

## **Renewable Energy in Bangladesh: Some Evidence from Rural Areas**

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### **Abstract**

*Renewable energy has the potential to play an important role in providing energy with sustainability to the vast populations in developing countries. The rural population of Bangladesh is characterized by unemployment, landless farmers, inadequate economic and social facilities, power crisis, low standard of living, poverty and deprivation. Therefore, it is necessary to tap all sources of renewable energy supplies and greater efficiency of energy use in an efficient converted form for benefit of the rural people. This article aims at providing an assessment on the ability of renewable resources to help in reducing poverty, aid in energy shortage, environmental degradation and climate change in rural Bangladesh. The scope of the study was confined to some variables such as: socio economic characteristics of the respondent households, occupation, income and expenditure, training, educational status and utilization of them. This article is based on survey findings conducted among the people of village societies, which has been conducted by some projects of government and non government organization of BARD, LGED, RIB, Grameen Shakti and BRAC. Both quantitative and qualitative methodological techniques have been used to collect the primary data, which were collected through interview method followed by structured questionnaire and checklist. The respondents (n=120) for KIIs (key informant interviews) have been selected through purposive sampling procedure from the village society members, non members and local representatives who received relevant training for increasing access to quality of life. Relevant data were also collected from secondary sources. One important contribution of this paper is the finding that renewable energy has different positive impacts on livelihood development, changes in rural life styles by creating employment opportunities, energy security, cost reduction and environmental benefits. Renewable energy is slowly finding a niche market in Bangladesh. Although it is economically viable for several applications, renewable*

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*energy has not been able to realize its potential due to some barriers to its penetration. On the basis of findings, it is recommended that people's participation and awareness regarding renewable energy consumption and initiatives should be developed, providing more training and low cost support service, innovation and expansion of durable technology, efficient operation and maintenance skill as well as availability of necessary equipments and technology should be strengthened for sustainable development in Bangladesh.*

**Keywords:** Renewable Energy, expansion of Solar Energy, income generation, trained man power, uses of Biomass, potential and barriers, rural initiatives

### **Introduction**

Bangladesh with a land area of 1, 47, 570 sq. km. and a population of ranging from 150 to 170 million and is the 8th most populous nation in the world. Most of the people of Bangladesh live in rural areas. [1] The rural population of Bangladesh is characterized by an abundance of open and disguised unemployment, large numbers of landless farmers, inadequate economic and social facilities, low standard of living, poverty and deprivation. Again population growth and poverty in developing country are considered to be the major causes of environmental degradation and resource scarcity. Not only the number of people but also the lifestyle, unsustainable consumption and production patterns, demographic factors such as population distribution and migration and regions people inhabit and use directly affect the environment. Thus the development of energy systems supplied from small, varied, decentralized and locally managed renewable sources supplies and greater efficiency of energy use in an efficient converted form for benefit of the rural people. Sustainable social and economic development depends on adequate power generation capacity of a country. There is no other way for accelerating development except to increase the power generation by fuel diversification. The demand forecasts for the period 1992-2020 reveal that the energy demands in Bangladesh will more than double by the end of 2020, with commercial energy increasing by 400%, and non-commercial energy displaying an increase of just 45% [2]. The Renewable Energy Policy envisions that 5% of total energy production will have to be achieved by 2015 and 10% by 2020. To achieve this target, GOB is looking for various options preferably Renewable Energy resources. Under the existing generation scenario of Bangladesh, Renewable Energy has a very small share to the total generation. The share of Renewable Energy exceeds more than 1% till now. The present Government is placing priority on developing Renewable Energy resources to improve energy security and to establish a sustainable energy

regime alongside of conventional energy sources. Government has already launched "500 MW Solar Power Mission" to promote the use of Renewable Energy to meet the increasing demand of electricity.[3] This paper aims at providing an assessment on the ability of renewable resources to help in reducing poverty, aid in energy shortage and the uses of renewable energy special emphasis on solar and biomass energy to improve the quality of rural life.

