

Data Estimation and Cost analysis of Rooftop Solar PV Power System

**This Report Presented in partial fulfillment of the requirements for the
Award of Degree of
Bachelor of Science in Electrical and Electronic Engineering**

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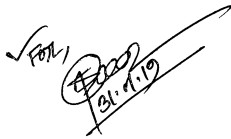
December 2018

TO
OUR BELOVED PARENTS
&
HONOURABLE SUPERVISER
Dr. M. Shamsu lAlam

Certification

This is to certify that this project and thesis titled “**Data Estimation and Cost analysis of Rooftop Solar PV Power System**” is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on October, 2018.

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LIST OF ABBROVIATION

SRS- Solar Rooftop Systems
IDCOL- Infrastructure Development Company Limited
GS - Grameen Shakti
GDP - Gross Domestic Product
PV - Photovoltaic
BD - Bangladesh
BPDB - Bangladesh Power Development Board
REB- Rural Electrification Board
LGED- Local Government Engineering Directorate
NGO - Non Government Organizations
SODIS - Sun based water sterilization
LGED - Local Government Engineering Department
BWDB- Bangladesh Water Development Board
SRE - Supportable Rural Energy
PDB - Power Development Board
DC - Direct Current
LED-Light Emitting Diode
RERC-Sustainable power source Research Centre
IFRD- The Institute of fuel Research and Development
BCSIR-Bangladesh Council of Scientific and Industrial Research
GOB- Administration of Bangladesh
NRECA-National Rural Electric Cooperative Association
DPDC- Dhaka Power Distribution Company

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ABSTRACT

Abstract Daily headlines make everyone aware of the dangerous long-term effects of power generation from the fossil fuels. It is widely believed that continuing to depend on fossil fuels to generate electricity can cause serious environmental problems. Moreover, fossil fuels are finite in amount and cost a lot of money as well. Hence, renewable energy is a potential solution to meet up electricity demand for the developing countries like Bangladesh. Among all the renewable technologies, solar photo voltaic (PV) is the most potential, favorable and promising one which converts solar energy into electrical energy, including or excluding battery backup. Although solar technology has nearly been successful in rural areas where most of the technologies are adopted based on Solar Home System (SHS), it has not yet been effective in urban areas after the imposed rule of meeting 3% of light fan load of a building. We have investigated the installed solar rooftop of 86 houses in Narayanganj, where the solar system of most of the houses were found inactive. Among them only 50 systems are active. In this thesis the overall analysis of urban solar prospect has been done in three layers based on this investigation. After all, the effectiveness of the system was discussed in brief to influence them to come to know about the appropriateness of the system and the proper way to maintain the system. It is seen that a few among them find the system useful and want to increase its capacity. The operating condition and maintenance of the SRS was evaluated as well. Most of the interviewed people do not either maintain the system or want to repair it. It is very unfortunate that most of the systems were found inactive or not connected in a proper way. Although urban people are more likely to know the efficient use of solar energy, they still prefer fossil fuels for their power generation. In this manner, they are indirectly contributing to environmental hazards and wasting a lot of money too. From the reading of an installed solar system, the cost per unit is calculated later as an example. However, the appropriateness of the system to the consumer is very limited due to having a lack of knowledge and training to operate the system productively.

Chapter One

Introduction

1.1 Introduction:

Presently Global warming and climate changes effect is the burning issue all over the world. Bangladesh will be the most affected country in the climate changes effect round the world. There are so many causes of global warming. Among them power generation is the most remarkable one. We cannot think about any development without power (Electricity). Finally, sources of conventional energy like Fossil fuel, Natural gas and Coal are limited. If we used them in the present rate it will be finished within the short time. So, there is no other way to think about environmentally friendly renewable energy production sources. In Bangladesh context solar energy is the most effective source for renewable energy production. Even if fuel is available within the country transporting that fuel to remote, rural village can be difficult. There are no roads or supporting infrastructure in many remote villages where transportation by animals is still common. Transportation by animals' limits loads capacities and some loads, diesel generators, for example may be impossible to bring to such locations. The use of renewable energy is attractive for solar energy application in many developing countries. This technology, referred to as photovoltaic (PV), converts the sun energy into electricity through electromagnetic means when PV module is exposed to sunlight. The solar radiation energy is converted into DC power and requires an inverter it into AC power. But still some problems have that make it uncomfortable to us. Its efficiency is so much low and the prices of its energy still so high. So, in this paper we try to find way to make it comfortable.

The Government want to confirm access to electricity for all by 2020. However, energy mainly come from oil, gas, and coal will assume an essential job in taking care of the developing demand.

During the last two decades, both developed and developing country are trying to utilize of renewable energy. The use of renewable energy free from environmental pollution, such as solar, wind, bio-mass, geothermal, tidal, hydro energy have taken on a greater sense of earnestness, especially in developing countries.

1.2 Statement of the problem:

Bangladesh usually depends on fossil fuel for power production. About 89% of produced power from carbon radiating gaseous, fluid fuel, coal, and hydropower. The supply of natural gas is inadequate to take care of the demand. The supply of this gas is insufficient that Bangladesh can't bolster household needs and additionally more power need for the country. The current save of oil and gas will be depleted soon. In the meantime, worldwide, there is an interest for spotless and maintainable energy. The requirement for creating sustainable energy like sun oriented, wind, bio-mass, and so forth. Has a more noteworthy feeling of criticalness.

As a tropical nation, Bangladesh is supplied with sun-oriented energy. In this situation, sunlight-based energy is a dependable, moderate and secure energy for the nation. Be that as it may, the present offer of renewable source for power generation is just 0.5% of the aggregate. Real individuals of Bangladesh live in rustic regions. There is solid interest for power accessibility in remote towns. Bangladesh has installed with a lot of solar energy. We can possibly be a sun-oriented power rich nation. Institutional, money related and mechanical capacities go about as imperative factors in achieving a coveted dimension of sun-based power creation and uses. In any case, we have an absence of data and incorporated research in this field. Solar energy provincial jolt started in the nation in 1988 at Norshingdi. Power Development Board (BPDB), Rural Electrification Board (REB), Local Government Engineering Directorate (LGED), Infrastructure Development Company Limited (IDCOL) and an essential number of private part associations including Non-Government Organizations (NGO) are locked in with sunlight-based power enhancement. Solar energy is progressively being utilized in an extensive variety of off-framework applications. Since the presentation of SRS, Bangladesh has introduced more than 2.2 million units. In this setting estimating the financial effect of SRS would be an outline for structuring rustic improvement elective energy demonstrate in the nation. The present examination is planned to recognize the elements related with the execution of sun-oriented energy and sun-based power framework and how far it has been prevailing with regards to diminishing destitution in rustic region of the nation

1.3 Specific objectives of this research:

To find the potential results in respects to solar energy frameworks in our nation and also the issues in regards to the business. A cautious audit prompts the improvement of the accompanying explicit research goals.

- To know the present condition of SRS in Bangladesh and the opinion of the consumers about it.
- Calculate, per unit cost of solar electricity.
- Try to make concern consumers about the usefulness of using SRS system.
- To have a conception about how many people are being able to operate the system in a proper way and how many of them is influenced to increase its capacity.
- Inform the consumers about net metering system of on grid SRS.
- To intend the idea about how much electricity the consumer gets on an average and in which purpose it is being used.
- How much electricity they are generating from solar and meant them for increasing the capacity.

1.4 Significance of the study:

Bangladesh is a tropical country of huge sunlight-based power. But alas, a significant amount of it is utilized. In spite of the fact that the origin of SRS in Bangladesh was in 1988 however it was undiscovered for a long time. At this point different utilizations of sun powered power are seen all through the world. Solar Panel gives power to sun-based antibody fridges, sun-based water sterilization (SODIS), and solar nourishment dryer and sun-based sanitization.

These aides in lessening water borne sicknesses. Sun powered telephone, sunlight-based Wi-Fi, sun-based radio increment provincial correspondence, decreases transport cost and diminish the computerized separation. solar cooker and sun powered water warming, dependence on conventional fills, for example, wood or charcoal, lessens indoor contamination. This expands the personal satisfaction in rustic regions, enhance wellbeing and training, decrease oil reliance, increment nearby work and lessen deforestation. Solar power exercises lead provincial improvement. Because of absence of data and study SRS is utilized just for family unit lighting in Bangladesh. Solar water system innovation is likewise getting well known in Bangladesh. As agribusiness-based nation, utilizing sun-based power water system framework would be a noteworthy main impetus for rural advancement. Government association, Academic establishments, NGOs and privately-owned

businesses are engaged with the sustainable power source area in the nation. Analyst, strategy producer, advancement accomplice in Bangladesh recognized the massive prospect of solar energy for rustic change. However, there is no coordinated investigation of the prospect and extent of solar energy for financial advancement in country zone Bangladesh. Starting at now there is exceptionally constrained scholarly examination on the financial or ecological effect of solar energy in rustic territory. So, the examination would help the worry policymakers and implementers to take fundamental measures for practical country advancement in Bangladesh. Distinguishing the new creative utilization of sunlight-based power in provincial zones would help the implementers for compelling arranging and undertaking programs. In addition, it will likewise help for new innovation move in country regions.

