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A Pragmatic solution to mitigate energy demand by using available renewable energy resources: District wise potential analysis of renewable energy

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***Abstract*— Bangladesh is a developing country which is facing acute electricity shortage and is one of the challenging issue to develop. Shortage of electric power generation causes a significant amount of load shedding. But there is a huge opportunity to back up the load shedding by using renewable energy sector. Maximum power plant in Bangladesh is based on fossil fuel or natural gas. Power generation in Bangladesh mainly depends on fossil fuel which is declining day by day. From last one decade, Govt. and non-govt. organizations trying to introduce electricity in order to develop social and economical conditions of rural people. Around 1.5 million Solar home systems and .5 million biogas plants already installed in rural areas .But it is necessary to think renewable energy as a backup source of electricity generation in order to mitigate energy demand. This paper will focus how renewable energy play a vital role to meet up energy demand by analyzing potential of available resources, Net energy demand and barriers to enhance renewable energy technology in Bangladesh.**

***Index Terms*— Biomass Energy, Bangladesh, Cattle Dung, Rice Husk, District, 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. Fossil energy resources in Bangladesh consist primarily of natural gas. Domestic oil reserve is considered negligible. Several small deposits of peat exist in the southwestern region of the country which have low calorific value. However, Bangladesh have substantial bituminous coal deposits in the north western region and mining of them are under active consideration of Government. Access to electricity in Bangladesh is one of the lowest in the world, coverage today stands around 30% of the total population [4]. However the rural areas of Bangladesh, where 76% of the population live, is seriously deprived of the electricity facility [8]. Larger energy supplies and greater efficiency of energy use are thus necessary to meet the basic needs of a growing population. It will therefore, be necessary to tap different sources of renewable energy and to use them in an efficient manner for the benefit of the people. GOB has vision to electrify the whole country within the year 2020 [2]. So this paper will include a pragmatic solution to reduce per capita generation cost of energy & give a potential calculation of testing region.

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II. METHODOLOGY

In this Paper, Among 64 districts of Bangladesh a certain portion of area is considered to represent how renewable energy mitigate energy demand of that area and reduce fossil fuel costs. To analysis this, we take one certain portion of Bangladesh (Pabna and Sirajgonj District) and calculate potential of renewable energy, those areas energy demand . This study was carried out during December 2008 to February 2013. Here we consider one area which have available solar and biomass resources and analysis of energy demand, potential of solar and biomass resources.

III. OVERVIEW OF GEOGRAPHICAL AND DESCRIPTION OF TESTING AREA AMONG 64 DISTRICTS OF BANGLADESH

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. Our survey was launched during November 2012 to February 2013 on Sirajgang & Pabna District. Its position 24.0100° N, 89.1800° E .This region has a population of 5.6 million. . It consists of 19 upazilas, 14 municipalities, 140 wards, 312 mahallas, 163 union parishads, 2600 mouzas and 3500 villages [3].The area of 4773.7 sq km. Average maximum temperature 36.9°C, minimum 9.6°C; annual rainfall 3472 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 2343, fishery 212, poultry 1423, hatchery 159 [6]. The testing area 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.

IV. Present Energy Scenario of Testing Area

At present, Bangladesh has actual power production capacity near about 6,200MW. But actual demand is more than 7,500MW [4]. 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 testing area is 155 MW authority allocate 135 MW and extra 20 MW is meet up by load shedding [4]. Like other districts of Bangladesh, Pabna & sirajgang (testing region) 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.

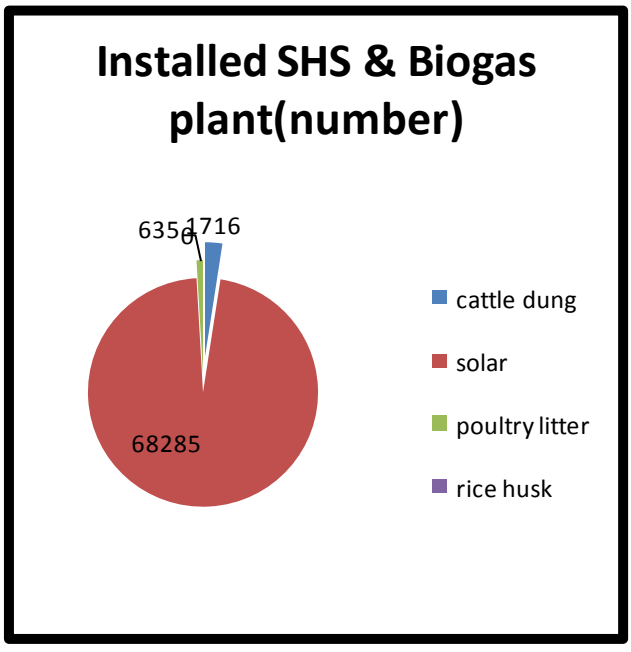

Fig-1: Installed SHS and Biogas plants in testing area based on available energy source.