### **Background of the study**

Government of Bangladesh has taken a systematic approach towards renewable energy development. In line with the Government approach Bangladesh Power Development Board formed the Directorate of Renewable Energy and Research & Development in 2010 [2]. Since the very beginning of establishment the directorate is dedicated to keep a sign for the enhancement of Renewable Energy use in rural sector. There is a good scope for solar, wind, biomass, and micro/mini hydro power generation in Bangladesh. BPDB has taken systematic steps for developing Renewable Energy projects as well as implement and promote Energy Efficiency Measures for the last few years to achieve the target of the Renewable Energy Policy 2008. Bangladesh's interim government has unveiled a renewable energy policy, the first of its kind, to ease the country's severe electricity shortages, and aims to achieve this by luring investors with a raft of incentives [3]. Therefore the directorate is established for feasibility study, planning, evaluation, examination, monitoring of such projects and to perform necessary research based works in relative fields. There are few studies regarding power crisis and its solution, prospects and trends and situation of renewable energy in Bangladesh have been conducted [6, 7, 8]. Therefore, this study is taken to assess the ability of renewable resources to help in reducing poverty and its effects on rural Bangladesh.

### **Objectives**

The general objective of the study was an assessment on the ability of renewable resources to help in reducing poverty and its effects in environmental degradation and climate change in rural Bangladesh.

#### **The specific objectives of the study were to**

- a. review the development activities of village societies through some projects with special emphasis on renewable energy use;
- b. to assess the socio economic characteristics of respondent households;
- c. efficiency of energy use and utilization of energy sources of rural people;

d. make recommendation and way out based on the findings of the study

### **Scope of the Study**

This study was conducted on village people, who were got technical and electrical training on specific energy sources and uses under the program of BARD (CVDP), LGED, RIB, Grameen Shakti and BRAC. Minimum ten people from each selected village from different district were participated in the interview schedule. The scope of the study was confined to the following variables:

- Socio economic condition i.e. population by age, sex, house hold size;
- Occupation, income and expenditure;
- efficiency of solar and biomass energy use and its utilization;
- Training and educational status;
- Interlink with the support service.

### ***Methodology of the study***

#### **Selection of Sample Areas**

In order to assess the uses and scope of renewable energy of rural people, the sample survey method was followed. This study was conducted in six villages namely Dhamra, Matiranga, Gopal pur, Lokkhipur, Kashinathpur, Jogotpur from Shahrasti, Matiranga, Nobinagar, Comilla Sadar and Burichong Upazilla respectively under relevant projects of BARD such as Comprehensive Village Development Program (CVDP), LGED, RIB, Grameen Shakti and BRAC. Mainly purposive sampling procedure has been followed in this study.

#### **Selection of Respondents**

The primary data of this study were collected through structured questionnaire and checklist of the sample villages. The respondents (n=120) for KIIs (key informant interviews) have been selected through purposive sampling procedure from the village society members, non members and local representatives who received relevant training and utilize that acquired knowledge and skill for increasing access to quality of life of rural people.

#### **Methods of Data Collection**

Survey methods were used to collect relevant data from the study villages, which were purposively selected. Relevant data were collected from both primary and secondary sources.

#### **Data Processing and Analysis**

Collected data were processed, analyzed and presented in such a manner that the reader could get a clear idea of potential, uses and scope of solar and biomass energy in rural areas of Bangladesh. Data were collected during July to October 2014.

### Renewable Energy: An overview

Bangladesh is endowed with plentiful supply of renewable sources of energy. The four renewable sources used most often are:

- Solar Energy
- Wind Energy
- Biomass Energy
- Hydro-power energy

### Solar Energy

Solar Energy can be 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 [3]. At this position the amount of hours of sunlight each day throughout a year is shown in the following graph in the Figure-1 [4]. The highest and the lowest intensity of direct radiation in  $W/m^2$  are also shown in the Figure-2 [4].

