ALTERNATIVE ENERGY SITUATION IN BANGLADESH
A COUNTRY REVIEW

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INTRODUCTION

The interest in renewable energy has been revived over last few year, especially after global awareness regarding the ill effects of fossil fuel burning. Energy is the source of growth and the mover for economic and social development of a nation and its people. No matter how we cry about development or poverty alleviation- it is not going to come until lights are provided to our people for seeing, reading and working.

Natural resources or energy sources such as: fossil fuels, oil, natural gas etc. are completely used or economically depleted. Because we are rapidly exhausting, our non-renewable resources, degrading the potentially renewable resources and even threatening the perpetual resources. It demands immediate attention especially in the third world countries, where only scarce resources are available for an enormous size of population. The civilization is dependent on electric power. There is a relationship between GDP growth rate and electricity growth rate in a country.

The electricity sector in Bangladesh is handled by three state agencies under the Ministry of Energy and Mineral resources (MEMR). These are

- Bangladesh Power Development board (BPDB)
- Dhaka Electric Supply authority (DESA)
- Rural Electrification Board (REB)

Bangladesh is a largely rural agrarian country of about 120 million people situated on the Bay of Bengal in south Central Asia. Fossil energy resources in Bangladesh consist primarily of natural gas. Domestic oil supply in considered negligible. Several small deposits of coal exist on the north eastern region of the country, but these consist of peat, with low caloric value and very deep bituminous coal that will be quite expensive to extract. Only 15% of the total population has got access to the electricity. In 1990 only 2.2% of total households (mostly in urban areas) has piped natural gas connections for cooking and only 3.9% of total households used kerosene for cooking. These are by no means a pleasant scenario.

Per capita consumption of commercial energy and electricity in Bangladesh is one of the lowest among the developing countries. In 1990, more than 73% of total final energy consumption was met by different type of biomass fuels (e.g. agricultural residues, wood fuels, animal dung etc.).

The rural and remote sector of Bangladesh economy, where 85% of the population live, is characterized by an abundance of open and disguised unemployment, high Man-land ratio, alarmingly large numbers of landless farmers, extremely inadequate economic and social facilities, low standard of living and a general environment of poverty and deprivation. 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 all sources of renewable energy and to use these in an efficient converted form for benefit of the people. Primarily this will be done in remote inaccessible un-electrified area in a stand alone system where grid expansion is expensive. This energy conversion will reduce pressure on the national power demand. This will not only save excessive grid expansion cost but will also keep environment friendly.

Recently a number of experimental and pilot projects are being undertaking by different organizations in different sectors of alternative energy technologies in Bangladesh. Some preliminary information on the main pilot projects of different energy technology are discussed in this paper.

RENEWABLE ENERGY RESOURCES AND TECHNOLOGIES IN BANGLADESH

Bangladesh is endowed with plentiful supply of renewable sources of energy. Out of various renewable sources solar, biomass, peat, and hydro-power can be effectively used in Bangladesh (Government of Bangladesh, 1991). Renewable energy practices in Bangladesh are

- Solar Energy
- Wind Energy
- Biomass Energy
- Hydro-power energy (* not included in this report)

SOLAR ENERGY

Solar Energy is inexhaustible and pollution free. It is available everywhere; but the greatest amount is available between two broad bands 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/m^2 which is 50-100% higher than in Europe. Taking an average solar radiation of 1900 kwh per square meter, total annual solar radiation in Bangladesh is equivalent to 1010 X 10^{18} J. present total yearly consumption of energy is about 700 X 10^{18} J. this shows 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 (Eusuf, 1997).

A good number of organizations and departments are doing research, development, demonstration, diffusion and commercialization of solar energy technology. Diffusion aspects of the solar energy technologies are using mostly in Bangladesh specially solar Photovoltaic (PV) systems, solar cooker, solar oven, solar water heater and solar dryer.

Solar energy technology in Bangladesh

1. Solar PV System: Rural electrification Board (REB), Atomic Energy Commission (AEC), Local Government Engineering Department (LGED), and Grameen Shakti (GS) have installed (are in the process of installation of) a number of solar PV systems in different parts of the country.

REB has undertaken a pilot project for supply of solar electricity in some islands of one main river (Meghna) in Narshingdi district. Five types of PV systems are delivered to 1370 consumers as shown in Table -1 below:

Table- 1 : PV Systems in the REB Pilot Project.

