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Renewable Energy for Rural Development in Bangladesh

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Abstract

Energy is one of the main prerequisites to ensure socio-economic development. The availability of energy sources and its proper utilization of energy are the prime concerns for achieving growth and progress in developing countries. Bangladesh is also facing difficulties in supplying energy to maintain its economic growth. The gap between demand and supply is gradually increasing. The situation is even worse in the rural areas where supply of energy is still very uncertain. There is also a notable discrepancy in the energy shares between urban and rural usage. The situation calls for adaptation of sustainable energy strategies that permeate energy level of the economy and can provide rural dwellers with the basic services that they need. Bangladesh has good potential for harnessing renewable energy sources such as solar, biomass, wind wave energy etc. It has been experiencing a gradual shift towards exploring renewable energy resources as a means of driving force for rural development. Few public and private organizations have started to take part to develop renewable energy technologies (RETs) projects. It is promising that the percentage of renewable energy usage in the rural area is increasing day by day with such initiatives. Renewable Energy Policy has been adopted and plans have been made to implement the policy and obtain a fare share of renewable energy at the earliest possible time. The implementation of renewable energy have brought about significant changes in the life of rural people. It has proved that development in rural areas can be much benefitted with the proper utilization of our renewable energy sources. However, in Bangladesh efficient utilization of renewable energy resources is yet to assume proper commercial dimensions and hence rational policy dissemination on renewable energy usage is essential

Keyword: Renewable energy, Rural development, Solar, Biomass, Wind, Mini-hydro, RET.

1. Introduction

For a developing country like Bangladesh uninterrupted electricity supply is of topmost priority. The scenario of power and electricity in Bangladesh in recent years with proposed solutions to improve the situation have been presented in various papers [1], [2], [3]. Bangladesh also relies on renewable energy to meet some of the power demands, especially in the rural areas. The overall status of renewable energy technologies(RET), their field of applications and prospects in this country have been shown in [4], [5], [6], [7], [8], [9]. For a sustainable renewable energy mix with respect to Bangladesh, there has been numerous researches. Different approaches to solve the power crisis in this country have been pointed out explicitly by various authors [10], [11], [12] etc.

This paper focuses on the present power scenario of Bangladesh and contribution of RETs in the rural development. It also discusses about some of the prime barriers to the implementation of RETs.

2. Current situation of power in Bangladesh

The total installed capacity was 4005 MW in FY 2000-01 which has increased to 6685 MW in FY 2010-11 (13 June, 2011) with an annual increasing rate of 6.62 percent. However, the maximum generation was 3033 MW in FY 2000-01 which has increased to 4699 MW in FY 2010-11 (13 June, 2011) with an annual increasing rate of 5.49 percent.

The following graphs shows the trend in demand and supply gap of electricity in Bangladesh.

Within the reach of the national grid Bangladesh is still reeling under 600 - 1200 MW of ‘load-shedding’. This gap in demand and supply of electricity has given rise to take renewable energy technologies (RETs) more seriously in contributing towards the deficiency.

Table 1. Electricity Scenario: At a Glance (31st December 2012)
[Bangladesh Power Development Board]

Generation Capacity	8525 MW
Maximum Generation (on 04 August 2012)	6350 MW
Per Capita Electricity Generation (including captive generation)	292kW-hr
Number of Clients (connection wise)	13.64 million
Total Beneficiaries	95.60 million
% of Population under electrification	60%