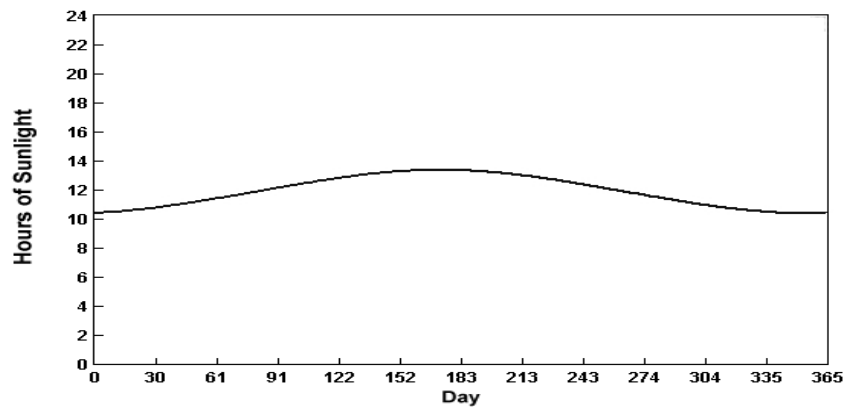
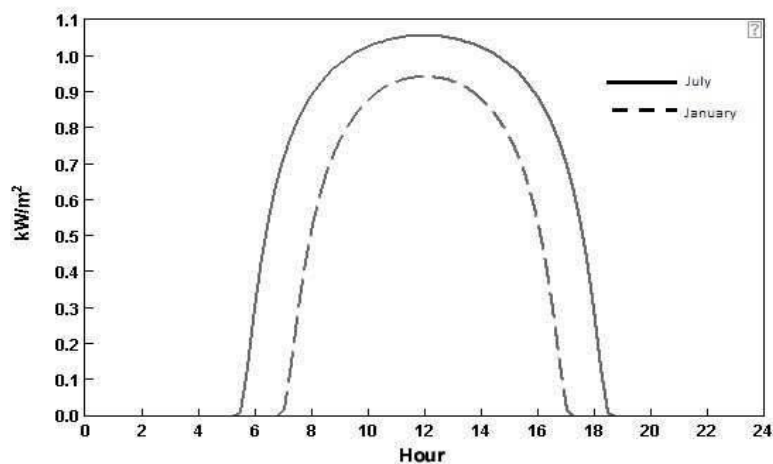


Fig.1. The amount of hours of sunlight in Bangladesh



**Figure 2:** The highest and the lowest intensity of direct radiation in W/m<sup>2</sup>

In a recent study conducted by Renewable Energy Research Centre, it is found that average solar radiation varies between 4 to 6.5 kWhm<sup>-2</sup> day<sup>-1</sup> and maximum amounts of radiation are available in the month of March-April and minimum in December-January [3]. So from the above figure and discussion we can say that there is a good prospect of harnessing solar power in Bangladesh because it is-

- readily available
- pollution free
- free source of energy in our country

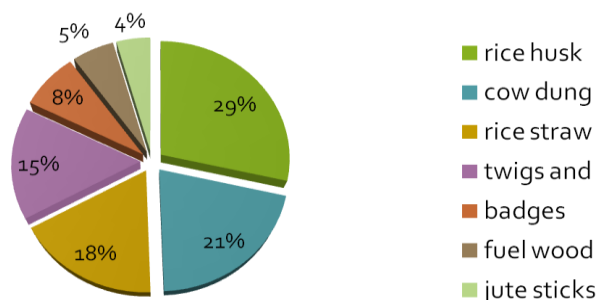
Different Solar photovoltaic (PV) applications are gaining acceptance as a technology for electricity generation in remote and rural areas of the country, including-

- Solar Home Systems (SHS)
- Rural Market Electrification
- School Electrification
- Health Clinic / Hospital Electrification
- Cyclone Shelter Electrification
- Micro enterprise (grocery shops, tailoring shops, clinics, restaurants, sawmills, rice mills, cellular phone services, barber shops) Electrification
- ICT Training Centre Electrification
- Water Pumping
- Signaling
- Remote Telecommunication
- Remote Rainfall Measuring Station

**Biomass Energy**

Bangladesh is densely populated country. Large proportions of rural and urban poor traditionally harvest; fire wood, Vegetation, animal excreta and agricultural residues for domestic cooking. These methods proved to be unsustainable as fire woods contributed to higher levels of deforestation. Population explosion and to meet related energy demands, deforestation level is higher than forestation efforts which is resulting environmental degradation. Uses of fire wood increases at rate of 2% annually. The high cost of petroleum products, low coverage of the electricity grid, gasification and increasing scarcity of traditional fuel woods due to deforestation created an energy deficit situation in rural

Bangladesh. Environmental experts predicted massive deforestation if crisis is not being met from alternative source. Country like Bangladesh, making people renewable way meeting energy demands, considerably Biogas technology is cheaper option. More than 73% of total final energy consumption was met by different type of biomass fuels.



