Solar Pump: A Possible Solution of Irrigation and Electric Power Crisis of Bangladesh

Hridkamol Biswas
Military Institute Of Science And Technology,
Bangladesh University Of Professionals.
Dhaka, Bangladesh.

Faisal Hossain
American International University-Bangladesh.
Dhaka, Bangladesh.

ABSTRACT
The main purpose of this study is to give support irrigation in dry season and reduce the gap between electric power demand and generation by using renewable energy source solar pump. Every year water level is going down 2m/year. As a result scarcity of ground water is increasing, which has a harmful effect on economy. On the other side, electric power demand is growing up for commercial, industrial, domestic, agriculture purpose. To cope up with the demand, dependency on fuel is increasing. If this scenario going on, very soon fuel resource will be finished. And green house gas emission is in dangerous level. Small hybrid system which uses renewable sources as a plant material might be an effective solution of this power crisis and polluted environment. It is high time to give emphasis on using solar energy (pump) in a large scale

Keywords
irrigation, electric power demand, fuel resource, green house gas, solar energy source (pump)

1. INTRODUCTION
Agriculture is the determining factor for food security and development of Bangladesh economy. Agriculture is the single most important sector of Bangladesh's economy. 80% of the 145 million people of Bangladesh is engaged in agriculture. Here total area is 14.845 million hectares and cultivatable land is 8 million hectares. 36% of GDP and 63.2 % of employment are from agriculture [1]. Bangladesh is losing at least 3.5% of (GDP) due to the shortage of Power supply according to a research report of Centre for Policy Dialogue (CPD) [2]. Though Bangladesh has got self-supporting in food, but here is some bad news, in dry season the scarcity of water for irrigation is noticed. In Bangladesh power demand is 6000 MW, but generation is around 4000-4500MW. That's why, the farmers are not getting their expected crops. For irrigation electric pump and diesel pump is using here. As a result, industries and people of Bangladesh are suffering from load shedding and failure of production.

2. BACKGROUND OF IRRIGATION SECTOR
Irrigation depends on 21% surface water and 79% ground water[1]. About 80% of the total rainfall occurs during the monsoons from June to September. Only 10% of the annual rainfall is available during the combined post-monsoon and winter periods, while the rainfall is extremely unreliable in the subsequent pre-monsoon period [figure-1] [3]. In dry season- in the month of November, December, January, February , there is very less rainfall, During that season, only a residual river flow is received after upstream use and diversion [4]. Surface water is very less, so ground water is only way. But bad news is that it's going down 2m/year[5]. So for irrigation purpose, the demand of deep tube wells is growing up which is shown in figure-2.

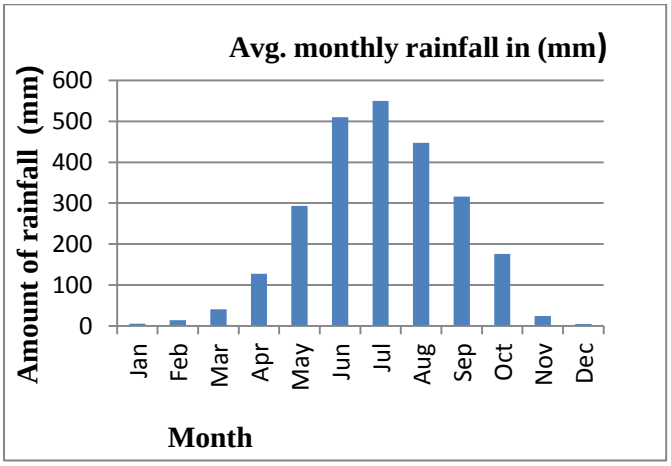

Fig-1: Average monthly rainfall in millimeter [1901-2009]

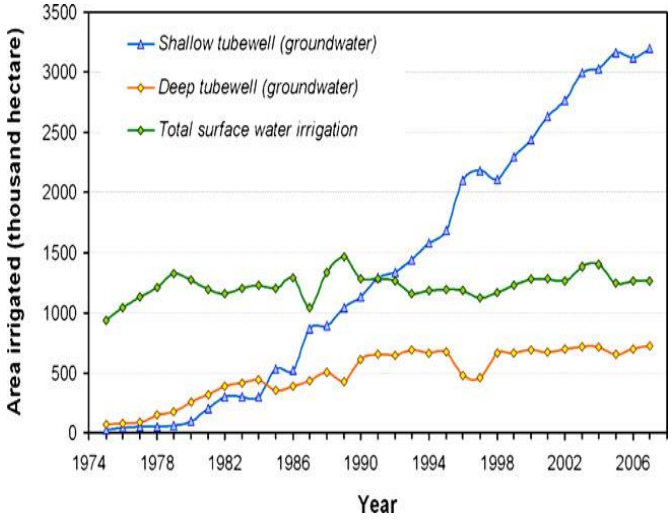

Fig-2: Trends in annual records of the area irrigated by shallow tube wells, deep tube wells, and surface water in Bangladesh [7]