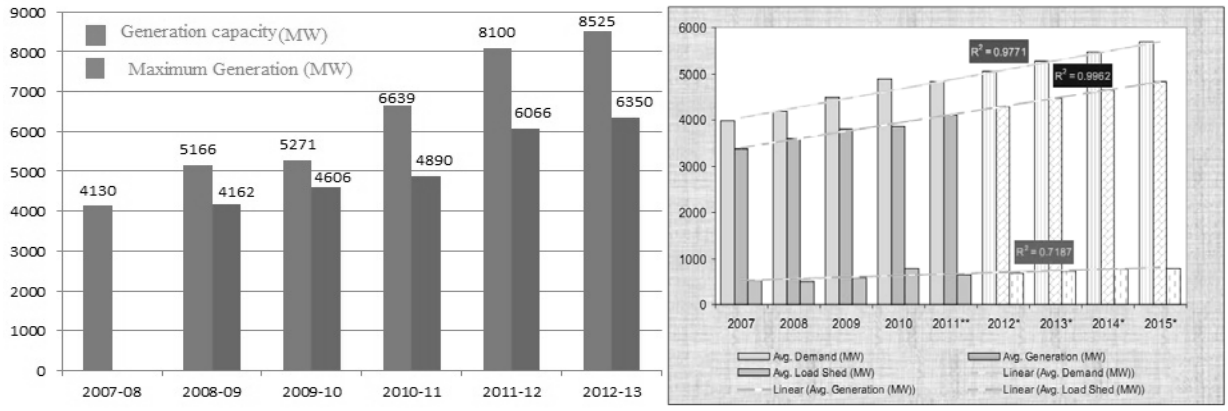

Fig. 1. Current situation and feasible future electricity demand, generation and load shedding

3. Different technologies in power generation sector

The following figures show the fuel mix of power generation in Bangladesh. It can be seen that though conventional fuels have been used steadily for the generation of electricity, renewable sources are gaining their share into the scenario.

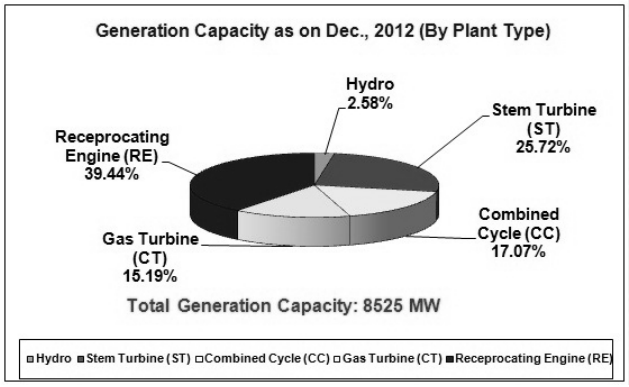

Fig. 2. Different technologies in power generation

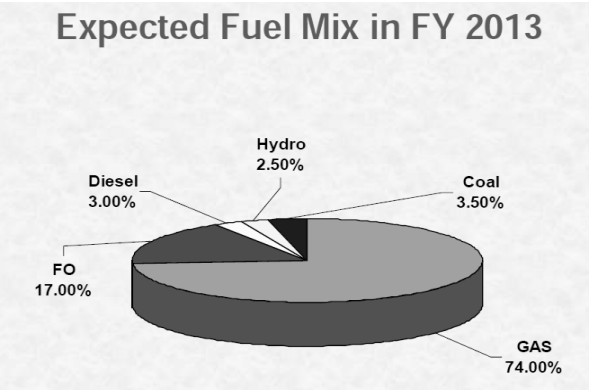

Fig. 3. Expected fuel mix in 2013

3. Renewable Energy Technologies(RETs)

Renewable energy technologies (RETs) can help Bangladesh to self-reliant in energy supplies. Some RET models have already been implemented in rural areas in Bangladesh. The following table shows installed capacity of different RETs in Bangladesh:

Table 2. Capacity of different RETs *[Infrastructure Development Company Limited (IDCOL)]*

Technology	Installed Capacity (Approximate estimation)
Solar	80 MW
Improved biomass cooker	around 300,000
Biogas	around 250,000
Wind turbine	2.8 MW
Micro-hydro	10 kW

Solar energy

Bangladesh is located between 20.30 - 26.38 degrees north latitude and 88.04 - 92.44 degrees east which is an ideal location for solar energy utilization. Here, the daily average solar radiation varies between 4 to 6.5 kWh per square meter [4]. Maximum amount of radiation is available on the month of March-April and minimum on December-January. Infrastructure development company limited (IDCOL) has supported NGOs in installation of solar home systems (SHSs) [14]. Bangladesh University of Engineering and Technology (BUET) has conducted many research works since 1980 on solar energy. Solar energy has been found to be useful in various ways to facilitate the rural people.