**Fig:** Biomass resources present in Bangladesh [5]

Sustainable Biomass energy has the positive impact on environment such as:

- Reduce higher level of deforestation.
- Reduce net greenhouse gas emissions.
- Improve air quality and reduce acid deposition
- Improve soil quality and reduce erosions.
- Reduce land filling by adding value to residues.
- Reduce agricultural chemical runoff.
- Improve sanitation condition.
- Improve habitat for native wildlife and improve biodiversity.
- Outlining sustainable land use and improved air quality.
- Improved habitat for wildlife and reduced use of fertilizers and insecticides compared with lands used for row crops, protection of riparian areas, and erosion protection for sensitive land areas.

Reduction of Greenhouse Gases from biomass power takes place because the carbon dioxide released during combustion is absorbed by the plants as they grow. Biomass could play a role in reducing CO<sub>2</sub> emissions in both of these sectors.

### **Technologies for Biomass Energy in Bangladesh**

1. Improved Cook Stove (ICS)
2. Boiler operation for parboiling
3. Briquette fuel
4. Electricity generation
5. Cooking and heating

There are some projects of renewable energy in Bangladesh as mention below [9]:

### **Projects by Governmental Organizations**

- Biogas Pilot Plant Project by IFRD (20,000 plants within 2004)
- Biogas Project by LGED (1,200 plants)
- Chittagong Hill Tracks Solar Electrification Project by BPBD
- Diffusion of Renewable Energy Technologies Project by REB
- Feasibility Study & R&D on Renewable Energies by IFR

### **Projects by the Private Sector/NGOs**

- RET Programs by Grameen Shakti (10,000 SHS)
- Dissemination Program by CMES (Rural Market Electrification)
- Renewable Energy Program by BRAC

### **Projects by Educational Institutions**

- Dissemination of RETs by Renewable Energy Research Centre
- RET Program of Centre for Energy Studies (CES), BUET

### **Projects by Bilateral and Multilateral Development Partners**

- Sustainable Rural Energy (SRE) Project by UNDP
- Renewable Energy Technologies in Asia (RETs in Asia) Program by SIDA
- Opportunity For Women In Renewable Energy Technology
- Utilization In Bangladesh Project by ESMAP (35 Women ESCO)
- BUET- Loughborough University Higher Education Link Project by DFID
- Solar and Wind Energy Resource Assessment (SWERA) Project by GEF/UNEP
- Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement (PREGA) Project by ADB
- Rural Electrification and Renewable Energy Development Project (REREDP) by World Bank/GEF, conducted by IDCOL
- Promotion of Renewable Energy in Selected Rural Areas of Bangladesh by GTZ

### ***Profile of the study villages***

#### **General Information**

The study was conducted in six villages which are located in five different upazila of Chandpur, Khagrachori, Bramanbaria and Comilla district. Among the societies of CVDP from BARD: two villages namely



Dhamra and Matiranga, and under Grameen Shakti and RIB programs: Gopal pur, Lokkhipur villages were selected. On the other hand Kashinathpur and Jogotpur were selected under BRAC and LGED program.

### **The households and respondents socio economic characteristics**

The total number of households in the study villages was 1, 656. These household had a total of 8478 members with an average family size of 5.12 persons. Villagers live on multi type of occupation. Of the total household 31% lived on agriculture. The rest household heads were engaged in trade, service and rickshaw pulling.

### ***Findings and Discussion on Renewable energy use in studied villages***

#### **BARD program**

Bangladesh Academy for Rural Development (BARD) has made an effort for rural development endeavor under village based cooperative organization through Comprehensive Village Development Programme (CVDP). Now it is a national project of the Bangladesh Government. The CVDP believes in individual's entrepreneurship in one hand and inclusiveness of villagers on the other, motivate the members for own initiative development through training and capability improvement. Therefore, CVDP provides training on various fields such as leadership, trade based skill training, eco sanitation, agricultural development and income generation through entrepreneurship development. On the other hand CVDP arranges technical training for the youth members of the society and giving training on electrical, plumbing, refrigeration, tailoring and solar installation training. Data reveals that in CVDP project villages of BARD, out of the total household 51% lived on agriculture. The rest 30% household heads were engaged in trade, service and rickshaw pulling. The rest households of 19% people engage with petty business. In the study village, 72% people are literate because of project initiatives and better school facilities. The village society's member under CVDP program revealed that 55% respondents of Dhamra and Matiranga village got training on electrical and solar installation and management from the Technical Training Centre (TTC) of Comilla. It was observed that trained rural people utilize the acquired knowledge to be self employed in their respective fields. It was observed that out of the total people of the studied village, 70% use solar PV system in maintaining light, fan, television, charging of electronic devices etc. Again the trained member of CVDP program gives expertise in repairing and maintenance support to the solar PV using families according to their needs. Again solar PV powered Street light has been installed in Khagrachori district.