Type	System I Lantern	System II	System III	System IV	System V
Units Supplied	400	380	275	190	125
Module (Watt peak)	6	Charged at PV charging station	Charged at PV charging station	46	2x46
Battery (no. X volts x amp hours)	6v x 3.2AH	12V x 60AH	2x12x60AH	12Vx60AH	2x12Vx100AH
8 W fluorescent	1	2	2	2	1
3 W incandescent	1	-	-	-	-
13 W fluorescent	-	-	1	1	2
Fan	-	-	1	1	1
Socket	-	1	1	1	1
CIF Cost (Tk.)	3,894	24,352	46,478	31,509	51,559
CIF Cost ($)	93	580	1,107	750	1,228

Under this project, PV systems have been installed at one rural health clinic for running fans, lights and refrigerators. Same systems are being set up in another clinic. The first solar module was installed on 3rd August 1996 and since then till 10-05-97 a total households have been provided with different types of systems as shown in Table-2:

Table 2. Progress of Solar PV installation as

System type	No. Of units supplied	Watt Peak
i	Nil	Nil
ii	233	Charging station
iii	27	Charging station
iv	113	5,198
v	115	10,588
Total of Household systems	188	
Charging station	3	29,440
Health clinic	1	828
		46,054

More than 500 potential consumers have been trained on the operation and maintenance of the entire PV system. This was conducted by BCAS and CMES experts.

AEC initiated solar PV programme (SPV) in 1985. The systems installed over the period 1985-1994 are 9790 watt peak. Most of the systems are not functional at present because of the lack of fund for spare parts, maintenance and back-up service.

LGED has so far installed SPV systems in 5 cyclone shelters, one at Cox's Bazar, four at Patuakhali. According to LGED all the systems have been working satisfactory since their installation.
During the year 1996-1997, GS has installed 67 units of solar home systems (SHS) at different districts of Bangladesh. This includes Fluorescent Tube lights, T.V. point, Fluorescent lamps etc. GS is planning to installe a total of 400 under next phase of the solar PV development project.

2. Solar Cookers: Institute of fuel Research and Development (IFRD) of BCSIR and Centre for mass Education in Science (CMES) are engaged in the development and dissemination of solar cookers. A low cost reflector type cooker developed by IFRD is a spun-aluminum parabolic reflector. It is light-

weight (2-3 Kgs), cheap and simple to construct, but the disadvantages are that it needs manual sun tracking frequently and the reflectivity deteriorates rather rapidly and cooking is interrupted by cloudy and hazy conditions. On a bright sunny day a 42 inch aperture spun aluminum cooker takes about three hours for cooking three items (rice, fish or meat, pulses) for a family of 5-6 members in Bangladesh.

3. Solar Oven and Dryer: Different models of solar ovens have been designed and constructed with locally available raw materials. The institute of Food Science and Technology (IFST) has developed a cabinet dryer for drying fruits, vegetables etc. by simply spreading a transparent cover over a box. These dryers are made of bamboo and polythene sheet.

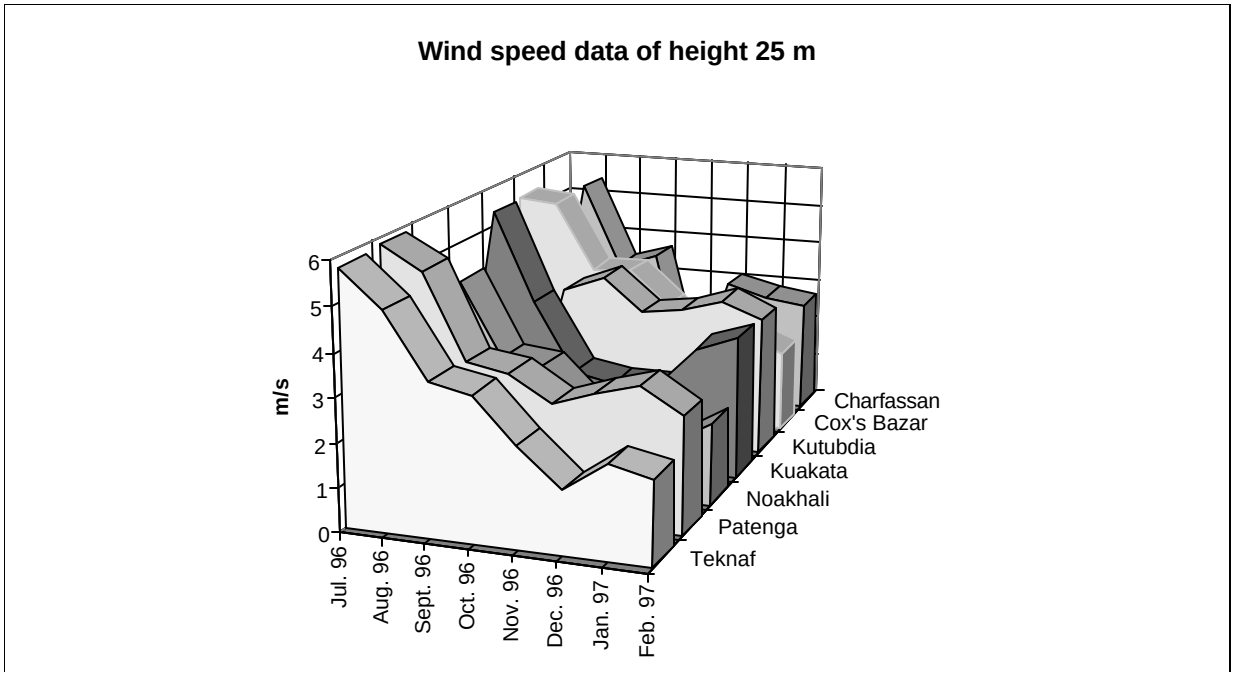
4. Solar Water Heater: This heater is designed and constructed by IFRD. It consists of coated flat-plate which absorbs solar radiation, convert into heat and transfers the resulting heat to circulating water. This type of heater is useful for supplying low grade thermal energy at temperatures below 90 ^{0}C.