Solar Home System (SHS)

SHS was first implemented by Rural Electrification Board (REB) followed by various private organizations like IDCOL, Grameen Shakti etc. A typical SHS in Bangladesh consists of solar panel, storage battery, charge controller and directly connected DC appliances. SHSs are attractive for small rural business; however, these are not economically viable for only household lighting purpose.

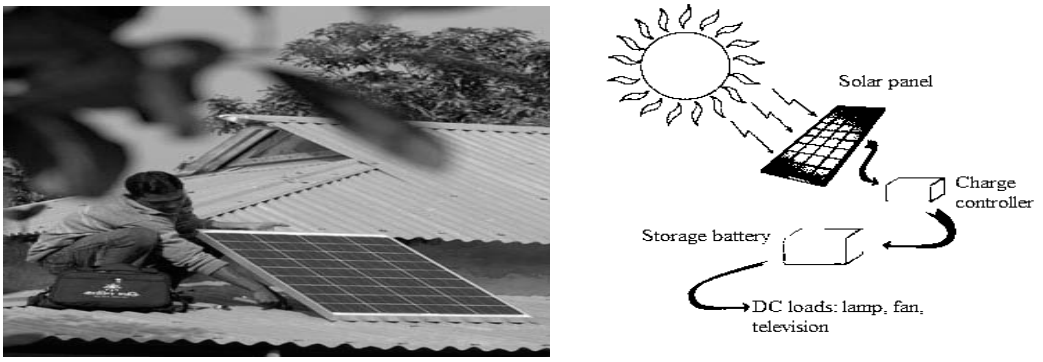

Fig. 4. Components of solar home system

Solar cookers

IDCOL, Grameen Shakti and BRAC are working on development and dissemination of solar cooker with the support from GIZ. Institute of Fuel Research and Development (IFRD) of Bangladesh Council of Scientific and Industrial Research (BCSIR) and Centre for mass Education in Science (CMES) are also engaged in promoting solar cookers. Several research projects have been conducted by BUET on solar cooker and its efficient construction. A low cost reflector type cooker can much benefit the rural mass in Bangladesh.

Solar Dryer

Different models of solar dryers have been designed and constructed with locally available raw materials. The Institute of Food Science and Technology (IFST), Bangladesh Agricultural University (BAU), BUET have been working on developing different efficient model of dryer for drying fruits, vegetables, fish etc. at an affordable price.

Solar Water Heater

Solar water heaters designed and fabricated by IFRD, BUET, Dhaka University (DU), BCSIR have been very useful. These heaters absorbs solar radiation, convert into heat and transfers the resulting heat to circulating water at a temperature below 90^{o}C.

Solar pump

Several organizations like REB, IDCOL, GIZ, Grameen Shakti, BUET, Oxfam, Bangladesh Jute Research Institute (BJRI) and many others have been working on solar pumps to provide water in the rural areas for irrigation and household uses. BUET with the support of Bangladesh Academy of Science (BAS) have established solar irrigation pumps. IDCOL also have financed many projects to set up solar irrigation pumps in different parts of the country. Some of this pumps is expected to provide irrigation facilities to more than 22.5 hectares of land benefiting as much as 22 farmers. GIZ has also been working on solar pumps to provide clean drinking water to households in the rural areas since 2010.

Solar micro grid

Solar micro grid has a great potential in solving power shortage in the countryside. IDCOL has been financing different NGOs to install solar micro grid based power system to supply electricity in remote places. Several pilot projects have been taken up already which are expected to successfully provide electricity in small villages.