1.5 Outline of the study:

- Chapter one contains introduction, statement of the problems, significant of the study and objective of the survey.
- Second chapter of this report will concentrate on check of selected structure and theoretical survey of SRS.
- In third chapter, it will examine the system of the examination.
- The fourth chapter is examination of the information, results and discussions.
- . The fifth section is ends and proposals and of this report.

Chapter Two

Literature review

2.1. Introduction

The MPPT system can be classified based on the algorithms used; power converter in the system and application of the system (Standalone or grid interconnection). Affordable, accessible and secure supply of energy plays a driving force for socioeconomic development of a country. This circumstance, solar energy is widely perceived as a promising technology for electricity generation in remote location of the developing countries. This chapter attempts to focus on the review of selected literature, key concept of solar electricity as driving force for socio-economic development, various kind of renewable energy explanation, benefit of solar energy, present condition of solar in our country, worldwide solar installation.

2.2 Energy

Energy, in physics, the capability for doing work. It should exist in potential, kinetic, thermal, electrical, chemical, nuclear, or alternative varied forms. There are, moreover, heat and work—i.e., energy within the process of transfer from one body to a different. When it's been transferred, energy is often selected in keeping with its nature. Hence, heat transferred might become thermal energy, while work done might come about within the kind of energy.

2.2.1 Energy can be classified into several types based on the following criteria:

- Primary and Secondary energy.
- Commercial and Noncommercial energy.
- Conventional and Non-conventional energy.
- Renewable and Non-Renewable energy.

Above all this criteria, renewable energy source is the best energy source because they do not create any negative impact on environment and most important things is that they can be replenished in a short period of time. The example is wind, biogas, hydro, geo-thermal, tidal and solar.

2.2.2 Wind:

Wind Energy can be an elective source of energy for Bangladesh. Since, through wind energy control is directly relative to the speed of the breeze. This suggests progressively the breeze speed increasingly the power age. Bangladesh has an ocean side line of 724 km along the Bay of Bengal. It blows over Bangladesh from March to September with a normal speed 3 m s^{-1} to 6 m s^{-1} .

Winds are available in Bangladesh for the most part in the midst of the tempest and around one to two months when the rainstorm and from October to February wind speed remains either calm or too low [6]. There are various islands along the Bay of Bengal where the breeze speed is high. Krakatoa, Sawndip and St. Martin are among those that have an ideal territory for wind turbines. There is no plausibility that they can get control from the national power cross section as it is hard to convey the line through to this domain. Wind energy can be the answer for this issue.



Fig-2.1: wind power plant

2.2.3 Tidal:

Tidal Power becomes another supply of energy which might fulfill our electricity demand. Tidal energy is delivered as a result of the variability of the ocean level. Bangladesh could be a surge plain delta having a 710 kilometer outline with the Bay of geographic region. Bangladesh has its nineteen regions within the bound front zone during which twelve square measure in direct contact with the ocean.

Tidal power exercises can be developed along the ocean side locales. They can provide the imperativeness demands in the meantime and furthermore is used as a protective extent of the, of the natural disaster. The below fig content the general symmetric arrangement of tidal power. Bangladesh is a Riverine country, so tidal power can be an extraordinary wellspring of sustainable power source of our country.



Fig-2.2: Tidal power plant

2.2.4 Biogas:

Biogas is that the fourth biggest energy supply in worldwide and provides essential energy stipulations to cookery and warming in rustic family units in developing countries. Installation of biomass offers a fantastic account ecological problem by decreasing the emanation of standard gas depleting substances.

This gas is burnable and can be utilized to create power. Biogas can be utilized for cooking and power generation. Grameen Shakti is a standout amongst the most articulated NGO in the field of biogas. They have completed 13,500 biogas plants. Recently Seed Bangla Establishment has proposed a 25 kW Biogas based Power plant in Rajshahi. IDCOL a Government claimed Investment Company repaired an objective to set 60,000 biogas plants in Bangladesh by 2018.



Fig-2.3: Biogas plant

2.2.5 Hydro:

Hydropower is another supply of renewable energy that needs each water current and flow and tallness to form electricity. The arrangement of this accessible energy is taken into account as protection and retention energy within the diagram of programmed stream energy. Smaller scale hydro management is good to form up to 5– 300 kilowatt of power.

This is one of the easiest innovations, which exchanges hydropower to mechanical power the developing country like Bangladesh is very much suitable for Micro-Hydro technology and the cheapest technology as well. Many canals and branches of the rivers in Karnafuli, Shangu, and Matamuhuri are supposed to be good prospects for installing micro-hydro power along with the Chittagong Hill Tracts. Recently, the principal small-scale hydropower unit at Bamerchara, Chittagong, has been set up by the Sustainable Rural Energy (SRE) under LGED [7]. In any case, just around 4 KW of power can be delivered on account of inadequate water current and flow. In 1981, Bangladesh Water Development Board (BWDB) and Bangladesh Power Development Board (BPDB) in the year 1981 investigated potential destinations, which are appropriate for smaller scale hydro control ages [7]. Supportable Rural Energy (SRE) has additionally found some conceivable areas for miniaturized scale hydro locales in Chittagong regions in 2004. It is clear that there is immense option of generating electricity from the micro-hydro energy. However, unfortunately, Bangladesh has been unable to generate power energy from the hydro energy. The total hydropower potential of Bangladesh in the three locations (Kaptai, Sangu and Matamuhuri) is about Gwh/year (755MW) of which 1000GWh/year (230MW) has been harnessed at Kaptai through 5 operational

units of hydro power plants. For obtaining the advantage of hydro power, proper attention should be imparted for its further development. BPDB has submitted a proposal to the government to install a 25KW power plant at the Teesta barrage [7]. Further analysis can open a new door of success in this regard. The Bangladesh Water Development Board (BWDB) and Power Development Board (PDB) carried out a joint study for the future prospects of micro-hydro power potentials in the country. If by dint of proper planning, we can make the best use of hydro power electricity then the whole nation can be benefited to a great extent from the view point of energy security and energy reserve.



Fig-2.4: Hydro power plant

2.2.6 Geo-thermal energy:

The term geo thermal originates from 2 Greek words 'GEO' and 'THERM'. The Greek word 'geo' meant the world while their word for 'therm' meant heat from the world. Geothermal energy is energy derived from the warmth of the world. The earth's center could be a distance of roughly 4000 miles and is therefore hot that it's liquefied. Temperatures square measure understood to be a minimum of 5000 degrees centigrade. Heat from the center of the world conducts outward and heats up the outer layers of rock known as the mantle. Once this kind of rock melts and becomes liquefied it's known as magma. Magma will reach slightly below the earth's surface. Rain generally seeps down through fault lines and cracks turning into super-heated by the new rocks below. a number of this super-heated

water rises back to the surface of the world wherever it emerges as hot springs or maybe geysers. Generally the new water becomes treed below the surface as an energy reservoir.

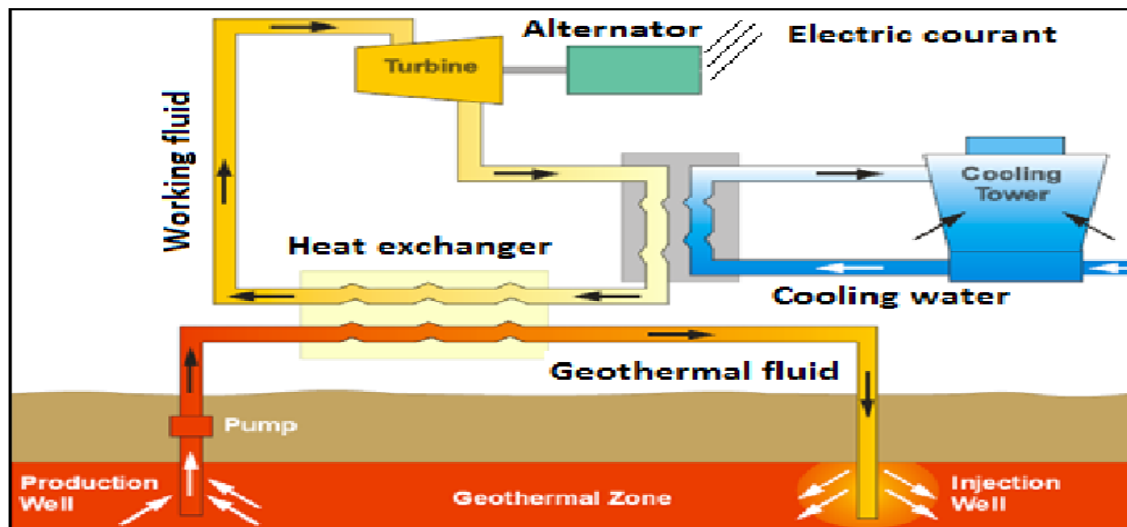


Fig-2.5 Geothermal power plant

2.2.7 Solar:

Because of the limitation of non-renewable energy source worldwide and in Bangladesh, the requirement for an extreme change to elective sources is needed. The solar energy requires a colossal interest in costly silicon boards. The solar panel covering a family housetop would be sufficiently hard to supply its family unit prerequisites likewise, would require batteries for use amid the night.

