Solar Home Systems for Rural Developments

By

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APPROVAL

This Project titled **"Solar Home Systems for Rural Developments",** submitted by Jesika Debnath (ID:173-17-367) to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of MIS in Computer Science and Engineering and approved as to its style and contents.

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I am declaring that, this project has been done by me under the supervision of Md Zahid Hasan, Assistant Professor, Department of CSE, Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

This research is an attempt to gauge the effects of Solar Home Systems (SHSs) and their part in financial advancement of provincial Bangladesh. After a short audit of past research chips away at SHS's significance, advantages and prospect, the review basically concentrates on the issues of SHS's effects on financial advancement. In this specific situation, the writing of SHS related works is investigated and a while later, the strategies and discoveries of an effect appraisal investigation of SHSs in rustic Bangladesh are portrayed in detail. The review depends on information from an overview of 90 family units from three towns in Goffargoaw Upazilla of Mymensign region. From the exploration discoveries, a few suggestions for SHS spread projects in Bangladesh are made. Furthermore, positive environmental effects are additionally seen as the substitution of conventional lighting powers spare carbon dioxide outflows. In rather case, disposing of the old batteries gathering and reusing framework is fundamental for guaranteeing naturally manageable environment in provincial territory of Bangladesh. Finally, I have shown a comparison in between the existing power generation and solar power generation in terms of environment as well as in terms of costs to justify my evaluation that how traditional system can be replace by solar energy system in provincial areas of an underdeveloped county.

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CHAPTER 1:

INTRODUCTION

Energy is a standout among the most requirements to enhance neediness and to realize financial advancement of a nation. Throughout the world, Solar, Nuclear, wind, water source and Fuel plants are the wellsprings of energy. Significant energy source is as yet non-renewable energy source however the save is declining. Non-renewable energy source is being utilized however it radiates ozone depleting substances for an unnatural weather change which is a risk to environmental change and manageable improvement. In this circumstance, practical and secure energy are the real concern around the world. Under these conditions there is a change in progress in the energy area. It is occurring because of decrease in fossil fuel accessibility, diminishment of worldwide discharges for alleviating environmental change and energy security. Under the changed point of view renewable energy particularly solar powered energy is getting to be distinctly well known for its centrality in commitment to worldwide environmental change and carbon exchanging prospect. United Nations Framework Convention on Climate Change (UNFCC) has stepped up with regards to Clean Development Mechanism (CDM). In this specific situation, solar based energy is getting to be distinctly across the board wellspring of energy all through the world. To take care of the developing demand for power in the undertakings, transportation and family utilize many created nations are as of now utilizing solar powered energy as renewable sources. This is not just meeting the greater part of energy request additionally giving huge financial advantage and keeping up clean environment. Bangladesh is an indistinctly populated tropical nation which has no adequate supply of energy. At present, around 62 percent (counting renewable energy) of populace has admittance to power, the per capital energy utilization is just 321 KWh per annum. Remaining 38 percent of the populace relies on upon excessive lamp fuel and characteristic sources. Bangladesh is still extremely concentrated to its capital city. Numerous areas outside the capital don't get legitimate consideration. Needy individuals can't bear to have power for their day by day exercises. Numerous remote islands and good countries are not associated with national network lines. Since extending the national framework in those confined territories is exceptionally costly and are not practical, solar powered energy could be a viable contrasting option to satisfy the power necessity in these off-network zones. As of late utilize Solar Home System (SHS) is developing quick for solar oriented power, however it has high introductory cost. As a generating nation, Bangladesh and its kin are experiencing force and power deficiencies. Nevertheless, the geological circumstance and positive atmosphere conditions give colossal chance to use solar oriented power for practically every part of our country, urban, semi urban employment of Bangladeshi common people.

1.1 Project Rationale

Bangladesh has a large unsatisfied demand for energy. The nation generally encounters unmanageable request supply crevice of power, particularly amid summer. The energy hole is one of the biggest bottlenecks for financial development in Bangladesh. By a few assessments, Bangladesh monetary development could have been around 8% had it not been compelled by energy lack. To support and advancing monetary development, administration of Bangladesh is effectively occupied with vitality emergency administration. The national energy grid has the unequivocal objective of providing the entire nation with power by 2021. Bangladesh embraced renewable energy approach 2008, which requires having no less than 5% control from renewable sources in the energy blend by 2015 and 10% by 2020. Till now, national limit of renewable energy-based power is around 90 Mega Watt (MW) and it for the most part originates from sun-oriented energy. SHS can change the lives of individuals in the provincial zone. Sun oriented power might be a method for improvement giving sun-oriented power answers for family units, agribusiness, human services, training, media transmission, rustic boulevards and commercial centers. Government, development partners, analysis establishments, NGOs and personal organizations are operating for turning Asian nation into associate energy economical country through the employment of untapped alternative energy. alternative energy is that the most potential supply among the renewable energy resources in Asian nation. By taking acceptable policy, rules and regulation, it's potential to mitigate country's growing electricity demand exploitation alternative energy. the present analysis so can determine the factors related to utilization of SHS and it socio-economic impact in rural areas.

1.2 Project Aim and Objectives

For the research, it is very important to outline the aims and objectives first. To be precise we need to set an aim which means we need to comply a clear understanding that what we are going to be doing for the research as well as to reach that aim/goal what are the objectives that is needed to be met. In this following section I will layout me understand by setting my aim for the research and the objectives of how to complete them.

The Aim of my study and the objectives to achieve them are:

- To outline the reasons behind choosing solar energy.
    1. Comparison in between other energies.
    2. By gaining Knowledge of other countries with solar energies implemented.
- To gain an alternative solution apart from oil, coal, gas and uranium.
- To justify that solar energy technologies are better economically and environmentally.
    1. Rural Electrification.
    2. Role of SHS (Solar Home Systems)
    3. Solar Panels in different weather condition.
    4. Environmental Impacts such as, Disposal of SHS battery.
    5. Role of PV (Photovoltaic) in solar assessment.

6. Role of SHS in terms of education.
7. Role of SHS in terms of agricultural development.
8. Role of SHS in reducing the incident of diseases.
9. Role of SHS in empowering Economic stability.

- To prove how Solar powered electricity generation is better in terms of economy and environment than the existing method.
    1. Contrast in between the technologies.
    2. Reduction of CO_2 emissions.
    3. Feasible Health Analysis.
- To Differentiate other technologies with solar in terms of costs.
    1. By measuring the economic development.
    2. To put in contrast with the existing resources available.

1.3 Project Feasibility

To complete a project, we had to go through a lot of harness. The most common of them is no gaining much of data. For example, the subject that I am doing my research on is "Solar Electricity System's influence in rural areas both economically and environmentally" and most of the time the problem/difficulty that I have face is to gain correct data. It was sort of like either I didn't have the access to the other writer's papers or it was not the paper with that amount of information that could help me to give certain amount of edge that could help me to make my research much more appropriate. Furthermore, there were also other deficiencies that I have faced during conduction my research. One of them is while conducting the research survey on the selected area. I have not had enough supports from the people or many of them didn't cooperate during the survey. They were frightened about the thought that their personal data could be hindered. To cope with this kind of problem I had to assure them that their information will not be used for the illegal cause and will be for their development. In this manner, I had to ask for help from the local law enforcements so that my data remain clean and raw.

1.4 Project Significance

Bangladesh is a tropical nation of colossal sun powered vitality. Be that as it may, an almost no measure of it is utilized. In spite of the fact that the initiation of SHS in Bangladesh was in 1988 however it was undiscovered for an extensive stretch. At this point, different uses of solar based power are seen all through the world. Presently a-days Solar Panel gives power to solar oriented immunization icebox, sunlight-based water sanitization (SODIS), solar based nourishment drier and solar based purification. These aides for lessening waterborne infections. Solar powered telephone, sunlight-based Wi-Fi, solar powered radio increment rural correspondence, decreases transport cost, and diminish computerized isolate. Adjacent to solar based cooker and solar based water warming, dependence on conventional energizes, for example, wood or charcoal, lessens indoor contamination and carbon outflow. This builds the personal satisfaction in country territories, enhance wellbeing and instruction, diminish oil reliance, increment neighborhood

business, and lessen deforestation. Solar powered power exercises lead country improvement. Because of absence of data and study SHS is utilized just for family unit lighting in Bangladesh.

Solar powered water system innovation is likewise getting famous in Bangladesh. As agribusiness-based nation, utilizing solar oriented power water system framework would be a noteworthy main thrust for country improvement. Government association, Academic organizations, NGOs and privately-owned businesses are included in renewable energy division in the nation. Specialist, strategy producer, improvement accomplice in Bangladesh recognized the tremendous prospect of solar oriented power for country change. However, there is no coordinated investigation of the prospect and extent of solar oriented power for financial advancement in rural region of Bangladesh. Starting at now there is extremely constrained scholarly review on the financial or ecological effect of solar oriented power in provincial range. Thus, the review would help the worry policymakers and implementers to take fundamental measures for reasonable country improvement in Bangladesh. Distinguishing the new creative utilization of sunlight-based power in country regions would help the implementers for viable arranging and undertaking programs. In addition, it will likewise help for new innovation move in provincial zones.

CHAPTER 2:

LITERATURE REVIEW

This chapter attempts to focus on the review of selected literature, key concept of solar electricity as driving force for financial improvement, issues and elements affecting financial advancement like family unit salary, wellbeing, training, agricultural creation, access to data and other infrastructural administrations. Many recent studies show that how electrification from solar based power helps in financial improvement of the nation in various ways. In this condition, solar based energy is broadly seen as a promising innovation for electricity generation in remote area of the developing nations. Reasonable, open, and secure supply of energy plays a main role for financial progression of a nation. But our focus should not only be on financial progression but also, we need to keep in mind that the environment is not affected with any of its drawbacks. Indeed, if it's so then we also need to suggest suitable reasoning to overcome those drawbacks. We will discuss all these things in this section. Moreover, other researcher's papers, articles and journals information will also be hypothetically evaluating in this section. Furthermore, the below sections will be providing you with the guidance that how solar applications such as rural electrification and solar roadways will help us to achieve the objectives that has been set earlier in the section above.

2.1 Why choose solar as an energy source?

Choosing solar energy as an energy source is being a vital part of this research. As, the applications are based on solar so the energy source has become further more important. Per Asif Hassan et al. (2014) [2] "Using energy from sources which cannot be used up – sun, wind, water and waves – supports sustainable development by reducing carbon emissions. This adds to expanding energy and atmosphere security for some groups over the world. Renewable energy originates from sources which can't be spent, for example, wind, sun, water and waves, as opposed to from fossil fills, for example, gas, oil and coal. Renewable energy sources are Wind, biomass, sun oriented, hydroelectric, geothermal, wave and tidal. Among every one of them wind is the most growing around the world. But due to the geological condition of Bangladesh, solar is most suitable renewable energy source" [2]. With the following proof, we can assume that solar applications can be a vital source in perspective to renewable energies and its role in the development in the underdeveloped countries. Furthermore, in another research per Amanda Manton (2015) [22], the research reflects that how by using solar based power can be helpful to the environment as well as how it is been used to lessen the harmful calamities in to the environment. Eventually, she stated "Solar power reduces a region's effect on the earth. Nations have put resources into sun powered energy to diminish their carbon impression and their consequences for worldwide environmental change. They accept sunlight-based power polices will lessen nursery gas outflow, for example, carbon dioxide. It is realized that fossil powers discharge carbon outflows and add to a dangerous atmospheric deviation. PV delivers no carbon

dioxide emanations or clamor while it produces energy (Manton, 2015) [22]. Sun oriented energy is a cleaner alternative than fossil powers to deliver power. Germany utilizes sun powered energy to diminish air contamination. With its solar energy strategies in 2005, Germany decreased their carbon discharges by 25% considering 1990's figures. Malaysia additionally inclines toward sun-oriented energy to help the environment. Their government favors sun-oriented energy to empower low-carbon transmitting innovation to advance feasible improvement and preservation. Nature is a worldwide concern bringing on numerous nations to incorporate sun-oriented power in their energy arrangements." Nonetheless, apart from helping the environment solar based powers can also help the economy of the country. In the following research by Amanda Manton (2015) [22] also expressed that other than helping the earth, the sunlight-based energy industry empowers the economy. A nation can utilize their property as a venture open door for different nations. The United States has arrived that is usable for PV plants. The land pulls in outside designers to put resources into the U.S. to invigorate advancement and occupation creation. Sun based power can likewise be an exportable decent. Japan leads in trading PV power and builds other nations' PV limit, which has extended their sun-based energy industry showcase. In 1992, the Japanese government and Malaysia's Ministry of Energy, Water, and Communication began a venture that gave power to Malaysia's rustic territories (Manton, 2015) [22]. With their joint exertion, Japan put resources into and built up Malaysia's solar energy part, which delivered employments for building and running those offices (Bureau for Economic Growth, Agriculture and Trade (EGAT), 2004) [7]. This likewise expands profitability in those zones since they can work into the night by not depending on sunlight to work. PV organizations in Malaysia, for example, First Solar, Sun-Power, Q-cells, and Tokuyama, have made 11,000 employments. Other than simply including the incomes of a nation, sun-oriented energy has brought down unemployment. Furthermore, Evidence of the resources out there to America shows that there are around thirty to fifty years of oil left, a touch less of gas, around one hundred to a hundred and fifty years of coal and even metal isn't infinite. It additionally tells America that the alternative energy that the plant receives simply throughout one year is considerably quite all famed resources for the remainder of your time, amounting to fourteen,500 times quite the world's energy consumption throughout one year. So, the potential is there, we have a tendency to simply ought to use it (Konrad-Adenauer-Stiftung, 2007) [19].

