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Conference Paper · September 2014

DOI: 10.1109/ICGET.2014.6966674

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A Study of Solar Home System in Bangladesh: Current Status, Future Prospect and Constraints

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***Abstract*—Power is one of the most important factors in developing the economy and the standard of living of a country. Like the rest of the countries of the world, in Bangladesh the demand for power is increasing day by day. To fulfill our future power demands, Solar Home System (SHS) seems to be the only feasible form of renewable energy despite the cloudy climate in Bangladesh. The objective of the study was to observe the present conditions of the SHS, the degree of satisfaction experienced by the users of SHS, finding the prospects and constraints as well as contributing in the field of solar energy through presenting and highlighting important principles of solar energy. Our study revealed the users' satisfaction level to be not that encouraging due to low back-up time, high cost and increased interest rate. If these hindrances are overcome then this would show positive proliferation in the energy sector of Bangladesh.**

Keywords-Renewable Energy; Solar Home System (SHS); Current Satus of SHS; Constraints of SHS; Future Prospects of SHS

I. INTRODUCTION

Electricity plays very important role in developing the economy and the standard of living of a country. To enhance employment opportunities, policies and incentives are there to facilitate the growth of both the agricultural and the industrial sector which are totally depends on electricity. However, generation and supply of electrical power in the country is lagging much behind the growing demand prohibiting sustainable growth of the economy. Bangladesh largely depends on natural gas and hydro power stations to generate major portion of power. But our demand rises day by day and power crisis becomes a major problem for our country nowadays. Though many power generation units have been added to the national grid to solve the power crisis issue, but it is not enough. High demand and increasing need of power have created challenge for the power stations to meet the demand.

In Bangladesh, a large portion of total population still does not have the access to electricity. Nowadays fuels account for 99% of energy consumed in rural households. Only about 60% of total populations in Bangladesh have access to electricity and it would take around 15 years to provide electricity to all [1]. To solve this energy crisis we can use different form of renewable energy to generate power. Renewable energy comes from different types of natural resources mainly from sunlight, wind, rain, tides, and geo thermal heat, biodiesel, biofuel, etc. [2]. Many Government and non-government organizations are working with different types of renewable energy sources to provide electricity to the common masses. To fulfill our electricity demand solar energy through solar home system (SHS) has become popular in Bangladesh due to its low price and loan system provided by different organizations. The implementation of SHS programs was carried through two different delivery models. The first model is implemented by the Rural Electrification Board (REB), the state-owned utility responsible for grid-electrification in rural areas. The second approach is through a private implementing agency, the Infrastructure Development Company Limited (IDCOL), which sold the systems to households using a micro-finance scheme implemented by various private agencies, such as Grameen Shakti. In particular, Grameen Shakti has played an important role in the dissemination of SHS in rural Bangladesh and its credit program has reached many low-income households [3].

Nowadays people of the country have taken solar energy as the alternate of grid electricity. However, SHS user may face some problems due to the new technology, lack of knowledge and lack of consciousness. Therefore it is very important to assess on SHS user for a bright future of solar PV panel as source of efficient electricity generation in Bangladesh. In this paper we discuss about the present electricity scenario from solar PV panel, different issues of solar home system users, user satisfaction level, constraints of SHS and overall impacts on the user of SHS in Bangladesh.

II. SOLAR HOME SYSTEM SITUTATION IN BANGLADESH

Solar Energy is a great source for solving power crisis in Bangladesh. Bangladesh is situated between 20.30 and 26.38 degrees north latitude and 88.04 and 92.44 degrees east which is an ideal location for solar energy utilization [4]. At this position the amount of hours of sunlight each day throughout a year and the highest and the lowest intensity of direct radiation in W/m² are also shown in the Fig. 1 [5].

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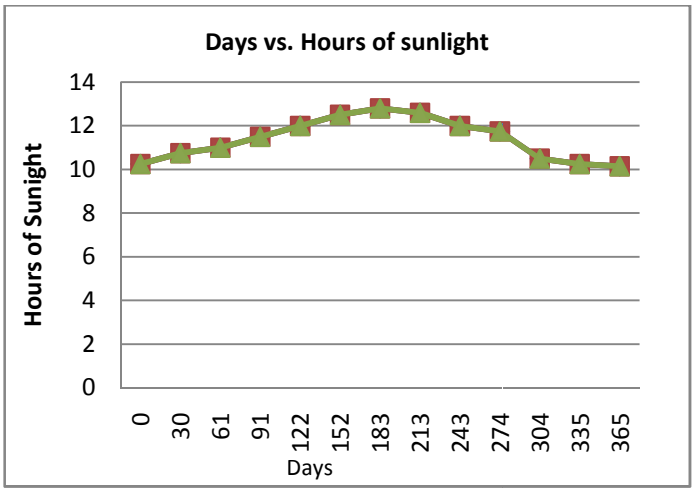

