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# Prospects and Potential Analysis of Solar and Biomass Energy at Pabna District, Bangladesh: A Realistic Way to Mitigate District Energy Demand

**Md. Rabiul Islam, T. H. M. Sumon Rashid**

***Abstract— Energy is one of the major concerns for the developing future of any nation and electricity is the most useful form of energy. Due to facing serious energy shortage, Bangladesh Government tried to give a temporary solution such as quick rental power plant to alleviate the present critical situation which costs more unit price than usual. Currently, Bangladesh power production based on Natural gas (75.99%) suffered by inadequate storage and supply. To make the energy system of the country sustainable, Government and other developing partners of Bangladesh searching alternating source of energy which is mandatory. By Inherently suitable geographic location and as an agricultural country, solar and biogas definitely be the promising renewable energy source of Bangladesh. This paper focuses on the fact that how proper district based investigation on these resources and its proper utilization can help to give an easy realistic solution on the way of sustainable energy security of Bangladesh.***

***Keywords— Biomass Energy, Bangladesh, Cattle Dung, Rice Husk, Sustainable Energy, Solar Energy.***

## I. INTRODUCTION

Renewable energy exists continuously and in plentiful quantity in the environment. It is ready to be attached; it is infinite and more significant. It is a clean alternative to fossil fuels.

Bangladesh is a country where energy crisis seems to be the major problem in spite of being blessed with rich solar irradiation (~4.5 kWh/m^2-day).Solar Energy is inexhaustible and pollution free. It is available everywhere; but the greatest amount is available between two broad band's encircling the earth between 15" and 35" latitude north and south. Fortunately, Bangladesh is situated between 20"43' north and 26"38' north latitude and as such Bangladesh is in a very favorable position in respect of the utilization of solar energy. Annual amount of radiation varies from 1840 to 1575 kwh/m2 which is 50-100% higher than in Europe. Present total yearly consumption of energy is about 700 X $10^{18}$ J in Bangladesh. This shows that even if 0.07% of the incident radiation can be utilized, total requirement of energy in the country can be met. At present energy utilization in Bangladesh is about 0.15 watt/sq. meter land area, whereas the availability is above 208 watt/sq. meter. This shows the enormity of the potentiality of this source in this country. [1].

Biomass energy is the important and oldest source of energy in many countries of the world. Like other third world countries Bangladesh is an agro based country and almost 80% of her population directly or indirectly depends on agriculture. So converting the waste material into energy is economically beneficial.

Bangladesh has a wonderful climate for biogas production. The ideal temperature for biogas is around 35°. The temperature in Bangladesh usually varies from 9.6°C to 33.9°C .But the inside temperature of a biogas digester remains at 22°C-30°C, which is very near to the optimum requirement. So, from environmental perspective Bangladesh is more efficient to produce Biogas [2].

## II. OVERVIEW OF PABNA DISTRICT

### *A. Geographic location and General description*

Bangladesh is a sovereign state located in South Asia. It is bordered by India and Burma and by the Bay of Bengal to the south. Bangladesh is divided into seven administrative divisions, each named after their respective divisional headquarters are Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Sylhet and Rangpur. Divisions are subdivided into districts (zila). There are 64 districts in Bangladesh, each further subdivided into upazila (subdistricts) or thana. Pabna District (RAJSHAHI division) was established in 1832.Its position 24.0100° N, 89.1800° E. It consists of 9 upazilas, 8 municipalities, 81 wards, 191 mahallas, 72 union parishads, 1321 mouzas and 1540 villages. The upazilas are ATGHARIA, BERA, BHANGURA, CHATMOHAR, FARIDPUR, ISHWARDI, SANTHIA, SUJANAGAR and PABNA SADAR. Now Pabna has 2523179 Population with an area of 2371.50 sq km. Average maximum temperature 33.9°C, minimum 9.6°C; annual rainfall 1872 mm. Main occupations are agriculture 34%, agricultural labourer 22.77%, commerce 13.27% etc. Main crops are Paddy, jute, wheat, sugarcane, oil seeds, onion, garlic, betel leaf, pulses. It has Dairy 1069, fishery 88, poultry 714, hatchery 37. Pabna has Paper mill, sugar mill, cotton mill, jute press, oil mill, pharmaceutical company, biscuit factory, rice and flour mill, ice factory, welding, saw mill, cold storage, etc. [3]

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### B. Present Energy Scenario

At present, Bangladesh has actual power production capacity near about 6,200MW. But actual demand is more than 7,500MW. Due to large difference between production and demand authority distribute less power than actual demand to all over the districts of Bangladesh.