2.2 Solar Power as Renewable energy in other Countries

Per Geetah Pande (2009) [23], In India renewable energy is delivered by utilizing distinctive sources, for example, sun-based power, biomass and wind control. The aggregate renewable energy created is (9220). As there is plausibility of decreasing customary vitality sources so there is need utilize renewable energy sources, for example, wind and sun based. In India utilization of Solar power is under 1 million tone(mtoe). The sunlight-based Isolation in India is 1700-2500 kwh/kept every year. Sun powered radiation is 4 to 7 kwh/m2/day. The appropriations are given to the organizations which create control from sun-based power. For offering sunlight-based energy items Ministry of Renewable energy is helping a few associations to open sun powered shops. So, that everyone can purchase sun-oriented items. The shops are named as Akshay Urja

Shops. Credits are given to setting up this sort of shops. In India, no net metering is there. VNL is the organization in India which is giving energy to GSM base station from sunlight-based power. The power utilized is 150W.Flat surface authorities are utilized for catching sun-oriented power. VNL is the organization that is utilizing renewable energies for GSM base stations. To begin with choice is sun-based energy and second is wind control. Using renewable energy hotspots for power is temperate. VNL is cantering fundamental around provincial ranges in India (Pande, 2009) [23]. Furthermore, per Amanda Manton's (2015) [22] study, In Germany, a dominant part of all sun-oriented energy is possessed by the mortgage holder, and a few neighbors may share a framework. Power is then less expensive by not buying it from a provider. Sun powered energy might be a superior wellspring of energy for specific ranges of a nation. China and India utilize PV to supply energy to their colossal country populaces because those ranges can't have a matrix framework introduced (Manton, 2015) [22]. This provisions power to more individuals and makes it simpler to make up for lost time with whatever remains of the world's innovative progressions. Malaysia has utilized sun-based energy to give power to remote regions. In the 1990's, the Ministry of Rural Development started offering power to country homes, facilities, group focuses, schools, and islands. As appeared, sun powered energy enhances individuals' lives. Farmers likewise utilize sun-based energy. In Malaysia, they utilize it to dry rural items, bamboo, and elastic. This exhibit sun-based energy can likewise be utilized monetarily. Sun based energy is flexible with respect to the ways it is utilized all inclusive, extending from private to mechanical utilize.

2.3 Rural Electrification and its Importance

Rural electrification implies giving simple access to moderate power in rustic region. Larger piece of populace lives in country zones in creating nations, and provincial charge is the key driver for budgetary change. It returns in 1930s when the across the board of provincial jolt began, generally in the United States and the more monetarily determined European countries. Joined State Agency for International Development (USAID) laid out a model of country jolt in the mid-1970s and the model was imitated in creating countries. Presently a-days provincial power circulation can be expert by either thought supply or decentralized philosophies. The unified approach refers to interfacing towns and remote regions to a national matrix, which is regularly claimed and worked by an open utility (Goldemberg, 2000) [17]. Rural Electrification through centralized approach includes high capital cost. Subsequently, remote, less-thickly populated ranges stayed a long way behind the entrance to normal and continuous power. Interestingly, decentralized methodologies for rural electrification, access to power is not provided by a national grid, but rather produced locally close to the place of utilization (Bureau for Economic Growth, Agriculture and Trade (EGAT), 2004) [7]. Decentralized power supply might be of two sorts: Mini-networks and Stand-alone frameworks. The most widely recognized energy sources for smaller than expected grids are diesel generators, small-scale hydropower, photovoltaic power stations, or diesel-wind cross breed frameworks. Stand–alone frameworks create power ideal beside the place of utilization, and are only utilized for small-scale energy request on family unit or private project focuses. Recent technologies that have been used for

rural electrification are diesel generators, sunlight based photovoltaic (Solar Home System) and little wind generators. A review embraced by the World Bank for 11 nations uncovers that rural electrification comes with extraordinary advantages, for example, enhancements of wellbeing offices, better wellbeing from cleaner environment as families diminish utilization of contaminating fills for cooking, lighting and warming, enhanced information through increment access to TV and better sustenance from enhanced learning and storerooms from cooler (Chu, 2011) [9].

Per Pieters (2015) [6] and his research based in rural electrification in Africa he portraits that there are three types of impact during this regard. They are: educational advantages because of increments in study time, changes in pay considering expanded non-agrarian exercises, and an abatement in respiratory diseases in view of reductions in kerosene usage. Moreover, the research information demonstrates that effect possibilities in Africa are distinctive. Potential outcomes to lessen respiratory infections are slipped by, as it were, because dry-cell battery driven lights have made advances into African family units, even in remote rural regions. This outline can't be seen to a practically identical degree in non-energized Latin America and Asia. Basically, he tries to make us understand that how rural electrification is empowering locales as well as how it is making an influence to the country's economy as well as how it is less polluting the environment.

In other paper, Saeed D. Foroudastan (2006) [15] has said "Ecosystems, developing societies, and the solar energy market will only benefit from an increase solar PV system installation. Funding for these systems, however, is a challenging aspect when there is so much need. Fortunately, as more and more people give donations and volunteer their professional and technical services, solar energy will become cheaper. The initial installation is basically the only cost, so the investment will simply pay for itself for the rest of its life and for the lives shared beneath its comforting glow." His words directly point out at one of my aims of the research of how solar energy sources are empowering economically for the underdeveloped countries but in between two research papers there's a few things that has been oversighted. If we pay a closer attention, we can see that Pieter's has outlined the influence how both economically and environmentally it can be successful but Saeed's paper has focused more on economic effects of it. Furthermore, Saeed has enlightened on one more vital point and that is Crowdfunding. As per as underdeveloped countries are concern here this is a very good idea in case of raising the money to meet the budget since we all know that to develop a project like this can be needing a huge amount of resources and for which it can be assume as a better idea in terms of economy (Foroudastan, 2006) [15].

Apparently, Darci Pausal et al. (2015) [10] expressed it in their examination "concentrate on dissecting fund components that can add to fill this generous hole. It will likewise focus on sunlight based controlled exterminate frameworks that are a standout amongst the most well-known little scale exterminate framework sorts of the district. Truth be told, sun-based energy is an awesome open door for master poor vitality access in immature nations since it is normally

pervasive, available in substantial amounts, continuously minimal effort, non-helpless against supply or cost variance (oppositely to fossil fuel), and good with the worldwide accord to build low-carbon energy generation. This current brief's primary goal was to stock inventive and effective instruments for financing provincial populaces access to feasible energy - particularly photovoltaic frameworks (PV)- and to distinguish basic pointers for assessing their productivity. For this reason, contextual analyses and models of back systems were examined and evaluated by weighting their shortcomings and qualities, and surveying their practicality and versatility inside remote zones in SSA to the three best-fitting account instruments dictated by our measurements examination" (Darci Pauser, 2015) [10].

Moreover, in another study by Saiydul Morsalin (2015) [10] he said that "Under the proposed program, a total of 10,000 solar irrigation pumps will be installed all over the country to replace diesel-based pumps". This is a huge evidence showing that how much environment friendly and less polluted a rural area can become after not being able to release it in the open atmosphere. To support my assumption, I will be referring the paper works of Robert P Chilcott (2006) [8] where he has clearly stated Diesel as a Compendium of Chemical Hazard. Diesel can affect not only the environment but also health. As far as well-being, Irritating to eyes, respiratory framework and skin. Compound pneumonia may emerge taking after goal of spews (optional to ingestion) or inward breath of airborne (or yearning of fluid) amid manual siphoning. Drawn out skin presentation may bring about skin bothering. Conceivable cancer-causing agent. Diesel is considered not to be a human conception or formative harmful insect.

2.4 Solar Panels in Different Weather Condition

Per my country perspective it is viable to rise question that if electricity is ought to produce to be based on solar panels then what will be the effect of it when the weather conditions will be apart from sunny conditions. Bangladesh has a subtropical monsoon atmosphere described by heavy rainfall, high temperatures and moistness. There are three unmistakable seasons in Bangladesh: a hot, damp summer from March to June; a cool, stormy rainstorm season from June to October; and a cool, dry winter from October to March. As a rule, most extreme summer temperatures go near 30°C and 40°C. April is the hottest month in many parts of the nation. January is the coldest month, when the normal temperature for most the nation is around 10°C. Moreover, Bangladesh is a country where heavy rainfall can be said as a characteristic of it. Except for the generally dry western area of Rajshahi, where the yearly rainfall is around 1600 mm, most parts of the nation get no less than 2000 mm of rainfall for each year. Because its area only south of the foothills of the Himalayas, where storm winds turn west and northwest, the areas in northeastern Bangladesh gets the best normal precipitation, now and again more than 4000 mm for every year. Around 80 percent of Bangladesh's rain falls within the monsoon season. So, now our research has a very important turn of tale here. One of the major questions that arises during the research period is that how solar panels will be producing energy in those months of the year? Mostly, my focus will be on cloudy seasons when the sun is most unlikely to come out. Moreover, per fundamental articles, is has been clearly stated the installation for each individual PV system, engineers must

use specific equipment, such as inverters, to ensure that the system runs at maximum efficiency (Samadhiya, 2016) [25]. Distinctive inverters are appraised for various greatest voltages and have higher effectiveness between various voltage ranges. Engineers should painstakingly measure the PV framework in various temperature situations to guarantee that the yield voltage is not very high, which could harm the hardware. Per Abhineet and Ruchi (2016) [27], their study focuses on the comprehension the impact of humidity, it is being considered by the two situations. The primary situation is the impact of water vapor particles on the radiance level of daylight and the second situation is humidity relapse to the sun-oriented cell walled in area (Samadhiya, 2016) [25].

At the point when PV cells are presented to mugginess for long haul there will be some debasement in execution. It has been watched that the high substance of water vapor noticeable all-around causes exemplify purification. As per the outcomes acquired in the review, the higher (outright) values for the effectiveness (or power) temperature coefficient related to the ventilated rooftop incorporated case. In this specific circumstance, our discoveries have plainly demonstrated that the contrast among cell and encompassing temperature diminishes with expanding wind speed, in this way tentatively highlighting the imperative part of receiving cooling measures (e.g. extricating warmth and utilize it for different purposes) in instances of high temperatures and ventilated modules. At long last, with respect to the assurance of the twist's impact on the warm misfortune instruments of PV boards, the outcomes were discovered rather close yet not indistinguishable (particularly for the open region PV ranch) to those current in the writing and utilized by the current PV reproduction/estimating programming.

