*IOSR Journal of Humanities And Social Science (IOSR-JHSS)*
*Volume 25, Issue 12, Series 4 (December. 2020) 50-56*
*e-ISSN: 2279-0837, p-ISSN: 2279-0845.*
*www.iosrjournals.org*

# Benefit derived by the Solar Home System (SHS)using Beneficiaries of "Renewable Energy Development in Remote off Grid and Char Areas in Bangladesh Project"

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**Abstract:**
**Background:**There are many chars and remote areas in Bangladesh where electricity facilities have not reached. Where, they have no choice but to provide oil for the hurricane. They need to take alternative measures of electricity. Although there are many types of energy sources, the use of solar energy is the most convenient and its production process is much easier and more efficient. The main purpose of this study was to determine the extent of benefit of the beneficiaries through solar home systems (SHSs) at the Gangacharaupazila of Rangpur district under 'Renewable Energy Development in Remote off Grid and Char Areas in Bangladesh Project'.
**Materials and Methods:**A questionnaire-based survey method was used to collect primary data from the period of July 2020 to August 2020. A total of 12600 PDBF beneficiaries of Gangachara upazila using SHS were constituted the population of the study. The sample size of this study was 273. A reserve list of 27 (about 10 % of the sample) was prepared for this study. All charts and diagrams were prepared using the software such as MS Excel and Statistical Package for the Social Sciences (SPSS) was used to analyze the data.
**Results:**The research reveals that solar electrification provided direct and indirect benefits to the users of the system, with many implications of a permanent nature. A correlation coefficient between benefit derived by using of SHS and receiving training and problem faced (0.809 and -0.295 respectively) were significantly correlated ($P<0.01$).It resulted in less pollution, higher quality light and more hours of light in the evening, as well as less work for cleaning kerosene lamps.
**Conclusion:**Solar electrification provide to the overall comfort and satisfaction of the consumers. Government and the private sector should take more initiatives to disseminate SHSs and develop infrastructure to solve our power crisis problem.
**Key Words:** Benefit Derived; Solar Home System; Beneficiaries.

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Date of Submission: 28-11-2020 Date of Acceptance: 13-12-2020

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## I. INTRODUCTION

Today, it is internationally recognized that Bangladesh is one of the most vulnerable and vulnerable countries to climate change. There is no denying the adverse effects of global climate change on biodiversity. Not only the fauna but the whole flora will also face this catastrophe. People have a large unsatisfied demand of energy, which is growing by 10% yearly. There are many chars and remote areas in Bangladesh where electricity facilities have not reached. They have to do all the work with wood fuel, hurricanes and candles. Where,theyhave no choice but to provide oil for the hurricane. They need to take alternative measures of electricity. Although there are many types of energy sources, the use of solar energy is the most convenient and its production process is much easier and more efficient.This makes the use of solar panels very effective in Bangladesh. Daily solar radiation is 4-6.5 kWh/m² and maximum radiation is generally received in the months of March-April and minimum in December-January. Hence, solar energy can be a viable solution for the power crisis in Bangladesh [7].The prospect of renewable energy in Bangladesh is very promising, especially in thecase of solar energy. Bangladesh is a south Asian country located in between latitudes 20°34' and 26°39'

north and longitudes 80°00' and 90°41' east. Therefore, it is an ideal location for solar energy utilization. Also, as it is a subtropical country, 70% of the year sunlight is plentiful [1]. Bangladesh government plan to increase the power generation capacity is 24,000 MW by 2021 and 40,000 MW by 2030 and by the year 2020 the renewable energy power generation will be 10% (2000 MW) of the total power generation. Energy saving will be 15% by the year 2021 and 20% by 2030 of total energy consumption. Gangacharaupazila of Rangpur district is a river flooded off-grid and chars area and also included to produce55 MW power from renewable energy in national planning. [3].That is why Bangladesh government took up a project with the help of PalliDaridroBimochon Foundation (PDBF) at this most vulnerable area named "Renewable Energy Development in Remote off Grid and Char Areas in Bangladesh" from March 2018 to June 2020. The main focus of this research is to ascertain the proper benefit derived that has resulted from the use of SHS in that project area.

## II. MATERIALS AND METHODS

This study was carried out during the period of 01July 2020 to 31August, 2020 in Gangacharaupazila of Rangpur district in Bangladesh. A total of 12600 PDBF beneficiaries ofGangacharaupazilausing SHSwereconstituted the population of the study. For finite population, the sample size was calculated by using the statistical formula [10]: $n= (z^2.pq.N)/\{(e^2 (N-1)+z^2.pq\}$.....(i).Thus the sample size of this study was273. A reserve list of 27 (about 10 % of the sample) was prepared for this study.7 selected characteristics such as age, education, family member, land position, training, down paymentand problem faced were the independent variable of this study. Where, Benefit derived by using of SHS was the dependent variable of this study. An interview schedule containing direct questions and some scales were used for data collection from the selected respondents under project beneficiaries. Data was collected from the respondents by face to face interviewing by the PDBF staffs of Gangacharaupazila.The software such as Excel and Statistical Package for the Social Sciences (SPSS) was used to analyze the data. Inferential (correlation,) and descriptive (e.g. range, observed range, mean,standard deviation and coefficient of variation) statistics were used to find out the research results.

## III. SOLAR HOME SYSTEM

**Potential of Solar Energy in Bangladesh (As environmental aspect)**

Bangladesh is located between $20^0$30` and $26^0$45` north latitude and has a total area of 1.49E+ 11 $m^2$. An average of 5 kWh / $m^2$ solar radiation falls on this land over 300 days per annum. Maximum amount of radiation is available on the month of March-April and minimum on December-January. A 2012 study found the daily sunlight hours in Bangladesh to range from 10 to 7 hours; they further reduced this by 54% (to 4.6 hours) to account for rainfall, cloud, and fog [6, 8].

**Typical solar home system**

A typical SHS is given in Fig. 1. The SHS is a fixed installationdesigned for domestic application. The solar module is installed andexposed to sunlight, generally on the top of roof. A simple SolarHomeSystem(SHS) consists of the solar generator (PVmodule), lead battery,and charge controller, aswell as the directly connected DC appliances.In addition, a support structure for themodule, cables, and sockets forthe appliances isneeded. SuchasSHS is able to supplyelectricalpowerneeded for lighting, TV, radio, or for a small refrigerator.

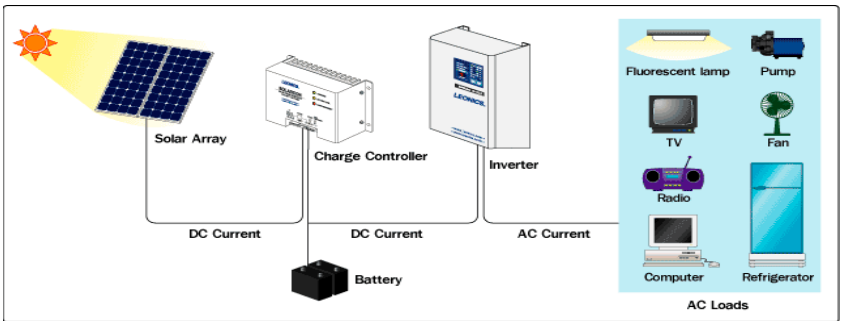


**Figure 1:**Typical solar home systems configuration Source: ttp://www.leonics.com/system/solar_photovoltaic/ solar_home_system/ solar_home_system_en.php[11]

Photo voltaic (abbreviated PV) is the most direct way to convert solar radiation into electricity and is based on the photovoltaic effect, both array size and sunlight availability will determine the amount of electricity available for daily use. PV panels can be mounted on existing structures (such as rooftops) to provided decentralized power. The PV systems are powered by solar energy, solar cells convert solar energy

into electricity. The electricity is stored in batteries and reliable power can be available at night and on dark days [12].

**Future plans and Target(Renewable Energy) of Bangladesh**

Bangladesh government plan to increase the power generation capacity is 24,000 MW by 2021 and 40,000 MW by 2030 and by the year 2020 the renewable energy power generation will be 10% (2000 MW) of the total power generation. Energy saving will be 15% by the year 2021 and 20% by 2030 of total energy consumption. Initiatives have been taken to produce 30 MW power from renewable energy from Dhaka, 60 MW from Rangunia, 3 MW from Sharishabari, 55 MW from Gangachhara, 200 MW from Mymensingh, 20 MW from Cox's Bazar and 200 MW from Sun Edition Solar project at Teknaf. To meet this target, government has prepared a year-wise plan, which is a bit upper range from the policy target. The year-wise achievement plan of renewable energyin Bangladeshhas been shown in the table 1[5].

**Table no 1:** Renewable Energy Year-wise targeted planin Bangladesh.

| Technology | Achievement up to 2016(MW) | 2017 (MW) | 2018 (MW) | 2019 (MW) | 2020 (MW) | 2021 (MW) | Total (MW) |
|---|---|---|---|---|---|---|---|
| **Solar** | 200 | 120 | 350 | 250 | 300 | 250 | 1470 |
| **Wind** | 2.9 | 50 | 150 | 350 | 300 | 300 | 1153 |
| **Biomas** | 0 | 6 | 6 | 6 | 6 | 6 | 30 |
| **Biogas** | 5 | 0 | 0.5 | 0.5 | 0.5 | 0.5 | 7 |
| **Hydro** | 230 | - | 1 | 1 | 2 | 2 | 236 |
| **Total** | **437.9** | **176** | **507.5** | **607.5** | **608.5** | **558.5** | **2896** |

Bangladesh state-owned infrastructure development company limited (IDCOL) have already installed 3 million solar home systems (SHS) by providing clean energy over 13 million of the rural population. Bangladesh receives an average daily solar radiation in the range of 4-5 kWh/m [14]. However the total production of solar energy in Bangladesh is 650.06 MW[5].

**Daily and monthly power generation at project areas**

Total 12600 Solar Home Systems (SHSs) were distributed to the PDBF beneficiaries atproject area.So to find out the daily energy generation we have to multiply this number to daily average sunshine duration. Again for finding the monthly energy generation we have to multiply daily energy generation to number of days of each month respectively.Using average 5 hours of full sun, gives us this equation-**65 watts** x **5 hours** x **75%,** that's 0.244 kW (244 watts) in a day per 65-watt panel. If we multiply 0.244 kW per panel by 30 days in a month, we will find that each 65 watt rated panel will produce about 7.3 kW in an average month [3]. Table no 2 is shown the daily and monthly average electricity generations in KWh provided panels by the "Renewable Energy Development in Remote off Grid and Char Areas in Bangladesh" named project.

**Table no 2: C**alculation of daily and monthly average electricity generations in KWh at project area

| Parameter | Daily energy generation (kWh) | Monthly energy generation (kWh) |
|---|---|---|
| **Power Generation (KW)/Panel** | 0.244 kW | 7.3 kW |
| **Power Generation (KW)/Total 1260 Panels of SHS Project** | 307.44 kW | 9198 kW |

## IV. RESULT AND DISCUSSION

Possible range, observed range, mean, standard deviation (SD), co-efficient of variation (CV%) of 8 selected characteristics (age, education, family size, land position, training, down payment, problem faced, benefit derived) of the SHS using beneficiaries in the present study have been presented in Table no3.The mean value of age, education, family size and land position of the beneficiaries were 41.48, 8.74, 5.07 and 56.69 respectively.

**Table no 3:**Possible range, Observed range, Mean, Standard deviation, Coefficient of variation of the selected characteristics of the respondent beneficiaries

| Selected characteristics | Unit | Possible Range | Observed range | Mean | Std. Deviation | CV (%) |
|---|---|---|---|---|---|---|
| Age | No. of years | - | 22-80 | 41.48 | 11.673 | 28.14 |
| Education | Schooling years | - | 1-13 | 8.74 | 2.565 | 29.35 |
| Family Size | No. of person | - | 3-10 | 5.07 | 1.383 | 27.28 |
| Land Position | Decimal | - | 3-222 | 56.69 | 59.433 | 104.84 |
| Training | Score | 0-15 | 0-15 | 12.28 | 2.573 | 20.95 |
| Down Payment | Score | 0-18 | 13-17 | 15.04 | 1.101 | 7.32 |
| Problem Faced | Score | 0-15 | 1-8 | 3.60 | 1.923 | 53.42 |
| Benefit Derived | Score | 0-21 | 0-21 | 18.25 | 3.964 | 21.72 |

Data contained in Table 4 indicate that slightly less than half (46.2 percent) of the beneficiaries were middle aged compared to 34.4 percent being young aged and only 19.4 percent in old agedcategory.Findings indicate that a large proportion (80.60 percent) of the beneficiaries were middle and young aged. These categories of beneficiaries and their families were more interested to use Solar Home System (SHS).

**Table no 4:** Distribution of the SHS beneficiaries according to their age

| Categories (years) | SHS Beneficiaries | | Mean | Standard deviation | CV% |
|---|---|---|---|---|---|
| | Frequency | Per cent | | | |
| Young (≤35) | 94 | 34.4 | 41.48 | 11.67 | 28.13 |
| Middle Aged (36-50) | 126 | 46.2 | | | |
| Old (>50) | 53 | 19.4 | | | |
| Total | 273 | 100.0 | | | |

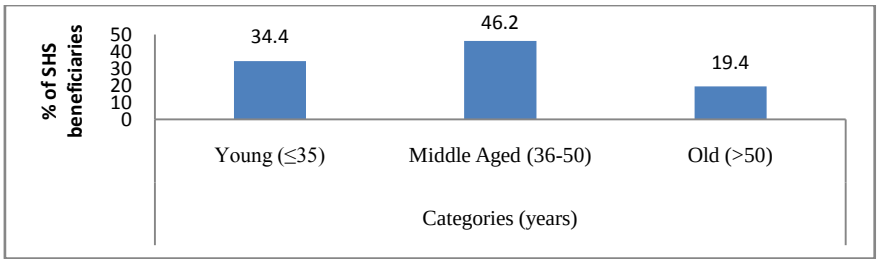


**Figure 2:**Distribution of the SHS beneficiaries according to their age

According to the level of educational qualification, the categories and distribution of the respondents were shown in Table no 5.Data indicated that more than half (59.00 per cent) of the respondent's educational qualification were secondary, compared to primary (22.30 per cent) and above secondary education level (18.70 per cent). From this we understand that the education rate in the research area is not worse than other areas of the country.Harun (2015) also found that ifthe rural electrification policies, programmes and plans integrate SHS as an alternative source for the supply of electricity services for remote rural communities, children will get access to lighting in the evening to extend their studies. [4]

**Table 5:** Distribution of the SHS beneficiaries according to their educational qualification

| Categories (Schooling years) | SHS Beneficiaries | | Mean | Standard deviation | CV% |
|---|---|---|---|---|---|
| | Frequency | Per cent | | | |
| Primary education (≤5) | 61 | 22.3 | 8.74 | 2.57 | 29.41 |
| Secondary education (6-10) | 161 | 59.0 | | | |
| Above secondary education (>10) | 51 | 18.7 | | | |
| Total | 273 | 100.0 | | | |

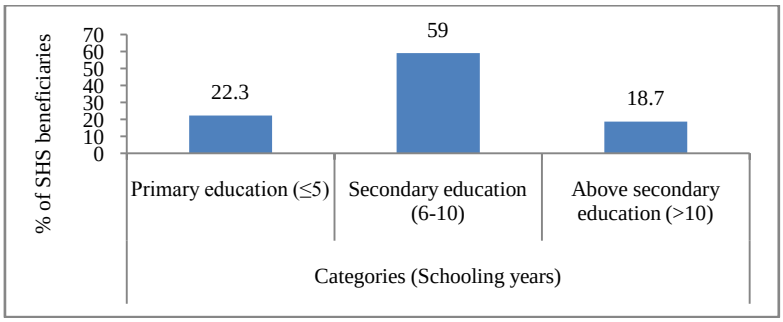


**Figure 3:** Distribution of the SHS beneficiaries according to their educational qualification

Data presented in the Table 6 showed that more than one third (39.2 per cent) of the SHS beneficiaries were small family andalso sameas (44.3 per cent) medium family.Whereas slightly less than one fifth (16.5 per cent) of the SHS beneficiaries belonged to large family. Findings indicate that a large proportion (83.50 per cent) of the SHS beneficiaries were small and medium family.This may be due to thepower supply of Solar Home System (65 watts) panel through the project.

**Table no: 6** Distribution of the SHS beneficiaries according to their family size

| Categories (No. of person) | SHS Beneficiaries | | Mean | Standard deviation | CV% |
|---|---|---|---|---|---|
| | Frequency | Per cent | | | |
| Small family (≤4) | 107 | 39.2 | 5.07 | 1.38 | 27.22 |
| Medium family (5-6) | 121 | 44.3 | | | |
| Large family (>6) | 45 | 16.5 | | | |
| Total | 273 | 100.0 | | | |

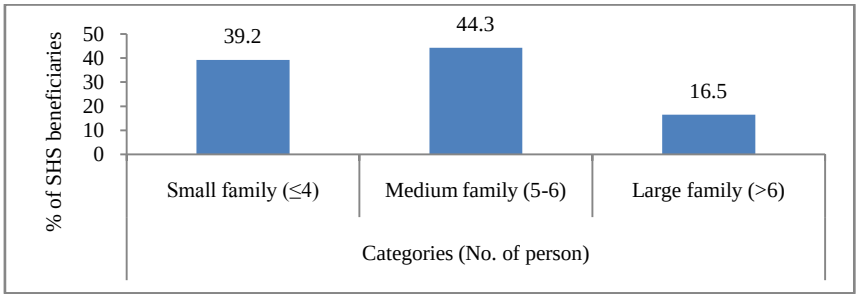


**Figure 4:** Distribution of the SHS beneficiaries according to their family size

As shown in Table 7, the most common occupations among SHS beneficiaries were agriculture (33.0 per cent) and, small business (29.7 per cent). More than half of all SHSbeneficiaries' occupations were those two types (62.7 percent). In thestudy areas, amongSHS beneficiaries' occupations a considerable percentage was in service (19.8 percent) and others occupations was 33.0 per cent.

**Table no: 7** Distribution of the SHS beneficiaries according to their occupation

| Categories | SHS Beneficiaries | | Mean | Standard deviation | CV% |
|---|---|---|---|---|---|
| | Frequency | Per cent | | | |
| Agriculture | 90 | 33.0 | 2.22 | 1.09 | 49.01 |
| Small Business | 81 | 29.7 | | | |
| Service | 54 | 19.8 | | | |
| Others | 90 | 33.0 | | | |
| Total | 273 | 100.0 | | | |

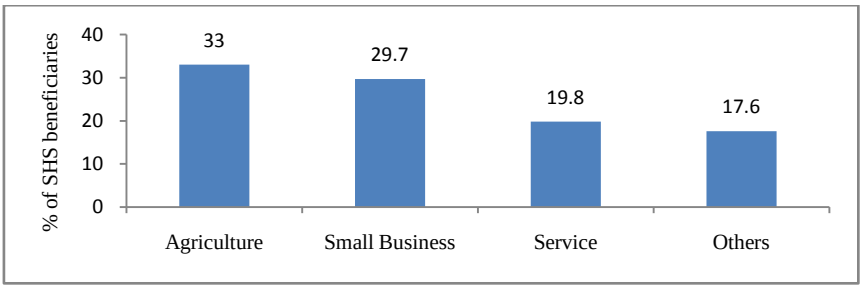


**Figure 5:** Distribution of the SHS beneficiaries according to their occupation

Data presented in the Table 7 showed that slightly more than two fifth (41.0 per cent) of the SHS beneficiaries were landless beneficiaries where slightly less than one third (29.3 per cent) of the SHS beneficiaries were medium farm beneficiaries. Small proportions slightly less than one fifth (19.4 per cent) of the SHS beneficiaries were marginal farm size. Very small proportions (10.3 per cent) of them were found as small farm size.

**Table no: 8** Distribution of the SHS beneficiaries according to their land position

| Categories (decimal) | SHS Beneficiaries | | Mean | Standard deviation | CV% |
|---|---|---|---|---|---|
| | Frequency | Percent | | | |
| Land less (≤20) | 112 | 41.0 | 56.69 | 59.43 | 104.48 |
| Marginal (21-50) | 53 | 19.4 | | | |
| Small (51-100) | 28 | 10.3 | | | |
| Medium (>100) | 80 | 29.3 | | | |
| Total | 273 | 100.0 | | | |

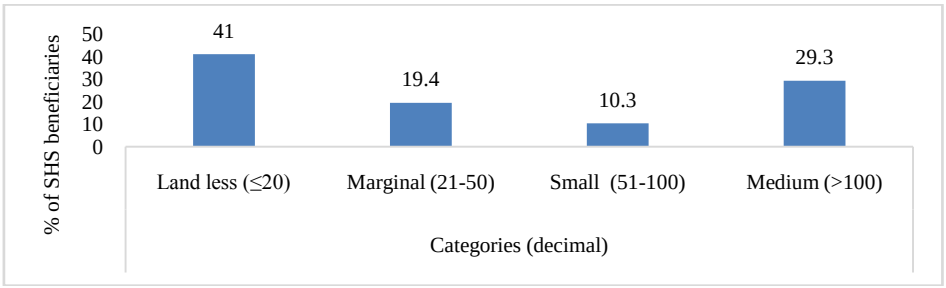


**Figure 6:**Distribution of the SHS beneficiaries according to their land position

A correlation coefficient between benefit derived and selected characteristics of the SHSs using beneficiaries is calculated and presented in the table 9. Receiving training, problem faced (0.809 and -0.295 respectively) were significantly correlated (P<0.01) with benefit derived by using of SHS. These findings are comparable with thepositive socio-economic impacts of SHS beneficiaries and it also revealed that solar lanterns have been rigorously reviewed with respect to the performance of children attending primary and secondary schools in a geographically challenged area in northern Bangladesh [8, 9].

**Table no 9:**Relationship between selected characteristics of thebeneficiaries and their benefit derived through using Solar Home System (SHS)

| Selected characteristics | Correlation co-efficient (r) |
|---|---|
| Age | -0.060(NS) |
| Education | -0.089(NS) |
| Family size | 0.024(NS) |
| Land position | 0.055 (NS) |
| Receiving training | 0.809** |
| Down payment | 0.066 (NS) |
| Problem faced | -0.295** |

NS= Not significant
** = Significant at 1% level

## V. CONCLUSION AND RECOMMENDATION

Solar Home Systems is considering the most effective renewable energy technology in Bangladesh. Time has come to look forward and work withthese renewable energy fields to produce electricityrather than depending wholly on conventional method.The use of SHSs improve the life quality, reduce the hazards effects of pollution, ensure uninterrupted electricity supply and also increase the reading hours and working hours of students and workers in night respectively. That iswhy; government andthe private sector should take significant effort and target to establish different projects on renewable energy to solve our power crisis problem.

## ACKNOWLEDGEMENT

The authors are grateful to Department of Agricultural Extension & Information System, Sher-e-Bangla Agricultural University. Thanks to Palli Daridro Bimochon Foundation (PDBF) staffs those whom were involved in the field-level data collection and also obliged to SHS beneficiaries at Gangachara upazila for their helpful coordination.

## REFERENCES

[1]. Chowdhury, M. N. M. (2015). "Present Scenario of Renewable Energy and Non Renewable Energy Sources in Bangladesh: A Compact Analysis" Business and Economics Journal.
[2]. Deb, A., Bhuiyan, M. A. M. and Nasir, A. (2013). Prospects of Solar Energy in Bangladesh. IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), 4(5), 46-57.
[3]. Ghosh, H. R., Ullah, S. M., Khadem, S. K., Bhowmik, N. C. and Hussain, M. "Measurement and Estimation of sunshine duration for Bangladesh" Renewable Energy Research Center, University of Dhaka, Bangladesh.
[4]. Harun, M A. (2015). The role of solar home system (shs) in socio-economic development of rural Bangladesh. Ph.D.Thesis, BRAC Institute of Governance and Development, BRAC University, Mohakhali, Dhaka, pp-34.
[5]. http://www.sreda.gov.bd/index.php/site/page/6a40-6e1f-2734-750f-b8e5-a6e0-4ba2-d411-f1eb-6df7[ accessed on 22 November, 2020].
[6]. http://www.wisegeek.com/what-is-solar-thermal-energy.htm [accessed on 22 November, 2020].
[7]. Hussain, M. (2016). "Bangladesh Energy Resources and Renewable Energy Prospects". P. Action, Poor People's Energy Outlook 2016: National Energy Access Planning from the Bottom Up, Practical Action Publishing.
[8]. Kudo, Y., Shonchoy. A. S.and Takahashi, K. (2015). Impacts of Solar Lanterns in Geographically Challenged Locations: Experimental Evidence from Bangladesh; IDE Discussion Paper No. 502; Institute of Developing Economies: Chiba, Japan. Available online: https://ideas.repec.org/p/jet/dpaper/dpaper502.html [accessed on 22 November, 2020].
[9]. Khan, S.A. and Azad, A. K. M. A. M. (2014). Social Impact of Solar Home System in Rural Bangladesh: A case study of rural zone. IAFOR Journal of Sustainability, Energy and the Environment, 1(1):5-22.
[10]. Kothari, C. R. (2004). Research Methodology: Methods and Techniques. India: Wishwa Prakashan.
[11]. Leonics. (2017). Solar Home System. Available online:http://www.leonics.com/system/solar_photovoltaic/ solar_home_system/ solar_home_system_en.php [accessed on 22 November, 2020].
[12]. Posorski, R., Bussmann, M. and Menke, C.(2003). Does the use of Solar Home Systems (SHS) contribute to climate protection? Renewable Energy, 28:1061e80.
[13]. Rahman, M. S., Saha, S. K.,Khan, M. R. H., Habiba,U.and Chowdhury, S. M. H.(2013). Present Situation of Renewable Energy in Bangladesh: Renewable Energy Resources Existing in Bangladesh. Global Journal of Researches in Engineering Electrical and Electronics Engineering,13 (5).
[14]. Sovacool,B. K.and Drupady,I. M.(2016). Energy access, poverty, and development: the governance of small-scale renewable energy in developing Asia, Rutledge.

M. M. Islam, et. al. "Benefit derived by the Solar Home System (SHS) using Beneficiaries of "Renewable Energy Development in Remote off Grid and Char Areas in Bangladesh Project." *IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 25(12), 2020, pp. 50-56.