#### **Grameen Shakti and RIB program**

Data reveals that under Grameen Shakti and RIB project villages, among the respondents, 68% people are literate and majority mainly depend on agriculture. The rest households of 20% people work in abroad and engage with petty business. Data revealed that 80% people have the electricity facilities from the RIB and other 20% people depends on own initiatives such as installation of solar PV system, using kerosene, charge light, candles etc. The people who use solar PV system, collects solar panel from the Grameen Shakti through 2-3 years duration credit facilities following monthly repayment of loan amount on the installment basis. Moreover it was found that solar market electrification of shop and health centre improved uses of CFL lamp, OT lamp, refrigerator, TV etc. In case of Bio energy uses by the rural people, it is found that 60% respondents depend on traditional cooking system and applies chemical fertilization in the agricultural works. The rest of the 40% respondents use bio sources such as wood, rice husk, agricultural residues and food waste for the regular cooking work.

### **LGED Program**

Local Government Engineering Department, a government motivated village development organization has been involved in dissemination of biogas technology since 1985 and has been able to demonstrate its usefulness at more than thousand sites in different parts of the country. At present Bangladesh meet 46.15% of its energy need by agricultural residue, 10.5 % by fuel wood and 33% by tree residue. Biogas will reduce energy deficit 15 %. Biogas is a proven technology; there is no risk of failure if proper design and supervision can be ensured. Most of the commercial banks are now convinced and took decision to provide loan for the construction of Biogas plants. Most of the urban poor can not afford gas connection as it costs Tk. 200 to Tk. 400 per month. Instead they can install Biogas plants with bank loan and repay the loan out of their fuel savings' domestic' size Biogas plant of 100 cft capacity cost Tk. 15,000 to Tk.18, 000 and can meet the cooking energy need for a five-member family. Large scale bio energy development in Bangladesh could bring significant environmental benefits.

LGED has constructed 61 Biogas plants in different rural villages, educational institutes, orphanages, hospitals, school/college hostels for solving the sanitation problems and getting biogas as an alternative energy source. Data reveals that studied Jogotpur village of Burichang Upazilla constructed a low cost biogas plant three years back which

served the purpose of septic tank as well as a source of gas and fertilizer. Now villagers are aware about environment and technology, create clear, healthy and acceptable environment in the villages and inspire the people around the villages to accept such project.

### **BRAC Program**

Data reveals that under BRAC project villages, among the respondents, 69% people are literate and majority mainly depends on agriculture and shop keeping. Previously BRAC conducted an action research project on rural electrification by biogas generation called Project Emergence during 2004-2009. The project plans to establish mini power plants (MPP) in rural villages of Comilla district, each of which will be owned and operated by two borrowers in a micro credit programme. Data reveals that under the studied Kashinathpur village of BRAC don't have specific project of biogas plant to produce electricity, fertilizer, and heat but recently they implementing training under wash project for environment friendly behavior, sanitation management and marketing of cow dung and fish feed. From the study of these villages under four different districts, it can be concluded that renewable energy has different positive impacts on livelihood development, changes in rural life styles by creating employment opportunities, energy security, cost reduction and environmental benefits. Again it has found that respondents face some disadvantages of using solar and bio energy which is given below:

Table-1: Opinion of the respondents about Advantages and Disadvantages of Biomass energy, 2014:

<b>Advantages of Biomass Energy</b>	<b>N=120 (%)</b>	<b>Disadvantages of Biomass Energy</b>	<b>N=120 (%)</b>
-easy uses of renewable fuel	90 (75%)	.-a large area of land is required for the production of fuel	58 (48%)
-can contribute to climate change mitigation	85 (71%)	-requires more fertilizer for crops	44 (36%)
-secure and diverse energy supply and economic development	88 (74%)	-burning of biomass may create pollution	63 (52%)
-opportunities for rural development and agricultural growth	80 (67%)	-a reduction in food or feed production may occur if existing lands are used to produce bioenergy feedstock	34 (28%)

*Source: Field survey, 2014*

Table-2: Opinion of the respondents about Advantages and Disadvantages of Solar energy, 2014:

<b>Advantages</b>	<b>N=120 (%)</b>	<b>Disadvantages</b>	<b>N= 120 (%)</b>
-solar energy is sustainable and non-polluting	92 (76%)	-requires large space	85 (71%)
-solar thermal and PV technologies do not generate any types of solid, liquid or gaseous by-products when producing electricity	70 (58%)	-may also require substantial amount of cooling water	35 (29%)
-solar energy can bring in significant benefits for rural people in replacing indoor polluting kerosene lamps and inefficient cook stoves	92 (76%)	-solar energy is variable and unpredictable	87 (73%)
-increased indoor reading, reduce time gathering firewood for cooking	90 (75%)	-solar electricity could be expensive	95 (79%)
-street lighting for security, improved health by providing refrigeration for vaccines and food products and media communications	68 (56%)		
-solar PV has job-generating potential	74 (62%)		

Table-3: Opinion of the respondents about renewable energy issues, 2014:

The opinion about renewable energy of the respondents as well as changes of attitudes related with the project were assessed. However, the following table furnishes the opinion of the project beneficiaries in the study villages.

<b>Issues</b>	<b>CVDP</b>	<b>Grameen Shakti</b>	<b>RIB</b>	<b>LGED</b>	<b>BRAC</b>
	<b>Number (%)</b>	<b>Number (%)</b>	<b>Number (%)</b>	<b>Number (%)</b>	<b>Number (%)</b>
a) Satisfactory use of electricity through solar PV system	15 (75%)	7 (38%)	17 (85%)	null	null
b) Practical use of Biomass energy	9 (45%)	2 (10%)	2 (10%)	16 (82%)	10 (54%)
c) Group formation, weekly meeting, share saving, credit increase their standard of living	17 (85%)	8 (40%)	5 (25%)	4 (20%)	15 (81%)
d) training for increasing	10	12	08	3	8

their income and economic solvency	(54%)	(60)	(40)	(15%)	(40%)
c) Aware about eco friendly environment and climate change	7 (38%)	2 (10%)	2 (10%)	9 (45%)	6 (30%)
f) Improve their ability to practice solar power and Biomass energy	14 (70%)	13 (65%)	8 (40%)	9 (45%)	6 (30%)

*Source: Field survey, 2014*

### **Opportunities and Barriers associated with the RE Project**

Renewable energy is slowly finding a niche market in Bangladesh. Although it is economically viable for several applications, renewable energy has not been able to realize its potential due to some barriers to its penetration.

<b>RE Type</b>	<b>Key Risk Issues</b>	<b>Barrier penetration</b>
Solar PV System	<ul style="list-style-type: none"> <li>• High initial cost</li> <li>• Dependence on weather</li> <li>• Component Breakdowns (e.g. Short circuits)</li> <li>• Maintenance cost</li> <li>• Theft</li> <li>• Third party dependency</li> <li>• Ownership Rights risk</li> </ul>	<ul style="list-style-type: none"> <li>• Raising people awareness</li> <li>• Publicity and advertisement</li> <li>• Installation</li> <li>• Training of operation and maintenance</li> <li>• Sun light readily available and pollution free</li> <li>• free source of energy in our country</li> </ul>
Biomass Power	<ul style="list-style-type: none"> <li>• Fuel supply availability</li> <li>• Environment liabilities</li> <li>• Unavailability of necessary information</li> <li>• Lack of operation and maintenance technology</li> <li>• Human resource barriers</li> </ul>	<ul style="list-style-type: none"> <li>• Transport of biomass fuel</li> <li>• Raising people awareness</li> <li>• Publicity and advertisement</li> <li>• Installation</li> <li>• Training of operation and maintenance</li> <li>• Eco friendly nature</li> </ul>

### **Conclusion and Recommendations**

Renewable technologies are clean sources of energy and provide an opportunity for mitigation of climate change (global warming), and reducing greenhouse emissions. Electricity generation from RE sources can play an important role to enhance reliability and efficiency of the power system (i.e. energy security- availability, reliability and affordability of energy supply). Though renewable energy is slowly finding a niche market in Bangladesh, at present electricity generation from renewable sources is becoming an essential part in rural areas of Bangladesh. On the basis of findings, it is recommended that people's participation and awareness regarding renewable energy consumption and initiatives should be developed, providing more training and low cost

support service, innovation and expansion of durable technology, efficient operation and maintenance skill as well as availability of necessary equipments and technology should be strengthened for sustainable development in Bangladesh.

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