2.5 Environmental Impacts of Solar Applications

As, I have mentioned earlier that not only we will look over the financial issues only but also, we will look after the environmental impacts of Solar Applications too. So, now this section will help us to understand what are the factors that we need to focus more on while using solar applications as well as how the environment is getting affected by it. Therefore, Sustainable development is that the most regarding issue within the world. world organization et al international organizations are operating to shield the natural setting reducing heating for human well-being and development. SHS improves the surroundings by reducing CO_2 and different Green House Gases (GHG) (GCEP Energy Assessment Analysis, 2006) [16]. The previous studies additionally determine the role of SHS for environmental improvement. SHS turn out electricity mistreatment daylight. As in system, there's no involvement of fossil fuel; mistreatment SHS for lighting cut back the CO_2 and different GHG emission. Battery lifetime of SHS is close to 5 years. Per the journal, Clean Energy Resource Centre it has been said that the lack of scientific management of the SHS battery might contaminate the soil and water. Therefore, in rural areas of Asian nation at the tip of lifetime of the battery, its disposal could be an essential issue (AKTER, 1997) [1]. In present study, these 2 most vital problems relating to disposal of battery in SHS and its impact in surroundings are examined. Moreover, per Factor et. al (2016) [14] waste management process has been driven so that the environment remains clean

and safe in terms of disposing the battery into the environment. In the paper, it has been discussed that Waste management approaches or plans need to consider diverse choices for accumulation frameworks (e.g., get as opposed to acquire frameworks). They likewise need to consider the nature and outline of items to oversee end-of-life and reusing forms satisfactorily (e.g., PV boards are frequently named e-squander). Consequently, squander administration leads additionally to an inspiration to change the outline of items themselves for less demanding waste treatment, for example. There are three fundamental methodologies for waste administration of items like PV boards or batteries:

Voluntary approach from makers that frequently depend on their interior natural administration frameworks to deal with most their organization's ecological obligations, including the finish of-life of their items or administrations. Inside this or different systems, some PV board makers have set up individual willful reclaim or item stewardship modified that permit flawed boards to be returned for reusing on demand. The administration of such customized can be borne specifically by the company (direct administration) or in a roundabout way through a reusing administration (circuitous administration).

Public-private approach is an intentional plan that incorporates both 'acquire' and "pickup" frameworks considering the rule of an open private organization amongst industry and controllers. A case is PV CYCLE. The affiliation was built up by driving PV makers and is completely financed by its part organizations so that end-clients can return part organizations' damaged boards at more than 300 accumulation focuses around Europe (GCEP Energy Assessment Analysis, 2006) [16].

Regulatory approach, in which controllers build up the makers' lawful obligation for item end-of-life, the waste gathering, recuperation and reusing targets, and least treatment necessities to guarantee environment and human wellbeing security (Factor, 2016) [14].

2.5 Contrast in Solar Powered Electricity and Existing Electricity Generation

Apparently, Paul Komor (2009) [18] in his study breaks down the idea that how renewable energy, for example, solar power, offers a few advantages contrasted with fossil-filled power generation (Komor, 2009) [18].

- Zero-Carbon Electricity: Solar, as opposed to fossil energizes, deliver no direct GHG emanations and, along these lines, offer the guarantee of zero-carbon power generation and a huge part in lessening GHG discharges to stay away from environmental change.
- Other Environmental Benefits: Solar evade numerous non-atmospheres related natural effects related with fossil-energized power. They have no immediate air outflows, they don't utilize a lot of water, and they don't require environmentally degrading fuel extraction.

- Fuel Diversification/Energy Security: Renewable power generation makes the power generation framework less dependent on coal and common gas and in this manner less presented to instability in local and worldwide fuel markets.
- Economic Development: Many supporters of renewable energy highlight the potential for occupation creation from putting resources into more renewable power generation. Albeit renewable, except for hydro control, as of now assume a minor part in the U.S. power supply, supporters have since a long time ago contended that the United States can and ought to make a fast move to more prominent utilization of renewable.

Moreover, his report concentrates on wind and sun powered innovations as they have a vast residual asset potential, are financially accessible and in fact demonstrated, and are the concentration of impressive arrangement consideration.

Furthermore, Paul Komor's (2009) [18] study not only ends by focusing on the contrast in between the electricity generation but also depicting the idea that despite having a well-formed environmental advantage what is holding it back from implementing? He explained it by enhancing the points that although it is valuable to first bring up elements that are not obstructions. The United States is not fundamentally compelled by the specialized capability of the renewable assets themselves. By one gauge, for instance, the United States has more than 8,000 gigawatts (GW) of accessible on-shore wind control potential asset, contrasted with a present aggregate U.S. power creating limit of around 1,000 GW (Komor, 2009) [18]. Potential sun-based assets are comparably gigantic. In principle, sun-based boards covering under 10 percent of Colorado, for instance, could give enough power to control the whole United States.

Solar Electricity: Challenges and Opportunities assets into power. Many these innovations are broadly accessible, dependable, and in fact demonstrated; although they are not practical as of now. The boundaries are, somewhat, identified with what can comprehensively be called "execution." Specifically, they include:

- High costs: Solar photovoltaic (PV) and concentrating sun-based power (CSP) creating plants, for instance, deliver power at expenses altogether higher than for power created from wind or fossil-energized control plants.
- Transmission: Transmission lines convey power from power plants to urban areas, industry, and different areas where it is required. As clarified beneath, utility-scale wind and sun-based power plants are frequently found more remotely than fossil-filled plants. Consequently, they require development of new, costly, and dubious transmission lines—and this has demonstrated exceptionally troublesome.
- Variability: The solar is a variable asset, implying that their accessibility as an energy source vacillates because of climate examples, mists, and cycles of day and night. The power yield from power plants reliant on these variable asset's changes in like manner. The interest for power, be that as it may, does not take after a similar example. Because wind power, power era is some of the time most noteworthy around evening time when

power request is least (Komor, 2009) [18]. There are different boundaries too, including siting and allowing challenges for the renewable power plants themselves and for the transmission lines that associate them to the matrix, higher saw specialized hazard, high proportion of cash-flow to working expenses, and arrangement instability. In any case, the three boundaries noted above—higher costs, the requirement for new transmission limit, and fluctuation of yield are at present the most noteworthy and along these lines are the concentration of this report.

The literature review section has been provided with knowledge of the other researchers of how they conducted their reports as well as how they manage to implement the ideas of how to use renewable energies. Furthermore, this section will help to get the ideas of the other researchers on the same topic of my research as well as will help to share my assumption based on other's ideas. Though I have related the aims and objectives with each of the researcher's knowledge and connect them still there's some key issues that has risen which helped me to redefine the research questions by adding more targets in my aims.

2.6 Key Issues

Some of the key issues are:

1. Will it be suitable to choose Solar energy system for rural development?
2. Can SHS (Solar Home System) be a rejuvenation in rural areas in terms of energy generation?
3. By how much the economic stability can be earned? Will it be enough?
4. Can waste management be implemented successfully if necessary, steps are taken?

2.7 Refined Research Questions

1. Will solar panels produce energy various weather conditions?
2. What can be the technological attitude of SHS?
3. How Solar electricity plays a modest role in supporting economically productive and education-related activities?
4. What can be the household attitude towards SHS electricity and technology for socioeconomic development?
5. Distribution of the use of solar electricity consuming activities in households?
6. How Kerosene (Traditional application in rural areas for lightning), Diesels and other harmful expenditure can be replaced by SHS?

CHAPTER 3:

RESEARCH METHODOLOGY

3.1 Introduction

This study is designed to explore the economic and environmental impacts of Solar applications such as; Solar Home Systems (SHS) in remote rural areas of Bangladesh. The examination depends on essential information. Auxiliary sources are likewise utilized. Because of innovation based research it's a blend of subjective and quantitative methodological methodologies are connected. General data in regards to the SHS 's effect on financial and condition of sun powered power are gathered from auxiliary source and meetings with nearby specialists. Essential information of the examination is gathered through a broad family unit study technique utilizing poll. Optional sources are likewise used to help the review information. Survey is planned as present and before SHS establishment to gauge job of SHS in monetary and natural improvement of rustic zone.

3.2 Research Strategy

Every sort of research outline that you can use to manage your exposition has one of a kind moral difficulty. These sorts of research configuration incorporate quantitative research plans, subjective research outlines and blended strategies investigate plans. The effect of each of these sorts of research configuration on research morals is talked about (Kothari, Methods and Techniques) [20].

3.3 Data Generation Methods

To reveal quantitative as well as qualitative information from users of SHS, empirical household level data are collected through a household survey conducted in three villages. By and large, 90 meets in rural family units have been led by composed survey. The survey is planned considering chose factors of the review. Survey is the chief apparatus for information accumulation (Annexure-1). The survey is portrayed by the blend of shut and open inquiries, permitting the gathering of quantitative and data on previously, then after the fact utilizing SHS in the family.

3.4 Data Analysis

To start with, the examination territory is chosen. It is situated at Goffergoaw upazilla in Mymensingh area, around 120 km north of Dhaka city and 40 km from Mymensingh. With the assistance of neighborhood organization and NGOs staff drew in for Solar Home System scattering (BRAC and Grameen Shakti) three towns are distinguished for the overview, to be specific Tangab (town A), Charkamaria (town B) and Sadua (town c). Add up to 90 Showed family information are gathered from the towns. Families are chosen arbitrarily as there are numerous SHS-possessed family units in every one of the towns. For auxiliary wellsprings of information diary, reports, working paper and records with respect to sun-based energy in

Bangladesh have been counseled. In addition, individual encounters and casual meeting technique are additionally used to have some more data about the issue. creator conducts Data accumulation. Because of broad poll, the normal term of meetings was around 15 minutes and it is found talked with family unit individuals indicated distinct fascination in the review exercises. As provincial individuals are absence of information in English, the inquiries have been converted into Bengali for well understanding. Following information accumulation, the information that has been gathered through studies are placed down into table and has been dissected by MS Excel and some of them through Watson Analytics. For money related investigation, family units are relegated into three pay bunches each generally speaking to 33% of the aggregate number of families: low-pay (underneath 6500 BDT/month), center salary (6500-14000 BDT/month) and high-pay (over 14000 BDT/month) families.

3.5 Sampling

Demographic information: This part is intended to gathered information on family unit head and life partner age, sex, conjugal status, training level including kids and their instructive status.

Economic information: Major data is gathered in this part. It is intended to gather information on financial circumstance, wellsprings of vitality for lighting and consumptions, gainful exercises in the family unit, enterprise, business, working hour, frame of mind and adjustment of SHS innovation, natural and social methodologies of SHS. As no gauge information is accessible, survey is planned asking for respondent to give all data to the current circumstance and also before utilizing of SHS. Information are gathered in three towns where SHS spread happened in the meantime. To distinguish SHS-towns for the family unit review the accompanying standard are additionally connected:

1. Medium size of town (around 400-500 family units)
2. Continuous SHS spread for around five years,
3. Power from the national network isn't accessible,
4. Salary dimension of family units is about normal (not particularly poor or rich).

3.6 Ethics

The potential ethical/moral issues raised by various research strategies not just differs starting with one kind of research technique then onto the next (e.g., overviews versus inside and out meetings), additionally the path in which an examination strategy is utilized (e.g., plain versus secretive perception). To outline a portion of the diverse moral issues you will confront crosswise over research techniques, we talk about overviews and organized meetings, perception and casual and inside and out meetings. Each of these exploration techniques is talked about thus:

3.7 Surveys and Structured Overviews

If we say, surveys and structured interviews must be composed before the examination procedure begins. Truth be told, since these two sorts of research technique normally utilize shut inquiries

where respondents must look over pre-defined alternatives, a large portion of the potential responses to inquiries are known ahead of time (Kothari, Methods and Techniques) [20]. Moreover, from ethical point of view, this makes it less demanding to get educated assent from respondents because most parts of the review and organized meeting procedure are genuinely sure. Before you begin the overview or organized meeting process, you can unmistakably clarify what you will ask potential respondents, and even demonstrate to them the whole research instrument (i.e., review and inquiries and alternatives) before they begin. This can help you accomplish educated assent, as well as facilitate the brain of the examination member, limiting the potential for pain, which is a vital fundamental standard of research morals. In my following research, I have used the survey as a method to collect my data. However, the following topics that I have used in my survey to collect data which has been directly connected with my aims and objectives (Department of health and science services, 2008) [11].

