

## THE PROSPECT OF 'SUSTAINABLE ENERGY' IN BANGLADESH

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**Abstract-** *'Uninterrupted power' is still a dream for the citizens of the third-world countries. Bangladesh is one of those nations which suffer intensely from electricity problems. Meeting the electricity demand has been a greater challenge over the years. The steps taken for the immediate settlement of the matter not only couldn't solve it but also raised some serious environmental issues. The practice of 'Sustainable Energy' has not yet started in a large scale in Bangladesh. But, using the natural resources and the renewable energy sources, Bangladesh has the potential to overcome the electricity crisis with the 'Sustainable Energy' technology. The current deficit of around 1200 MW can be easily met by the introduction of sustainable energy technologies like 'Solar', 'Wind', 'Biomass' and etc. The prospect of these technologies is very good in Bangladesh and the government is now trying to introduce these technologies to the power sector of Bangladesh.*

**Keywords:** Power crisis, Sustainable energy technology, Social context, Political context, Economic context.

### 1. BANGLADESH: A BRIEF INTRODUCTION

Bangladesh is located in the south-east Asia surrounded by India in three sides and 'Bay of Bengal' and Myanmar in the other side. Bangladesh achieved its sovereignty in 1971 after a nine month long liberation war against Pakistan. The total area of Bangladesh is 147,570 km<sup>2</sup> with a 6.4% of water. Bangladesh has a population of around 160 million and ranked 8<sup>th</sup> most populous country. The population density is 1033.5/km<sup>2</sup> which places Bangladesh among the top most densely populated countries in the world. The largest religion is Islam with about 89.5% of the population being Muslims. Bangladesh is famous for the liberation war of 1971, the language movement of 1952, Cox's Bazaar (the world's longest sea beach), The Sundarbans (the home of Royal Bengal Tiger), manufacturing products (mostly garments) and Cricket etc.

The climate of Bangladesh generally follows a four-season cycle which is: Winter (December-February), Summer (March-May), Monsoon (June-September) and Autumn (October- November). Agriculture, settlement and forest take up most of the land area of Bangladesh. But this trend is changing as the need for land for industrial and urbanization purposes are growing. Paddy, wheat, potato,

jute, sugarcane etc. are the main crops that are grown. Bangladesh is experiencing the increase in GDP in the recent years and this advancement is expected to continue[1].

### 2. BANGLADESH: THE POWER SECTOR SCENARIO

Bangladesh has struggled to overcome the electricity demand for over a decade. At present, there has been a positive change in this regard, but still there's some shortage. About 49% of the total population is connected to the electricity grid. The largest proportion of the population live in the rural areas (more than 70%) with only one-fourth of them connected to the electricity grid. The Government of Bangladesh has taken a target to overcome this 'electricity demand' challenge by the year 2020 where renewable energy technologies will play the vital role. Solar energy technology is thought to be the pioneer in this case due to the availability of solar energy all round the year. Bangladesh has a 600-1200 MW deficit of electrical power which results in 'load-shedding'. The scenario gets worse during the irrigation season when the gap between the demand and supply reaches around 1500 MW. 87% of the total energy consumption is by the

domestic (43%) and industrial (44%) sectors where lighting is one of the main energy consuming sections. Experts found out that, most of the energy deficit occurs in the evening and to cover up for that, energy-efficient lighting technologies are being adopted[2] The electricity consumption, generation and capacity of Bangladesh is shown in figure 1.

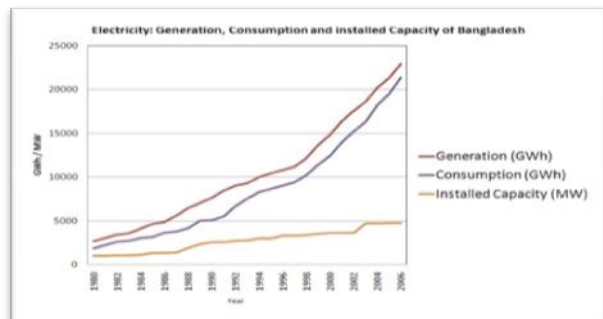


Fig. 1: Electricity consumption, generation and capacity of Bangladesh[2].