It is observed total demand of pabna is near 70MW but, authority allocate 60 MW and extra 10 MW is meet up by load shedding [4]. Like other districts of Bangladesh, Pabna have a plenty of renewable energy source, i,e. Solar energy, Biomass energy (Cattle dung, Poultry liter, Rice husk etc.). But, presently a small amount of these resources are used to meet energy demand.

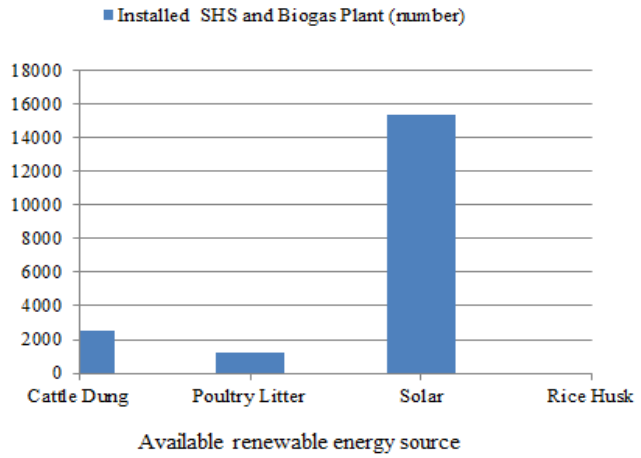


Fig.1 Installed SHS and Biogas plants in pabna district based On available energy source.

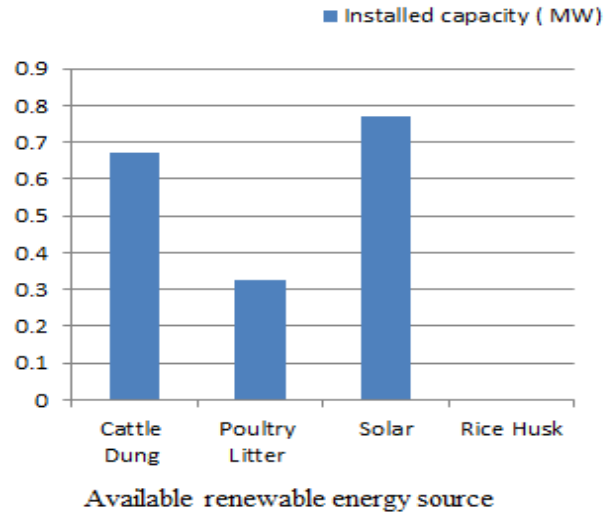


Fig. 2 Used power from installed renewable energy source in Pabna district

## III. POTENTIAL OF BIOGAS IN PABNA

A survey was carried out at Pabna district during April, 2012 to September, 2012 and it is observed that till now total 15,385 Solar Home System (50-60 watt) and 3,731 biogas plants were constructed by different organizations. At Present, 16 organizations are supplying Solar Home Systems to consumer [5]. Pabna have 2.5 million population, 1.3 million cattle and 5.4 million poultry population with a vast agricultural land [6]. Pabna have suitable weather condition to produce enormous amount of biogas energy. By considering only these energy resources, we are calculating potential of electricity generation:

### A. Solar Energy

Pabna have 5,90,749 households with 25,23,179 populations [7]. During survey, we also get information about monthly income per households. From those data, it is observed that around 30 percent households have capability to take Solar Home System. By assuming 30% house owner of Pabna district will take SHS with capacity of 50 watt and 10% house owner of off-grid area will take SHS with average capacity 50 watt.

Available Power from Solar Energy calculation:

1) Total Households of Pabna = 590749
2) Total number of Solar home system (SHS) = 2, 36,299
3) Electricity that may be obtained = 11.8 MW

(By assuming 40% house owner of Pabna district will take SHS with capacity of 50 watt)

### B. Cattle Dung

1) Total cattle population of Pabna = 1.3 million
2) Dung available = 13 million kg/day
3) Gas that may be obtained = 0.481 million m3 (Mm3)/day
4) lectricity that may be generate from obtained Gas = 41 MW/day

(Each cow yields = 10 kg dung/day, 1 kg of dung yields = 0.037 m3 gas, each cubic meter (m3) of biogas contains the equivalent of 6 kWh of calorific energy. However, when we convert biogas to electricity, in a biogas powered electric generator, we get about 2 kWh of useable electricity, and the rest turns into heat which can also be used for heating applications.)[8]

### C. Poultry Litter

1) Total poultry population of Pabna = 5.3 million
2) Total poultry litter that may be obtained = .53 million kg/day.
3) Gas that may be obtained = 39220 m3/day.
4) Electricity that may be generate from obtained Gas = 3.3 MW/day.

