

# Feasible Micro Hydro Potentiality Exploration in Hill Tracts of Bangladesh

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1

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## Abstract

The energy demand is expected to grow rapidly in most developing countries over the next decades. For Bangladesh, economic growth has been accelerating and it is expected that the population will grow from an estimated 162.20 million people in 2011 to 200 million by 2050, with almost half of the population living in urban areas. For meeting the expected energy demand as the population will rise and to sustain economic growth, alternative form of energy “renewable energy” needs to be expanded. This paper tries to explore the possibility of finding the renewable energy mainly from micro hydro in different places of Chittagong hill tract region by thoroughly describing present condition of energy along with data collection, calculation and feasibility of power generation from July 2011 to Jan 2012.

**Index terms**— Bangladesh hill tract region, micro hydro, renewable energy.

## 1 Introduction

The development of a country is mostly dependent on per capita energy use. Bangladesh is one of the poor countries in the South Asian region. A large number of its population is out of electricity. Only 48.5 percent of the total population has access to electricity [7]. Most of the power generation of Bangladesh is based on fossil fuel sometimes which is playing a negative impact on finance in the long run operation. So to supply the electricity to the rest people is a great challenge. In future fossil fuel will not be able to supply the electricity to the user as it will be finished & not environment friendly also. So to search and depend on environment friendly renewable energy is now a great desire of the country. Bangladesh has a great probability of renewable energy. It has much different form of renewable energy resources. Among them micro hydro may play a major role specially to serve electricity in the remote area of Chittagong hill tract for ensuring economic growth of the country. Though a great potentiality of micro hydro to serve power in remote areas but real feasibility of implementation of this type of power generations are still behind limelight.

Development of micro-hydro power plant can reduce electricity scarcity problems so economically in remote areas of Chittagong Hill Tract without any major hassle.

## 2 II. PRESENT POWER SCENARIO OF BANGLADESH

In the South Asian region Bangladesh is one the most densely populated country (1099 people/km<sup>2</sup> in 2010) [7]. With high population Bangladesh is experiencing extreme energy challenges especially for the shortage of electricity. Shortage of electricity may be considered in two forms firstly, reviewing the scenario of per capita electricity consumption and percentage of population having access to electricity in Bangladesh compared to other countries and secondly, determining gap between demand and supply of electricity in perspective of country's economic situation and GDP growth. By the dichotomy of power generation and demand Bangladesh faces a severe load shedding. Bangladesh relies greatly on fossil fuels for its energy, but the present reserve would be depleted by the year of 2015 [7]. Bangladesh government has taken a long term plan to develop the power sector and mitigate the present power scarcity. According to the plan Electricity Generation in the country by 2013

will be 8500 MW and within 2015 this generation will rise to 11,500 MW and surplus power will be possible to give to national grid. Within the year of 2021 there is a plan to generate 20,000 MW power and to provide power to the whole area of the country [4]. In last few years to meet up the scarcity of power so quickly government has taken some short term steps and thus establish quick rental power plant. So far, as many as 18 quick rental power plants have been approved and 14 of them are operational now. To fuel these power plants, the additional cost for the current fiscal year, as projected by the World Bank is between Tk. 52 billion and Tk. 56 billion, which is about 0.6 per cent or 0.7 per cent of the Gross Domestic Product (GDP) [1]. Excess payment for quick rental power plants has already affected various government economic decisions and posing a serious threat to the economy. For this reason the topic to quest and establish renewable energy based power plant come to forward. So this paper has a little effort to meet the demand of searching that renewable energy sources and supply power to some remote areas.

### III.

## 4 RENEWABLE ENERGY SCENARIO OF BANGLADESH

### a) Solar Energy

Bangladesh is located between 20.30 to 26.38 0 North latitude and 88.04 to 92.44 0 East which is an ideal location for solar energy utilization. Here, the daily average solar radiation varies between 4 to 6. 1. Large hydropower plants (>10 MW), usually with reservoirs, that cannot only produce electrical energy Continuously, but also are able to adjust their output according to electricity demand. Small hydropower plants (<10 MW) that are less flexible with respect to load or demand fluctuation due to their dependence on the water resource.

### IV.

## 5 MICRO HYDRO POTENTIALITIES IN BANGLADESH

The scope of hydropower generation is very limited in Bangladesh because of its plain terrains except in some hilly region in the North East and South East 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. To explore potential sites of micro hydro; several studies have been conducted by Bangladesh Water Development Board (BWDB) and BPDB in 1981.