Even during summer months, large number pumps are using. Electric power demand goes up that season. According to estimation of Bangladesh power development board [BPDB], gap between generation and demand of electricity in Bangladesh can reach a peak of 2000MW during summer months, when extra supplies are required to drive pump-driven irrigation systems for the agriculture sector.[6]. During

the period of 1983-2000, the surface-water irrigation coverage fell from 93% to 35%.During the same period groundwater irrigation coverage rise from 6 to 75 percent [4]. So number of shallow and deep tube wells are increasing every year, so here need huge electric power or diesel. But generation and resources can't keep pace with it. Diesel is limited and its price is increasing rapidly. As a result production cost is very high, which has effect on daily life.

Statistics shows that fuel price is increase 2 or 3 times over a year.Figure-3, shows the frequent change of diesel price. Each year emission of CO_2 gas is increasing by combustion of this huge amount diesel

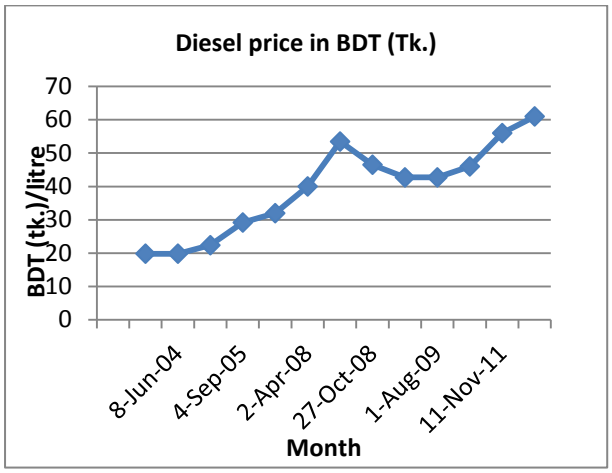

Fig-3: Frequent change of diesel price in BDT (taka) per litre.

3. BACKGROUND OF ELECTRIC POWER GENERATION SECTOR

In Bangladesh, only 39-40% of the population has access to electricity with a per capita availability of 136 KWh per annum. There are more than 87,319 villages in Bangladesh, and most of them are not connected to the national grid [8]. Bangladesh's power sector is confronted by significant challenges. These include the limited availability of natural gas, aging and unreliable power plants, a rapidly growing population and corresponding energy demand, and vulnerability to volatile diesel and fuel oil prices. Unscheduled power plant outages regularly occur due to natural gas shortages and technical problems With steady annual growth in energy demand around 7%, addressing the challenge of providing power for a growing population of more than 160 million is crucial to the continued development of Bangladesh. As of October 2011, Bangladesh's total generation capacity was7,119 MW. In 2011, 82% of actual generation was fueled by natural gas, 7% by diesel, 6% by fuel oil, 3% by hydropower, and 2% by coal. This heavy reliance on natural gas for power plants has become a challenge as Bangladesh has suffered from persistent gas shortages. The shortages reduce power generation capacity by 400-600 MW. Combined with overall generation capacity shortages due to unplanned maintenance, this results in load shedding of up to 800 MW during peak summer days.

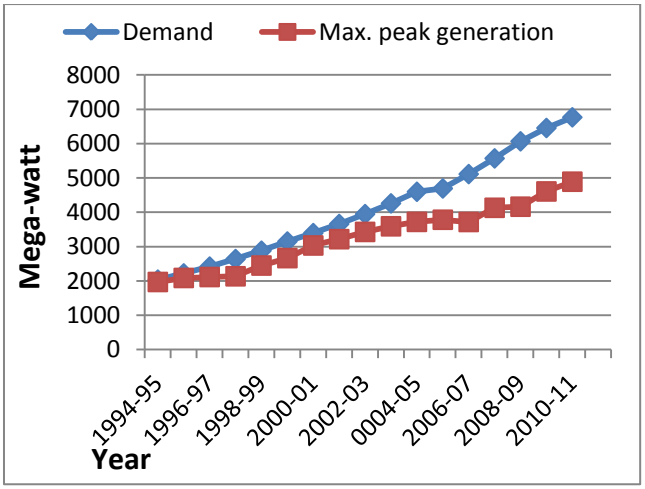

Figure-4: electric power generation and demand curve

Bangladesh is also facing the problem of an aging power plant fleet. 23% of Bangladesh's generation capacity comes from plants that are over 20 years old [9]. From figure-4, there is always a gap between demand and generation. According to the Power Sector Master Plan 2010 [10], the power demand in 2030 will be nearly 34,000 MW. With the current generation of around 4,500 MW [11], Bangladesh will require an additional ~29,000 MW power in 2030. Therefore, it is imperative to explore alternate sources of energy to cope up with this energy crisis.