Wind energy

Bangladesh has a 724 km long coast line and many small islands in the Bay of Bengal, where strong south-westerly trade wind and sea-breeze blow in the summer months and there is gentle north-easterly trade wind and land breeze in winter months. Along the coastal area of Bangladesh, the annual average wind speed at 30m height is more than 5 m/s. Wind speed in northeastern parts in Bangladesh is above 4.5 m/s while for the other parts of the country wind speed is around 3.5 m/s. The Bangladesh Power Development Board has estimated that wind energy can contribute to 10% of the energy needs of the country.

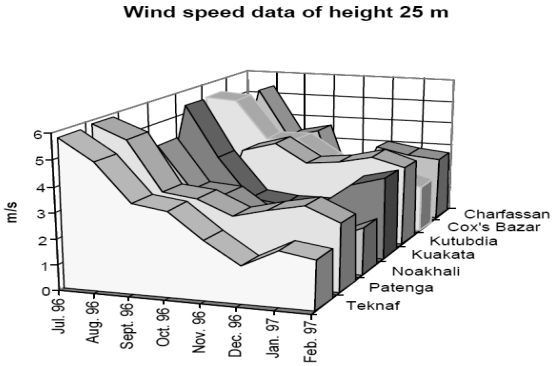

Fig. 5. Feasibility of Wind Conditions at Different Places

Recently, Bangladesh's first-ever generation of electricity from wind at a 900-kilowatt plant has ushered in new hopes for generation of power with minimum cost in the country. The power plant, located near the Muhuri Dam in southeastern Feni district, have four separate wind turbines of 225 kW each. It is now ready to generate electricity from wind and supply to the Muhuri Irrigation Project and the national grid, according to The Bangladesh power development board.

Beside several small wind generators have been installed by BRAC (11 small wind turbines in various coastal sites) and Grameen Shakti (two wind generators of 300 W and 1 kW at its Chakoria Shrimp Farm). Grameen Shakti has recently installed 4 small wind generators (three l.5 kW and one 10 kW) in Barguna district.

Biomass and Biogas

For an agro-based country like Bangladesh produces huge amount of waste materials. According to an estimate 29.7 billion m^3 of biogas can be obtained from the livestock of the country which is equivalent to 1.5 million tons of kerosene (which is the principal fuel in the rural areas). Converting these waste materials into energy is economically advantageous as well as helpful to solve the issue of power crisis. Bangladesh has a wonderful climate for biogas production. The ideal temperature for biogas is around 35ºC. The temperature in Bangladesh usually varies from 6ºC to 40ºC and also the raw materials for biogas are easily and cheaply available everywhere in this country.

The Government along with several NGOs is working together for development of power production from Biogas. Several studies on biogas plants and efficient functioning have been conducted by BUET at different times. BAU, IFRD, REB, IDCOL, Grameen Shakti, BRAC, GIZ and many other organizations have successfully installed numerous biogas plants across the country. Grameen Shakti have completed 13,500 biogas plants. Recently Seed Bangla Foundation has proposed a 25 KW Biogas based Power Plant in Rajshahi. IDCOL, a Government owned Investment Company fixed a target to set up 37,669 biogas plants in Bangladesh by 2012, under its National Domestic Biogas and Manure programmers (NDBMP). It has also set a target of 25 per cent of the total target of biogas plants in the northern region which is yet to be brought under the national gas grid. Besides working in partnership with IDCOL, some organizations have constructed domestic biogas plants with their own funds. These are Grameen Shakti (about 3,664 plants of their own), BRAC (about 3,664 plants of their own), and some other private organizations which promote biogas plants independently. Moreover, since May 2011, IDCOL along with its