## 6 MICRO HYDRO POWER CALCULATION

The amount of power available from a micro hydropower system is directly related to the flow rate, head and the force of gravity which can be derived by the following equation:  $P = Q \times H \times g$    
Theoretical power output in kW,  $Q =$

Usable flow rate in m<sup>3</sup>/s,  $H =$  Gross head in m and  $g =$  Gravitational constant (9.8 m/s<sup>2</sup>)

## 7 MICRO HYDRO POTENTIALS SURVEY IN HILL TRACT REGION OF BANGLADESH

Greater Chittagong Region has a great geographical diversity and thus has a potentiality to get the micro hydro power. In last few decades several attempts have been made to find out the potential of micro hydro power generation. To explore the possibility of hydropower from small hilly rivers/streams in the country, a working committee was constituted on February 1981 with officers from Bangladesh Water Development Board (BPDB). A study was also conducted by a group of Chinese experts and by LGED in 2002-2003 [9]. This research has a goal to find some places according to mathematical scrutiny where the establishment of micro hydro is possible. For measurement of flow, passing the length of 13 ft or 3.96m following data were recorded. Head,  $H = .9144$  m, Width,  $W = 2$  ft = .6096 m, Depth,  $D = 3$  ft = .9144 m Area =  $W \times D = .6096 \times .9144 = .55741$

For measuring the velocity we took the following data of time(t) to pass a distance of 16 ft. Here,  $L = 16$  ft = 4.88m

## 8 CONCLUSION

There is a great potential of micro hydro in Chittagong hill tract region of Bangladesh. This paper shows some feasible places beside the government survey to establish micro hydro and generate power. There is a diversified geographical feature with hill, mountain, river, canal and spring exists in this region. This hill tract region has promising resources to play a great role in the economy of Bangladesh. But without abundant power and shortage of energy supply this promising resources can't be utilized. On the other hand it is so tuff to provide power from the national grid to the remote areas of Hill Tracts and it needs huge expenditure. So to provide the electricity in that region without extra expenditure it is very fruitful to establish the micro hydro power plant. This paper has an effort to bring the micro hydro power plant into limelight and also to show some new promising places with proper calculation where this kind of plant can be established. If it is possible to develop power plant using

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96 micro hydro then it will definitely change the overall scenario of electricity in these region which will certainly  
affect the life style and economic stability of the people in that region as well as Bangladesh.



Figure 1: Fig. 2 :

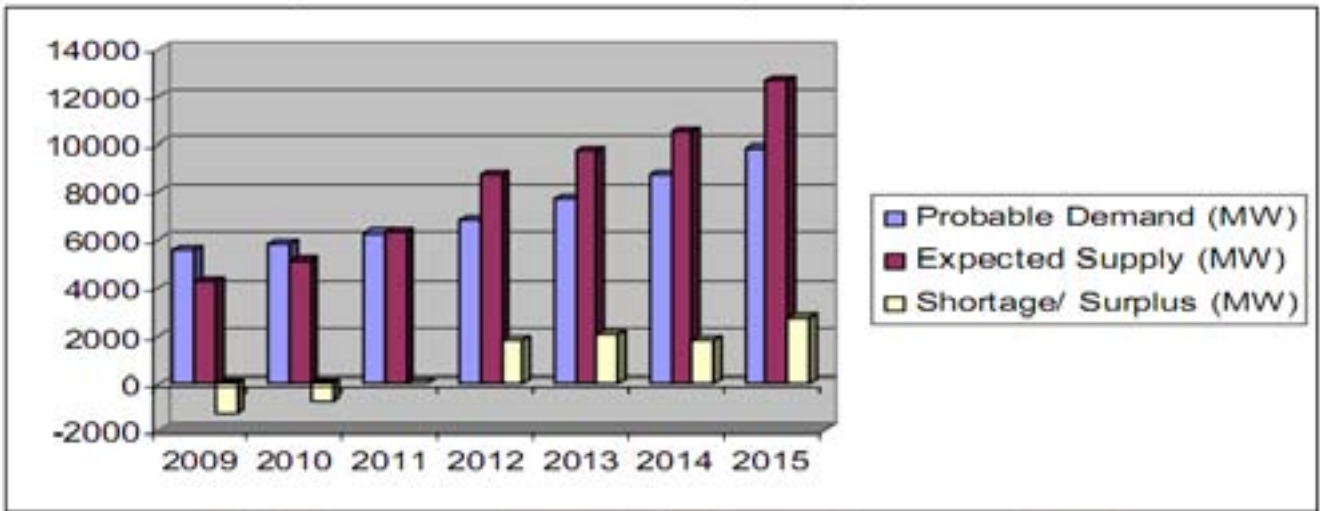


Figure 2:

Figure 3: Table

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Fuel	Percentage of use (2010)
Furnace oil	2.81
Diesel	1.75
Hydro	3.39
Coal	3.77
Gas	88.29

a) Production of Power in Bangladesh

Bangladesh	Power Development Board
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(BPDB), Ashuganj Power Station Company Limited (APSCL), Electricity Generation Company of Bangladesh (EGCB) is producing electricity in the public sector. On the other hand, through IPP (Independent Power Producer) and through Rental electricity is produced in the private sector which is purchased by the Government at a fixed rate [8]. At present nearly 54.40 percent of total electricity production is produced from public entities. BPDB alone produces 43.51 percent of total electricity production [5].