4. INTRAGRATING SOLAR PUMP IN NATIONAL GRID SYSTEM

There are different types energy source, but all of them can't follow our demand curve. Biomass has low efficiency of photo synthesis [12]. Nuclear energy plant is highly risky and its need widespread public awareness. Fossils are not environment friendly. Hydro power is not much effective because most of our cities are few meters up from sea level. Solar energy is the ultimate solution because it offers carbon-free energy. About 1.2× 105 TW power from sunlight falls on the Earth's surface in 1 hr, which is higher than the global energy consumed by all human activities in 1 year [13]. 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. Bangladesh is a country of enormous sun shine. Average annual solar radiation on a 240 inclined surface is estimated as 4.2 kWh/m-2/day-1 [14]. According to PDB "The Rural Electrification Board (REB) needs 2500 MW, but is given less than half of that. Dhaka Electricity Supply Authority (DESA) and Dhaka Electric Supply Company (DESCO) need more than 2000 MW power and the PDB needs another 2000 MW" (Saifullah, K., 2009) [15]. From the above statistics, the rural areas are the major consumer of electricity. Use of alternative sources of power supply in rural areas will definitely reduce the demand and the gap between demand and supply. A large amount power of total demand in rural area is used for irrigation purpose. So solar pump is the best solution to reduce gap between demand and supply. During the last decades considerable advances in some of the solar energy technologies have been made and

some have already reached the commercial stage. Bangladesh should give emphasis on use of solar pump. Because its offers low cost, low green house gas emission.

5. REDUCTION OF GREEN HOUSE GAS EMISSION

Carbon dioxide (CO2) is one of the most important compounds in the atmosphere. Natural emission of CO2 from living animals, humans, wetlands, volcanoes, and other sources is nearly balanced by the same amount being removed from the atmosphere by plant photosynthesis and by the oceans. Human activity, on the other hand, is disturbing this equilibrium by generating increased CO2 from fossil fuels coal, gas, and petroleum products; imbalances are believed to be green house effects: global warming, melting of polar ice sheets and caps, a rise in sea levels and subsequent coastal inundations, and damage to agriculture and natural ecosystems, among others. So to and combustion via electricity generation, transportation, industry, and domestic use). The results of these reduce the emission of gas have to minimize the use of fossils fuel like diesel. Otherwise if this present rate of emission continues, then by the year 2020 the temp. will be increased 2 degree Celsius[16]. Bangladesh, a country with a population of 160 million, is currently contributing 0.14 percent to the world's emission of carbon dioxide (CO2). However, mostly due to a growing population and economic growth (which both lead to an increase in energy consumption), Bangladesh's share in CO2 emissions is increasing. Without ozone, every living thing on earth would be incinerated. Approx. 90% of the ozone is found in stratosphere where the peak conc. is 300 ppb. A steady decline of about 4% of the total amount per decade is found in stratosphere. Diesel is vital element for decline ozone.

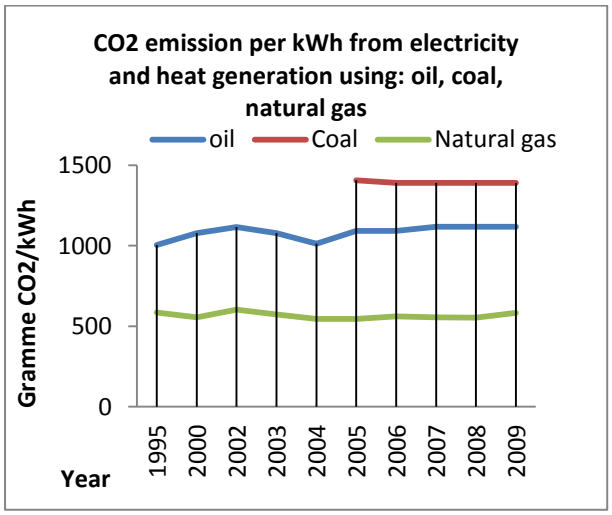

Fig-5 shows the CO2 emission from different energy resource. [source:BPDB]

From the combustion of fuel, it emits CO2, CO, NO, NO2, sulpher dioxide etc. where NO(nitrous oxide) decompose O3(ozone) Since 65% CO2 of total emitted CO2 is from energy sector [17,18]. So dependency on fossil fuels has to be reduced and alternate renewable energy source has to use largely. If oil, coal can be replaced by solar energy, then huge amount CO2 gas reduction possible.