Figure 1. The amount of hours of sunlight in Bangladesh

Infrastructure development company limited (IDCOL) has supported NGOs in installation of solar home systems (SHSs) and a total of 1,320,965 SHSs having capacity of about more than 36.5 MW have been installed up to February 2013 [6]. IDCOL now has a revised target of financing 4 million SHSs by 2015. In 2012 alone, IDCOL has managed to finance 642,994 SHSs through its partner organizations. At this pace, in three years from 2013 to 2015, total installations in the next three years will be around 1,928,982. The cumulative total will be 3,882,868. This shows that with an extra push, IDCOL can achieve its target of 4,000,000 installations by 2015 (Fig. 2) [7,11].

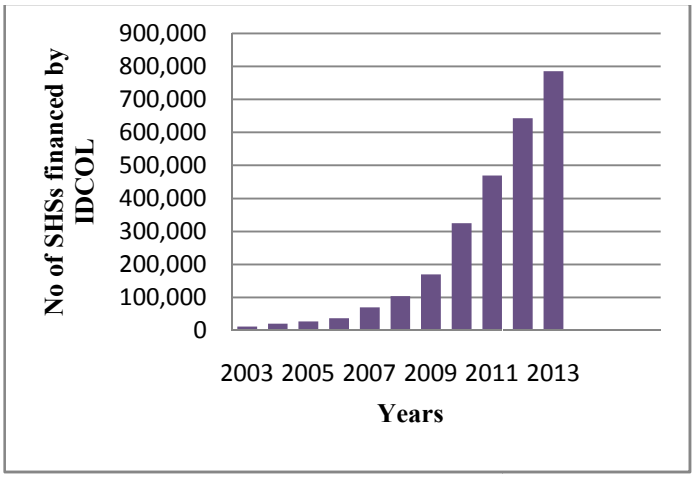

Figure 2. Shows year-wise installations of SHSs in Bangladesh by IDCOL

Figure. 2 show a sharp rise in the growth of number of yearly installation of SHS in recent years.

Bangladesh power development board (BPDB) has implemented an excellent Solar PV electrification project in the Chittagong hill tracts region. The Solar PV electrification has emerged as the most appropriate technological option for the electrification of these areas [8]. A 10 kW central AC solar PV system has been installed in one selected market in each of the three Rangamati district's sub-districts. With these systems, the shops of that market have been electrified with normal AC electricity [9, 11]. Different organizations are working on SHS installation and the following Fig. 3 shows the amount of SHSs installed by different Companies [10].

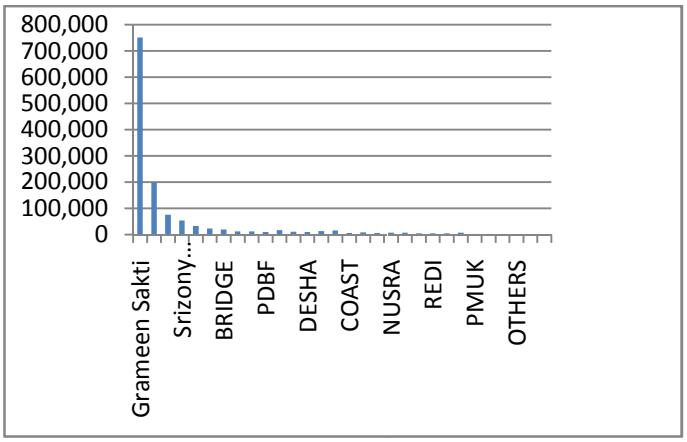

Figure 3. SHS's installation up to February 2013

Figure 4 show the approximate division wise SHSs installation. The figure illuminates that the distribution of the SHSs is highest in the Dhaka district whereas lowest in the Sylhet district [10,11].