Fig. 6. A Biogas plant

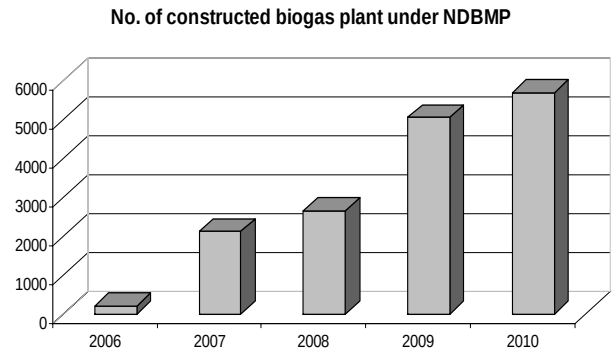

Fig. 7. Biogas plants construction in Bangladesh under NDBMP

partner organizations; has installed 18,713 biogas plants in different parts of Bangladesh. Some of these partner organizations and projects are listed below:

Table 3. Biogas Plant installation up to May, 2011 *[IDCOL Renewable Energy Project,2012]*

Partner Organization	Biogas plant completed
Grameen Shakti	10,637
Rahman Renewable Energy Co. Ltd. (RB)	896
Save our urban life - SOUL	865
Kamrul Biogas and Compost Fertilizer Research Development Co. Ltd. (KB)	850
Hossain Biogas and Compost Fertilizer Company Ltd. (HB)	609

Economic benefits derived from such biogas plants in terms of fuel and chemical fertilizer saving can have notable impact on the national economy. In future, the biogas technology is expected to be the driving force for ongoing growth of the poultry industry in Bangladesh.

Bangladesh has a huge resources of biomass fuels like crops residue, rice husks, sugarcane, vegetables, animal dung, poultry wastes etc. Different Government organization and NGOs have been working to promote biomass technology. IDCOL have financed to set up some biomass plants at different parts of the country. There has been a number of researches on fabrication of biomass plants for improved performance

Micro hydro

Hydropower is an eco-friendly clean power generation method. The scope of hydropower generation is very limited in Bangladesh because of its plain terrains except in some hilly region in the northeast and southeast parts of the country. However there are lots of canals, tributaries of main river Karnafuli, Shangu, Matamuhuri as well as tiny waterfalls having good potentials for setting up mini/micro hydropower unit in Chittagong Hill Tracts (CHT) region. A 50 kW micro-hydro plant was installed at Barkal Upazila of Rangamati district in 2005. BPDB has taken steps to install 50-70 kW Mohamaya Irrigation-cum-Hydro Power Project at Mirersorai, Chittagong and 50 kW Micro-Hydro Power Plant at Barkal Upazila of Rangamati district. Several projects are still under planning of BPDB.

4. Barriers

There are plenty of barriers of different types hindering the widespread deployment of potential RETs. Different types of barriers are: Policy barrier, Institutional barrier, Technical barrier, Market barrier, Economic, Financial and Financing Barrier, Information Barriers, Human Resource Barriers etc. Some of the barriers of various types experienced from the past are enlisted below:

- There is lack of public awareness on renewable energy technologies other than that they exist. For example, Availability of renewable energy resources is very site specific, requiring detailed analysis of the local specific conditions.
- knowledge that the life cycle costs of most renewable energy technologies are often competitive or even lowest among cost options is mostly absent.
- Lack of awareness of renewable energy in public, industry, utility, financial institutions and policy-makers.
- High initial capital costs.

- Higher perceived risks of the renewable energy technology.
- Local manufacturing and/or assembly of renewable energy technology components are currently very limited, although the knowledge, skills, expertise and facilities are available in the country.
- Lack of information about renewable energy resources, technical/economic information about RETs, equipment suppliers, and potential financiers.
- Lack of financial incentive policies to encourage renewable energy development
- Lack of standards and quality control for renewable energy equipment.
- Limited knowledge on the renewable energy market potential.
- The high upfront cost at the end user level for renewable energy is a major barrier to the increased use of renewable energy sources for the provision of modern energy services.
- No dedicated financing for renewable energy activities exists with financial institutions now. The capacity within the financial institutions and power utilities to appraise renewable energy proposals and requests for loan is limited or non-existing;
- Limited in-country capacity for renewable energy data collection and analysis.