The chemical analysis shows that at an average gas fired power station emits CO2 of 559 gramme/kWh, diesel fired 1118 gramme/kWh and coal fired 1390 gramme/kWh. In Bangladesh 82.69% power station are gas fired, 3.48 % are diesel fired and 4.55 % are coal fired. 1 KWp sol panel provides at an average 4KWH per day in Bangladesh. As per this statistics, if we set up solar power plant of 250 KWp, it will mitigate the CO2 emission as below [Table-1] [19]:

Table-1: Comparison of mitigation of CO2

SN	Items	Mitigation of CO2 in comparison to		
		Gas fired Power Station (Kg/Yr)	Diesel fired Power Station(kg/ Yr)	Coal fired Power Station(Kg /Yr)
1	1 KWp solar panel	562.10	1080.40	1416.20
2	250 KWp solar panel	1,40,525.00	2,70,100.00	3,54,050.00

6. COST ANALYSIS

During the Boro season, rice field in Bangladesh is irrigated by 1.33 million different types of water pumps, among which 87% are diesel operated requiring 800 million liter diesel per year. 1.33 Million total pumps are engaged in irrigation. Out of that, 0.18 Million is electric pump and 1.15 Million diesel pump.The introduction of solar power irrigation system will save 760 MW power and 800 million litre diesel every year if the conventional power and diesel run irrigation pumps are converted into solar power[20]. The Government provides 5400 million subsidy on diesel operated water pumps. Which can be saved by solar system. A 10 H.P. diesel engine consumes 1350 litres of diesel a year requires over BDT 3 lakh in total cost to run for one year which does not include governments subsidy on diesel [1 million= BDT 10 lakh]. From the data of Rahimafrooz renewable energy limited, to irrigate 20 acres land the initial cost will be BDT. 30 lakh by using 10 H.P. motor. And next 20 years it does not need any maintenance cost. So running a solar pump for one year costs only BDT 1.5 lakh. By investing BDT 30 lakh 50 farmers can be benefited. Though its initial cost is high, but it has no maintenance cost as much, which makes it cost effective over the years it will operate.

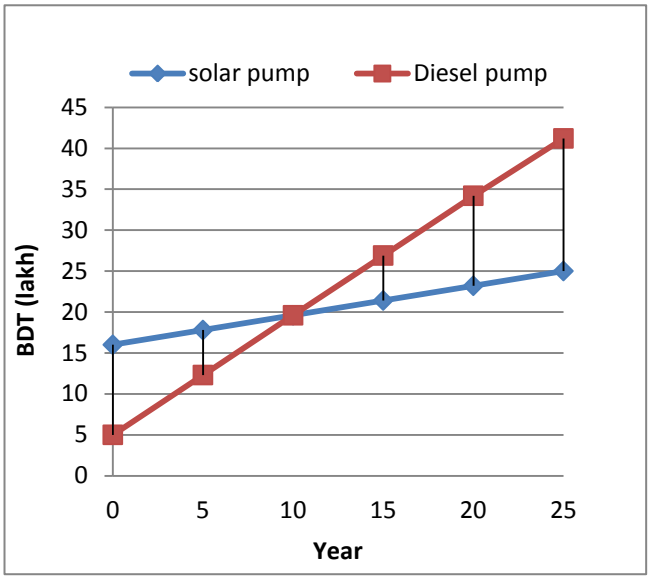

Fig-6: Life cycle cost over 25 years in BDT [For 25ft Lift and 50,000 Liters Flow/Hour [19]

7. CONCLUSION

In the 21st century human life is directly depending on electricity. The energy crisis is severe in Bangladesh which is a threat to the economical development. In Bangladesh, the generation of electricity mostly dependent on gas and diesel fuel. Since this resources are limited, so this paper tries to figure out the necessity of solar pump instead of diesel pump and high power consuming pump. Ground water level is so much disturbed that some areas of Bangladesh (Rajshahi, Jessore and Dhaka districts) have already restricted access to groundwater via shallow irrigation and hand-operated tube wells for food production and drinking-water supplies[6]. Green house effect an important cause of falling water level. But Bangladesh is third largest rice producing country[7], so water is needed here at any cost. By using large scale solar pump, this problem can be solved sufficient percent.

8. ACKNOWLEDGMENTS

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