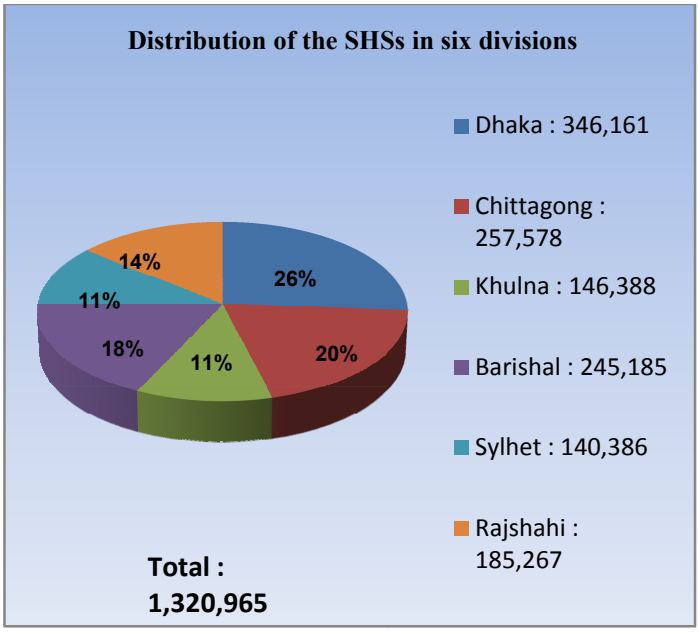

Figure 4. Distribution of the SHSs in six divisions in Bangladesh up to Feb 2013

Now-a-days, around 2 million SHSs already installed under IDCOL's financing with average capacity 50 W, total generation capacity in December 2012 is approximately 94 MW. At present around 60,000 SHSs are being installed every month under IDCOL's SHS program. At this rate, by December 2015, total generation capacity from this SHS program should reach about 200 MW. Introduction of solar PV systems has been in progress since 1980 but the total wattage up to December 2002 was just 1,000 kW [12]. In recent years, apart from SHSs, various other renewable energy projects such as biomass (rice-husk) gasification based power plants, biogas (from poultry litter and cow dung) based power plants; municipal waste based power plants are being implemented in Bangladesh. According to new regulations, every newly built high-rise building must install solar PV panels at the roof top before they get connection to electrical distribution lines. All these renewable energy projects are contributing in achieving the government's target of producing 5% power from renewable sources by 2015 and 10% by 2020 as declared in the Renewable Energy Policy of Bangladesh [13].

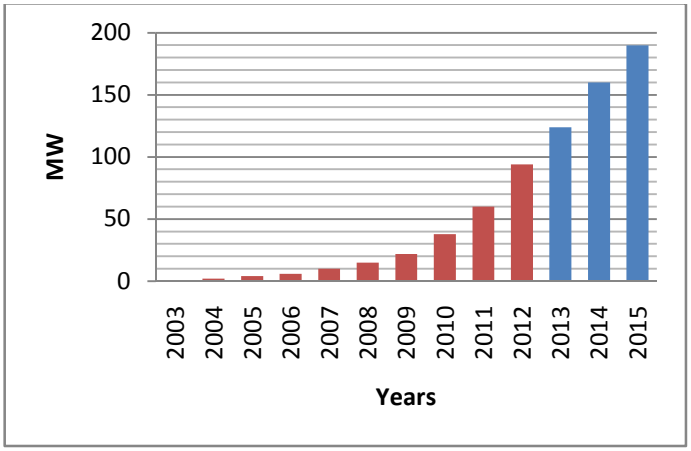

Figure 5. Cumulative power generation from SHSs

Figure 5 presents projected power generation from 2003 to 2015 if the current rate of installations is maintained.

III. Assessment Areas on SHS Users and Methodology

A mixture of qualitative and quantitative methodological approaches was applied, giving explanatory information regarding electricity's influence on the quantifiable socio-economic data. To complete this information with field level data, an extensive household survey and individual short interviews with shopkeepers, owners of small businesses and different institutions.

The main objective of our work is to find out different kind of problems faced by SHS users and determining why SHS is not receiving recognition all over Bangladesh. We selected mainly three kinds of locations- less remote, remote and highly remote areas to understand how the behavior of users and service providers varies with remoteness. We also attempted to understand how PV became admired in different kinds of areas. The less remote areas, where there are both grid electricity connection and SHS, helped us to understand users' comparative views on grid connection and PV connection. The less remote villages, where specifically there were both grid connection and SHS, were Toroprum-Ghunipara and Khas-Ghunipara; P.O.: Salimabad; Dist.: Tangail; and Mohongonj, Hashnipur and Achinghat; P.O: Chanderara; Dist.: Rajshahi; the remote village, Teparia; PO: Salimabad; Dist: Tangail; and the highly remote village, Bolorampur; PO: Dhuburia; Dist.: Manikganj. Almost equal number of users was selected from the mentioned above villages at random. In total 630 SHS clients were surveyed. We collected different kinds of data form SHS users such as their current PV panel size, connection duration, method of payment, why they decided for installations, commonly encountered problems with their connections, number of problems faced yearly, service provider issues, client satisfaction, total number of family members, future demand i.e. whether if they would increase connections in near future etc. Several shops were surveyed, also including several mosques and educational institutions. We tried our best to survey all types of people and exclude any unwanted biasing to provide proper sample population representation.