### 3. BANGLADESH: THE CURRENT TECHNOLOGY

Bangladesh currently has the electricity generation capacity of 8525 MW. The public sector power companies contribute 4794 MW (56%) and the private sector contributes the rest 3731 MW (44%). The power plants installed uses mostly natural gas (67%) as fuel, of which Bangladesh has a good resource. The other fuels which are used in the power plants are diesel, furnace oil, coal, and hydro power among which, hydro power is the only sustainable energy technology[3]. This is shown in the figure 2.

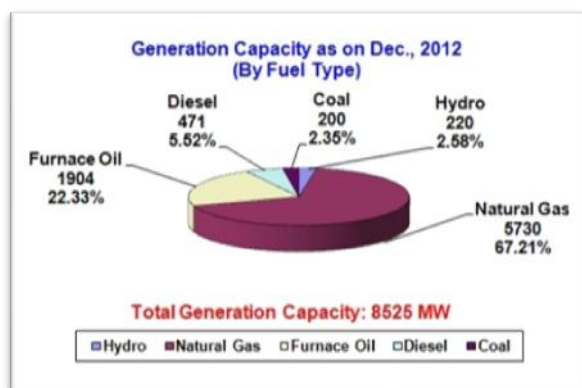


Fig. 2: Fuels used in electricity generation in Bangladesh[3].

The government of Bangladesh has taken different plans to solve the electricity problem. The planning includes installations of coal-fired plants (20 GW by 2030), nuclear power plants (4 GW by 2030) and renewable energy technology (2 GW by 2020) which clearly proves the fact that the implementation of ‘Renewable energy’ technology is not the top priority here[4].

Nevertheless, it is clear that, the government is very conscious about the electricity crisis and taking serious measures to deal with the problem as quickly as possible. The electricity generation capacity of Bangladesh has increased rapidly over the years and if the plans succeed, this rate will increase as the time passes which can be seen from the figure 3.

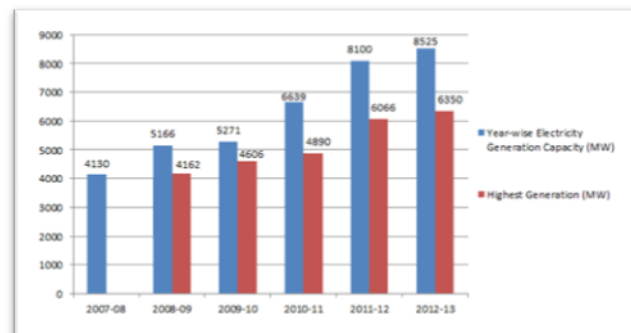


Fig. 3: Electricity generation capacity and highest generation over the years in Bangladesh[2].

### 4. SUSTAINABLE ENERGY RESOURCES AND PRACTICE IN BANGLADESH

Bangladesh has plenty of renewable energy resources which if properly utilised, can meet the required energy demand. The renewable energy technology is developing gradually which makes the implementation of such technology more practicable, economically feasible. The government of Bangladesh has focused on utilising the renewable energy resources such as solar energy, wind energy, biomass and biogas, micro-hydro and etc. The ratio of different renewable energy resources in Bangladesh is shown in figure 4.

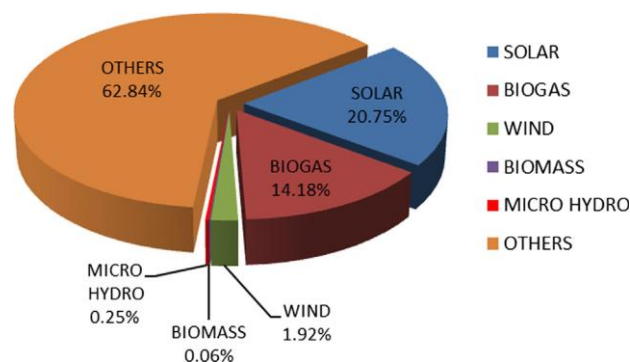


Fig. 4: Ratio of different renewable energy resources in Bangladesh[5].

#### 4.1. Solar Energy:

Solar energy is the most available renewable energy source all over the world with about 40000 TW of energy available to utilise. The prospect of solar energy in Bangladesh is very bright. The value of daily solar irradiation intensity ranges within 3-6 kWh/m<sup>2</sup> with the maximum intensity during March-April and minimum during December-January as shown in figure 5.