3.8 Observations

Observation is method for social occasion information by watching conduct, occasions, or taking note of physical qualities in their common setting. Observations can be overt (everybody knows they are being watched) or covert (nobody knows they are being watched and the onlooker is disguised). The advantage of covert observation is that individuals will probably carry on the off chance that they don't know they are being watched. In any case, you will commonly need to direct plain perceptions because of moral issues identified with hiding your perception. Perceptions can likewise be either immediate or backhanded. Overt observation is the point at which you watch associations, procedures, or practices as they happen; for instance, watching an instructor educating a lesson from a composed educational module to figure out if they are conveying it with devotion. Covert observations are the point at which you watch the consequences of connections, procedures, or practices; for instance, measuring the sum plate squander left by understudies in a school cafeteria to figure out if another sustenance is worthy to them (Department of health and science services, 2008) [11]. For, comparing the CO_2 emission and to compare the cost of Coal power plants and Solar I have used observations.

3.9 Limitations

Amid field work a few impediments are experienced. These are:

Non-availability of Documents: One test is the trouble in social event recorded data from authorities. Sometimes, archives may not be found promptly accessible and thought about classified.

Limited time: Time is another imperative in the field work. The time given for the information accumulation is excessively short. Subjective investigation requires more opportunity to examinations information while gathering data. At similar occasions, it might likewise require additional opportunity to rebuild its structure in the light of new advancements and bits of knowledge.

3.10 Conclusions

This chapter will depict the ideas of how the processes has been carried out to draw my results. Nonetheless, apart from conveying data I have also tried to maintained the ethics during the data collection process and data analysis. For more, for sampling I have used surveys and observations in terms of generating or gathering the information. I have used the questionnaire which has been attached to (Appendix-1) to generate information from the local people. On that issue, I had to kept in mind about the ethics and make sure that the data has not been tampered which might hamper my results (Kothari, Methods and Techniques) [20]. Difficulties faced in a manner that when people were not really wanted to get involved in a survey and had to make them believe that this will not hamper them in any cost instead the result might bring a new era of development in their living.

CHAPTER 4:

FINDINGS AND ANALYSIS

4.1 Introduction

Foundation, idea, approach and current circumstance of sun-based charge dispersal for acquiring financial improvement provincial territories have been examined. It is seen from the past exchange that energy assumes the key part for advancement. Because of ascent of fuel cost and expanding carbon emanation around the world, there is a worldwide move towards renewable energy like sun powered, wind and so on. Being in tropical district, Bangladesh is a sunlight-based energy rich nation. Sunlight based energy can play an essential and secure energy hotspot for reasonable improvement. The primary goal of this review is to evaluate the effects of sunlight-based energy on financial advancement in rustic regions of Bangladesh. To check the goal experimentally, a cross-area of 90 randomly chose family units in three towns have been studied with an organized poll. The overview results are breaking down as follows in the accompanying areas.

4.2 Analysis

4.2.1 Sample Village Overview

As specify in strategy the study is directed in three towns. Town Tangaba (Village An) is the greatest of the reviewed towns with an expected 1,596 families. Normal family unit size is roughly 5 people for every family unit and the surmised populace of the town is around 7,510. The families are reduced and arranged in open zone secured by rice and vegetable fields. An elementary school and nearby market are accessible. The following electric matrix line is around 10km far from the town. SHS scattering was begun around six years back. Scorch Kamaria (Village B) is somewhat littler with around 3,416 tenants. The town constitutes around 683 families and normal family size is roughly 5 people for every family unit. Family units are scattered. There is likewise a school and nearby market. The lattice line is around 15 km far from the town. Over half of households are furnished with SHS and its dispersal was begun over five years prior. Sadhua (Village C) is littler than the two different towns and constitutes roughly 458 family units with around 2,252 occupants. This town is more minimized than other two towns. Rice creation and fish development are predominant around the town. A grade school and town market are additionally accessible in the town. SHS scattering was begun in the town around six years' prior (Bangladesh Bureau of Statistics, 2010) [5].

4.2.2 Demographic analysis of households

An aggregate of 90 respondents are met for essential information gathering in the study. Amid the overview men like to take an interest in meeting than ladies. In any case, ladies likewise demonstrate their unmistakable fascination in noting the inquiries. In this way, 67% male family individuals and 33% female family unit individuals are met in the review

Figure 4.1: Gender OF Respondents

Figure-4.1 delineates the recurrence of sex dispersion of test where 60 respondents are male and 30 are females. Some of the time other family individuals or neighbors have likewise partaken and indicated unmistakable fascination in the overview. Respondent's age is shifted from 20 to 60. The histogram in Figure-4.2 represents the rate dissemination of respondent age gathering. It demonstrates that respondents of 34-40 age gathering (24.4%) take an interest more than the others age gathering. Furthermore, young people of age group around 20-28 (23.3%) has been the second most eager one to participate in the survey and helped us to extend our knowledge about the subject by providing their most valuable information.

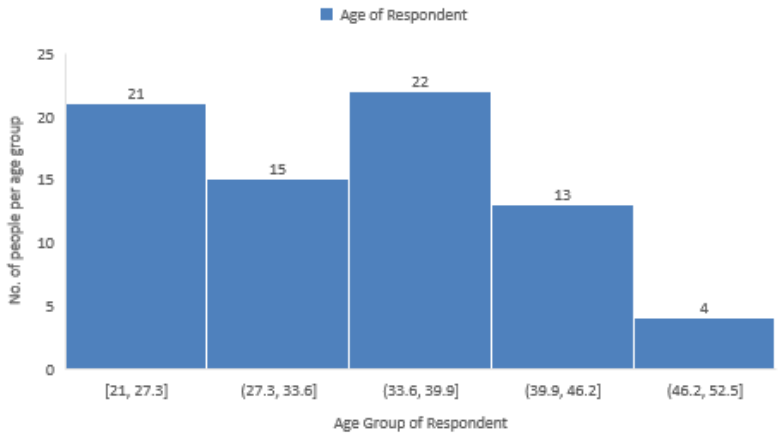

Figure 4.2: Respondent's Age Group

In the investigation, it is discovered that spouse of the families is on a normal ten years more seasoned than their wives which shows the conventional marriage age differentials in Bangladesh. The dimension of training among the family unit male and female is particularly striking. Figure-4.3 outlines the instructive status of male and female in the family unit. It speaks to that instructive status of 59.4% (n=60) male and 70.5% (n=64) female are beneath S.S.C level while 22.6% (n=15) male and 10.1% (n=10) female are S.S.C passed. Male and female instruction status are close same at H.S.C level yet female is not very many at graduates' level.

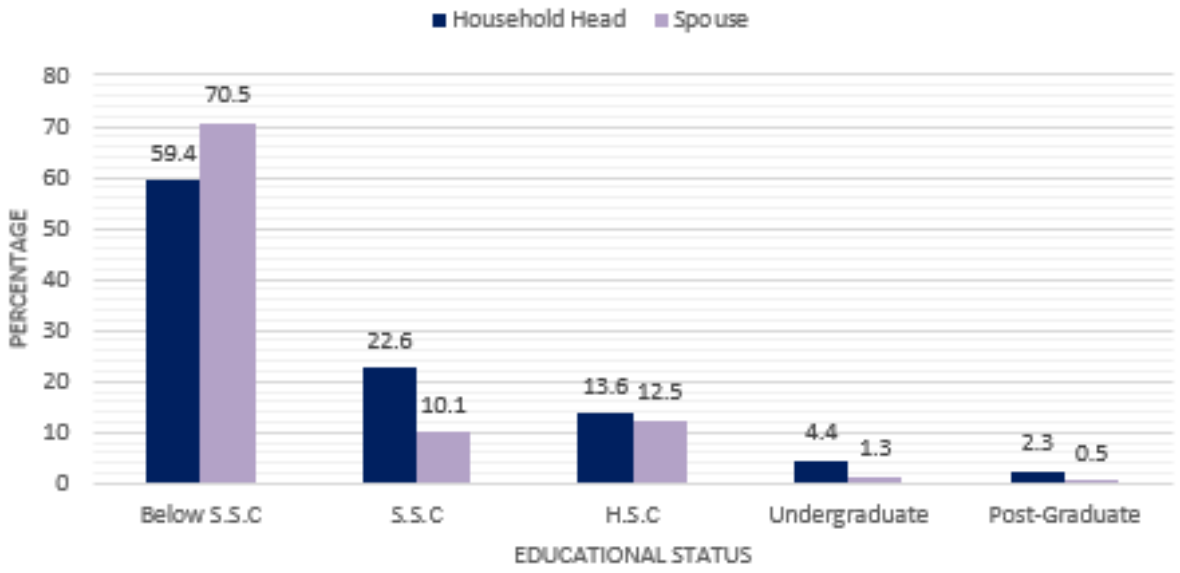

Figure 4.3: Educational Status of Householders

Normal year of tutoring for the family unit head and companion is 6.74 years. Normal year of tutoring for male is 7.41 years while it is 6.08 years for female of the family unit (Bangladesh Bureau of Statistics (BBS), 2011) [4].

4.2.2.1 Household income and economic condition

Family unit pay of the review towns essentially originates from agribusiness, horticulture related work and private ventures. Harvest development, domesticated animals, poultry and fish cultivating are principle agrarian exercises. The major farming harvests are rice and vegetables. After horticulture, remote settlement (for the most part from Middle-East and Malaysia) is the principle wellspring of salary in numerous family units of the towns. Other common monetary exercises are exchanging agrarian merchandise, independent venture in town market and administrations like horticulture work, rickshaw or van puller and laborers of government and private association at town level. Grown-up guys of the families are the fundamental acquiring people. Ladies are occupied with family related work. In few cases ladies are occupied with workmanship generation or administrations. Be that as it may, the greater part of the low-pay family guys are day worker. In review, evaluated present normal month to month add up to salary of the family units is 9333 BDT and before introducing SHS it was around 7866 BDT which is almost same as the normal family unit pay 9648 BDT for the entire of provincial (Bangladesh Bureau of Statistics, 2010) [5]. From normal salary, it is discovered that the towns are neither well off nor extraordinary poor. The accompanying Table-1 speaks to the family month to month add up to pay in the towns when establishment of SHS.

Table 4.1: Household monthly total income in the villages before and after installation of SHS

Present household total income		Household total income before installing SHS	
Household total Income (BDT/month)	Percent	Household total Income (BDT/month)	Percent
4000- 6000	11.1	4000-6000	14.4
6001-8000	16.7	6000-8000	27.8
8001-10000	30.0	8001-10000	33.3
10001-12000	31.1	10001-12000	21.1
12001-14000	8.9	12001-14000	3.3
Above 14000	2.2	Above 14000	-

Salary of the family units is scattering from 4000 BDT to over 14000 BDT. Almost 11.1% family unit pay is underneath 6000 BDT and about 2.2% family unit pay is over 14000 BDT. For better understanding the dispersion of salary has been assembled as lower pay gathering (beneath 8000 BDT), center pay gathering (8000-12000 BDT) and higher pay gathering (over 12000 BDT). The accompanying Table-4.2 and Figure-4.4 speak to circulation of family pay bunch when introducing SHS.