The interviews were recorded and transliterated for further analysis. Not all the data gathered through the interviews will be presented in this paper, as not all questions were meant to provide information for the current research objective. In our future work a variety of solar companies will need to be interviewed for the collection of data regarding the cost of installation and maintenance for photovoltaic systems.

IV. Results and Analysis

From our assessment on solar home system user in rural areas in Bangladesh, a clear idea was developed about the present status of solar home system in the households and different purpose, the difficulties faced by them, maintenance, service provided by SHSs provider company, user satisfaction level. Here we showed some important curves and relations that help us to understand the present prospects and constraints of solar energy in our country. In this research work we tried to figure out the actual condition of solar PV system and how the life style is affected by the solar energy. Following graphs show an overview of our study.

As mentioned earlier home, small business and educational institutions were surveyed. It is clear that SHS is basically used for household use as fuel cost can be reduced to a great extent by using SHS. Small business industries and shops are basically run during daytime in rural areas and they tend to depend less on SHS. We also surveyed educational institute and others small industries. Graph shown in the following Fig. 6 shows the relation between the types of user and percentage of SHS user.

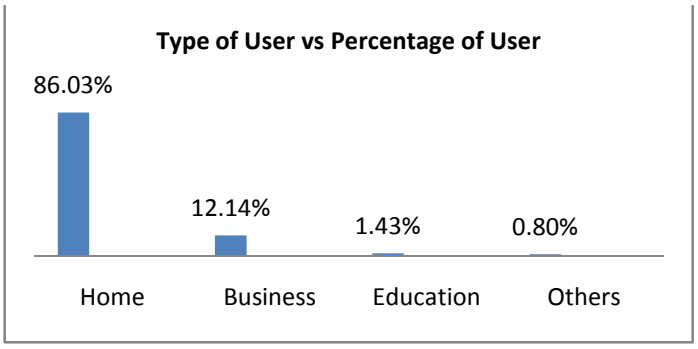

Figure 6. Type of user vs. percentage of user of SHSs.

Now we want to show the number of user of solar PV system depending on Size of panel.

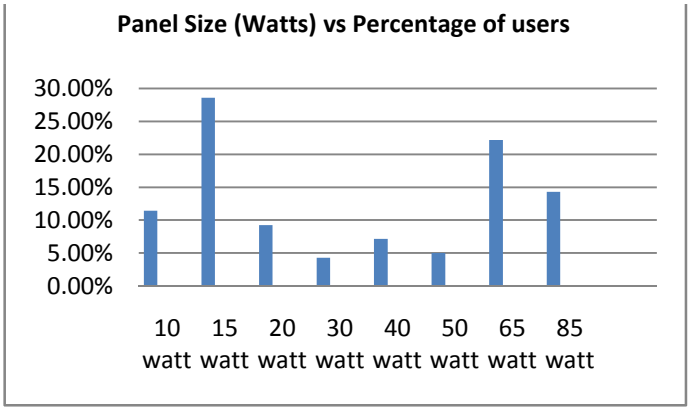

Figure 7. Panel Size vs. Percentage of users

Figure 7 shows the panel size vs. percentage of users. PV 15W panel is used most basically in highly remote areas for its affordability and the percentage of 15W user is large than others. 65W connections are used basically in less remote areas where users use solar panel for both comfort and lighting.

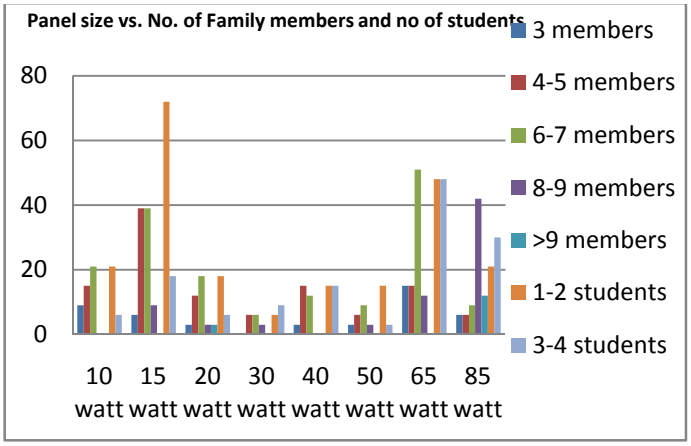

Figure 8. Panel size vs. No. of family members and no. of students

Figure 8 shows the variation of panel size with respect to family members and no. of students on that family. We see that the families having larger members uses large size panel and the families having smaller no of family members use small size panel. We can also conclude from the graph that small families mostly uses 10 to 20 watt panel and big families basically use 65 watt or 85 watt panel. Small shop users not included in this graphs.

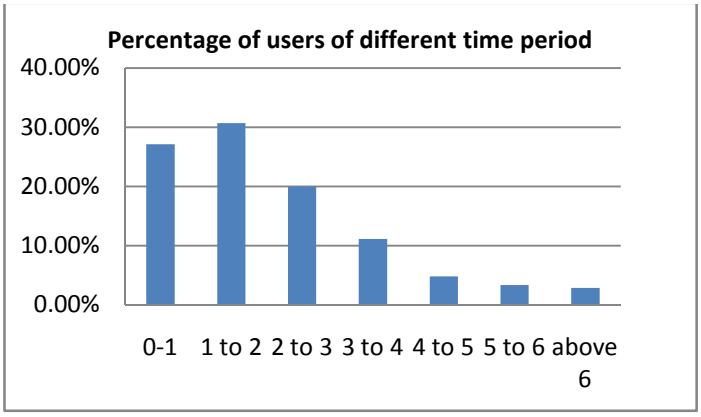

Figure 9. Percentage of users of different time period

SHS first came in these areas about a decade ago. Initially it did not get well recognition and number of SHS users increased at a steady rate. SHS became popular almost 4 years ago where its number pumped up almost 2 years ago. No of SHS user in last year is comparatively low. The reason for this is that SHS service providers are not getting new users in less remote areas as grid connection is increasing and almost all users who can afford connection has already taken connection. Highly remote areas are less targeted by SHS service providers. Figure 9 shows the relation between the percentages of SHS user with users at different time period.

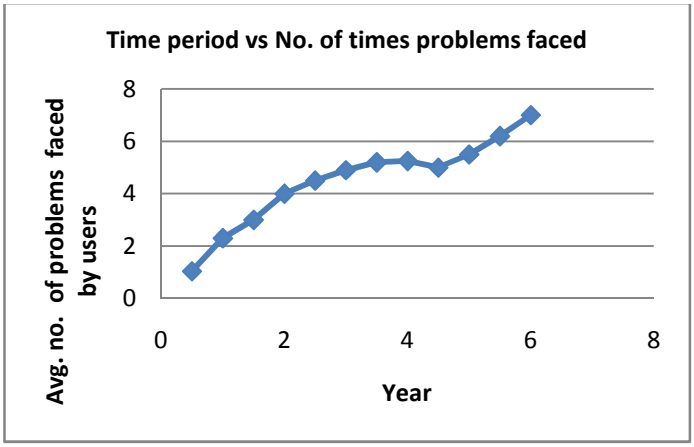

Figure 10. Time period vs. No. of times problems faced by users

Figure 10 shows the average number of problem faced by SHS users over time. Thus it represents the quality of SHS supplied over time. If the SHS quality was same then the graph would have been a straight line beginning from 0 and increasing. Above graph shows that number of problems faced by user increases depending on time period.