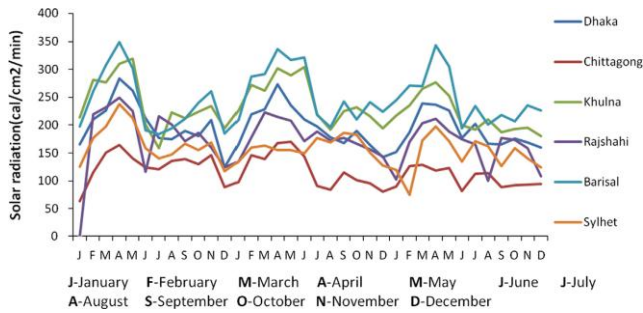


Fig. 5: Average solar radiation in different divisions in Bangladesh[5].

At present many government organizations, universities and NGOs are conducting research on expanding the use of solar thermal technology for implementation in new sectors. The solar photovoltaics are also being implemented in Bangladesh gradually. High initial investment is the reason behind the slow progress of the solar PV systems in Bangladesh.

- Solar thermal systems: Various types of solar thermal systems have been developed but yet to be commercialised in Bangladesh. Some of them are solar cookers, solar dryers and solar water heaters[6].
- Solar PV systems: Solar PV systems has been proven as 'very effective' in generating electricity from solar energy. But the huge initial capital is the barrier in the implementation of that technology in a developing country like Bangladesh. Solar PV systems can be implemented for generating electricity, street lighting, water pumping and also telecommunication in Bangladesh. Solar home systems (SHS) are being popular in Bangladesh day by day. Various NGOs such as IDCOL, REB, BRAC and Srizon Bangladesh installed 1,320,965 solar home systems with a capacity of 36.5 MW. Although the installed capacity is very low comparing to the demand, the development is still a positive sign[5].

Till now, solar energy technology is the frontrunner in case of implementation in Bangladesh. 45 MW of electrical power is generated from solar power whereas the second in this ranking is wind energy with the contribution of only 2 MW[7].

Recently, the government of Bangladesh has taken a project of a solar power plant with a generation capacity of 500 MW[4].

## 4.2. Wind Energy:

Wind power technology utilises the wind energy to convert into electrical energy using wind turbines. The wind turbine generally uses the kinetic energy of the wind to transform it into mechanical energy. But the capacity of converting wind energy into electrical energy is confined to 59% which is also known as 'Betz limit'.

Bangladesh has many highlands and islands in the 'Bay of Bengal' and also 724 km long coastline which may facilitate huge amount of wind energy to be utilised, which is shown in figure 6. In the monsoon season, from the Indian ocean, a strong south and southwesterly monsoon air flows over the Bay of Bengal and the coastal areas. The average wind speed ranges within 3-6  $\text{ms}^{-1}$  from March to September. Studies have shown that, the wind accelerates once it enters the V-shaped coastlines of the country. There has been huge improvement in the wind power technology as now, power can be extracted from wind with speeds as low as 2.5  $\text{ms}^{-1}$ . Different government organizations, universities and NGOs are continuing their research in this field and the data from 'Bangladesh Centre for Advanced Studies' showed that for turbines of 50m height, wind speed varies from 4.1 to 5.8  $\text{ms}^{-1}$  which is very promising[5].

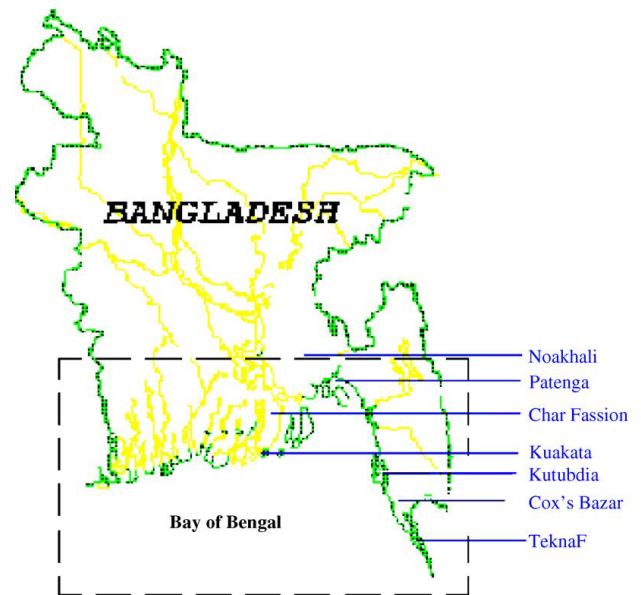


Fig. 6: Prospect of wind energy in coastal regions of Bangladesh[6].