5. Summary

There is no doubt that Renewable Energy Technologies will play a significant role in the future development scenario of the country. The conventional energy sources are failing in our country to meet the demands with the current budget. However, it is promising that the percentage of renewable energy usage in the rural area is increasing day by day with the initiative by both the Government and the private sectors. Renewable Energy Policy has been adopted and plans have been made to implement the policy and to obtain a fare share of renewable energy at the earliest possible time. The implementation of renewable energy technologies have brought about significant changes in the life of rural people. It has proved that development in rural areas can be much benefitted with the proper utilization of our renewable energy sources. But the developing countries like Bangladesh should take efforts to establish the technical reliability and social acceptability of such technologies through Demonstration / Pilot Projects. Proper guidelines and execution of plans taken so far could bring a revolutionary change in the life of the rural people as well as a positive result for the country.

6. References

[1] M.H. Ullah, T. Haque, M.M. Hasib, "Current Status of Renewable Energy Sector in Bangladesh and a Proposed Grid Connected Hybrid Renewable Energy System", International Journal of Advanced Renewable Energy Research- Vol. 1, Issue. 11, pp. 618-627, 2012.

[2] K. Mahmud & A.K.M.M. Haque, "Power Scenario of Bangladesh and Schemes of Sustainable Optimal Reduction in the Power System Loss", Global Journal of Researches in Engineering Electrical and Electronics Engineering Volume 12 Issue 9 Version 1.0, Global Journals Inc. (USA), 2012.

[3] K.M.M. Rahman, "Electricity Scenario in Bangladesh", Report of research program: Enhancing the responsiveness of the government to address exclusion and inequality, Unnayan Onneshan-The Innovators, 2011.

[4] N. Akter, "Alternative Energy Situation in Bangladesh: A Country Review", Regional Training Orientation Course on Alternative Energy Technologies, APPROTECH ASIA Philippine Social Development Center, Philippines, 1997.

[5] N.R. Chowdhury, S.E. Reza, T.A. Nitol, and A.F.I. Mahbub, "Present Scenario of Renewable Energy in Bangladesh and a Proposed Hybrid System to Minimize Power Crisis in Remote Areas", International Journal of Renewable Energy Research, Vol.2, No.2, 2012.

[6] N.C. Bhowmik, "Renewable Energy Report", Report of a consultancy assignment, Asian and Pacific Centre for Transfer of Technology of the United Nations – Economic and Social Commission for Asia and the Pacific (ESCAP).

[7] M.M. Biswas, K.K. Das, I.A. Baqee, M.A.H. Sadi, H.M.S. Farhad, "Prospects of Renewable Energy and Energy Storage Systems in Bangladesh and Developing Economics", Global Journal of researches in engineering: J General Engineering Volume 11 Issue 5 Version 1.0, Global Journals Inc. (USA), 2011.

[8] I. Sharif, "Renewable Energy Development in Bangladesh", Executive Exchange on the use and integration of Renewable Energy in the Power Sector, Madrid, Spain, 2009.

[9] A.K.M.S. Islam, M. Islam, T. Rahman, "Effective renewable energy activities in Bangladesh", Elsevier Renewable Energy, 2006.

[10] K. Anam and H.A. Bustam, "Power Crisis & Its Solution through Renewable Energy in Bangladesh", Journal of Selected Areas in Renewable and Sustainable Energy (JRSE), September Edition, 2011.

[11] M.A. Rahman, "Country Paper Bangladesh", Regional Seminar on Commercialization of Biomass Technology, Guangzhou, China, 2001.

[12] M.G.K. Khan, T. Rahman, M.M. Alam, "Wind Energy in Bangladesh: Prospects and Utilization Initiatives", 3rd International Conference on Electrical & Computer Engineering, 2004.

[13] M. A. R. Sarkar, "Renewable Energy Technologies for Rural Development in Bangladesh", PPT presentation,2012.