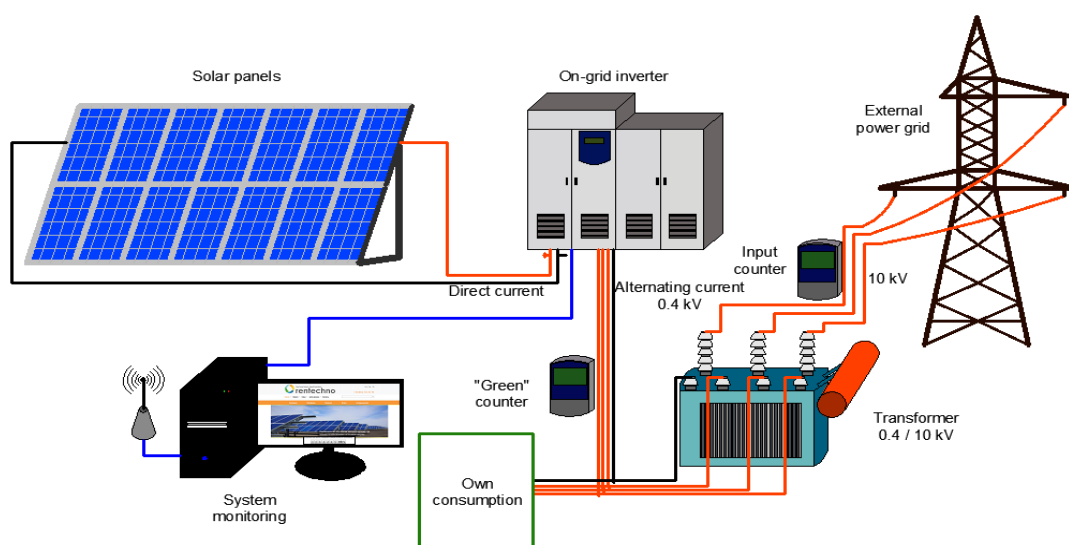


Fig-2.6: Solar

2.2.8 Rooftop solar home system:

The immediate change of sunlight into power is called photovoltaic solar energy. A fundamental segment of Photo Voltaic (PV) framework is the sunlight-based cell, in which the photovoltaic impact happens. At the point when light falls on the semiconductors of the cell, it delivers a little electric flow. Photovoltaic modules, or boards, comprised of various cells associated together to give voltages and flows sufficiently high for down to earth utilize. More typical in rustic jolt program is the utilization of sun-oriented PV as remain solitary frameworks in families, social establishments, or spots of beneficial or business exercises. For the most part, the framework is alluded to as 'Housetop Solar Home System' (SRS). The SRS giving burden is low (underneath 100 W), anyway can be satisfactory for controlling of lights, radios, TVs, and to refrigerate remedies at commonplace offices. In spite of the way that SRS is apparently expensive at first look, it is fiscally astute in giving force at little scales in areas without access to system power or some other feasible power source. Its application can additionally be sensible where ask for is depicted by low measurements or the securing cost of fuel is high (GOLDEMBERG 2000: 376, SUDING et. al 2004: 72) [7]. In any case, with rising fuel costs SRS headways may end up being more cost-profitable than off-network alternatives subject to oil subsidiaries.



Fig-2.7: Rooftop Solar home system

2.2.9 Technical background of SRS:

Solar energy comes from the Sun. The photovoltaic/solar module changes over the daylight into power. It ordinarily has a limit of between 20 to 100WP. The battery stores the electric energy for around night time amid shady climate. The charge controller is a device that bargains with the electric travel through the framework and shields the battery from harm. It alerts the customer when the battery needs charge or when the module isn't working really. Wires and related switches scatter the power inside the framework and to the heap for instance, lights or electric machines. Ordinary SRS work at 12 volts coordinate current (DC) and use capable fluorescent or Light Emitting Diode (LED) lights and machines to make best usage of the given power (HANKINS 1993: 10) [8] . A conventional 50WP SRS can give enough ability to work four minimal bright lights, and a little 15-inch exceptionally differentiating TV for up to five hours (CABRAAL et al.996: 8) [9]. The below figure is the solar home system module, where we can see that how SRS worked.

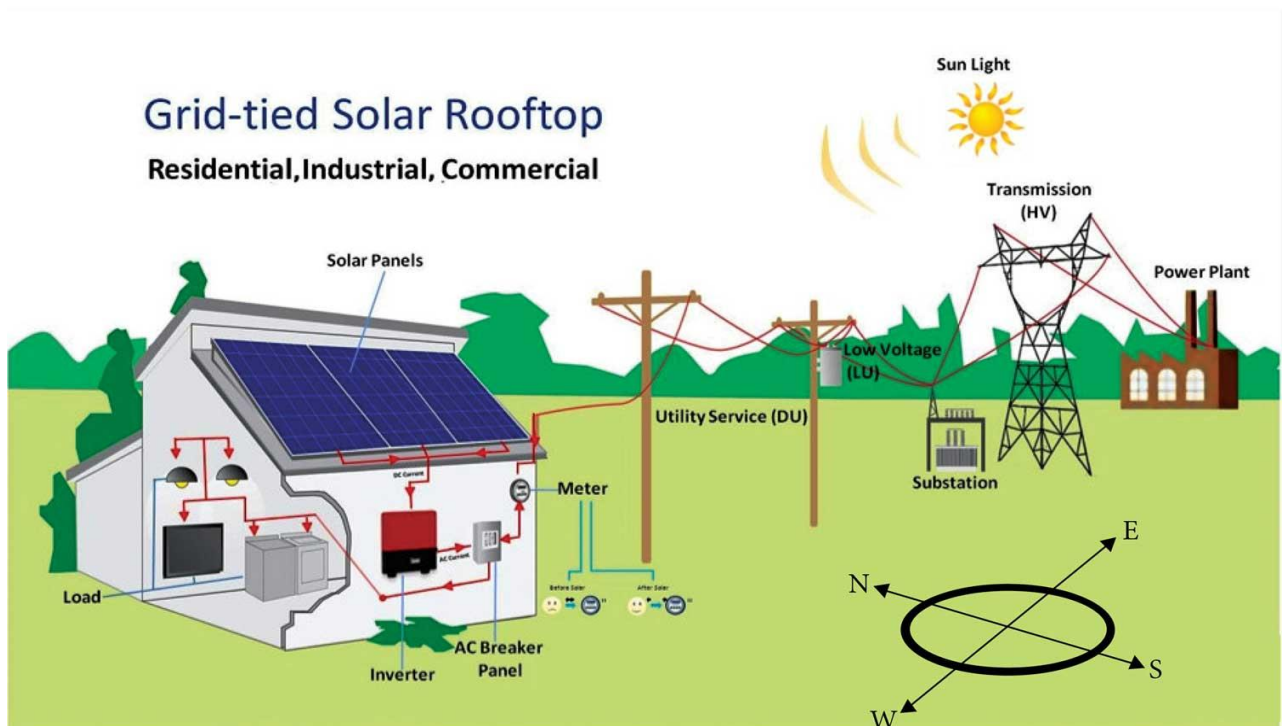


Fig-2.8: Technical background

Solar panel: Solar panels are made of photovoltaic (PV) cells, which transform daylight into electricity. This power would then be able to be encouraged into our home's mains power supply.



Fig-2.9: Solar panel

Charge Controller: It is a device which is basically a voltage and/or current regulator to keep batteries from overcharging. It controls the voltage and current coming from the solar panels going to the battery.

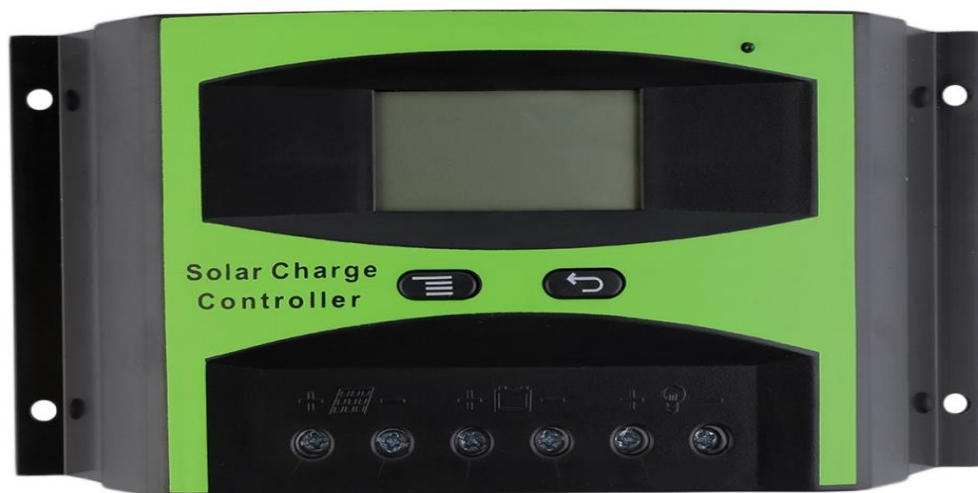


Fig-2.10: Charge controller

Inverter: An inverter changes over the DC voltage to an AC voltage. basically, the input DC voltage is usually lower while the output AC is equal to the grid supply voltage of either 120 volts, or 240 Volts depending on the country.



Fig-2.11: Inverter

Battery: A battery is a device which is store electricity. In solar home system, battery can play an important role it store energy when it is day light and it is ready to supply the power in night .