The highlands, islands and coastal regions of Bangladesh experience wind at speeds within 3-6  $\text{ms}^{-1}$  in the monsoon season, which can be utilised for electricity generation. Many explorations and researches have been conducted to find out the potential of wind energy in Bangladesh. Bangladesh Meteorological Department (BMD) performed a thorough research on the wind speed in Patenga, Chittagong, which is assumed to be the best site for utilising wind energy for electricity generation purposes. The data is given in figure 7.

Year	Month	Average wind speed (m/s)
1994	June	8.25
	July	7.81
	August	7.48
	September	6.93
	October	6.70
1995	January	6.43
	February	6.45
	March	7.37
	April	7.92
	May	8.47
	1-10th June	8.69

Fig. 7: Wind speed measurements at Patenga[6].

There has been a lot of research recently to develop a wind map for Bangladesh in order to find out suitable locations where wind farms can be established. A reference wind turbine was also selected to find out the power density. Social and technical constraints were then applied on the wind map to narrow down the focus on the potential sites for wind farms. The resulting wind map is shown in figure 8.

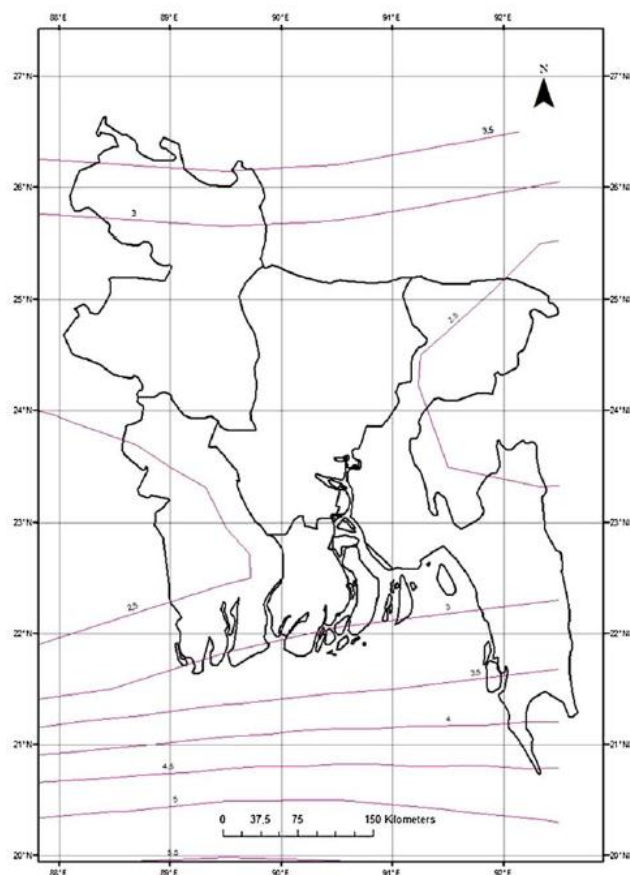


Fig. 8: Wind map of Bangladesh at 50 m based on the NASA SSE data set[8].

#### 4.3. Biomass and Biogas:

Among the renewable energy sources in Bangladesh, biomass can be considered the largest. Biomass is basically the biological material from living or recently living organisms. Biomass can be effectively used directly or can be converted into bio-fuel for use. Rice husk, dead trees, branches, yard clippings, wood chips and even municipal solid waste, hemp, corn, poplar, willow, sorghum, sugarcane etc. can be considered as biomass sources. On the other hand, the composition of Biogas is  $\text{CH}_4$  (40-70%),  $\text{CO}_2$  (30-60%) and other gases (1-5%). These are generally generated from composts and poultry fertilizers in specific bio-digesters. Biogas can be burnt and also can be utilised in electricity generation.

The staple food of Bangladesh is Rice. The paddy production per year reaches the mark of 35,000,000 MT on an average. From this huge amount, if some portion (about 20%) of the rice husk can be utilised through gasification technology, a significant amount of power can be

generated. Also, everyday 436 tons of recyclable waste is managed in Bangladesh, which can be used in conversion from waste to energy[5].

Figure 9 illustrates the amount of energy supplied by biomass fuels:

('000 tons of coal equivalent)				
Fuels	2000-01	2001-02	2002-03	2003-04
Cow-dung	2471	2471	2471	2505
Jute stick	966	1010	966	922
Rice straw	1429	1409	1418	1218
Rice hulls	2810	2854	2898	2854
Bagasse	3-10	366	366	392
Fire wood	1166	1219	1219	1272
Twigs and leaves	1378	1471	1484	1537
Other wastes	1230	1273	11317	1361
Total	11790	12033	12139	12258

Fig. 9: Energy available from biomass fuels[5].

Studies showed that, about 29.7 billion  $\text{m}^3$  of biogas can be obtained from the livestock of Bangladesh, which is equivalent to 1.5 million tons of kerosene. There's also a possibility of getting 10 billion  $\text{m}^3$  biogas if all the families in Bangladesh can be associated with biogas plants. The research conducted by IFRD states that, Bangladesh has the potential of establishing 4 million biogas plants[9].

In Bangladesh, the practice of Biogas has started and till now about 40,000 small plants have been set up by the government and different NGOs. There are plans to construct more biogas plants to utilise the available biogas energy source[10].

#### 4.4. Hydro Power:

Hydro power is another realistic, effective source of renewable energy for Bangladesh. In the Chittagong hill tracts area the largest hydro power plant of Bangladesh is located which has a generation capacity of 230 MW.

Micro-hydro technology is one of the simplest among the renewable energy technologies. There are many rivers in Bangladesh which makes it a land of opportunities for micro-hydro technology. Very recently, the first ever micro-hydro project was constructed and commissioned in Bamerchara, Chittagong. The plant has a very limited generation capacity because of unsatisfactory water currents[5].

Recently, the government has taken steps to utilise the available energy as much as possible with the establishment of a 50 kW micro-hydro project and plans for two more projects with in total about 100-120 kW generation capacity[11].

### 5. SOCIAL CONTEXT

The impact of deployment of sustainable energy in Bangladesh will not be very big. People are not really much concerned about the technology and their benefits, what they want is the uninterrupted energy supply. As a developing country, Bangladesh has a lot of problems to

deal with along with the electricity crisis. The major portion of the population live in the rural areas and a huge share of them are not educated. The people living in the urban areas tend to care about the technologies but there are always some other important issues than a 'Sustainable technology' which carries away the focus.

In many countries of the world, the deployment of wind energy faced some social barriers. People reacted negatively with issues such as noise, shadow flickering, capturing land and etc. But, as per the research, in Bangladesh, the potential sites for wind energy will be mainly the coastal regions. For which, people will not be very close to the farms to complain. Although, if a locality is near a farm, there's not much to worry about the noise as there has been many cases before and in U.S. the matter went up to the court, where it was dismissed. The other problems like shadow flickering, wind turbines being 'irritating' can not be solved as these opinions vary from person to person and these are not much to pay for what advantages wind power technology will bring.

## 6. POLITICAL CONTEXT

The government always try their best to satisfy the people so that in the next election, they get a positive feedback. Sustainable technologies are way better than other technologies in the long run, but the success also depends on the resources and investment. Depending on the resources, there can be less generation in one day whereas there are other technologies which will deliver at a constant rate while polluting the environment.

The government is also hesitating in taking long term plans as if they are not elected in the next term, the other party might just enjoy the positive feedback for the previous party's deeds. In fact, the effect of environmental pollution will not be visible very soon, but the satisfaction of the people might even win the election for them. These political issues come up as people don't raise their voice to save the environment much as they do when they don't get electricity. In those moments, the government decides to invest more in technologies which are able to deliver quickly. The sustainable energy technologies are proven techniques and can meet the energy demand when implemented successfully, but there's a long way to go for Bangladesh as a lot of explorations need to be done. Also the initial investment is very high in sustainable technologies. These are the reasons why the growth of sustainable technology in Bangladesh is still slow. The first priority is electricity not environment, for the people and so as for the government.