[Note: ?]

Figure 4: Table 2 :

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Year	Government Sector	Private Sector	Total
2010	360	432	792
2011	920	—	920
2012	505	1764	2269
2013	725	950	1675
2014	1170	—	1170
2015	—	2600	2600
	Expected Extra Generation		9426

Figure 5: Table 3 :

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Figure 6: Table 4 :

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Chittagong, Bangladesh.	
No of Obserbation	Width (ft)
1	7
2	11.3
3	12.5
4	11
5	10.8
Average Width, $W = 10.52 \text{ ft} = 3.21 \text{ m}$	

Figure 7: Table 5 :

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Chittagong, Bangladesh	
No of Obserbation	Width (ft)
1	2.2
2	2.7
3	2.4
4	2.6
5	2.8
Average Depth, $D = 2.54 \text{ ft} = .774 \text{ m}$ and Area = $W \times D$ $= 3.21 \times .77 = 2.48 \text{ m}^2$	

Figure 8: Table 6 :

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Chittagong, Bangladesh.

No of Obserbation

	Time (Sec)
1	4.35
2	4.30
3	4.58
4	4.86
5	4.82

Average time,  $t = 4.58$  sec,Velocity,  $V = 3.96/4.58 = .86 \text{ ms}^{-1}$ ,Flow Rate,  $Q = V \times A = .86 \times 2.48 = 2.14 \text{ m}^3/\text{sec}$ , Power, $P = 9.81 \times Q \times H = 9.81 \times 2.14 \times .9144 = 19.19 \text{ kw}$ .

b) Mahamaya

Bangladesh

Choramirosorai, Chittagong,

Figure 9: Table 7 :

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No of Obserbation

	Time (Sec)
1	4.72
2	5.03
3	4.8
4	4.95
5	4.86
6	5.07
7	5.05

Average time,  $t = 4.92$  sec,Velocity,  $V = L/t = 4.88/4.92 = .99 \text{ ms}^{-1}$ ,Flow Rate,  $Q = V \times A = .99 \times .55741 = .5518359$ Power,  $P = 9.81 \times Q \times H = 9.81 \times .5518359 \times .9144 = 4.95 \text{ kw}$ 

Figure 10: Table 8 :

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Bangladesh.	
No of Obserbation	Width (ft)
1	69.5
2	65.3
3	89.1
4	77.7
5	82.5

Average width,  $w = 76.82 \text{ ft} = 23.415 \text{ m}$ , Average depth,  $d = 4.5 \text{ ft} = 1.372 \text{ m}$  and Cross sectional area,  $A = w \times d = 32.12 \text{ m}^2$

For measurement of flow the passing the length of  $L = 1.2192 \text{ m}$  following time were recorded

Figure 11: Table 9 :

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No of Obserbation	Time (Sec)
1	50.45
2	51.08
3	50.3
4	50.45
5	51.25

Average Time,  $t = 50.706 \text{ sec}$ ,

Velocity  $v = L/t = 1.2192/50.706 = .024 \text{ ms}^{-1}$ , Flow,  $Q = V \times A = .024 \times 32.12 = .77088 \text{ m}^3/\text{sec}$  and Head,  $H = 5\text{m}$ .

Therefore Power,  $P = 9.81 \times Q \times H = 9.81 \times .77088 \times 5 = 37.81 \text{ kw}$

d) Sailopropat Spring, Sailopropat, Bandorban, Bangladesh

Head,  $H = 27.59 \text{ ft} = 8.41\text{m}$ , Width,  $W = 2 \text{ ft} = .61 \text{ m}$ , Length,  $L = 4 \text{ ft} = 1.2192 \text{ m}$

Area,  $A = W \times L = .74 \text{ m}^2$

For measurement of flow the passing the length of  $L = 1.2192 \text{ m}$  following time were recorded.

Figure 12: Table 10 :

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Feasible Micro Hydro Potentiality Exploration in Hill Tracts of Bangladesh  
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Figure 13: Table 11 :





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