Fig-2.12: Battery

2.3 Movement of solar energy in Bangladesh:

Bangladesh is a subtropical nation, subsequently 70% of year daylight is fallen in Bangladesh. For this rationale, we can utilize solar boards to deliver power to a great extent. Sun powered radiation contrasts from season to season in Bangladesh. Bangladesh gets a normal day by day sunlight-based radiation of 4– 6.5 kW h m⁻² with the most noteworthy sum in April and least sum in December (Fig: 2.12). Sustainable power source Research Center (RERC), Dhaka University is the fundamental source which has whole deal evaluated data of Dhaka; thusly, sun-based imperativeness can be an inconceivable hotspot for handling the power crisis in Bangladesh. The Bangladesh government has as of late found a way to motivate individuals to utilize PV energy. Basically, every as of late built level building is at present used sunlight-based boards alongside the matrix association with getting bolster amid the heap shedding period.

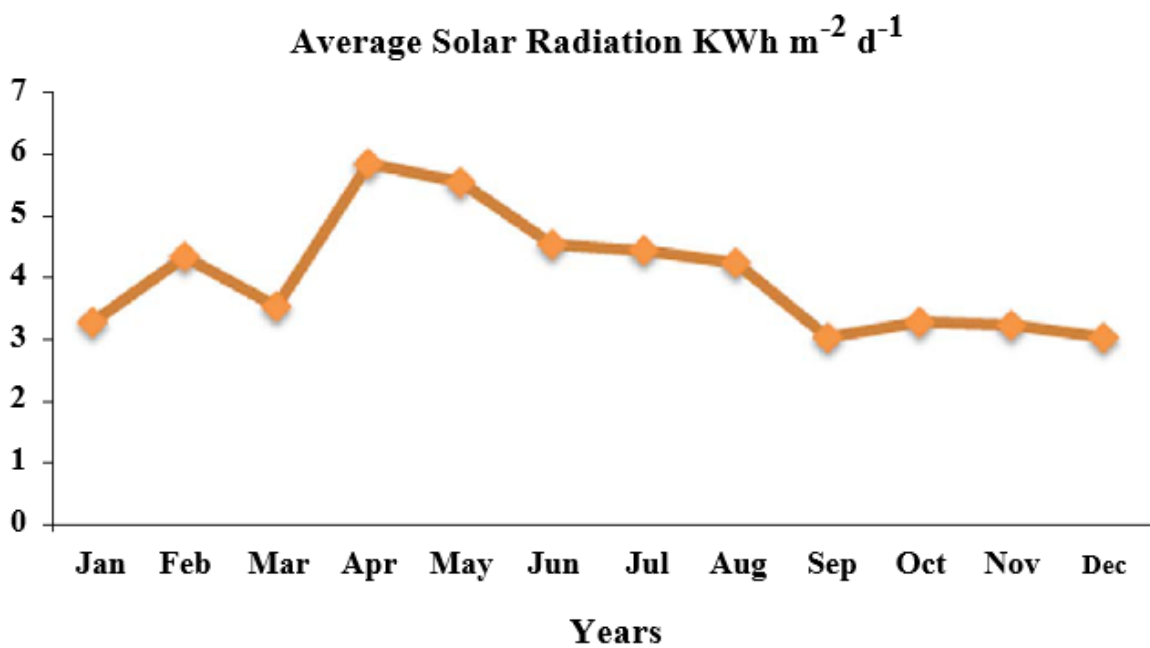


Fig. 2.13: Monthly average solar radiation profile in Bangladesh

Even in the rural areas, some NGO's have been attempting to convey solar boards to the villagers at a low-evaluated price. The SRSs establishments have significantly greater up to 2015. The chart enlightens that the appropriation of the SRSs is most elevated in Dhaka area, while least in the Sylhet. We can figure sun-oriented power using the going with condition. Solar power, solar=area per sq-ft×watts per sq-ft.

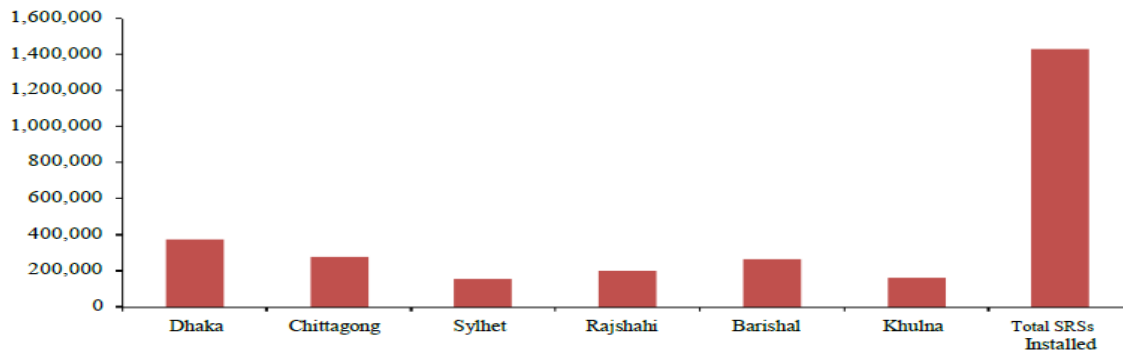


Fig. 2.14 Distribution of SRSs in six divisions of Bangladesh up to Jan 2015

2.4 Benefits of solar energy:

The Institute of Fuel Research and Development (IFRD) of Bangladesh Council of Scientific and Industrial Research (BCSIR) and Centre for Mass Education in Science (CMES) cooperated and effectively made one cooker which is low in expense and light (presumably about 2–3 kg) in weight. But it has one disadvantage, as it has to track down the sun manually on a splendid bright day it will take around three hours to cook for a group of 5–6 individuals.

The Institute of Food Science and Technology (IFST) is working on increasing Solar Dryer. They have built up a bureau dryer for drying organic products, vegetables and fruit.

It is structured by IFRD and has a covered level plate which assimilates solar radiation, changes over into heat and transfers the resulting heat to circulating water. This kind of heater is valuable for providing low grade thermal energy at temperatures below 90°C [10]. Solar PV based irrigation is not a new concept in Bangladesh. It does not require any highly sophisticated component. The main challenge comes from the actual cost of irrigation, which is mainly dependent on the irrigation model in the context of the socioeconomic condition of rural Bangladesh. Since necessities are intense just in the midst of the dry months (3–4 months), the overhead cost ends up being too high for significant irrigation projects. Last 5–6 years, SRS a massive improvement in nation Bangladesh and it reflects the aura of the rustic individuals towards an elective source. Incredibly, essentialness yield in a SRS is low and is barely enough to meet the crucial nuclear family require like lighting, as the yield of SRS are not all that high. SRS isn't intended to give energy bolster even too little scale industry. A choice is a micro grid framework where autonomous little size lattices are intended to give capacity to little country regions from a midway found power station. These power stations could be only sun-oriented photovoltaic, or sun-oriented photovoltaic. Diesel half breed. There can be two choices so

far, the plans of the smaller scale matrices are concerned 1) AC micro grid and 2) Dc miniaturized scale matrix [11]. Still initial cost might be high, yet it can keep running for quite a while. We find right now two kinds of electric vehicles are running in our nation. One is privately called "simple bicycle". It looks carefully comparable conventional CNG based auto rickshaw with the exception of its keep running on battery. The second one is two situated rickshaws. The two are energy efficient and condition cordial being basic on the planet and also Bangladesh. Ordinarily they continue running on 50Ahr, 80Ahr, 100Ahr and 120Ahr battery subject to the size and speed of the vehicle. At present there is no alluded to stimulating station for charging them as it expands heaps of intensity from the framework. So, a Solar PV based electric vehicle energizing station can be made. This methodology can continue running near to the Normal CNG filling station or petroleum, Pump, as the sun-based boards would be mounted over it. This strategy can work in basically all parts of BANGLADESH as the whole country stand up to generally same sun-based protection enough to convey required electrical energy [11].

2.5 Solar cooking and its future in Bangladesh:

A sun-oriented cooker is a gadget that utilizes daylight to create warm with the end goal to cook sustenance. Sun-powered cooking is the clean and safe method of cooking. It uses sun-oriented energy which is luxuriously accessible in nature to cook nourishment. It has three noteworthy kinds of sun-based cookers [11]. Provincial having power accessible to them, found there is fundamentally more that ought to be conceivable to improve their, welfare, training, horticultural production new vocations have been made where have been set up to give after-bargains organizations to the customer, and show the authorities customer on the most proficient method to work and keep up the SRSs. No less than 20,000 green occupations have been made with around 5000 women arranged as sun-based specialists using this system and step by step people are getting drawn in with this program [12].

2.6 Socioeconomic development in rural area through solar system:

One of the elemental financial exercises of country Bangladesh depends upon common markets known as Haat. The mercantilism continues till night. Generally, kerosene lights known as Kupi, Hurricane and Mantle lights known as Hazzak are the massive mechanical assemblies went to instruct the Haat outlets. Directly consumer outlets are related to sun-oriented PV smaller scale energy and victimization lights to instruct their outlets that are protected and terrible.

The principal sun-based PV smaller scale energy was set up in September 1999 in Manikgonj. Contribution from customers of a sunlight-based PV smaller scale energy in Manikgonj Bazaar demonstrated that customers were extraordinarily content with this advancement. [12]. Sun oriented energy may give clients' comfort to some degree and can add to the national economy if it's sold inside and outside of the country; the examination expects to explore whether sustainable power source business industry executes a run of the mill philosophy to position itself in wherever all through the country.