Despite this scenario, the government is taking initiatives to introduce sustainable energy in the national grid and have major plans for the deployment of solar energy plants and wind energy plants. Although the coal-fired technology is introduced again in the country as a fast solution, the government is also concerned about the environment and has set up targets for energy production utilizing the renewable energy sources, which is a silver lining for the sustainable technology in Bangladesh.

## 7. ECONOMIC CONTEXT

Bangladesh is a developing country. The GDP and other factors are increasing gradually but still Bangladesh has to seek economic help when it comes to large projects.

The initial investment in sustainable technology is very high. This economic barrier is a huge challenge for Bangladesh. The government wants to make sure the risks they take by taking loans, show progress fast. This is the reason behind less funding in sustainable technologies.

In various countries of the world, there are many examples of community financing and establishing a plant for sustainable energy technology. But in Bangladesh, the social scenario is very different as the economic scenario. So, this type of community financing is still not feasible in Bangladesh.

## 8. ENVIRONMENTAL CONTEXT

The CO<sub>2</sub> emission per capita for Bangladesh is 0.3, which is very good. But still there are pollution of different types. Air, water and noise pollution have become parts of life. The power generation technologies in action are not very environment friendly. People suffer from different diseases because of the pollution and many die. In this situation, the deployment of sustainable technology not only can save the environment but also can allow people to live healthy life.

## 9. CONCLUSION

Bangladesh has huge resources of renewable energy. So, the deployment of sustainable energy has a very bright prospect. There are some social, political and economic barriers but these can be solved. The recent initiatives of the government in the renewable energy sector has opened the door for successful implementation of sustainable technology in Bangladesh. The wind energy has a brilliant potential in Bangladesh but it is not utilised yet. The effective exploitation of this available energy can help in meeting the electricity demand as well as preserving the environment. With the recent policies and schemes, one can hope for a progressive future of sustainable technologies in Bangladesh.

## 10. REFERENCES

1. M. Rofiqul Islam, M.R.I., M. Rafiqul Alam Beg, *Renewable energy resources and technologies practice in Bangladesh*. Renewable and Sustainable Energy Reviews, 2008. **12**(2008): p. 299-343.
2. *Energypedia*. 20-05-2013]; Available from: [https://energypedia.info/wiki/Bangladesh\\_Country\\_Situation#Overview](https://energypedia.info/wiki/Bangladesh_Country_Situation#Overview).
3. *Bangladesh Power Development Board*. 23-05-2013]; Available from: [http://www.bpdb.gov.bd/bpdb/index.php?option=com\\_content&view=article&id=5&Itemid=6](http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=5&Itemid=6).
4. *Prothom Alo*. 22-05-2013]; Available from: <http://www.eprothomalo.com/index.php?opt=view&page=1&date=2013-03-06#>.



5. Ferdous Ahmed , A.Q.A.A., M. Hasanuzzaman, R. Saidur, *Alternative energy resources in Bangladesh and future prospect*. Renewable and Sustainable Energy Reviews, 2013. **25**(2013): p. 698-707.
6. A K Hossain, O.B., *Prospects of renewable energy utilisation for electricity generation in Bangladesh*. Renewable and Sustainable Energy Reviews, 2007. **11**(2007): p. 1617-1649.
7. *Power Division - Ministry of Power, Energy and Mineral resources*. 23-05-2013]; Available from: <http://www.powerdivision.gov.bd/user/brec/49/89>.
8. Md. Alam Hossain Mondal, M.D., *Assessment of renewable energy resources potential for electricity generation in Bangladesh*. Renewable and Sustainable Energy Reviews, 2010. **14**(2010): p. 2401-2413.
9. A.K.M. Sadrul Islam, M.I., Tazmilur Rahman, *Effective renewable energy activities in Bangladesh*. Renewable Energy, 2006. **31**(2006): p. 677-688.
10. Nahid-ur-Rahman Chowdhury, S.E.R., Tofaeel Ahamed Nitol, Abd-Al-Fattah-Ibne Mahabub, *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, 2012. **2**(2).
11. *Bangladesh Power Development Board*. 22-05-2013]; Available from: [http://www.bpdb.gov.bd/bpdb/index.php?option=com\\_content&view=article&id=26&Itemid=24](http://www.bpdb.gov.bd/bpdb/index.php?option=com_content&view=article&id=26&Itemid=24).