Table 4.2: Distribution of household income group before and after installing SHS

Present household income		Household income before installing SHS	
Household income group (BDT/month)	Percent	Household income group (BDT/month)	Percent
Below 8000	27.8	Below 8000	42.2
8001-12000	61.1	8001-12000	54.5
Above 12000	11.1	Above 12000	3.3

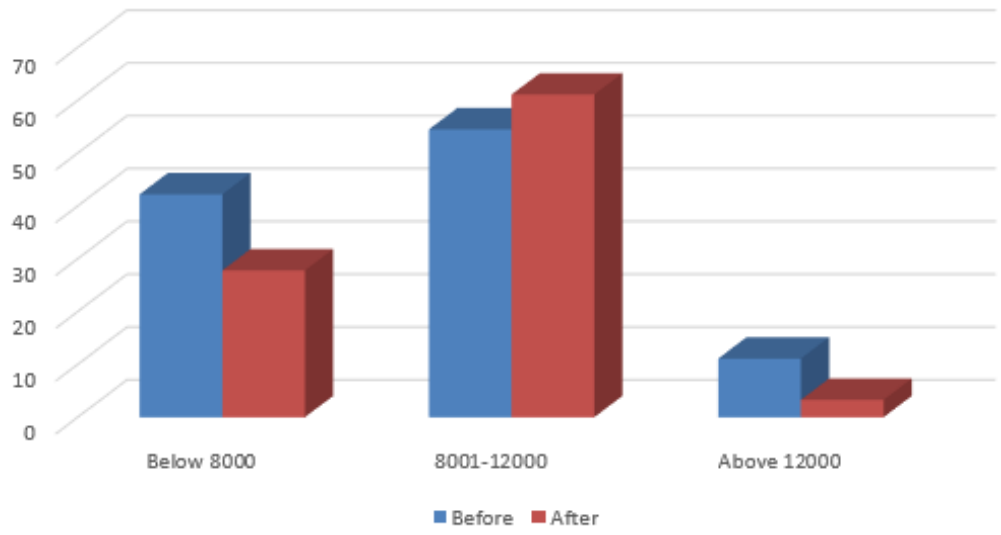

Figure 4.4: Distribution of household income group before and after installing SHS

4.2.2.2 Household solar electricity consuming activities

All families utilize sun-based cylinder lights for brightening of their homes and cell phone chargers to charge cell phones. Almost 60% family units use SHS for perusing reason. Over 44% family units utilize sun-oriented power for sitting in front of the TV and about 12% of families utilize sun-based power for listening radio. Concentrate likewise uncovers that 13.3% families utilize sunlight-based power for running sun-oriented fans and just a single individual uses sun-based power for running a workstation. Utilizing sun-oriented fan is exceptionally constrained because of high utilization of power. In addition, families can't utilize cooler for low normal limit of SHS. Table-4.3 demonstrate the dispersion of the utilization of sun-oriented power devouring exercises in families.

Generally, lamp fuel was the most essential uses of vitality for lighting in provincial families of Bangladesh. Because of increment reasonableness to purchase SHS uses of sun powered power for diversion and access to data through radio, TV and cell phone, use fan in sweltering summer, charging battery of cell phones and PC have risen in the provincial families.

Table 4.3: Distribution of the use of solar electricity consuming activities in households

Activities	Percent	Cumulative Percent
Charging of mobile phone	30.0	30.0
Watching TV and Charging mobile phone	10.0	40.0
Watching TV, reading under light and charging mobile	21.1	61.1

Watching TV, listening radio, reading under light, use solar fan and charging mobile	12.2	73.3
Watching TV, reading under light, charging mobile phone, Use solar fan and laptop	1.1	74.4
Reading under light and Charging mobile phone	25.6	100.0

Generally, lamp fuel was the most critical utilizations of vitality for lighting in provincial families of Bangladesh. Because of increment moderateness to purchase SHS utilizations of sun-based power for amusement and access to data through radio, TV and cell phone, use fan in sweltering summer, charging battery of cell phones and PC have risen in the country family units.

4.2.2.3 Household attitude towards SHS electricity and technology for economic development

Each family's wants power as it encourages quality life in rustic territory. Because of inaccessible lattice line power, SHS clients are happy with the framework. About 80% family part communicates their fulfillment and 20% family unit part communicates their disappointment with the present framework. Table-4.4 and Figure-4.5 represents the overview result.

Table 4.4: Percentage of Household Member's Attitude

Attitude of households	Percent
Highly dissatisfied	8.9
Dissatisfied	11.1
Satisfied	16.7
Moderately satisfied	26.7
highly satisfied	36.7

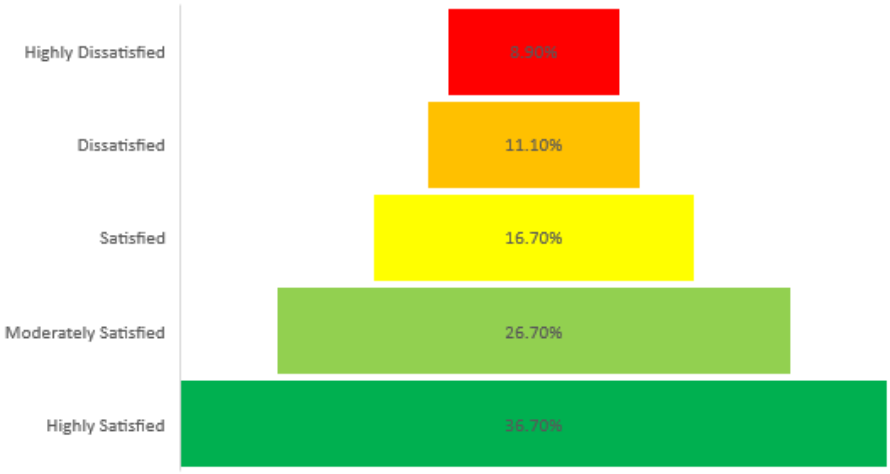

Figure 4.5: Percentage of Household Member's Attitude

Disappointments are for deficient administration from particular NGO, low intensity of SHS and low limit amid overcast day. Be that as it may, the best side of SHS power use is self-proprietorship and continuous supply of intensity. Additionally, families incline toward SHS for its dependable and ceaseless electric supply as opposed to lattice related issues like power cuts and load shedding rehearses. Safe innovation is another factor for loving SHS in family units. Numerous investigations additionally notice these variables are critical for family unit frame of mind towards sun-based power. To discover mentality towards sun powered innovation families are asked as "Are TV, Radio and cell phone valuable for financial improvement". Table-4.5 and Figure-4.6 demonstrates the suppositions of the family units.

1.2.2.4 Technological attitude of SHS

Table 4.5: Technological Attitude of households

Technological attitude of SHS households	TV	Radio	Mobile
	Percent	Percent	Percent
Disagree	21.1	26.7	00.00
Neutral	14.4	20.0	00.00
Agree	47.8	46.7	35.6
Strongly agree	16.7	6.7	64.4

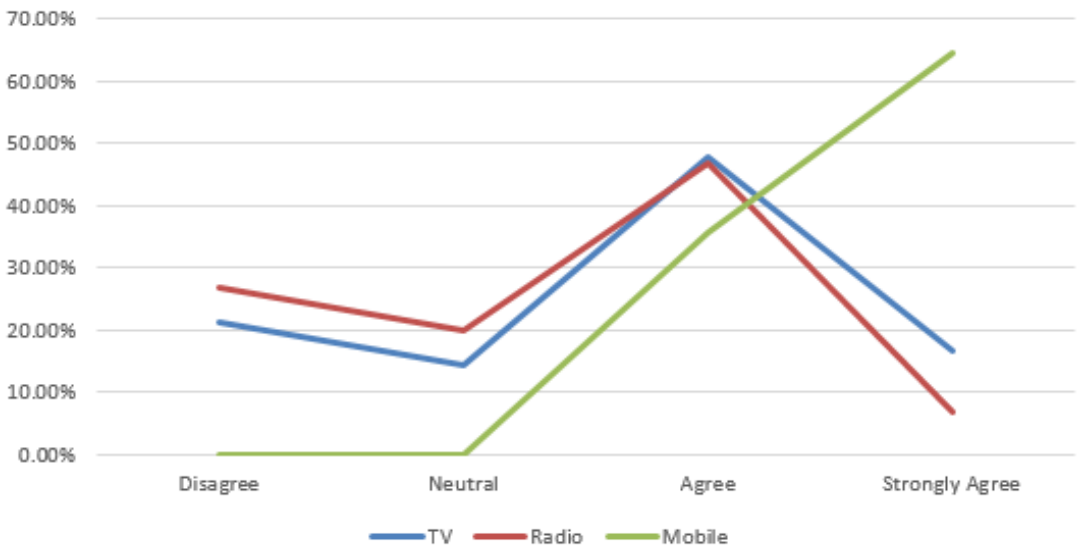

Figure 4.6: Technological Attitude of households

All the family's express that cell phone is most useful for financial advancement. Almost 64.5% family units concur that TV is valuable for advancement, 14.4% families are impartial and 21.1% families can't help contradicting the sentiment. If there should be an occurrence of Radio, 53.4% families concur, 20.0% family units are unbiased, and 26.7% differ that radio is valuable for financial advancement in country regions.

4.3 Education

Electric lighting in families for the most part enhances family unit condition for instruction. Numerous SHS specialists called attention to the likelihood of school going youngsters to ponder under electric lights at night to be an essential issue. Carbon less clear light urges kids to take part in all the more contemplating. Numerous investigations in this line moved toward becoming agreement in this issue. Table-4.6 and Figure-4.7 gives the consequence of the examination which uncovers a higher accord with this issue and communicates an expansion nature of perusing and considering.

Table 4.6: SHS increases quality of reading and studying

Does SHS make easy and extended time for reading?	Percent
Disagree	2.2
Neutral	25.6
Agree	50.0
Strongly agree	22.2

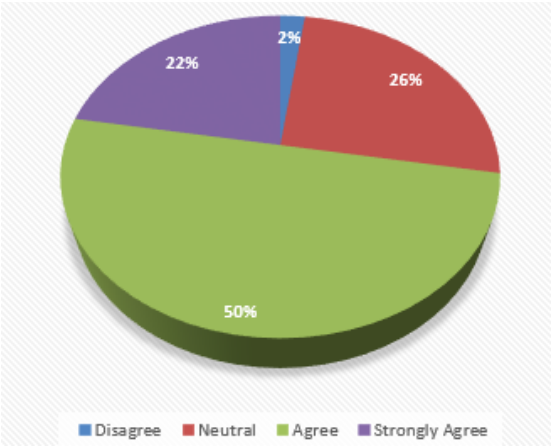

Figure 4.7: SHS increases quality of reading and studying

About 72.2% family units concur that SHS sets aside a few minutes for perusing. Perusing under lamp oil light makes stressing on the eyes. Be that as it may, sun-based power enhances the family unit condition in remote provincial zone for quality training. The review affirms that carbon less clear light inspires provincial kids to connect additional time in perusing and examining. Kids in SHS family units get the advantage of enhanced light and expanded time for perusing and examining, which hauling the under favored kids in power less zone to the standard of improvement and disturbing to reach in reasonable advancement.

4.4 Health and Environment

Like instructive effects sunlight-based power additionally enhanced family condition for quality wellbeing. Wellbeing related issues can be considered from the family unit perspective and from the provincial wellbeing foundations. In family level, SHS continue new indoor air because of absence of carbon and smoke free light. In the meantime, wellbeing, related mindfulness program shape TV and radio has an effect in family level. Country Health Centers (RHCs) in Bangladesh are not compelling because of absence of power. Sun based power in RHC encourages to utilize refrigeration and other restorative hardware. Past investigations referenced the advantages of sun-based power in rustic wellbeing place for utilizing antibody refrigeration, nebulizers, rotators machine, sterilizer, water treatment gear, crisis care around evening time and media transmission. An investigation directed by H U Chowdhury found that 'sun-based power made individuals consciousness of medicinal services and family arranging through EPI customized. Giving power at network facility enhanced the entrance to nature of human services, access to drugs, nearness of doctor(s)/wellbeing worker(s), and security in and outside the home (H U Chowdhury, 2006) [15]. A few specialists likewise contended for SHS impacts on wellbeing at family unit level for smoke less lighting empowering enhanced treatment of patients around evening time and break from lamp fuel related mishaps. Respondents in the present study additionally express that SHS enhances the indoor air quality. They bring up that lamp fuel lights

make smoke, which increment the episode of respiratory and eye sicknesses. Table-4.7 and Figure-4.8 speaks to respondent concession to SHS diminishes rate of sicknesses.