WIND ENERGY

Of the several available option of renewable energy, wind systems have captured interest for a long time. The modern development of wind turbines was started from 1973 and the main achievement of this development lies in the improvement of aerodynamic efficiency and reliability, leading to lower costs per kWh generated. A great deal of information has been gathered in the past two years on the wind energy potential along coastal Bangladesh. The potential of wind energy in the coastal areas of Bangladesh is very high but this cannot be determined accurately until sufficient good quality data on wind speeds over at least twelve months of the year are available in different location.

Bangladesh Centre for Advanced Studies (BCAS) with the assistance from Overseas Development Administration (ODA) of UK launched the Wind Energy Study (WEST) Project in October 1995. The aim of this project is to assess the potential of utilizing wind energy as mechanical and electrical power. They collect and analyse wind speed data at seven areas of Bangladesh. The locations are widely

dispersed along the vast coastline in the district of Cox's Bazar, Chittagong, Noakhali, Bhola and Patuakhali. The average wind speed of those locations are shown in Figure below.



The data obtained by meteorological department have been assessed by Bangladesh University of Engineering and Technology (BUET). The data show a prospective source of wind energy in many places in Bangladesh. The wind speed in some regions of Bangladesh is satisfactory for operation pumps and for generation of electricity. The wind turbines may also be useful to drive hand pumps used in irrigation agricultural land. It was found that the wind speed in Chittagong is 2.57 m/sec or more for 4000 hours a year. At this available speed a wind plant can be operated both for generation of electricity and for driving pumps. Grameen Shakti has been assessing the wind resource at Chokoria, Cox's Bazar as well. Till now, the activities regarding wind energy are related to wind resource assessment only.

There has been little investigation of potential markets for wind power. There are some industries along the Bay of Bengal coastline using wind power for electricity supply. These are shrimp farming, fish

processing, and ice making industries. These are all electricity intensive and represent major industries along the coast, especially in the Cox's Bazar, Chokoria, and Chittagong, and Khulna areas. Many of these industries are in areas without electrical grid availability, and rely on diesel generator to provide electricity. In particular, there are a number of islands, such as Mohaskhali near Cox's Bazar, that could be important locations for fish and shrimp related industry, but that are far from the grid and are not likely to receive grid connection in the near future due to the high costs of running the trunk lines out to these islands. These islands may also have among the highest wind speeds in the country.

Site for wind turbines needs wind speed at least 6 m/s. goo accessibility of the location for heavy transport and cranes, wind direction, soil condition, noise, birds, disturbance of landscape, TV and radar reception interference should be considered for wind turbines installation.

BIOMASS ENERGY

Biomass energy is the important source of energy in many countries of the world. It is oldest type of fuel which men used for centuries after discovery of fire itself. The increase in population has forced larger numbers of rural poor to use the forests unsustainably for fuel-wood, bamboo, fodder, game meat, medicines, herbs and roof materials. Deforestation will upset the natural recycling system as well as increase the cost of fuel wood required, both in time and money, creating a vicious circle and further deforestation. Forest in many developing countries are disappearing at a high rate.

Major problems are facing Bangladesh are food and fuel. In Bangladesh, commonly known Biomass fuels are: fuel wood, agricultural residues and animal dung. The country has naturally high potential for production of Biomass resources; but because of high growth rate of population (2.4%) forest cover is being reduced in an alarming proportion.