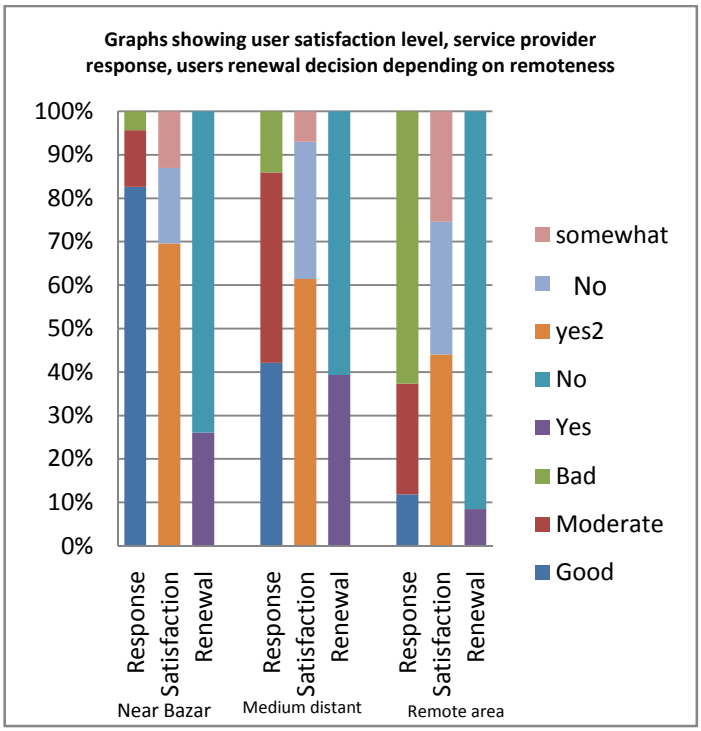

Figure 11. Graphs showing user satisfaction level, service provider response, users renewal decision depending on remoteness

Figure 11 represents different data which are basically distance related. Service provider response and customer satisfaction are both good in less remote areas. But they do not want to increase their connection as grid connections are rapidly increasing in remote areas.

In remote areas service provider response is above average and customer satisfaction is slightly lower than less remote areas. People of moderate remote areas are more likely to increase connection. In highly remote areas service provider response is unsatisfactory. Most people of these areas do not want to increase their connection because they cannot rely on service providers.

V. Constraints of Solar Home Systems

Solar panel is still a new concept in Bangladesh. SHS users as a result face different problems due to their lack of technical knowledge. Due to poor maintenance they do not get sufficient output from their connections. Moreover different new companies are arising and to sustain and make profit in this competitive market, they often operate on such policies that reduce the acceptance of SHS to users. For this reason, the constraints of SHS are categorized basically in the following two parts which are discussed below:

A. User-based Constraints

1) Tilt Angel: Tilt angle of PV panel is most important issue for efficient power production. In our study we saw that the proper tilt angle is not maintained in maximum houses due to their lack of knowledge on SHS and unconsciousness as a result they cannot abole to get efficient output from PV panel [3].

2) Shading and Hotspot problem: Shading is one of major constraints of SHS that results hotspot problems [14].

3) Panel Cleaning: Solar panel efficiency decreases day by day due to unconsciousness about panel cleaning [3].

4) Peoples cannot get efficient output from PV panel due to careless about taking necessary training on PV panel [15].

B. Service Providers-related Constraints

1) High interest rate: SHS is sold at high interest installments. During the survey we have seen that majority of the users take the connection in installments including upper-middle class people.

2) Poor number of counseling: A SHS service provider company has plenty of workers who do servicing but they do not provide sufficient trainings to users about the maintenance of SHS .

3) Immature and unregistered organizations: Different new companies are arising every day. To gain popularity in this competitive market they offer SHS connection at a relatively low price. For this they provide low quality equipment which is more prone to facing problems. Moreover their service is of low quality and they do not maintain any remarkable program to train users about the proper maintenance of SHS. All these things create confusion in users and they are discouraged to increase connection in future [16].

4) Low response in remote areas: In highly remote areas there are less SHS users compared to less remote areas, that is their income is low from highly remote areas. This may be the reason for their poor response in highly remote areas which is clear from our study.

VI. Conclusion

Solar home system is becoming more popular day by day in Bangladesh particularly in remote areas. The installation of solar home systems provide a convenient and sustainable way of power by supplying high quality, reliable, clean, and environmentally friendly energy services It has a huge impact on the lives of the rural people in Bangladesh by providing them with numerous direct and indirect socio-economic benefits. But some constraints like high generation cost, lack of sufficient backup support by battery, output reduction due to shading,

hotspot problem, inefficient service due to dust accumulation and rainy seasons etc pose serious threats to the wide scale use of SHS in future in Bangladesh. Our study reveals that if we can overcome different kinds of limitations of PV panel & panel users then it would be a major source of alternative electricity generation in Bangladesh. Therefore, SHS can provide better facilities in education, recreation and communication in rural area and it can promote small commercial activities as well as improve living standard of rural community.

ACKNOWLEDGMENT

We would like to thank the 'Center for Natural Science & Engineering Research (CNSER/CenNSER)' for its financial support to conduct our research work.

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