Table 4.7: Respondent agreement on SHS decreases incidence of diseases

Does SHS decrease the incidence of diseases?	Percent
Neutral	10.0
Agree	52.2
Strongly agree	37.8

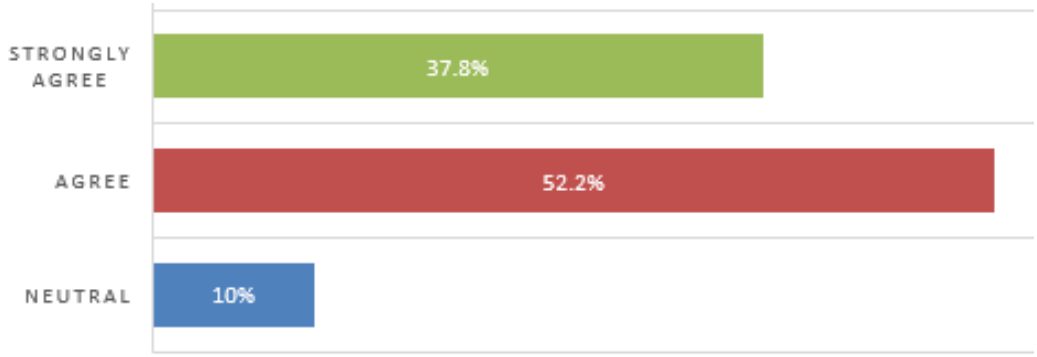

Figure 4.8: Respondent agreement on SHS decreases incidence of diseases

In the study 90% family units express that SHS decline the rate of ailments. Individuals from the review family units additionally express that wellbeing related program on TV and radio increment their insight base on wellbeing and sanitation. Also, portable messages on inoculation program causes them to make fundamental move on due time. New indoor air, normal wellbeing related mindfulness program in TV and Radio, wellbeing concern portable message and lessen mishap from lamp fuel lights are essential elements which enhance wellbeing and sanitation of SHS-family unit's part on a long-haul premise. Table-4.8 and Figure-4.9 will edify the reality about enhancing condition through SHS.

Table 4.8: Environmental Improvement after installing SHS

Does Installation of SHS improve environment?	Percent
Neutral	25.6
Agree	56.6

Strongly agree	17.8
Total	100.0

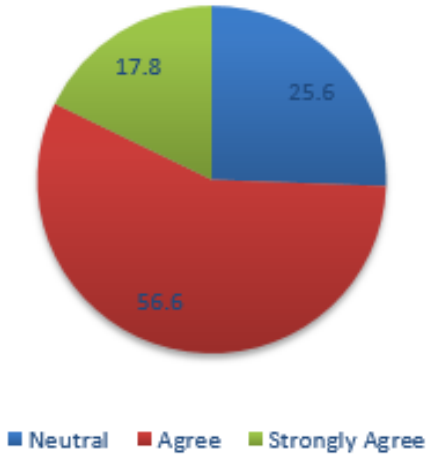

Figure 4.9: Environmental Improvement after installing SHS

4.5 Electricity generation from a coal plant and a solar plant

Fundamentally, sunlight-based power depends on upon sunshine. In addition, in light of the fact that the proportion of sunshine falling on it amid a period isn't predictable, the yield of the daylight-based plant moreover moves. All things considered, a sun powered based plant which has a power yield of 1 kW gives 5 units of electrical vitality in multi day (24 hours) which can be utilized by machines. (In the event that it's not all that much inconvenience observe this is an inaccurate figure, the total usable vitality may move subject to different parts) (Tiwari, 2016) [27]. On the other hand, 1 kW control which is conveyed from coal (in power plants), gives 24 units (1 kW * 24 hours = 24 kWh) in the midst of multi day. After the above fundamental estimation, we see that the number of usable units gave by a 1 kW coal control plant in multi day = 24 unit and the number of usable units gave by a 1 kW sun-controlled plant in multi day = 5 unit. In the event that there is a need of 50000 units at a place, the required furthest reaches of sun-situated plant should be = 50000/5 = 10000 kW = 10 MW however the required furthest reaches of a coal control plant would be = 50000/24 = 2083.3 kW = 2.1 MW (approx.) It infers that the required furthest reaches of a coal control plant to make a given proportion of electrical imperativeness will around be one-fifth of the required furthest reaches of a sun-arranged plant to convey a comparative proportion of electrical energy.

4.6 Comparison of specific CO_2 emissions

For an overall comparison of particular CO_2 outflows (i.e. kg CO_2/kWh) a full "Life-Cycle Balance", including site erection and fuel supply, is vital. The diagram underneath demonstrates

that the emanations can't be dismissed for sun-oriented power; then again, atomic power is exceptionally aggressive in this sense. At last, carbon dioxide outflows are by all account not the only standard for environmental change issues. Some other nursery gasses like methane have higher Global Warming Potential (GWP) than CO_2 (Eambiente, 2014) [12]. Along these lines, gas pipeline spillages for instance could considerably affect the Life-Cycle Balance of gas-based power supply, yet they are hard to evaluate (2% to 8%). Figure-4.10 shows the comparison of specific CO_2 emissions in between Hard Coal plant and Solar power plant.

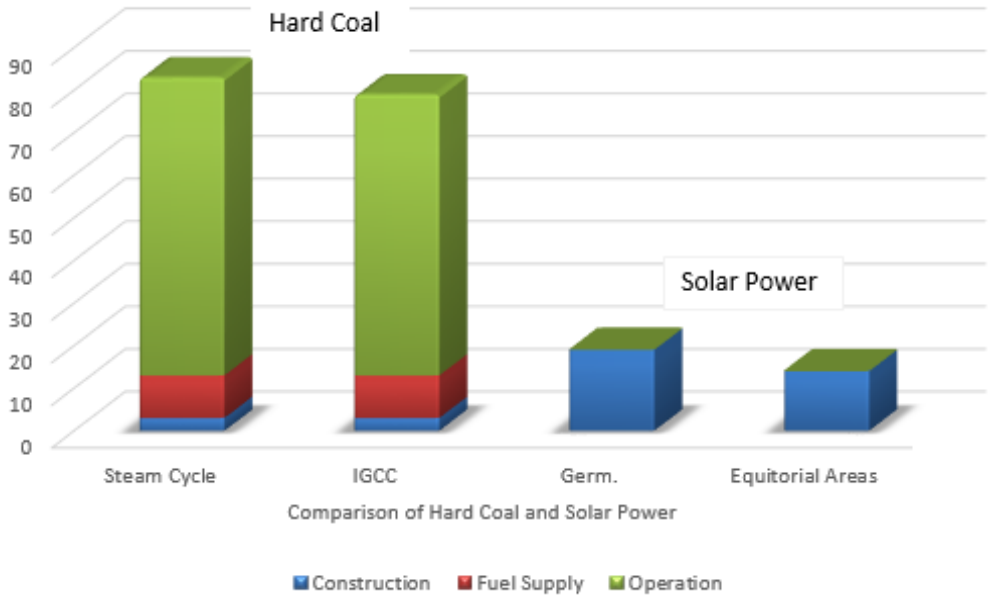

Figure 4.10: Comparison of CO_2 emissions between Hard coal and Solar power (Union of the Electricity Industry - EURELECTRIC, 2003) [28]

4.7 Conclusions

My result shows that how economically and environmentally rural areas can be developed. Per my results, it is now clear that if we can power the rural areas with solar energies our profit will be beyond expectation which is in means of Education, Agricultural development, Entrepreneurship as well as by sustaining the environment by reducing GHG and CO_2 which is a major threat to mankind. Although, I am not saying that we should be totally dependent on Solar energies but in rural areas we can provide. The reason behind not completely dismissing the coal powered electricity in spite having that much of a result is that as an underdeveloped country we are not that much sustain economically and Solar plant causes a huge amount of currency to implement. Apart from that, we can totally flexible in switching the electricity production method. Nonetheless, my justification will always be with my findings and that is if we can implement SHS in each rural area we will not only gain our economic stability but also environmentally it will be a good initiative to put a halt on the Global warming.

CHAPTER 5:

DISCUSSIONS

5.1 Introduction

In this section, I will be discussing about the results that has been our findings in the previous chapter. Although we have analyzed it and found out some results now it's time to discuss those result that how they are definitive with my research. Per the results, it seems to me that Solar Home System (SHS) is a very good idea and truth to be implemented more rather than other technologies. As, we know how much important for the people who are living in the rural areas to get electricity. On the other hand, it will be wrong if I say that they didn't get the electricity (F.D.J. Neotenous, 2000) [17]. They did got electricity but the problem arises when it's in terms of maintaining. Lack of maintenance have been the main issues here and by means of an underdeveloped country's perspective it is unrealistic to think that people tend to care more. Moreover, not only that due of having less educational attempt people in rural areas are afraid to changes and thus they are always being away from the light and thus maintaining something is becoming much more complicated day-by-day for them. In this regard, if SHS can be driven in rural areas people will get

5.2 Statement of the Problem

Power system of Bangladesh depends on fossil fuels both in private sector and state-owned power plants. Around 89% of produced power originates from carbon discharging regular gas, fluid fuel, coal and hydropower. The supply of regular gas is not adequate to take care of the demand. Current gas creation limit in Bangladesh can't bolster residential needs and in addition more extensive power era for the nation. The current hold of oil and gas will be depleted soon. In the meantime, worldwide there is an interest for spotless and feasible energy. The requirement for creating renewable wellsprings of energy like solar powered, wind, bio-mass, and so on has a more noteworthy feeling of direness. As a tropical nation, Bangladesh is invested with solar powered energy. In this unique situation, solar powered energy is a solid, reasonable and secure energy for the nation. In any case, the present share of renewable energy for power creation is just 0.5% of the aggregate. Significant individuals of Bangladesh live in country ranges. There is solid interest for power accessibility in remote towns. Bangladesh has inserted with a lot of solar based energy. We can possibly be a solar based power rich nation. Institutional, money related and innovative abilities go about as vital components for achieving a craved level of solar based power creation and usages. Nevertheless, we have nonappearance of information and joined research in this field.

Solar energy based provincial charge began in the country in 1988 at Norshingdi. Bangladesh Power Development Board (BPDB), Rural Electrification Board (REB), Local Government Engineering Directorate (LGED), Infrastructure Development Company Limited (IDCOL) and a

critical number of private area offices including Non-Government Organizations (NGO). Solar powered electrification is progressively being utilized as a part of an extensive variety of off-framework applications. Since the presentation of SHS, Bangladesh has introduced more than 2.2 million units. In this view the financial effect of SHS would be an outline for planning provincial improvement elective energy show in the nation. The present review is expected to distinguish the variables connected with the usage of solar based energy and its applications as well as how far it has been prevailing with regards to diminishing destitution in rural region of the nation.

5.3 Household income and productive use of SHS

The correlation of household income with rural electrification is a debating issue. Previous study mentioned as "Providing electricity for meeting lighting needs of households and rural markets can yield positive results, including improvements in quality of life and increasing income and employment opportunities". Sun oriented PV innovation program in remote, rustic and off matrix towns has a colossal effect particularly on ladies and youngsters. Ladies can appreciate bother free helping and procure additional cash by sewing or poultry cultivating using their all-inclusive night time. Ladies can include in fix, support and offer of sun-oriented adornments. It makes not too bad occupations for ladies right in their towns. Past examinations underlined on SHS impacts on country business. They often referenced that SHS increment working hour, pull in client for enhanced light, enhanced efficiency for outside air and clear light. The investigation additionally referenced the capability of SHS in salary creating exercises for clear and crisp light during the evening like rice husking, poultry cultivate, sunlight-based siphon for water system or bungalow businesses (sewing, craftsmanship generation). The exploration recognized that enlightenment of poultry ranches expanded profitability: at night, chicken diminished sustenance consumption and the measure of laid eggs whenever kept in haziness. In addition, the examination likewise referenced broadened time in night expanded salary in private venture and shops at town showcase. Be that as it may, there is exceptionally restricted subjective information on the effect of SHS particularly on family unit salary and efficiency. To discover effects of SHS on family unit salary age exercises survey is intended to state on production– related data when establishment of SHS. The table 5.1 underneath delineates the data of family pay age when SHS establishment.