In Bangladesh, while looking at over all energy consumption over the past 15 years, Biomass energy contributed 83% in 1980-81, 73% in 1989-90, and 67% in 1994-95. With the growth of GDP, consumption of commercial fuel increased more rapidly than that of Biomass fuel.

Alternative technology for Biomass energy

1. Improved Stove: in the institute of Fuel Research & Development (IFRD), BCSIR both single and multiple stove have been modified to give fuel saving to the extent of 50-70%. There are several NGOs like Swanirvar Bangladesh, VERC, BACE, Bandhujan Parishad, AID-Bangladesh, and TSP are engaged in dissemination of improved stoves under Fuel Saving Project and have achieved some success.

2. Biogas technology: Biogas is a kind of gas obtained by anaerobic fermentation of animal and agricultural, wastes or other words any thing which decomposes on standing. There are two models - one is the floating cover design and the other is the fixed top design are used in Bangladesh.

Bangladesh Agricultural University (BAU) first setup a biogas plant in the University campus in 1972 to study the gas production characteristics and later set up a family size plant. Department of Environment (DOE) started the programme in 1981 under a government grant. Under the "Fuel Saving Project of BCSIR", the gas holder was supplied free of cost on condition that the owner would bear the cost of the digester and other accessories which usually involved approximately half the total cost. The IFRD of BCSIR in collaboration with Dhaka City Corporation built an experimental biogas plant of 85 M^3 digester volume in 1992 for treatment of city garbage. So far, about 1000 biogas plants have been installed in the country.

Since the current status of the technology, 4-5 cattle heads are needed for a family size plant, therefore only the well-to-do families of rural areas can be brought under biogas programme. As seen in the table -3, only upper 20% of the rural households own more than four cattle head.

Table -3. Cattle heads per household of the rural areas of Bangladesh

Farm size (acre)	Cattle/house-hold (av. no.)	House-hold (% of the total)

0-0.99	0.40	59
1.00-2.49	2.24	21
2.50-7.49	4.40	16
7.50 and above	6.80	04

Recently a project entitled "biogas pilot plant" worth Tk. 68.96 million has been approved by the Government of Bangladesh and being implemented by IFRD, BCSIR. The objectives of the project are

- to provide alternative sources of energy to the rural people for cooking, lighting, irrigation and electricity generation.
- to provide organic fertilizer, rich NPK and micro-nutrients of the soil.
- to improve hygenic and sanitary conditions of the rural areas.
- to check deforestation and maintain ecological equilibrium.

Barriers for Sustainability of Alternative Energy Technologies:

1. High initial cost
2. Dependence on the weather
3. lack of awareness
4. Lack of established high-volume supplier-dealer chains.
5. High prices of the components.
6. Lack of fund.

Under the circumstances sustainability depends on the correct design of the installment payment mechanism that takes into consideration recipients' cash constraints and the upper limit of the amortization period.

According to Mr. Eusuf (1997), it is well known that for any new systems and as such effective post-installation monitoring and services must be ensured.

ROLE OF BRAC ON ALTERNATIVE ENERGY TECHNOLOGY

BRAC is implementing Biogas project in one of the BRAC operated area as experimental basis since September 1996. There are two biogas plants is presently running. It will be extended to a pilot project at all Rural Development Programme (RDP) areas at the end of this year. BRAC has a plan for extension of this biogas project to all over Bangladesh after successful completion of pilot project.

BRAC's another indirect activity related to renewable energy is social forestry programme. Which is one core programme under BRAC's Rural Development Programme. The social forestry programme has been continuously contributing to increase the country's total forest area. Bangladesh has a very small forest area estimated to be less than 9% of the total land in contrast to its requirement of 25% to ensure a stable environment. Social forestry programme has been aiming to improve the general environment by increasing total forest area, reducing soil erosion, decreasing the risks of tidal bores and cyclone, and minimizing ecological degradation.

BRAC also uses the social forestry programme as a vehicle to increase awareness among the rural people on the value of planting trees and its relation to improved environment. BRAC's Agroforestry Programme in one RDP area is a successful programme. Through expansion of this programme it would be possible to increase the soil self fertility and reduce artificial fertilizer and insecticides uses. It also plays a role on increasing biodiversity by promoting use of our local species for plantation.

Within next three years BRAC has plan

- to expand biogas project in all BRAC operated areas
- to start a project on Solar PV for BRAC programme participants
- expansion of agroforestry forestry programme and green belt at coastal area as well
- start a new project "Banasri" under Non-Formal Primary Education (NFPE) programme i.e. tree plantation by NFPE student.

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