before using renewable energy, how much kerosene (in liter) did you use monthly? And how much did it cost you monthly?

Amount of monthly usage of kerosene:……liter

Monthly cost of buying kerosene:…….(BDT)

5. Does the company help to install, operate and repair the solar energy?

☐ Yes ☐ No

If 'Yes' then please explain:……

6. Tell about the changes in food habit in your family after starting to use renewable energy.

7. Explain about the health condition your family members after starting to use renewable energy.

8. Tell about the changes social status of your family after starting to use renewable energy.

9. Express about educational and recreational facilities after started to use renewable energy.

10. Tell about information and technological benefits after started to use renewable energy.

11. Explain about increased work and income generating activities after started to use renewable energy.

12. Tell about changes in monthly income and financial conditions of female members of your family after started to use renewable energy.

13. Express about the opportunity of increased working hour after started to use renewable energy.

14. Tell about the changes of living and accommodation situation after started to use renewable energy. Explain about the following.

Housing structure, clean and hygienic environment, sanitation system, and reduced pollution

15. Is there any negative impact of using renewable energy?

Appendix B

Semi-Structured Interview Guideline for Qualitative Interviews

(For the participants who do not use renewable energy)

[This information will be only used for research so privacy and confidentiality is ensured]

Title: Relationship between Renewable Energy and Socio-economic Development: A Study in Patuakhali District

A. Socio-demographic information

Serial No.	Name	Occupation	Age	Sex	Monthly Income	Educational Status	Marital Status
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

Present Address:

Permanent Address:

B. Socio-economic condition

1. Do you use renewable energy?

☐ Yes ☐ No

2. How much kerosene (in liter) do you use monthly? And how much does it cost you monthly?

Amount of monthly usage of kerosene:……liter

Monthly cost of buying kerosene:…….(BDT)

3. Explain why you do not use renewable energy?

4. Tell about the food habit in your family.

5. Explain about the health condition your family members.

6. Tell about the social status of your family.

7. Express about educational and recreational facilities in your family.

8. Tell about information and technological facilities in your family.

9. Explain about increased work and income generating activities in your family.

10. Tell about monthly income and financial conditions of female members of your family.

11. Express about the opportunity of increased working hour in your family.

12. Tell about the of living and accommodation situation of your family. Explain about the following.

Housing structure, clean and hygienic environment, sanitation system, and reduced pollution

13. Do you think using renewable energy can help to improve your family's socio-economic condition?

☐ Yes ☐ No

If 'Yes' then please explain how:.....

Appendix C

Semi-Structured Interview Guideline for Focus Group Discussion (FGD)

(With the Employees of Grameen Shakti)

[This information will be only used for research so privacy and confidentiality is ensured]

Title: Relationship between Renewable Energy and Socio-economic Development: A Study in Patuakhali District

A. Reaching to the Clients to Provide Renewable Energy

- What strategy or process is applied to reach the clients to offer renewable energies?
- Are there any conditions of eligibility to buy renewable energies for the clients?
- How does the company integrate with local government to reach their clients?
- Does the company have an approach to choose certain group of people to offer renewable energies?
- How do the customers get repairing service from the company?

B. Role of Grameen Shakti on Renewable Energy Development

- Can the company ensure sufficient extent of accessibility of renewable energies for the people?
- Is the cost of buying renewable energies affordable for the rural people and how?
- What are the major impacts of Grameen Shakti to implement the renewable energy policies in Bangladesh?
- How does the company utilize the funds and resource to offer renewable energies?
- Explain about the concept of eco-village development (EVD)

Appendix D

Semi-Structured Interview Guideline for Local Community Leaders/Local Government Personnel

[This information will be only used for research so privacy and confidentiality is ensured]

Title: Relationship between Renewable Energy and Socio-economic Development: A Study in Patuakhali District

1. Does the company integrate with you to reach their clients?
2. What is the role of local government to ensure the usage of renewable energies for rural people?
3. How does local government help the company to offer solar energy to the people?

Appendix E

CONSENT FORM

Please give tick to the (✓) relevant boxes

1. I confirm, the information sheet is clear to me ☐

2. I am aware of my participation ☐

3. I provide permission to participate ☐

4. I give my consent to remain confidential members at the focus group ☐

5. I am glad to be approached ☐

Signature:

Date: