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Solar Park: The Next Generation Energy Source in Bangladesh

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Authors' contributions

This work was carried out in collaboration between both the authors. Author ZAL designed the study, managed the literature searches, wrote the challenges and social impact part and wrote the first draft of the manuscript. Author MRI wrote the solar energy and solar park part and performed the technical analysis. Both authors read and approved the final manuscript.

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ABSTRACT

The continuous depletion of fossil fuel reserves and threats on climate change makes it essential for searching alternative energy sources. Renewable energy can play a vital role in this regard. Solar energy is the most promising renewable energy source available so far. In this paper, the availability of solar energy in Bangladesh and the prospects of solar photovoltaic based power generation are discussed. Analysis for different sources of solar energy is revealed. Especially the current scenario and prospect of Solar Park is investigated. And the result shows that according to the future plan, Solar Park is going to hold the largest share among all the renewable energy sources. According to the Renewable Energy Master Database, the total renewable energy capacity including all categories is about 2.4 GW. Among these, solar park projects are the main contributors in terms of capacity which is 2,110.56 MW.

Keywords: Renewable energy; solar park; photovoltaic electricity potential and global horizontal irradiation.

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1. INTRODUCTION

The economy of Bangladesh is the 42nd largest in the world in nominal terms, and 31st largest by purchasing power. It is classified among the next eleven emerging middle income economies and a frontier market. According to the International Monetary Fund (IMF), Bangladesh's economy is the second fastest growing major economy of 2016, with a rate of 7.1% [1,2]. Also the projected real GDP for 2020 is 7.4 [3]. This ever growing economy needs the constant availability of energy. Natural gas is the key source of energy in Bangladesh. As technology is advancing, the consumption of power is steadily rising. Sufficient and reliable source of electricity is a major prerequisite for a sustainable and successful economic development [4]. According to future planning, in order to secure energy sources in 2021 especially oil, gas and coal, substitute energy sources such as wind, hydro and solar energy has been brought into considera-tion.

Several financial incentives have been extended by the government to Renewable Energy project designers and investors. Devoted funding support has also been prolonged through government financial institutions like Bangladesh Bank, IDCOL and private commercial banks. Moreover, government has extended financial incentives including duty exemption on certain renewable energy products like solar panel and its manufacturing accessories, charge controller, Inverter, LED light, solar operated light and wind power plant. Encouraged by the success of solar home system (SHS), government has initiated number of programs like, solar irrigation, solar mini/micro-grid, solar park, and solar roof top. The main focus of this step is to deliver electricity to the rural areas and to decrease the dependency on diesel and in turn reduce the carbon emission.

Several researches have been published to explore the prospect of Renewable Energy Resources in Bangladesh [5,6]. But there are no research works available on the impact of solar park on the development of this country. This research work is intended to explore the possible impact of solar park in Bangladesh.

2. RENEWABLE ENERGY SOURCES IN BANGLADESH

Bangladesh has a long heritage in the field of renewable energy, which started back in 1957 with the start of construction of Country's first hydroelectric project on Karnaphully river at Kaptai, Chittagong. On the other hand, SHS has become the biggest renewable energy program in Bangladesh and so far installed 5.8 million units [7]. At present, the different categories of renewable energy that are being used in Bangladesh are hydro-electricity, Solar power using solar PV, wind power, electricity from municipal waste, bio gas using cattle dung and poultry liter and finally electricity and thermal energy generation from biomass like rice husk bagasse, waste residues from industrial processes etc. The present state of the renewable energy for electricity generation is shown in the Table 1.

Table 1. Present state of the renewable energy for electricity generation in Bangladesh [6]

Technology	Off-grid (MW)	On-grid (MW)	Total (MW)
Solar	313.55	80.43	393.98
Wind	2	0.9	2.9
Hydro	0	230	230
Biogas to Electricity	0.63	0	0.63
Biomass to Electricity	0.4	0	0.4
Total	316.58	311.33	627.91

3. SOLAR ENERGY

Solar energy is a renewable and free source of energy that is sustainable and totally inexhaustible, unlike fossil fuels that are limited. Solar panels are able to harness the energy from the sun and convert it into electricity. It is also a non-polluting source of energy which does not emit any greenhouse gases when producing electricity. Therefore, the use of solar panels is environment friendly. Therefore it reduces dependence on foreign oil and fossil fuels. It has virtually no maintenance as solar panels last over 30 years. It creates jobs by employing solar panel manufacturers and solar installers and in turn helps the economy. It can be installed virtually anywhere. Another advantage of solar power is its safety compared to traditional electric current [8]. Besides the advantages, it has some drawbacks as well. It has a high initial cost for material and installation and it needs lots of space. There is no solar power at night so there is a need for a large battery bank. Depending on geographical location the size of the solar panels vary for the same power generation. Solar

powered cars do not have the same speeds and power as typical gas powered cars.

3.1 Mainstream Technologies

Many industrialized nations have installed significant solar power capacity into their grids to provide a substitute to conventional energy sources while an increasing number of less developed nations have turned to solar to reduce dependence on expensive imported fuels. Solar power plants use one of three technologies. The first one is the Photovoltaic (PV) systems which use solar panels, either on rooftops or in ground-mounted solar farms, converting sunlight directly into electric power. The second one is the concentrated solar power or concentrated solar thermal plants which use solar thermal energy to make steam and then converted into electricity by a turbine. The third one is a hybrid one.

3.1.1 Photovoltaic

A solar cell or PV cell is a device that converts light into electric current using the photovoltaic effect. The array of a PV system produces direct current (DC) power which fluctuates with the sunlight's intensity. For practical use this requires the conversion to alternating current (AC), through the use of inverters/converters. This can also be fed into the utility grid. Multiple solar cells are connected inside modules. Modules are wired together to form PV solar array. From this array it goes to the power conditioner through blocking diode. In power conditioning block it takes the decision to store it directly or convert. invert it to use it locally. Such system is shown in Fig. 1.

Many residential PV systems are connected to the grid wherever available. In these grid-connected PV systems, use of energy storage is optional. In some applications such as satellites, lighthouses, or in developing countries, batteries or additional power generators are often added as back-ups. Such power systems permit operations at night.

3.1.2 Concentrated solar power

Concentrated solar power uses lenses or mirrors and tracking systems to concentrate sunlight and then use the resulting heat to generate electricity from conventional steam-driven turbines.

Among the best known concentrating technologies are the parabolic trough, the compact linear fresnel reflector, the stirling dish and the solar power tower. Various methods are used to track the sun and focus light. In all of these methods, a working fluid is heated by the concentrated sunlight and is then used for power generation or energy storage [10]. Thermal storage efficiently allows up to 24-hour electricity generation [11].

3.1.3 Hybrid systems

A hybrid system combines PV and CSP with one another or with other forms of generation such as diesel, wind and biogas. The combined form of generation enables the system to modulate power output as a function of demand. Hybrid systems are most often found on islands where the idea is to increase the efficiency of the combined solar/thermoelectric system to convert the solar radiation into useful electricity [9].

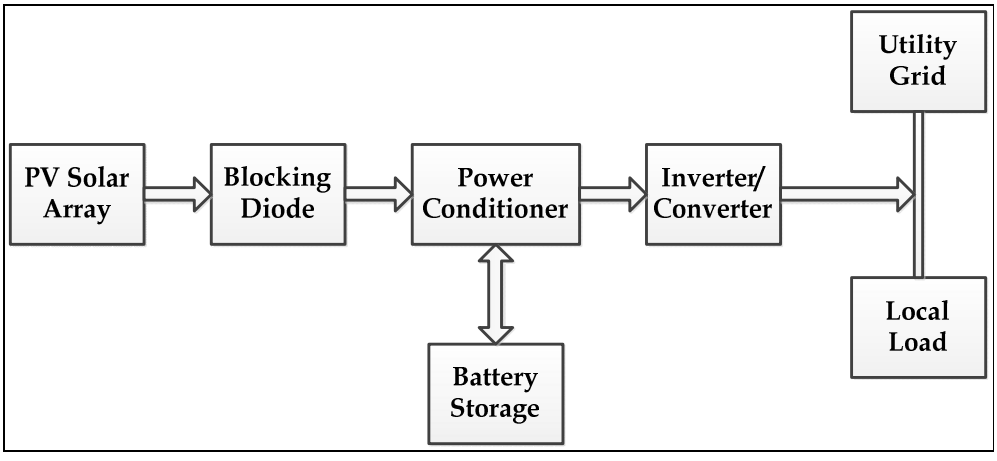
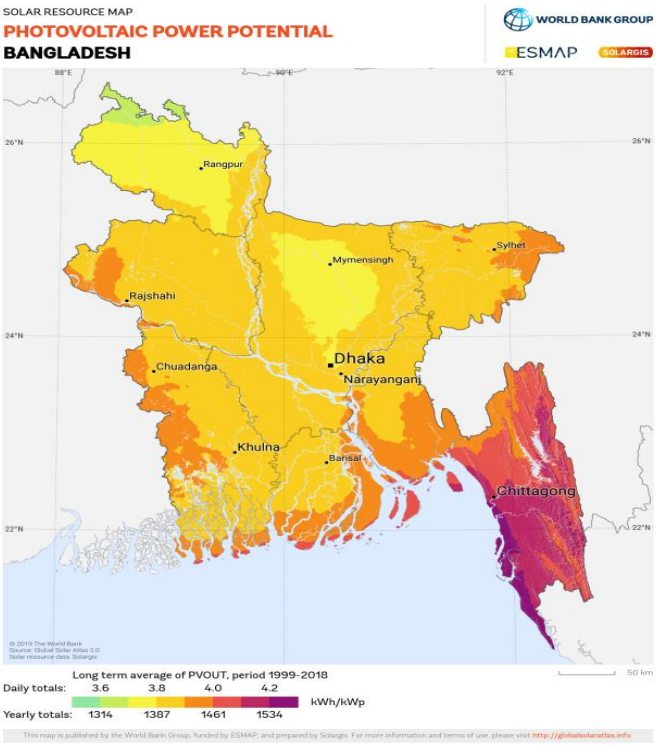
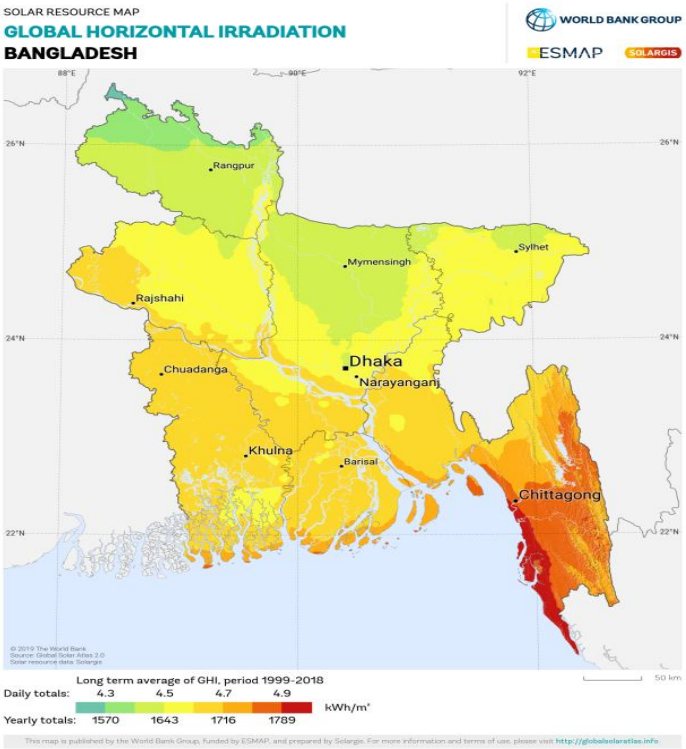


Fig. 1. Block diagram of a PV power system



a) Photovoltaic power potential



b) Global horizontal irradiation

Fig. 2. Photovoltaic power potential and global horizontal irradiation for Bangladesh

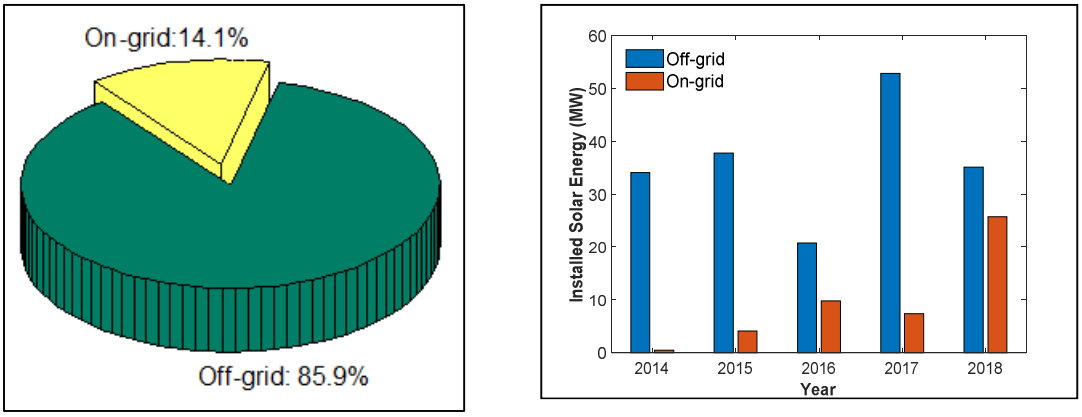
3.2 Solar Energy Situation in Bangladesh

Bangladesh receives an average daily solar radiation in the range of 4.5 kWh/m²/day. The Photovoltaic power potential and global horizontal irradiation for Bangladesh [12] are shown in Fig. 2. Global horizontal irradiance is the total amount of shortwave radiation received from above by a surface horizontal to the ground. This value is of particular interest to photovoltaic installations and includes both direct normal irradiance and diffuse horizontal irradiance.

Based on connection to the grid, the solar power distribution is divided into two types. The on-grid and off-grid solar power distribution. This distribution is shown in Fig. 3a while the Figure in b) shows the installed solar energy in the last five years based on both on-grid and off grid.

Solar energy is utilized via different technologies. The contribution by different solar energy technologies in Bangladesh is shown in the following Table 2.

The main focus of Renewable Energy is to provide electricity to the rural areas and to reduce the dependency on diesel and in turn to reduce the carbon emission. Solar Park has become one of the largest sources now a day and has a great potential to be the largest source of renewable energy in near future. Several solar park projects are underway. But the largest solar park so far started contributing to the national grid on September 13, 2018.



a) b)

Fig. 3. Solar energy utilization in Bangladesh. a) Solar energy based on connection to the grid b) Installed solar energy in the last 5 years

Table 2. Total installed and possible capacity of different Solar energy technology [7]

Technology	Quantity	Off-grid MW	On-grid MW	Total Installed MW	Capacity MW
Solar Park	4	0	38.4	38.4	2110.56
Rooftop solar except Net Metering	109	14.477	25.027	39.504	41.187
Net metering rooftop solar	797	0	12.446	12.446	12.458
Solar Irrigation	1377	30.343	0	30.343	0.073
Solar home system	5804225	248.293	0	248.293	248.293
Solar Minigrid	21	0	4.538	4.538	5.656
Solar Microgrid	0	0	0	0	0
Solar Nanogrid	2	0	0.001	0.001	0.001
Solar charging station	12	0.237	0.016	0.253	0.253
Solar street light	202017	10.59	0	10.59	10.59
Solar powered telecom BTS	1933	8.06	0	8.06	8.06
Solar drinking water system	152	1.55	0	1.55	1.55
Total				393.978 MW	2438.681 MW

4. SOLAR PARKS IN BANGLADESH

A photovoltaic power station, also known as a solar park, is a large-scale photovoltaic system designed for the supply of commercial power into the electricity grid. They are distinguished from most building mounted and other decentralized solar power applications as they supply power at the utility level, rather than to a local user or users. With an intention to reduce dependency on fossil fuel for electricity generation, Government of Bangladesh has initiated the plan to set grid tied solar based power generation projects in the Government owned nonagricultural lands. Power generated from the solar park will be fed into the grid on commercial basis.

Two types of lands have been targeted for the solar parks. The first types are those which are owned by the government but are not being used for agricultural production. The second types are the private lands owned by private investors. Since the railway division also has many unutilized land or open spaces which can be efficiently utilized for development of Solar Park.

There are many renewable energy projects going on in Bangladesh now. According to the Renewable Energy Master Database, the total renewable energy capacity including all categories is about 2.4 GW. Among these, solar park projects are the main contributors in terms of capacity which is 2,110.56 MW (including all categories: Completed and running. Depending on the status of these solar parks, we are dividing them in four categories: Completed and Running, Implementation Ongoing, Under Planning and Rejected from Planning Phase. According to the present status these categories are explained below.

4.1 Completed and Running Solar Parks

There are 4 solar park projects which are already in running condition and contributing to the consumers. Their installed capacity is 38.4 MW. They are shown in the following Table 3.

4.1.1 Grid-connected 3 MW solar park at Sharishabari, Jamalpur

It was the first-ever solar plant connects to national grid. The 3 MW plant was constructed on a “build, own and operate” basis on eight acres of land at Sarishabari in Jamalpur by a local company, Engreen Sharishabari Solar Plant Ltd. The power plant uses 11,500 solar panels spread out over eight acres of land. The plant began to produce power from December 22, 2017.

4.1.2 Teknaf 20 MW Solar Park by Joules Power Limited (JPL)

The largest solar park in the country started its operation beside the Arakan Drive road that connects Teknaf and Cox's Bazar. The 116 acre park has been built on the bank of the Naf River by Teknaf Solartech Energy Ltd (TSEL). TSEL is running with 86,000 solar panels and began contributing to the national grid on September 13, 2018. The people of Teknaf and Ukhiya upazila used to face severe load-shedding previously. Keeping that in mind, the researchers start investigating several parameters at Cox’s Bazar like insolations. The rotation of earth causes night and day while the tilt of the Earth is the primary cause of our seasons. Earth's tilt causes seasonal temperature variations because the solar radiation strikes earth's surface at different angles. Insolation is the incident solar radiation onto some object. Depending on the types of insolation the generated energy in a solar cell varies. Three types of insolation are flat surface, vertical surface and adjusted throughout the year [13]. Energy generated for different insolations in Cox's Bazar are shown in Fig. 4 for different months in a year. After successful investigation, the project is implemented. Now the plant is benefitting over 8 lakh people and thousands of small to medium businesses there. Usually, demand for power in these two upazilas stands at 17 megawatts while the remaining 3 megawatts produced at the park will be added to the national grid to supply power to other areas of need. TSEL is supplying the power to BPDB

Table 3. Completed and running Solar Parks in Bangladesh

SL.	Location	Agency	Capacity
1	Kaptai Upazila, Rangamati	BPDB	7.4 MW
2	Panchagarh Sadar, Panchagarh	BPDB	8 MW
3	Teknaf Upazila, Cox's Bazar	BPDB	20 MW
4	Sarishabari Upazila, Jamalpur	BPDB	3 MW
Total			38.4 MW

at a price of USD 0.13 for every kilowatt/hour. A 20 megawatt power plant running on diesel would emit about 20,440 tonnes of carbon dioxide a year. The plant runs from sunrise to sunset and is supervised by 15 engineers.

4.1.3 Kaptai 7.4 MW grid-connected Solar PV power plant

Honorable Prime Minister Sheikh Hasina inaugurated Kaptai 7.4 MW Grid-connected Solar PV Power Plant on September 11, 2019. The project is the country's third largest PV installation. The Rangamati array, which is built in Kaptai district, will supply electricity to a nearby 2 MW hydropower plant, with the rest of its output to be fed into the national grid.

The plant was built at a cost of $14 million and was jointly funded by the Asian Development Bank (ADB), the government of Bangladesh, and the country's Power Development Board (PDB). China's ZTE Corporation has built the project. The installation is supplying electricity to the grid at a rate of $0.065 /kWh [14].

4.1.4 Panchagarh 8 MW solar park by parasol energy Ltd.

Honorable Prime Minister Sheikh Hasina inaugurated this 8 MW solar plant in Tetulia, Panchagar, Bangladesh, in November 13, 2019. As of today, the project has already generated more than 4,140 MWh since its commercial operation date in 2019. Adding clean renewable energy to the power grid, it can reduce carbon dioxide emissions by 3,000 metric tons per year as well as other harmful pollution.

Tetulia project is the second large scale project to reach commercial operation in the country and the first with a focus on optimizing land use specifically. Using Paragon's established poultry farm in Tetulia as a base, the Tetulia solar farm combines a space-efficient east-west installation method and rooftop facilities to minimize the plant's footprint [15].

4.2 Implementation Ongoing Solar Parks

These solar parks are already approved and they are in the process of implementation. There are 11 solar parks like this. Their total capacity is 974.8 MW. They are listed in the Table 4.

4.3 Under Planning Solar Parks

These solar parks are in the planning stage. Their location, agency and capacity are already approved but the implementation is not yet started. There are 19 solar parks like this which will contribute 1257 MW in the community and they are listed in the following Table 5.

4.4 Rejected from Planning Phase Solar Park

These are the solar parks which were initially there but are rejected in the planning stage. They could contribute 200 MW to the community. They are listed in the Table 6.

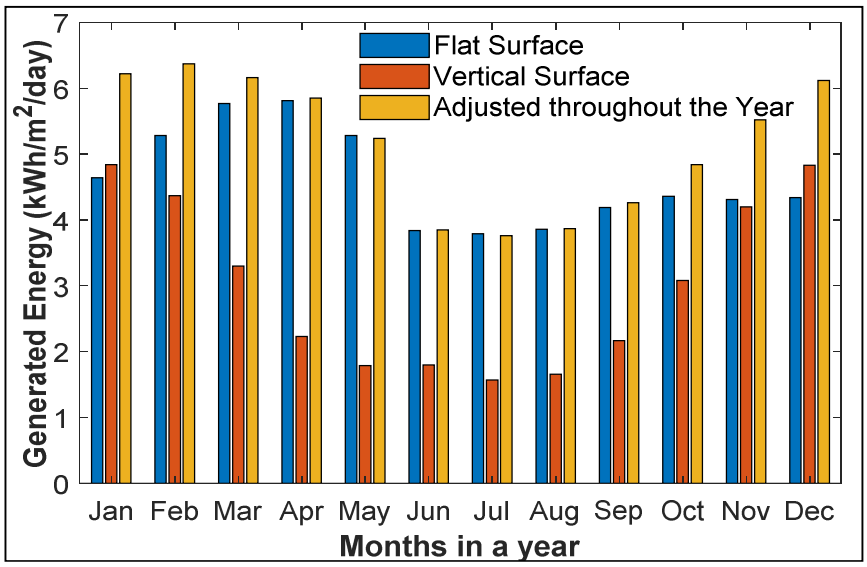


Fig. 4. Energy generated for different insolations in Cox's Bazar

Table 4. Implementation Ongoing Solar Parks in Bangladesh

SL.	Location	Agency	Capacity
1	Sonagazi, Feni	EGCB	50 MW
2	Patgram, Lalmonirhat	BPDB	5 MW
3	Sirajganj Sadar Upazila, Sirajgonj	NWPGCL	7.8 MW
4	Whole Bangladesh	BPDB	360 kW
5	Shibalaya Upazila, Manikganj	BPDB	35 MW
6	Gauripur, Mymensingh	BPDB	50 MW
7	Dharampasha, Sunamganj	BPDB	32 MW
8	Gowainghat, Sylhet	BPDB	5 MW
9	Sundarganj, Gaibandha	BPDB	200 MW
10	Gangachara, Rangpur	BPDB	30 MW
11	Teknaf Upazila, Cox's Bazar	BPDB	200 MW
Total			615.16 MW

Table 5. Under Planning Solar Parks in Bangladesh

SL.	Location	Agency	Capacity
1	Sonagazi, Feni	EGCB	100 MW
2	Sonagazi, Feni	EGCB	100 MW
3	Madarganj Upazila, Jamalpur	RPCL	100 MW
4	Boda, Panchagarh	RPCL	30 MW
5	Madarganj Upazila, Jamalpur	B-R PowerGen	100 MW
6	Debiganj, Panchagarh	BPDB	20 MW
7	Debiganj, Panchagarh	BPDB	47 MW
8	Moulvibazar Sadar, Moulvibazar	BPDB	10 MW
9	Katiadi Upazila, Kishoreganj	APSCL	100 MW
10	Whole Bangladesh, Panchagarh	BPDB	50 MW
11	Whole Bangladesh, Nilphamari	BPDB	50 MW
12	Sonagazi, Feni	BPDB	100 MW
13	Aditmari, Lalmonirhat	BPDB	100 MW
14	Rangunia Upazila, Chittagong	BPDB	60 MW
15	Gangachara, Rangpur	BPDB	55 MW
16	Pabna Sadar Upazila, Pabna	BPDB	100 MW
17	Tetulia, Panchagarh	BPDB	30 MW
18	Gowainghat, Sylhet	BPDB	5 MW
19	Mongla Upazila, Bagerhat	BPDB	100 MW
Total			1257 MW

Table 6. Rejected from Planning Phase Solar Park

SL.	Location	Agency	Capacity
1	Charbhadrasan Upazila, Faridpur	NWPGCL	100 MW
2	Mollahat Upazila, Bagerhat	RPCL	100 MW
Total			200 MW

5. CHALLENGES OF SOLAR PARK

5.1 Challenges Due to Land

Scarcity of suitable lands: Large-scale solar PV power plants require plenty of land. Being agriculture dominated economy; the Government of Bangladesh justifiably preserves agricultural lands from being used for the development of solar PV project. As a result, there are very little non-agricultural lands that lie mostly in the north-western part of the country. The solar insolation of those areas are little less than that in southern area. However, the river banks and islands, sand bars and coastal regions are suitable for PV power plants. But most of these areas are far away from the national grid services or are limited by the grid capacity.

Ownership of land: The population density is very high in Bangladesh and very frequently it is found that the ownership of suitable lands for large-scale solar PV project is distributed among several hundred individuals. The legal acquisition of land from several hundred owners requires a substantial amount of time. Moreover, it has also been found that the transfer compliancy due to inheritance of lands through deeds was not properly conducted in the past. The consequence is the legal complications leading to difficulty in acquisition or purchasing of land. This in turn extends the project implementation period and thus incurs cost. Until the ownership of the lands is clear, the project financial closure cannot be achieved.

Land development: Having a flat terrain, Bangladesh is disposed to flooding and majority of the suitable land for solar PV project development are on the banks of rivers. Therefore, most of the land available for solar PV projects needs to be backfilled. This adds an additional cost to the project.

Erosion protection: There are some mighty rivers which flow through Bangladesh. To make these lands on the banks of these rivers suitable, it needs an erosion protection scheme, which leads to excessive project cost and thus the tariff [16].

5.2 Challenges Due to Weather and Climatic Conditions

Harsh weather conditions: Due to its geographical location, Bangladesh experiences cyclones and tornadoes in the southern region regularly. This creates the need for some special precaution in the form of mounting structure design and efficient assembly. And this increases the project cost.

Low irradiance: Solar irradiation is moderate in Bangladesh (4.5 kWh/m^2/day) with consequent land requirement (Hectare/MW) is much more than our neighboring countries. In some parts of India the annual average GHI (Global Horizontal Irradiance) is over 6 kWh/ m^2/day. Thus, per unit generation of solar power is much less and land requirement is much more in Bangladesh.

Dust: Dust accumulation on the solar panels is much higher in Bangladesh compared to other countries, which results in higher operation and maintenance cost for the plants. Therefore, higher maintenance cost needs to be allocated in the project operation and maintenance budget, which increases the cost of electricity from these solar parks.

Longer implementation period: During the monsoon, most of the country's land is flooded and it is very difficult to work in the rainy season. This extends project implementation time and thus increases the cost.

5.3 Challenges Arising from Gaps in Supply Chain

Insufficient local human resources: There is a lack of human resources with sufficient knowledge of solar park development in Bangladesh. So far, the country has only four grid-connected solar PV projects (3 MW at Sharishabari, Jamalpur, 20 MW at Teknaf, 7.4 MW at Kaptai and 8 MW at Panchagarh). To design the system and implement, the contractor needs to hire experts from outside this country. The construction environment for those foreign experts is rather new as the country is yet to have sufficient number of solar PV projects.

Economies of scale: So far, the implemented utility scale grid tied solar PV projects are relatively small (in size and in quantity) and Bangladesh is yet to fully grasp the real challenges of implementing solar parks. Unless the market intensifies, the cost comparison with the neighboring countries may not be feasible.

Limited information on available services: Lack of information on related services, such as supply chain companies, finance, developers, and relevant standards affects and delays important design related decisions.

Long interruption: Unless there is a stable market, component failure or damage can lead to long periods of system interruption due to the lack of local expertise and access to replacement parts.

5.4 Challenge of Existing Power Infra-structure and Technical Standards

Weak grid: Renewable power is discontinuous in nature. National grid of Bangladesh is still not robust and reliable enough to absorb shock due to recurrent fastening in and fastening out power beyond a certain capacity. This necessitates a severe and effective grid integration study. Again, at present, the country lacks the local capacity to conduct thorough study on the impact of recurrent power injection into and removal from the national grid. So, if the

investors see some risks, they may not invest or they have to conduct such studies on their own which act as frustrating factor for the investors.

The right of way for transmission network: Generally, the selected solar PV power plants are far away from the grid substation. Getting right of way for the evacuation line construction and transmission tower installation is also a exciting work, as the concerned land owners do not want to provide permission to establish transmission towers on their land. Establishing the transmission lines are subject to legal complicacy and time consuming and sometimes exceeds the estimated cost considering the population density of the country.

Insufficient transmission infrastructure: The capacity of the power transmission network also hinders the development of solar parks. According to government policies and estimates, most of the suitable lands for solar project developments are in the north-western part of Bangladesh, with lesser solar irradiance. Therefore it needs more land requirement per unit (kW) of solar project. The transmission line availability also limits the progress of solar project development in those areas.

Lack of technical standards: There is a lack of nationally recognized technical standards and codes for large solar parks. Unless these codes and standards are developed, the works and studies need to be done by the developers. Moreover, significant assumptions are made in the absence of data which compels the developers to take risks and that results in risk premiums.

5.5 Other Challenges

Cost and research Losses: Being the major component of Solar Park, Solar PV is some years away from true cost competitiveness and from being able to compete on the same scale as other energy generation technologies. In the developed countries, approximately 40 percent of the total cost of generation of energy by Solar PV makes the solar energy sources highly unfeasible. Bangladesh is using the end product of this Solar PV system and is paying the extra 40% cost of energy generation.

Research facility: Despite of being a developing country, the University should be given enough funds for conducting research and there should be collaboration between industry and University. Collaboration can also be made with foreign industries and Universities.

Training: Training and development of human resources to drive industry growth and PV adoption should be given priority.

Awareness: Consumer awareness about the technology, its economics and right usage is a dire necessity.

Private sector involvement: All the Solar park projects of various kinds so far are financed and run by the Government organizations. Private sector organizations should come forward and be given the opportunity to run the Solar Parks. Different facilities should be provided for successful completion of these projects.

6. SOCIAL IMPACT OF SOLAR PARK

Solar Park has both the positive and negative impacts. The major advantage of large-scale solar plant is that it will provide the electricity service to the people inhabiting in that region where mainstream electric distribution center cannot be deployed and people will be able to use light, fan, and other necessary benefit, such as, charging the phone and listening radio channel. Besides, people living in this region will get the opportunity to get work especially in the preconstruction phase of a plant. It is because at this phase, less skill is required to get work although there is a huge chance to restrict people from getting work in the construction phase. Another crucial benefit for large-scale solar plant is that during the construction of solar plant they need to transfer heavy materials and huge amount of technical components, thus, they contribute to the establishment of new road which positively impact on the life of the local people. Moreover, implanting large-scale solar plant paves the way to be a center of economic activity on which people can get the opportunity to involve with this and make their life economically solvent.

The requisition of a huge amount of land is the major drawback of implanting large-scale solar plant. The total scenario of the area is totally transformed from agricultural to industrial area. Consequently, the transformation of land causes the losses of local way of living. Because, they were living in such a state of environment where they got accustomed with it but the transformation of the land type to barren and unproductive create a miserable condition. Beside this problem, although with much hardship male population can manage something to the adjacent area for making their livelihood, but women, as a special vulnerable group got marginalized abruptly. Production of solar panels

requires capital-intensive manufacturing facilities that are highly automated. At present Bangladesh is unable to manufacture the required PV modules and these are thus imported from outside countries. This is also true for high tech devices like LED's. Nevertheless, these high tech components are imported and assembled in Bangladesh by the partner organizations to produce the final device. For that reason the cost of components and installation is very high.

7. CONCLUSION

Renewable energy sources are the substitute to fossil fuels and solar cells are exhibiting an excellent performance in Bangladesh. Hence these solar cells can be chosen as the ultimate choice for the next generation energy source. In this paper, the solar energy situation in Bangladesh is thoroughly investigated and the future plan to mitigate the energy crisis is portrayed. From this paper it can be easily said that the solar park is going to be the next generation energy solution. According to the Renewable Energy Master Database, the total renewable energy capacity including all categories is about 2.4 GW. Among these, solar park projects are the main contributors in terms of capacity which is 2,110.56 MW. As of now, solar park projects are not coming in operation as expected but with the proper guidance and boost by the government, this project will become the savior of energy crisis in Bangladesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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