Table 5.1: Most beneficiary of SHS

Who is the most beneficiary of SHS?	Percent
Women	20.0
Children	23.3
Women & children	32.3

Men, women & children	24.4

5.4 Solar Applications promotes education

Education plays a basic part for destruction of poverty. Any effort that adds to propel guidance is welcome all around. Sun situated lighting gives higher quality edification than light oil lights, increased audit time and moreover better comfort and security. In sun oriented light youngsters appreciate better offices for instruction. It can enhance instructive chances and give diversion. It is accounted for that sunlight-based power lighting in remote nation school's licenses children to grow their surveys during the evening. For a few children, especially young women in rural domains the nonappearance of intensity changes over into a botched opportunity to go to class since they are over-load with humble endeavors, for instance, bringing water and fuel in the midst of daylight hours. Besides, sunlight-based PV lighting empowers access to radio, TV, and web, which increment instruction openings and permits separate learning. Kids in power fewer common regions put basic piece of their energy in nuclear family's activities in the midst of day time. They don't have light to learn around night time. A few hours of capacity to get the hang of amid the night understudies can realize noteworthy redesigns in their execution. On the off chance that country jolt approaches, software engineers and plans incorporate SHS as an elective hotspot for the supply of power administrations for remote provincial networks, kids will gain admittance to lighting at night to broaden their investigations.

5.5 Solar Applications facilitates health benefits

General wellbeing is a basic segment in off-framework networks. Sun powered vitality can essentially influence occupations in rural reaches. The replacing of light oil lights with SHS decreases indoor air defilement, which impacts the prosperity and success of nation families. World Bank has classed indoor air defilement in making countries among the four most fundamental worldwide biological issues. Indoor air smoke adds to respiratory contaminations that represent up to 20 percent of the 11 million passing of kids every year. Sun oriented energies improve prosperity by decreasing extreme respiratory infection and conjunctivitis, routinely expedited by indoor defilement (Chilcott, 2006) [8]. However, there is nonattendance of quantitative data on the conceivable degree of diminishing of indoor air smoke from light oil light by using daylight-based light. Sun powered electric water siphons can give clean water, diminishing the effort necessity for social affair. Sun based power can make possible the refrigeration of antibodies and activity of restorative rigging in rural prosperity offices. A strong life is a key marker in the limit approach to manage poverty. Women in labor require clean light to have safe child movement at whatever point. In a country center where there is no power, ladies convey under truly awkward conditions because of the absence of fundamental hardware, restorative offices and poor perceivability after nightfall. In this way, it is important to re-

accentuate the requirement for down to earth approaches to set up ecological health– amicable advances like SHS to work remote rustic wellbeing focuses proficiently.

5.6 Solar Applications promotes agriculture and rural enterprises

Agribusiness assumes a crucial job for sustenance security and monetary improvement. Anchoring access to water assumes a vital job in guaranteeing rural generation. In such way, sun-based PV water siphoning can supply water for dry land water framework. Keeping an eye on vitality issues related to agribusiness and off-farm activities can fabricate prospects for cash period in provincial nuclear families/tries by offering imperativeness to water framework, sustenance taking care of, sustenance preservation and numerous sorts of manual creation in the midst of night hours. Control inadequacy and low voltage impact water framework for the power worked siphons realizing lower formation of yields. Other than diesel worked siphons require extending cost for oil (Chilcott, 2006) [8]. Considering the vitality crisis of the country and things over the globe, it is fundamental to explore elective vitality hotspots for water framework to ensure both sustenance and vitality security. Sun oriented Home System (SIS) is a creative, money related and normally welcoming response for the back based economy of a country like in Bangladesh. Sister grants farmers to yield paddy more than once in a year and substitution of a part of green siphons with Solar PV advancement could in like manner balance amazing GHG spread. SHS causes little scale dares to create additional compensation by expanding their working hours after sunset. With sun fueled power people, can work rice-beating plant in common zone. Little nation stores can moreover develop their stock by including things that can be protected using sun based controlled coolers. For example, sun-based PV-controlled icemakers can help town littler scale endeavors in calculating, offer of ice strong shapes and cold refreshments. It in like manner makes business as deliver, rebate suppliers, retails bargain business, advantage business, for instance, system plan, structure foundation, advising organization, etc. Various affiliations have taken the get-together, fixing of sun-situated collaborators to the rustic areas, making green livelihoods for nearby people. Other than private use, people are harnessing sun-arranged vitality to run privately owned businesses. Introduction of SHS in the commonplace extents makes an open entryway for the villagers to open autonomous endeavors like mobile phone charging shops, PC planning centers, TV and compact shops. Regardless, in the composing not a lot of conveyed data is open in quantitative terms of additional wages inclined to be made by different sun controlled shocked endeavors and, in this manner, there is necessity for further research. Move of battery in SHS Solar vitality is green, secure and suitable sustainable power source.

5.7 Disposal of battery in SHS

Solar energy is green, secure and maintainable renewable energy. So, power deliver by utilizing sunlight-based energy typically don't dirty nature. Just battery related waste is the negative effect for environment. For the most part, SHS battery life traverse is about five years. Following five years it ought to be supplanted with new one. So consistently a great deal of batteries must be supplanted (Wasfi, 2011) [29]. An uncontrolled transfer of battery makes danger of soil sullying

and water contamination. In Bangladesh, it is the obligation of accomplice association of SHS scattering system to gather old battery from rustic family and return it to the maker for reusing purposes. Be that as it may, the accumulation of all battery from rustic range is a testing work. In this review, to recognize the administration of battery transfer respondents are asked for to express the transfer administration of old battery (Factor, 2016) [14]. About 39% families don't know how to discard the old battery. Over 54% states that as it is perilous, they will offer it in the nearby market and around 7% express that they will discard it after its life expectancy. However, the families realize that in the event of battery disappointment before the finish of the five-year guarantee period, they will get another battery free of cost, yet most extreme family unit don't have the foggiest idea about the technique of battery transfer. From the above information, it is especially disturbing for the provincial region as they don't have a clue about the best possible method for transfer the battery. Utilizing SHS in Bangladesh is expanding quickly. Bangladesh is the quickest developing sun-based nation on the planet. Effectively gigantic measure of sun-based battery is spread in the provincial region. In the review, it is additionally uncovered that 13.3% family unit are utilizing SHS over five years, however they don't change the battery with another one, even they don't know how to change the old battery in the framework. Indeed, even PO does not visit the SHS family unit after gathering their portion. Absence of consciousness of the clients and absence of earnestness of the PO, the colossal number of old batteries may make another danger for nature, and accordingly hinder the practical improvement.

5.8 Reduction of Green House Gas emission

Lamp oil was the primary fuel for lighting in study regions, which is utilized as a part of "Hurricane" or "Kuppi". The customary fuel delivered CO_2, which is one of the critical wellsprings of GHG. As indicated by IPCC "warming of the atmosphere framework is unequivocal", and "the greater part of the watched increment in worldwide normal temperatures since the mid-twentieth century is likely because of the watched increment in anthropogenic nursery gas focuses." The environmental change report delineated the significance of Green House Gasses (GHGs), particularly CO_2, for an Earth-wide temperature boost and environmental change and underlined the requirement for further lessening individual outflows. The utilization of SHS does not create CO_2 rather spared CO_2 emanations. With a specific end goal to decide the general reserve funds of CO_2 emanations from SHS, outflows from lamp fuel utilize and discharges coming about because of the SHS producing procedure and transport to the rustic territories must be deducted. Be that as it may, information on CO_2 discharges from the SHS creation handle and the appropriation of SHS to their place of establishment is not accessible (Union of the Electricity Industry - EURELECTRIC, 2003) [28]. Along these lines, the GHG emanations emerge from the transportation and fabricate of SHS is overlooked to decide lamp fuel reserve funds and individual lessening of CO_2 discharge. An early review made by Cabraal demonstrates that lamp fuel utilization of a family unit utilizing wick lights in Sri Lanka was 0.5 to 1 liter for each day i.e. 15 to 30 liters for each month. IPCC rule recommends that CO_2 discharge from lamp fuel is 2.5 kg/liter. As indicated by an investigation of Kaufmann emanation from lamp oil light was 2.4 kg CO_2/liter. The conventional lights (Kuppi and tropical storm)

utilized by the provincial individuals were tried at BCSIR. The normal CO_2 emanation from customary lights utilized by the country individuals in Bangladesh was 2.41 kg CO_2/liter as per the test. In the review on a normal 4.2 liters of lamp fuel were utilized as a part of family units every month and after establishment of SHS 90% lamp oil utilization is lessened. Life traverse of a SHS is 20 years. So, normal lamp oil spared by a SHS is around 3.78 liter/month that implies 907.2 liter in 20 years in the family unit. With a lamp oil CO_2 discharge element of 2.41 kg/liter, this equivalents a month to month substitution of 9.109 kg CO_2 identical. One SHS in the review zone will diminish 2186.352 kg of CO_2 identical discharge amid its working existence of around 20 years (Goldemberg, 2000) [17].

5.9 Comparison of Existing Power plant and Solar based Power plant

There has been an impressive proportion of buzz going around about using inexhaustible wellsprings of energy. The sustainable power sources which have significant course of action support in India for power time join wind and sun based. Under the JNNSM (Jawalar Lal Nehru National Solar Mission) impelled in 2010 the Indian Government has set the hopeful focal point of passing on 20,000 MW of structure related sun-based power by 2022. Say there are two power plants of 1000 MW, one produces electrical power from coal and the other from sun-situated vitality. Things being what they are, does it suggest that they both make a comparable proportion of intensity (usable units)? No. The electrical imperativeness conveyed by a sun powered power plant and a coal fueled plant, the two of which have a comparative most extraordinary limit, is by and large unique. How? Allow us to see.

Every now and then we keep running over news of the organization setting up some power plant of 500 MW, 1000 MW or substantially more a portion of the time, in different parts. By then we consider whether a power plant evaluated at 1000 MW will make 1000 MW electrical vitality? Not by any means. Numerous individuals get dumbfounded between the power yield of a power plant and the power which it is conveying. While these two are interrelated, they are not the equivalent. There is constantly a biggest purpose of control of the yield of each power plant. Similarly, there is a base most extreme of power which must be made by the power plant with an explicit true objective to keep running. When you hear in the news that a power plant of 1000 MW is developed, it is the most extraordinary power yield limit (1000 MW) you get some answers concerning (SHAH, 2012) [26]. The base yield limit of a power plant ranges from 40% – 50 % of the most extraordinary yield limit. Exactly when a power plant is developed (say having a most extraordinary yield limit of 1000 MW), it infers that the power plant would be prepared for giving a brisk power of 1000 MW. The measure of this power is used, is something which chooses the power making of the power plant. Say if there is a power plant which has the most extraordinary limit of 1000 MW, and the diverse stations and sub-stations (which transmit capacity to the posts from where control accomplishes our homes) are drawing most the 1000 MW yield of the power plant, at that point in 1 hour the power formation of the power plant will be 1000 MWh (which is equivalent to 1000 x 1000 kWh = 1000000 units of intensity). This will be the most extraordinary power which the power plant will have the ability to allow in an hour

(Union of the Electricity Industry - EURELECTRIC, 2003) [28]. Practically speaking the real power yield is not exactly the appraised control yield. The proportion of real power yield over a time frame to its appraised yield is known as limit element of the power plant.

5.10 Comparing the costs of Power plant generations

Total expenses of power generation per kWh produced include the expenses for capital speculation, operation and support and fuel. With respect to life-cycle adjust decommissioning and outer impacts of outflows (e.g. wellbeing, atmosphere) must be incorporated, albeit outer expenses are hard to survey:

• The aggregate expenses of fossil-based power generation fluctuate from 3 to 4 eurocent/kWh at current fuel costs, notwithstanding for normal gas in consolidated cycle generation. Although speculation expenses are low for gas-based plants, gas costs change impressively occasionally in contrast with hard coal and lignite (in a few nations fuel assess must be included). Outer costs: critical outflow decreases are being accomplished, yet there remains a negative effect, particularly CO_2, that reviews show to be 20%, and in some skeptical view up to 60% of the aggregate expenses (Union of the Electricity Industry - EURELECTRIC, 2003) [28].

• as a rule, atomic frameworks have altogether, focused costs when contrasted and fossil fuel era frameworks. The speculation expenses are higher, yet today the greater part of these plants deliver for fuel expenses and along these lines are alluring. The most recent plan concentrates like the European Pressurized Water Reactor [EPR] have been finished under the essential to be focused to coal and even gas at aggregate expenses. The outside expenses are low due to almost zero emanations; be that as it may, the atomic waste issue ought to likewise be considered.