2.7 Importance of solar energy for rural electrification in Bangladesh:

In 1971, the season of opportunity of Bangladesh, only 250 out of 87,928 towns approached power. Administration of Bangladesh (GOB) subscribed to build up a program for giving power to rustic regions. Article 16 of the Constitution of Bangladesh states: “The State shall adopt effective measures to bring about a radical transformation in the rural areas through the promotion of an agricultural revolution, the provision of rural electrification, the development of cottage and other industries and the improvement of education, communications and public health, in those areas, so as progressively to remove the disparity in the standards of living between the urban and the rural areas”[13]. Bangladesh Power Development Board (BPDB) was framed to work and extend the electricity network, which essentially focused on electrification of urban centers. To increment rural electrification National Rural Electric Cooperative Association (NRECA) was authorized to conduct an extensive study.

NRECA built up master plan emphasizing on the provision of electricity for agricultural mechanization, irrigation and rural industries. The master plan was adopted in 1977, closely followed by the establishment of the Rural Electrification Board (REB) in the following year [14]. By January 2014, in excess of 50,194 villages had been electrified through the REB program serving more than 84, 22, 246 domestic line (REB, website) and 53.34% people get access to electricity service and the rest 46.66% depends on kerosene and other sources [14]. The REB has set a goal to bring all villages of Bangladesh under electrification by 2020. However, it must be noticed that the electrification of a village does not necessarily mean that all households will instantly get a connection, as affordability of the underlying association cost makes an issue for certain number of families. Subsequently, just a little minority (10%) of rural Bangladesh is have access to electric power. Moreover, the nature of supply is regularly inadmissible because of successive load shedding and voltage fluctuation [16]. In more remote zones, dissemination line set-up is all the more exorbitant because of its landscape dominated by extensive areas of water, regular flooding, hilly and certain regions of river islands. In

this circumstance, decentralized power supply with RETs might represent a viable and cost-effective alternative to conventional grid-based electrification. Natural gas reserves assessed to be depleted soon and Bangladesh's petroleum consumption being absolutely import-based, increased use of renewable energy sources seems to be a reasonable step for the development of a sustainable long-term energy scenario [17]. Despite the fact that Bangladesh's physical scene is molded by tremendous measures of water, the potential for hydroelectric power generation is quite limited. Country's only hydroelectric plant, Karnafuli power plant, has a total generating capacity of 230MW, representing about 5% of the total installed capacity of electricity in the country. The development of the dam and the reservoir for the Karnafuli power plant prompted extreme negative ecological and social influences making long drawn social distress among the nearby populace. Again, electricity generation from wind power is likewise more constrained in Bangladesh for scarcity of usable wind speed. Besides, generation of electricity from biomass for example, animal waste or deposits are still in the beginning period of improvement and testing. Bangladesh is geologically situated in an ideal position for outfitting sunlight accessible plentifully for a large portion of the year. Normal everyday radiation of sunlight-based energy is about 4.5 kWh per square meter making it in fact very practical to utilize photovoltaic energy for electrification purposes [18]. Experience has revealed that Photovoltaic (PV) electricity seems to be more appropriate for isolated rural areas away from conventional gridlines [18]. He also states for the future that with enough political help it is conceivable to 'Plug even the remotest rural areas of Bangladesh to the sun' [18]. From the above conditions, the use of solar energy (Solar Home System) is the most achievable choice for rural electrification in Bangladesh. In figure 2.15 we can see that there is boat, it is not an ordinary boat, basically it is a floating school which is provide education in floating area such as tangorhayor in sunangonj . This area is often flooded under water most of the time of a year. BRAC and other organization decided that to educate this flooding area children. As a result they made a floating school and this school is electrified by solar panel.



fig 2.15: Solar based school in rural area

2.8 Worldwide solar rooftop home installation:

The utilization of solar electricity expanded at the revelation of photovoltaic cell in 1839 by French physicist Edmond Becquerel. Progressive specialists have created cells with more productivity. The primary enthusiasm for solar technologies for rural stand-alone electrification arose in the 1970s. An economic breakthrough happened when Dr. Elliot Berman could plan a more sun-based cell bringing the cost down from \$100 per watt to \$20 per watt. This huge cost savings opened up a large number of applications that were not considered before because of high costs. The 1973 oil embargo and 1979 energy crisis caused a reorganization of energy policies around the world convey are established thoughtfulness regarding creating solar technologies. Between 1970 and 1983 photovoltaic installations grew rapidly, yet falling oil costs in the mid-1980s directed the development of solar photo volt from 1984 to 1996.

By the mid-90s, different activities were launched to scale up into expansive SRS commercialization and government-supported scattering program. Since 1997, solar electrification has accelerated due to supply issues with oil and natural gas, global warming concerns and the improving economic position of PV relative to other energy technologies. Before the finish of 2005, 2.4 million SRSs had been introduced worldwide with an expected yearly establishment of in excess of 270,000 frameworks (REN 21 2006: 12) [19]. Dissemination of SRS depends on affordability. According to F. D. J.

Nieuwenhout adequate service infrastructure is required to make projects viable. Household choice in system sizes is often too restricted in donor-funded projects. Smaller frameworks sold for money can be a decent choice to credit frameworks by offering to expanded moderateness (F.D. J.Nieuwenhout, et al, 200; 9: 455-474) [20]. Contingent upon their size, costs of SRSs can shift between US\$ 100 and US\$ 1,100. There are also significant price variations for different countries observable. Local costs rely upon variables, for example duties, taxes, and subsidies, the scale of manufacturing and assembly processes, the scale and cost of marketing and other services, the degree of competition, capacity utilization in manufacture, sales & servicing and the cost of funds for working capital and capital costs. The other real issues to be considered are the high starting costs, the foundation of a responsive and practical framework and the ensuring of value items and administrations. Reducing the market prices of SRS by impacting the above components is an imperative methodology of numerous SRS spread projects (CABRAAL et al. 1996: 8-9) [21]. In recent years most of the global growth in SRS deals has focused on a couple of Asian nations, to be specific India, Sri Lanka, Nepal, Bangladesh, Thailand, and China. In these the problem of affordability has been overcome either with micro-credit or by selling small systems for cash.



Fig-2.16: Worldwide solar rooftop home installation

2.9 Summary:

The article takes a look at the basic factors to be considered to build up a solar rooftop system. The system comes out of the solar energy. Solar energy uses the sun as the source of energy and helps it to turn the energy into electricity for home or business. Various Classifications of energy are analyzed within this review. The main procedures that help the system to run are also serially discussed here additionally with the explanation of different examples of the energy.

Chapter Three

Research Methodology

3.1 Introduction:

As it is indicated within the title, this article is included in the thesis investigation process. In more details, in this half the artificer outlines the investigation strategy, the investigation method, the experiment approach, and the strategies of data collection, the choice of the sample, the research method, the type of information analysis, the moral issues and therefore the research limitations of the project. This observation was intended to research the socio-economic effects of solar rooftop system and find out the answers what is the users think about its appropriateness. These study are applied in business and industrial areas of Bangladesh. the survey initially based on social analysis. After that, we gain basic data about the impacts of solar electricity and its effectiveness are Collected through an intensive unit survey technique victimization form. Initial judgment of the survey is actually collected from the users of solar roof system and taken judgment by the owners or the users of this system.

3.2 Flow chart of our working procedure:

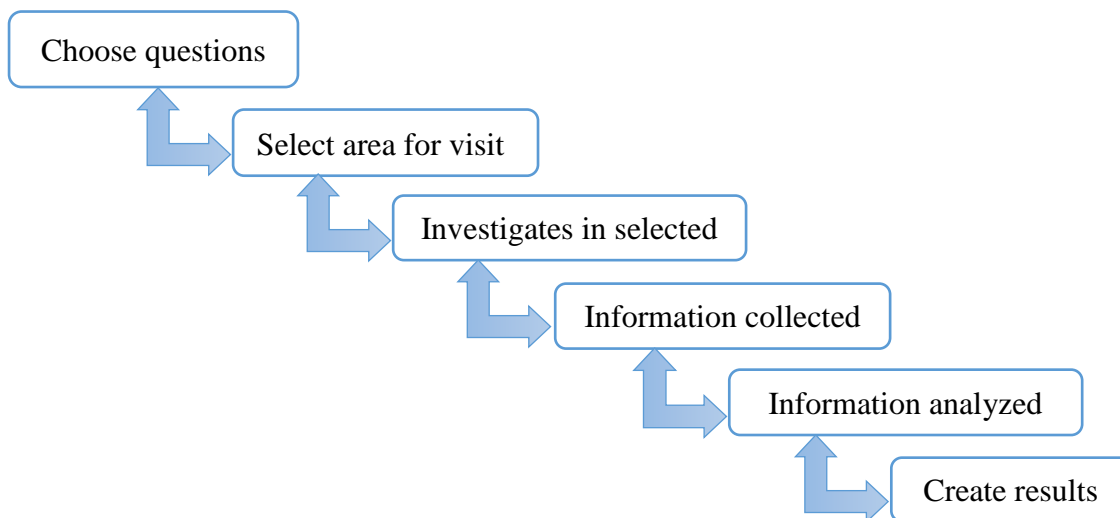


Fig 3.1: Flow chart of our working procedure

3.3 Site Selection:

The survey is mainly covered in one of the busiest cities of the country. Narayanganj is a city in the central of Bangladesh and it near the capital city of Dhaka. Narayanganj regarding 24 kilometers far away from Dhaka. It is known as a town in central Bangladesh. It has a population of about 2.2 million. The town is on the bank of the Shitalakshya stream. The area of the city is 33.57 km² (12.96 square meters).