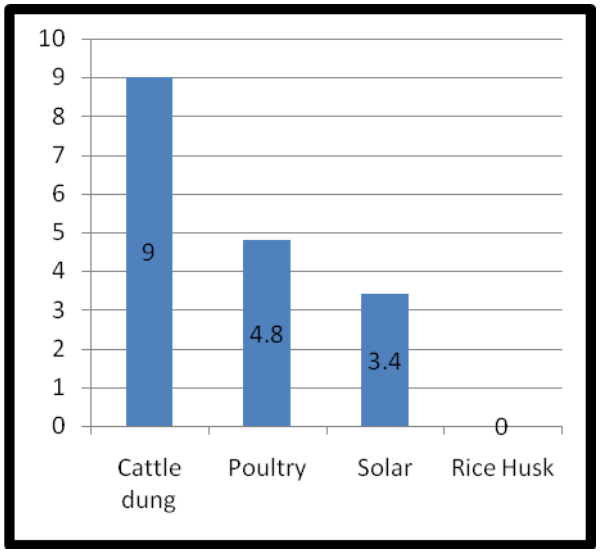

Fig- 2: Used power from installed renewable energy source in testing area.(Energy in MW)

V. Potential calculation of solar and biomass energy

A survey was carried out at testing area during April, 2012 to September, 2012 and it is observed that till now total 68,285 Solar Home System (50-60 watt) and 2,351 biogas plants were constructed by different organizations. At Present, 16 organizations are supplying Solar Home Systems to consumer. The testing area have 5.6 million population, 2.76 million cattle and 8.8 million poultry population with a vast agricultural land [7] .It has suitable weather condition to produce enormous amount of biomass energy. By considering only these energy resources, we are calculating potential of electricity generation.

A. Solar Energy

The testing area has 1,305,720 households with 5,620,668 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 testing area 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 testing area = 1305720
2) Total number of Solar home system (SHS) = 522288
3) Electricity that may be obtained = 26.08 MW
(By assuming 40% house owner will take SHS with capacity of 50 watt)

B. Cattle Dung

1) Total cattle population of testing area = 2.76 million
2) Dung available = 27.6 million kg/day

3) Gas that may be obtained = 1.02 million m3 (Mm3)/day
4) Electricity that may be generate from obtained Gas = 86.8 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.)

C. Poultry Litter

1) Total poultry population of testing area = 8.8 million
2) Total poultry litter that may be obtained = .88 million Kg/day.
3) Gas that may be obtained = 65120 m3/day.
4) Electricity that may be generate from obtained Gas = 5.4 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.)

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 tones of paddy each year. About 70% of this paddy is processed in local rice mills to produce food grain rice [9]. 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 testing areaaround 92.187 million tons per year. By assuming 20 percent of weight is converted in to husk, around 18.5187 million tons per year is produced which can play an important role to produce electricity at testing area [9].

1) Total Paddy processed at testing area= 92.5187 million tone/year.
2) Total amount of available husk = 18.5187 million tone/year. [assume 20% of weight is converted in to husk]
3) Total amount of available husk per day = 506875.687 kg/day.
4) Electricity that may be generate from obtained husk = 16.3 MW/day. (Steam Turbine Plant)
5) Electricity that may be generate from obtained husk = 11.6 MW/day. (Gasification Plant).

VI. Out comes from potential estimation

From above calculation, total electricity that may obtained from these biomass resource is 86.8 MW(Cattle Dung), 5.4 MW (Poultry Litter), 11.6 MW (Rice husk) and from solar energy (26.08 MW). Hence, Total 129.88 MW electricity can be produced from solar and biomass energy at testing area which
meet local demands. An estimate of the total solar and biogas potential in testing area is presented in fig.3

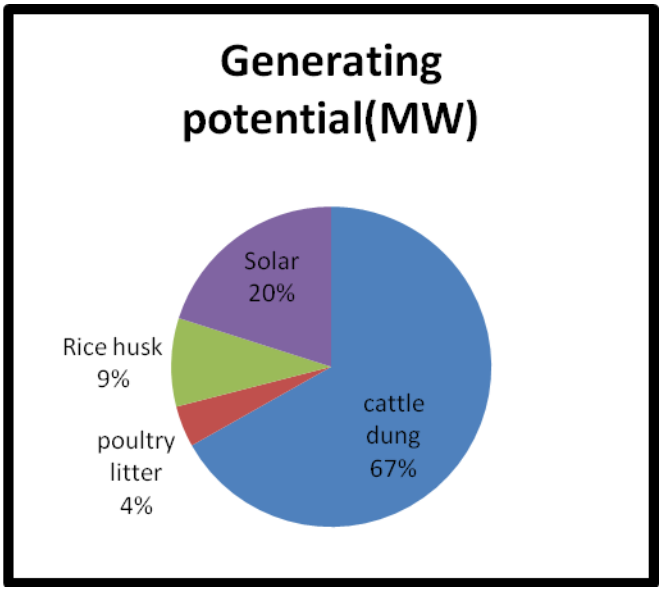

Fig-3: Estimated Capacity of power generation considering certain amount of available resources .

VII. Benefits analysis of Renewable Energy:

In Bangladesh total energy consumption 16.6 million ton equivalent. Per capita energy consumption 171 kg oil equivalent. Per capita co2 emission. 3 metric tons. Per capita electricity consumption 145 KW per hour per annuam. Solar energy can be generated all part of Bangladesh. Radiation varies between 4- 6.5 kwh per square meter [10]. This can be use as solar pumping, lighting, solar mini grid and other. There are 3 millions households with adequate cattle/poultry. Biogas also used for cooking purpose. About 11 – 12 million metric tones rice husk annually produced [10].1 wind turbine = 1 mw capacity at kutubdia by BPDB. Also we can launch micro hydro and mini hydro power plant. So we observed renewable energy is vital source of energy to mitigate a whole country energy demand. During our study, It is observed that Energy demand of our study area is 155 MW which is totally comes from diminishing fosil fuel. But from available renewable energy resources, 129 MW electricity can be generate which is 83.2 percent of our energy demand. So, by

utilizing renewable energy resources we can reduce energy production cost , save our fossil fuel and develop our country.

VIII. Conclusion

According to mentioned procedure if we implement the whole thing we get 129.6 MW which is close to actual demand that is 155 MW of testing region. 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. The Govt. should make proper utilizethe wind, hydro, geothermal power & other renewable resources.

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