(Each bird yields = 0.1 kg litter/day, 1 kg litter yields = 0.074 m3 gas, each cubic meter (m3) of biogas contains the equivalent of 6 kWh of calorific energy. However, when we convert biogas to electricity, in a biogas powered electric generator, we get about 2 kWh of useable electricity, and the rest turns into heat which can also be used for heating applications.)[8]


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### D. *Rice Husk:*

As Bangladesh is an agro based country and almost 80% of her population directly or indirectly depends on agriculture. So converting the waste material into energy is economically beneficial. Bangladesh produces more than 46 million tonnes of paddy each year. About 70% of this paddy is processed in local rice mills to produce food grain rice. Husk is produced as waste biomass during the rice Processing. Annual rice husk production is about 9.0 million tons in Bangladesh. Husk primarily used for producing steam in rice mill for parboiling and drying process of rice. After burning of husk for parboiling, the excess amount husk could be used as a biomass resource for electricity generation. The rice residue can dominates in biomass sector of Bangladesh. Rice Husk is a unique Biomass Fuel of good calorific value. By installing gasification Power plants based on these available rice husks, we can generate enormous amount of electricity. Bangladesh has four major rice processing zones viz. Dinajpur, Naogaon, Pabna (Iswardi) and Bogra. Total paddy processed at Pabna (Thana: Iswardi) around 92.5048 million tons per year. By assuming 20 percent of weight is converted in to husk, around 18.5009 million tonne per year is produced which can play an important role to produce electricity at Pabna [9].

1) Total Paddy produced at Pabna = 92.5048 million tone/year.
2) Total amount of available husk = 18.5009 million tone/year. [assume 20% of weight is converted in to husk]
3) Total amount of available husk per day = 506875.6164 kg/day.
4) Electricity that may be generate from obtained husk = 16.24 MW/day. (Steam Turbine Plant) [10]
5) Electricity that may be generate from obtained husk = 11.35 MW/day. (Gasification Plant) [11]

## IV. OUT COMES FROM POTENTIAL ESTIMATION

From above calculation, total electricity that may obtained from these biomass resource is 41 MW(Cattle Dung), 3.3 MW (Poultry Litter), 11.35 MW (Rice husk ) and from solar energy (11.8 MW). Hence, Total 67.5 MW electricity can be produced from solar and biomass energy at Pabna which meet local demands. An estimate of the total solar and biogas potential in the Pabna district is presented in fig.3.

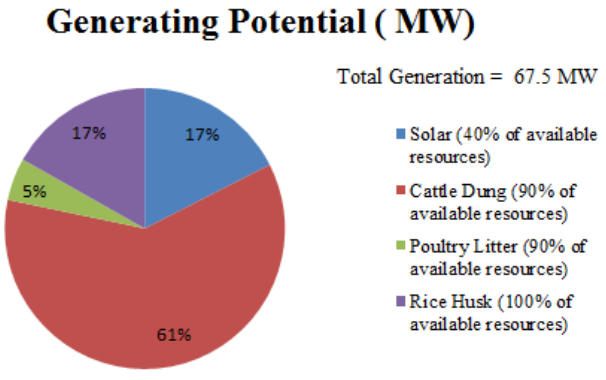


Fig.3 Estimated Capacity of power generation considering certain amount of available resources

## V. REALISTIC WAY TO ACHIEVE 67.5 MW

### A. *Solar Energy (11.8MW)*

In solar energy estimation we assume 40% house owner will take SHS, now the question is how we achieve 40%? It's easy and probable solution is Bangladesh Government have to force household owner who have taxable income to take at least 50 Watt SHS and give loan to 10% house owner who are not getting electricity (off-grid area).

### B. *Biomass Energy (41MW)*

Pabna has 1540 villages, 590749 households, 1069 dairy, 714 poultry. On an average each village have 384 households and 1535cattle population. So, it is possible to construct a 27kw biogas power plant in each village and total district power production is 41 MW.

Since Pabna (Iswardi) is one of major rice processing zone in Bangladesh, so, estimated 11.35 MW Gasification power plant can be installed at Pabna (Iswardi).

## VI. CONCLUSION

According to mentioned procedure if we implement the whole thing we get 67.5 MW which is close to actual demand of Pabna district. After analyzing the whole thing presented in this paper clearly indicates that a district of Bangladesh can be easily self-dependent in producing electricity by following the mentioned method. In this regards Government should take immediate initiation to utilize district based renewable energy resources to meet local demand rather than thinking distributed utilization of renewable energy resources in order to face challenges of present energy shortage. Present installed capacity around 2 MW, which are powered by self-motivated people, but on the way of self-dependent district government should take a vast program to motivate people in large scale.

## VII. ACKNOWLEDGMENT

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