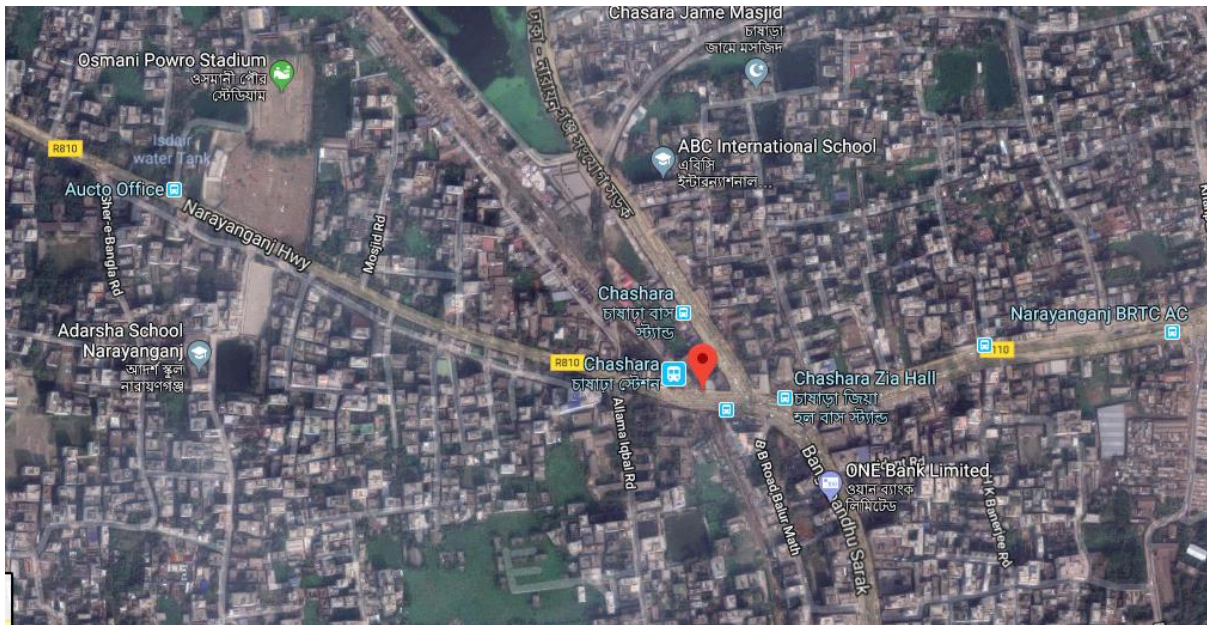


Fig 3.2: Map of the survey location

The port of Narayanganj is an important shipping and industrial center. It is also a center of business and industry, especially the jute trade and processing plants, and the textile sector of the country. It's nicknamed the Dundee of Bangladesh because of the presence of its many jute mills. According to the base of the analysis, this city was chosen for this study. Approximately 30 fields regarding buildings and industries are infrequently visited for the analysis of the thesis. These fields are circulated under the assistance of DPDC. Some areas regarding new chasara, Allama Iqbal Road, north chasara, Chandpura Adarsha Chasara, Nag road are given for the survey. For well understanding More than 30 queries are asked in Bengali and no one feel hesitated it was taken as simple as it is possible. At the survey time most owner of the buildings are not found there. So, the queries are actually asked to the person who operates the system but we realize that some fields couldn't provide us with the actual data and information. So, the information's taken from the owners of the system or the person who looks after the

system through a phone call as they are not present over there. The remarkable thing is that most of the operators or the owners of the system are very helpful to the survey activity which makes the project go thoroughly. To make the survey easier, couple of assistance is provided from the DPDC. It obviously makes the process easier and to find the places of SRS-owned area.

3.4 Working Sheet:

Through information assortment and observation of the prevailing SRS, a transparent plan was developed concerning the current standing of solar roof system within the households, the difficulties faced by them, maintenance facilities and therefore the time of rectification needed during fault condition was noted in several cases. Normally, it takes some of days if the fault develops within the SRS. There's a good impact of solar power on our country additionally as on our rural folks. It is intended to try to figure out however the life-style is stricken by solar power. We got an outline from the questions sheet.

3.4.1 Questionnaires:

Table 3.1: Table of questionnaires

Serial No.	Items	Questions	Description
01	Consumer information	i) Name of the owner: Md. Jahangir hossain ii) Mobile No. 01711560898, Address: 46/27-A, new chasara iii) Consumer No.1435694	In this technique we have a tendency to simply collected client data
02	Installation Information	i) Date of installment: 3 years ago ii) Total capacity: 1.92 KW iii) Bought SRS from where: Market	During this half we have a tendency to asked and tried to seek out the data of installment.
03	Operation	i) SRS are in operation or not: Yes ii) Is consumer use it?: Yes	In this part we checked the present situation of SRS

		iii) In which purpose they use it? : Policy obligation iv) Electricity generation: Yes	and how much electricity they get from solar.
04	Maintenances	i) Do the clean the panel: No iii) Do they get any training about SRS: No	In this part we wanted to know about maintenance and training.
05	Consumer satisfaction	i) Do they want to increase SRS capacity: No ii) SRS is useful or not: Yes iii) Is it the waste of money: No	The part we tried to know the consumer are satisfied or not.
06	Cost analysis	i) Total cost for SRS: 2 lakhs ii) How much electricity generated: 1101.63 kwh	In this section we calculated the electricity generation per unit and its cost.

Maximum solar rooftop systems were found on grid and in operation. In addition, some of the systems were found uninstalled as well. There's a query about whether the people find it useful or not. Generally, a major number of people find it useful and satisfied to use the electricity from the system for their various purposes. The total costs of the system were approximately found in between eighty thousand and six lakhs. Many interviewed people showed their keen interest to increase the capacity of the system as well which is a good sign of the appropriateness of the solar rooftop system on our country. There's a matter to find out that how many of them actually clean the system and repair it and what's the actual duration to clean it. As it is found that most of the people are not well trained to operate the system, a few numbers of people were found who cleans the system within certain duration and test the system in a regular basis. Alongside with all the queries, there's a very limited support from the government to increase the crews of users of the solar rooftop system.

3.5 Summary:

In this survey we know that about deficient thinking for solar roof top setup and also mentioned earlier home, tiny business and academic institutions were surveyed. It's clear that solar rooftop system is largely used for social unit use as fuel value is reduced to a good extent by using SRS. The noticeable thing from the study is that a number of people are coming to know the usefulness of the system. Due to lack of knowledge about it, some people also find itself just a waste of money. According to the study, there's no hesitation to say that majority opinion finds the system appropriate for reducing the value of electricity. If the government gives proper support, crew of the users will grow up gradually and many of the present users will be intended to increase the capacity of solar rooftop system.

Chapter Four

RESULT

4.1. Introduction:

Background, concept, and gift scenario of solar electrification dissemination for transfer socioeconomic development in numerous areas are mentioned. It is observed from the previous discussion that energy plays the key role for development. Due to rise of fuel value and increasing carbon emission worldwide, there's a worldwide shift towards renewable energy like solar, wind etc. Being in tropical region, Bangladesh could be an alternative energy wealthy country. Alternative energy will play a significant and secure energy supply for property development. The most objective of this study is to assess the impacts of alternative energy on socio-economic development in rural areas of Bangladesh. To verify the target through empirical observation, a cross-sectional of twenty-five haphazardly elect households and industries in Narayanganj space are surveyed with a structured form. The survey results are analyzed as follows within the following sections.

4.2 Data Analysis:

In this part we are showing the results through the questionnaire segment part. In these part we tried to show the results of the each items of the questionnaire segmet. We also tried to find out the solution from bellow results.

4.2.1 Consumer informaton:

Figure 4.1 indicates that we divided the survey area into four different region. These four regions are Killarpul, Fatulla, Nitaiganj, Chasara , College road And Bk road. For showing information, we used pie chart.

Number of consumers:From pie chart, we can see that 8 consumers are in Chasara, 5 consumers are Killarpul, 3 consumers are in Fotulla , 5 consumers are in Nitaiganj Area, 4 consumers are college road and 4 consumers are in Bk road .