• Hydro and geothermal power are – if everywhere scale – the main renewable sources giving adequate energy thickness and accessibility to produce control at alluring expenses. On the off chance that speculations are paid, substantial hydro control plants have the most reduced aggregate expenses, i.e. under 2 eurocent/kWh. Outer expenses are hard to appraise (i.e. dislodging CO_2-discharging plants) however similarly low (Bertsch, 2015) [6].

• Wind turbines, biomass and sun based warm power plants have add up to expenses of no less than 5 eurocent/kWh under ideal conditions. At typical conditions, 10 eurocent/kWh can without much of a stretch be surpassed. This considers well for little hydro plants (< 5 MW) (Union of the Electricity Industry - EURELECTRIC, 2003) [28].

• Total expenses from photovoltaic power generation are high: 35 eurocent/kWh can be surpassed even under sunny conditions. To give a case: in Germany, photovoltaic power is financed around 50 eurocent/kWh, which covers roughly just 50% of the aggregate expenses for photovoltaic application in this nation. Outside expenses are moderately little contrasted with this measurement, yet practically identical to those of gas-let go control plants.

A key variable for a feasible – that implies environmentally, monetarily and socially perfect – control supply is the cost of spared $kgCO_2/kWh$. A few reviews demonstrate this should be possible through measures that are moderately shabby to acknowledge – i.e. retrofitting propelled turbine sharp edges – when identified with expanded power yield. In correlation, raising wind converters could cost up to 10 times more for each CO_2 diminished and photovoltaic frameworks more than 100 circumstances more (see diagram beneath). Thusly, the most financially perception CO_2 subsiding method is enhancing ordinary power supply (Union of the Electricity Industry - EURELECTRIC, 2003) [28].

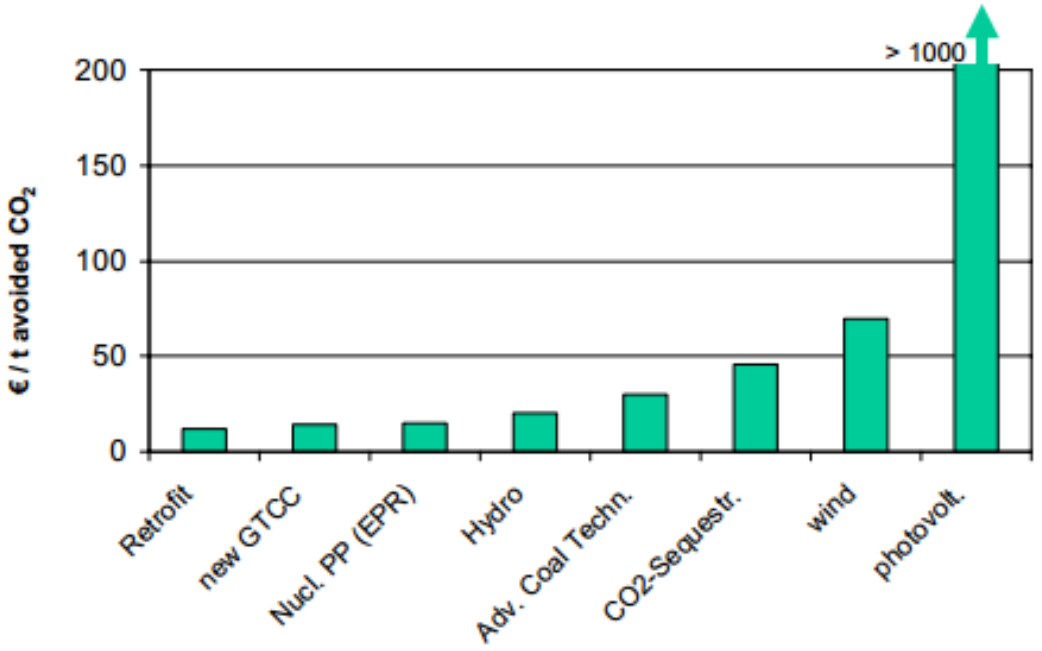

Figure 5.1: CO_2 emission's costs compare to others (Union of the Electricity Industry - EURELECTRIC, 2003) [28]

5.11 Conclusion

As, I rest my discussion above. My Discussion section implies about the research findings that has been carried out as well as the analysis. I have tried to focus on the various aspects of the region. Moreover, I have started stating the problem that why we need of rural electrification and then how SHS can be helpful and productive for the household and for the householders also how SHS can promote Education, Agriculture, Rural enterprises, Communication technologies and to the Health and safety to both human and Environment. Furthermore, I have also discussed about how the waste management processes can be carried out in terms of Disposal of Batteries and CO_2 emissions and at the end I have compared the Solar Power plant implementation and its output in contrast to the existing power plant that is situated in the country along with their costs for each.

CHAPTER 6:

CONCLUSION, RECOMMENDATION AND FUTURE SCOPE

6.1 Conclusions

Human life straightforwardly relies upon power. In Bangladesh, the age of power is for the most part reliant on gas and diesel fuel. Since these assets are restricted, sun powered vitality will be the principle wellspring of power. Scientist, strategy producer, improvement accomplice recognized the gigantic prospect of sunlight-based power in rustic region of Bangladesh. Despite the capability of sunlight-based power to catalysis provincial improvement, access to this innovation has not been converted into far reaching appropriation in rustic range. Right motivators, approach arrangement, advancement of nearby mechanical capacities, political and institutional support is particularly basic for feasible and successful utilization of SHS. Presently ample opportunity has already past to incorporate auxiliary set up for utilizing this undiscovered asset. Besides, sun-based Roadways have ventured out making the world's biggest sun powered board: The Company utilizes safety glass and photovoltaic cells to make canny, vitality collecting asphalt, finish with inherent warming components for softening ice and LEDs for signage. The innovation is still in its early stages, however with financing from the Federal Highway Administration and an Indiegogo crusade, the organization completed a model parking area in Idaho a year ago, Sun powered Roadway has discharged the principal photos of their new Solar Roadways model parking area. Introductory establishment is finished, with a few increments still to come (i.e., covers for mounting openings, mastic between boards, programming for LED designs). The parking garage is completely useful with sun powered cells, LED's, warming components, and the finished glass surface. The model outcomes demonstrate the centrality of sun-based power streets extraordinarily. However, installation cost is very high this new technology can replace the costly fossil fuel system and can give us clean energy without any climate change.

6.2 Recommendations

Amid field work a few restrictions are experienced. These are:

- Non-availability of Documents: One test is the trouble in get-together recorded data from authorities. At times, archives may not be found promptly accessible and thought about classified.
- Limited time: Time is another limitation in the field work. The time given for the information accumulation is excessively short. Subjective examination requires more opportunity to dissect information while gathering data. At similar occasions, it might likewise require additional opportunity to rebuild its plan in the light of new advancements and bits of knowledge.

6.3 Future Scope

6.3.1 Solar Home System

Bangladesh can meet portion of its capacity request by means of the framework. Very nearly 40% region of the nation stays in obscurity during the evening where matrix power can't reach or isn't monetarily reasonable. This remote zones and network remain nonviable regions can be cover with SHS. Government has taken sustainable power source strategy and it imagined to supply power with 2020. Yet at the same time a few issues obstruct for the development of sun-based power. Numerous scientist and global association have contemplated prospect of sun-oriented vitality (F.D.J. Nieuwenhout, 2000) [13]. In Bangladesh, photovoltaic sunlight-based power is being utilized by numerous associations and government organization, however the nodal office for co-ordinate the activity and Regulatory system for reasonable sustainable power source advancement is in essential stage.

6.3.2 Solar Roadways

In future, normal roads can be replaced by the solar roadways but huge initial investment is required. The solar roadway alternative could be made at less cost with an energy return while phasing out the old system (Ayushi Mehta, 2015) [3]. As, old roads are scheduled to be under maintenance, the process of solar roadway placement could occur seamlessly. The alternative of airports and parking lots are under varying timelines (Ranjan, 2015) [24]. Whenever fiscal dilemmas become the primary motivating factor for a state or municipal budget, the option of solar roadways should be presented and defended. With respect to solar roadways being future proof asphalt roads are a dead end (Kulkarni, 2013) [21]. There are no redeeming features to asphalt that should hinder the progress of a new model. The ITS program seems to be begging for a concept that is readily available for the next step. Solar roadways will answer our nations problem in the field of transportation pollution, waste pollution, coal pollution, transportation funding and energy (Yotov, 2015) [30].

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APPENDICES

Appendix-1

Basic data:

Main interviewee:
□ Head
□ Spouse

Name----------
Mobile phone no ----------

(A) Demographic information

(i) Basic information of household.

	Name	Sex	Age (year)	Marital status	How many years of schooling completed?
Household Head		□ Male □ Female		□ Single □ Married □ Divorced □ Widowed	
Spouse		□ Male □ Female		□ Single □ Married □ Divorced □ Widowed	

1. How many people live in your household? ----------

2. How many sons and daughters are in your household? Son--------, Daughter---------

3. How many children attending school/Madrasa/collage are there in your household?

a. Primary school----------
b. High school ----------
c. Madrasa ----------.
d. Collage ----------
e. University ----------.

(B) Economical Information

A) Economic
Household income:

	Present	Before SHS installation
04. What is your occupation?	□ Farmer labor □ Skill worker Service □ Housewife Shopkeeper □ Business unemployed □ Rickshaw/Van □ Puller/Driver □ others	□ Farmer labor □ Skill worker Service □ Housewife Shopkeeper □ Business unemployed □ Rickshaw/Van □ Puller/Driver □ others
05. What is the occupation of your spouse?	□ Farmer labor □ Skill worker Service □ Housewife Shopkeeper □ Business unemployed □ Rickshaw/Van □ Puller/Driver □ others	□ Farmer labor □ Skill worker Service □ Housewife Shopkeeper □ Business unemployed □ Rickshaw/Van □ Puller/Driver □ others
	Present	**Before SHS installation**
06. How much do you earn in a month (BDT)?	□ 4000-6000 □ 6001-8000 □ 8001-10000 □ 10001-12000 □ 12001-14000 □ Above 14000	□ 4000-6000 □ 6001-8000 □ 8001-10000 □ 10001-12000 □ 12001-14000 □ Above 14000
07. How much does your spouse earn in a month (BDT)?	□ 4000-6000 □ 6001-8000 □ 8001-10000 □ 10001-12000 □ 12001-14000 □ Above 14000	□ 4000-6000 □ 6001-8000 □ 8001-10000 □ 10001-12000 □ 12001-14000 □ Above 14000

08. Has the general living condition in your household improved, does it stay the same or degrade after SHS installation?
□ Improved, why? ----------
□ Degraded, why? ----------
□ Stay the same

B) Adaptation

09. Distribution of the use of solar electricity consuming activities in households.

□ Charging of mobile phone.
□ Watching TV and Charging mobile phone.
□ Watching TV, reading under light and charging mobile.
□ Watching TV, listening radio, reading under light, use solar fan, and charging mobile.
□ Watching TV, reading under light, charging mobile phone, Use solar fan and laptop.
□ Reading under light and Charging mobile phone.

10. Are you satisfied with the benefits of your SHS?
□Yes □No
If yes then what is the level? (1=Minimum, 5=Maximum).

1	2	3	4	5

11. Men, Women, children who benefits most from electricity supply of the SHS?
□ Men □ Women □ Children □ Others----------

12. Are TV, Radio, and mobile phone beneficial for economic development?
□Yes □No
If yes then what is the level? (1=Minimum, 5=Maximum).

1	2	3	4	5

13. Does SHS make easy and extended time for reading?
□Yes □No
If yes then what is the level? (1=Minimum, 5=Maximum).

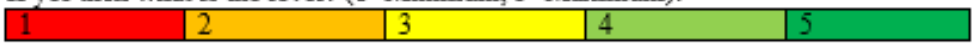
1	2	3	4	5

C) Environmental

14. Did you think installation of SHS improve environment?

□Yes □No

If yes then what is the level? (1=Minimum, 5=Maximum).



15. Does SHS decrease the incidence of diseases?

□Yes □No

If yes then what is the level? (1=Minimum, 5=Maximum).

16. What do you do with the old battery?

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17. In the past had there been any accidents in your house relating to use of kerosene or others energy sources?

□Yes □No

If yes, which of the following?

□ Kerosene □ Candle □ Solar Home System □ Others