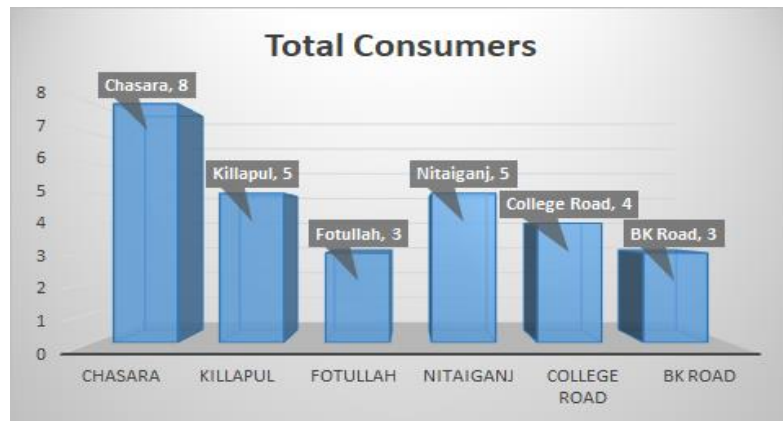


Figure 4.1: Total consumers

4.2.2 Installment Condition:

In installment condition parts, we showing three different regions of installation system. These two are total capacity, installment condition and brought the solar system.

➤ **Total capacity of solar panel:**

Figure 4.2 shows that, after calculating the total capacity of the result is 20KW. In between 20KW, west zone have been intall 13kw of the total capacity and east zone part have been intall 10kw of the total capacity .

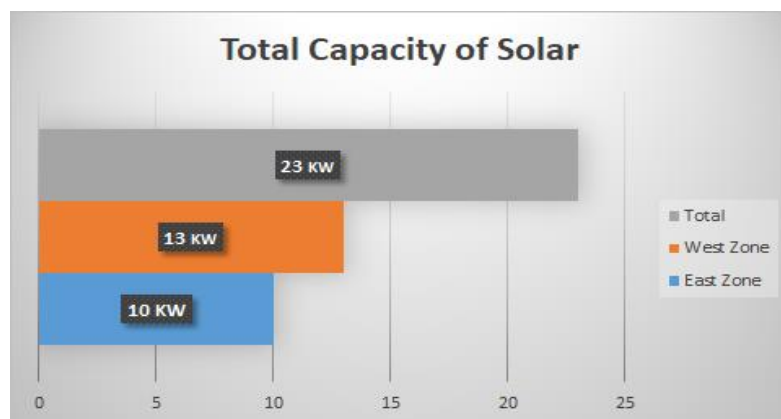


Figure 4.2: Total capacity of solar

➤ **Solar system provider:**

Under Narayanganj NOCS, we collected 30 consumers data samples. Figure 4.3 indicates that, between those consumers, 20 consumers are brought SRS from market for installation of solar home system, 10 consumers are brought SRS from DPDC agency But the consumers those are brought SRS from the market cannot get much electricity according to their capacity.

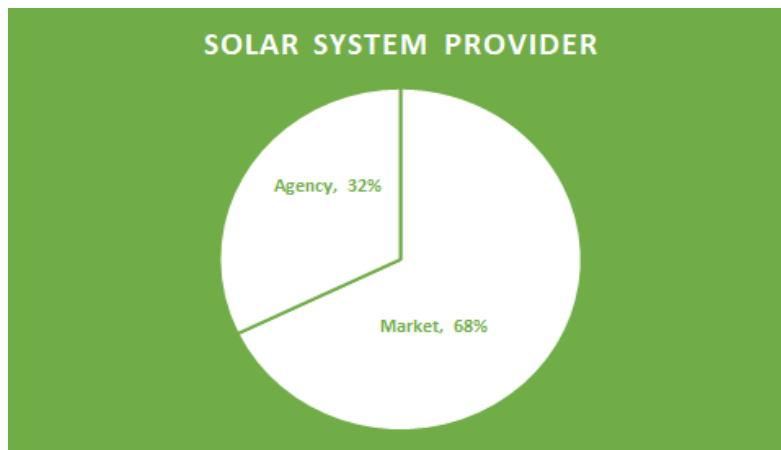


Figure 4.3: Brought the SRS

Installation process:

Figure 4.4 provides information that 24 consumers are installed SRS for the policy obligation. That means they have no interest to install the solar system. Other 6 consumers are interested to install the SRS system. That's why they intalled SRS for their own choice.



Figure 4.4: Installment condition

4.2.3 Operation:

In operation part we showing one chart which is solar system operate or not operate.

➤ **Operating status:**

In figure 4.5 we used bar type chart. This bar shows that, in home unit 3 SRS systems are in operation among 5 consumers, and in industrial sector, among 11 consumers, only 3 consumers are in operating modes and 8 consumers are not in operating modes. Its a very low numbers of SRS are in operating modes in industrial sector. Though there is highest numbers of SRS intalled in industrial sector. In commercial building, only 1 SRS is in operating modes among 4 consumers. At last we see in hospital there is 100% SRS system are in operation. That's are 5 out of 5 in operation .

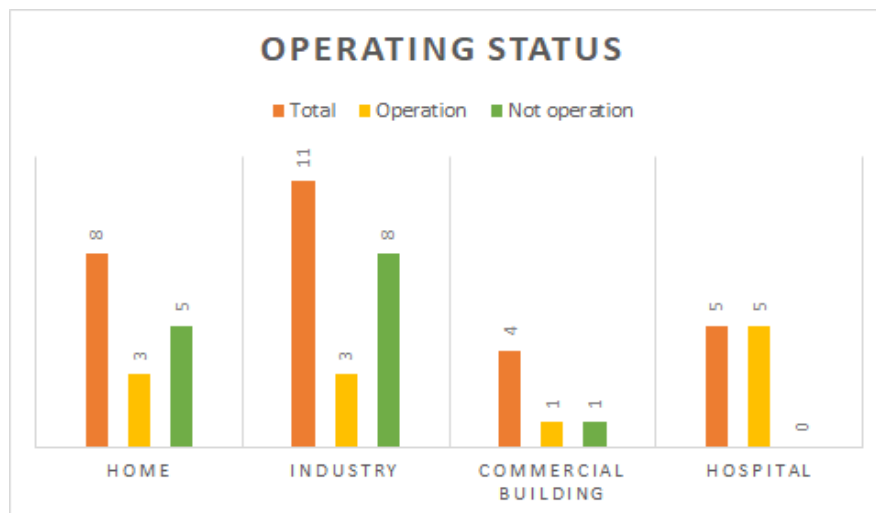


Figure 4.5: Operating condition

4.2.4 Maintance:

In maintances part we showing different types of conditional chart which is importance for maintances. These are cleaning the solar, getting any kinds of traning, facing any kinds of survey and records the solar elcetricity data.

Cleaning the solar panel:

In figure 4.6 indicates that we divided consumers into four different sectors. These sectors are home, industrial, commercial building and hostipal. In home sectors, 30% users are cleaning the solar panel and next 70% users are not cleaning the solar panel. In industrial sectors, 20% users are cleaning the solar panel and next 80% users are not cleaning the solar panel. In

commercial building sectors, 10% users are cleaning the solar panel and next 90% users are not cleaning the solar panel. In hospital sectors, 100% users are cleaning the solar panel.



Figure 4.6: Cleaning the solar panel

Getting training for SRS operation:

Figure 4.7 is a pie chart, which indicate that if consumer get any training on SRS . From chart, we can say that, between 89% percent consumers are not get any kinds of training for SRS operating. They are not interested to use solar energy and for this they don't agree to take any kind of training about it..



Fig 4.7: Training on SRS system

Facing any kinds of survey:

Figure 4.8 showing the pie chart with percentage value of facing any kind of survey. The pie chart indicates that 18 % users are facing survey one or more time. And 82% users are not facing any kinds of survey. Some of them realise that there need to held such kind of survey.

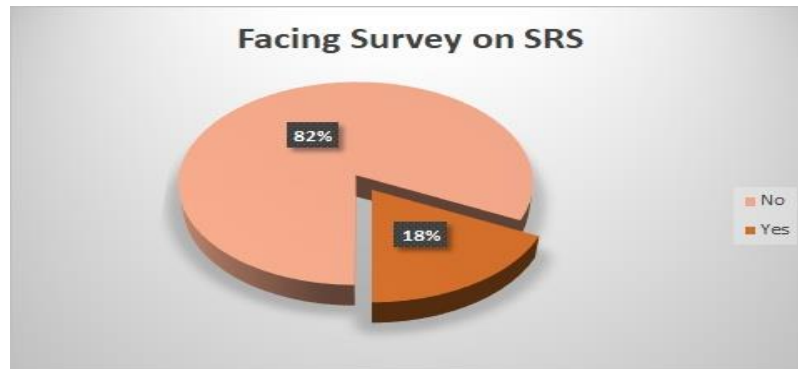


Figure 4.8: Facing any kinds of survey

Records of solar electricity:

In figure 4.9, we used bar type chart with data table of the consumers. In these chart, provides that in hospital sectors all consumers are recording the solar electricity. In commercial building between 4 consumers of 1 consumers are recording the solar electricity and 3 consumers are not recording the solar electricity. In industrial sectors, between 11 consumers of 8 consumers are recording the solar electricity and 3 consumers are not recording the solar electricity. And last sector is home. In home sectors, between 8 consumers of 4 consumers are recording the solar electricity and 4 consumers are not recording the solar electricity.

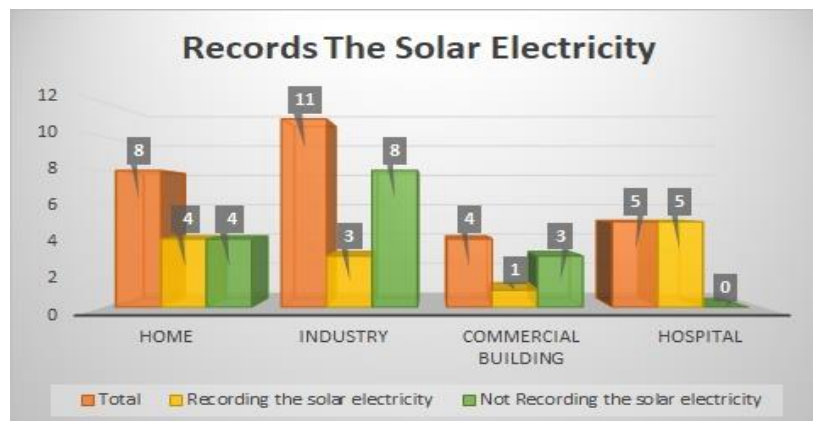


Figure 4.9: Records of solar electricity

4.2.5 Consumer Satisfaction :

In consumer satisfaction part, we get various types of questions or comments which is useful for making these report. These questions or comments are showing through chart. These chart are increasing the capacity of the solar, solar is useful, is it waste of money.

Increasing the capacity of the solar:

Figure 4.10 gives us consumers interest about increasing the capacity of the solar system. It shows the information that all 40 users didn't want to increasing the capacity of the solar system. They think that the solar system is not useful and waste of money.

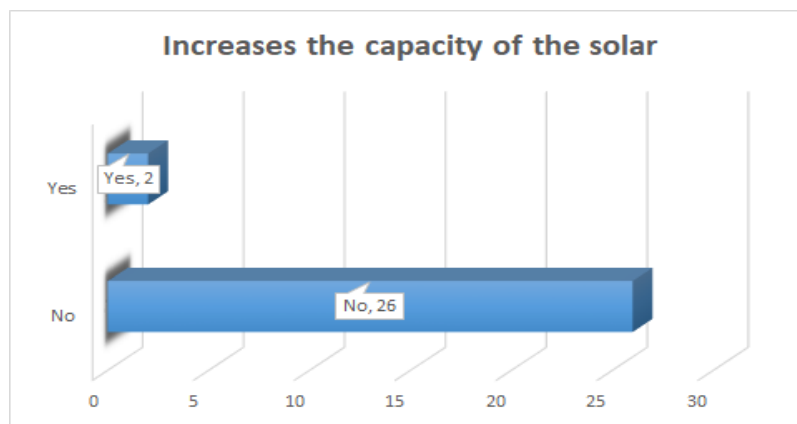


Figure 4.10: Increasing the capacity of the solar

Waste of money:

In this chart showing the result of the survey that is most of consumer are thinking that , this is the waste of money. That is indicated that they are not adopted the using of our renewable source like sun ray.



Figure 4.11: Waste of money

4.3 Cost calculation of per kWh of solar electricity:

➤ **Sample calculation:**

Lifetime of solar panel = 20 years

Total cost of solar system = 200,000 taka

Date of installment of solar system = 2015/10

Date of survey= 2018/11

Time duration of starting generation = 3 years
= 3.00 years

Yearly generated = $\frac{1101.63}{3} = 367.21$ kwh/year

Total generation = $367.21 \times 20 = 7344.2$ kWh

Cost of per kWh of solar electricity = $\frac{200000}{7344.2} = 27.23$ taka/kWh

- In below we added a table, which is indicating the previous two-cost calculation and more:

Table: 4.1 - Cost Calculation of per kWh of solar electricity

SL No.	Total Cost	Capacity	Lifetime(years)	Cost of per kWh(taka/kWh)
01	90000	880 W	20	12.10
02	50000	500 W	20	19.72
03	100000	500 W	20	30.67
04	200000	1.92 kW	20	27.23
05	150000	1.20 kW	20	11.36
06	450000	8.4 kW	20	14.37
07	120000	1 kW	20	15

From this table we clearly see that, which consumer solar electricity cost per unit is less than 20 Taka. They all are bought from DPDC agency. That information we collect from the survey, there the DPDC providing SRS are more proficient than the local market SRS. We also compare that per unit cost of two consumers and after analysis we got the which consumer per unit solar electricity cost is more than 20 Taka they all are bought SRS from local market. This is very high rate of per unit cost of solar electricity

4.4 Problem finding and suggestion:

After completing the survey according to the indicators and analyzing the result we pointing out some important things,

- The main thing is there consumers are not concern about the SRS properly.
- So, here need to guidance the consumer when SRS is provided.
- Consumers do not have enough knowledge about how to clean it and the usefulness SRS system.
- There should need to train the consumer so that they can clean it properly and should inform about the usefulness of the SRS system.
- Majority of the consumer do not know about the net metering system.
- Government organization should inform the consumer how they will get profit by net metering system.
- About 98% consumer think that SRS system is waste money, they do not get much energy from SRS but its initial cost is very high.
- Government should reduce the market price of instrument for the SRS system.
- From above analysis it can be roughly estimated the data in the respective areas.
- To find out actual data on solar rooftop system, we need huge time. Further studies are required in this line for better understanding of SRS in various area of Bangladesh.

Chapter Five

Conclusion

5.1 Introduction

In this paper we discuss about solar roof system with its usefulness and significance to the modern society. In this technology helps us growing day after days, to this and using all of it for the betterment of future. The advantages and disadvantages, various limitations of solar rooftop system have been discussed here. Among all the advantages of solar panels, the foremost necessary factor is that solar power could be an actually renewable energy supply. It is often controlled all told areas of the globe and is on the market daily. We have an inclination to run out of alternative energy, in distinction to variety of opposite sources of energy. Solar power goes to be accessible as long as we have got the sun. Star top system, could also be associate degree electrical phenomenon plant that has its PV panels place in on the roof of a building. The urban atmosphere provides an outsized amount of empty top areas and should inherently avoid the potential land use and environmental concerns. The utmost dimension of associate degree top theme depends on the planet of the roof, so top star systems unit of measurement generally very little compared to ground-mounted physical phenomenon power stations. The standard dimensions of associate degree electrical phenomenon panel (power from 280 to 340 W supported efficiency and vary of cells of that it's composed) is regarding 1mx2m, so one kWh of PV panels covers regarding 6-7 finances of roof. Additionally to the dimensions of the quilt, the power of a top theme is in addition influenced by different factors just like the position, orientation and inclination of the roof. Since you will be meeting variety of your energy wishes with the electricity your system has generated, your energy bills will drop. What proportion you save on your bill goes to be addicted to the dimensions of the system and your electricity or heat usage.

Moreover, not solely can you be saving on the electricity bill, however if you generate additional electricity than you employ, the excess are going to be exported back to the grid and you'll receive bonus payments for that quantity (considering that your electrical device system is connected to the grid). Savings will any grow if you sell excess electricity at high rates throughout the day then obtain electricity from the grid throughout the evening once the rates

square measure lower. To justify the statistics of the appropriateness of any project, gathering the people's thought is the best way to do the job. At the end of the time, public demand matters. Solar rooftop system is the simplest way to reduce the waste of electricity. In this study and survey period, this was the initial basis to research whether the users of the system are taking it within a positive way or not. In the research, it is found that majority of people don't know either the significance or the usefulness of the solar rooftop system. Being a developing country, the government should obviously be concerned to this system about how the system can be developed to the modern society. Some steps are to be taken as people gets query and come to know about the system. If this happens orderly, people will definitely be influenced to increase the capacity of the system.

From the survey we found that, various types of consumers information who are using SRS system. There we visited 25 consumers in Narayanganj area. We collected consumers name, contact numbers, addresses. Here we check those SRS are in operation or not. If those are in operation, we collect the meter readings and calculate per unit cost. If those are in not operation, trying to know the reason behind it. From 25 consumers we found 10 SRS system are in operation and rest 15 are not in operation and 5 of them are brought the SRS from the DPDC agency and others are from local market. We see here that 90% of consumers do not clean the solar panel. For this maximum SRS cannot generate proper electricity according to their capacity. There no consumers do not get any kind training about SRS. And mainly we found 92% consumers are not satisfied to use SRS. The per unit cost of solar electricity is about 15-30 taka. This is very expensive.

5.2 Future work:

At this survey was taken within various areas of Narayanganj throughout an inquiry form. Now we can survey another city or in this city other side. A proposed discussion has been going on that another survey will be covered within Dhaka city under DPDC as well. After completing this survey both Dhaka and Narayanganj city we make a report on SRS system for DPDC which is help them to make decision about solar system.

In this survey we know that 92 percent of the interviewed people are not satisfied with the system and its actualization, this people want to need some improvement in solar system. A

hypothetical discussion has been going on that another survey will be covered within Dhaka city under DPDC as well. The principle of this objective is to circulate the usefulness and its effectiveness to people who keeps a limited knowledge about solar rooftop system. Among the circulation, an inquiry form will be also provided to the interviewed crew. It is hypothesized that a stimulation lesson will be discussed with the people not taking the system due to having below knowledge about it. It will be emphasized that solar energy systems typically don't need a great deal of maintenance. You merely got to keep them comparatively clean, thus cleansing them a few of times annually can do the task. Technology within the solar energy business is consistently advancing and enhancements can intensify within the future. Innovations in physical science and engineering science will doubtless increase the effectiveness of solar panels and double, or maybe triple, the electrical input of the solar energy systems.

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