BIISS JOURNAL, VOL. 25, NO. 2, APRIL 2004; 159-186

A.B.M. Ziaur Rahman

RENEWABLE ENERGY RESOURCES IN BANGLADESH: CHALLENGES AND OPPORTUNITIES

Abstract

Electricity for all of the population by 2020 is a constitutional commitment and a vision of the successive governments in Bangladesh. However, the present state of electricity generation, transmission and distribution does not make the vision realisable by 2020. This has resulted in creating social, economical and environmental problems. In this regard, renewable energy supply through off-grid systems can be an appropriate tool for meeting the energy supply in the rural areas of the country. The paper identifies the problems in promoting renewable energy technologies (RETs), assesses the potentials of different RETs and discusses their opportunities.

Introduction

With a view to "progressively remov[ing] the disparity in the standards of living between the urban and rural areas", the Bangladesh Constitution provides that the State shall adopt effective measures to provide rural electrification[1]. However, the state of electrification in Bangladesh over the last 32 years since its independence shows a dismal picture. Only 30% of the population

Mr. A.B.M. Ziaur Rahman is a Research Officer at the Bangladesh Institute of International and Strategic Studies(BIISS), Dhaka. His e-mail: zia@biiss.org, abmzr@ hotmail.com

1 Bangladesh Constitution, Article 16, available from http://www.bangladeshgov.org/pmo/constitution/consti2.htm#15. [accessed on 18/01/04]

have access to electricity[2] and each year the demand for electricity is growing by 300 MW (Mega Watt)[3]. Various studies have shown that access to electricity has a positive correlation with employment, public health and hygiene, recreation, increase in income level, literacy rate, better environmental conditions etc. Presently, the installed electricity generating capacity of the country stands at 4,710 MW[4], of which 18 government power plants supply 3,420 MW and 7 independent power producers (IPP) supply 1,290 MW of electricity. Although the government has a vision of providing electricity to all the population within the year 2020, the present state of connectivity and electricity production does not make the vision anyway realistic.

Besides financial costs, one major obstacle that lies in connecting the rural areas with the national grid is that in most of the cases it has proved to be too remote to connect them with the national electrical grid. There are reports that nearly 1.6 billion people (nearly one-quarter of the world's population) have no access to electricity[5]. In most of the developing countries the demand for electricity greatly surpasses that of its supply. This results in erratic and poor quality electricity supply[6] resulting in loss of industrial and agricultural production. Most of the developing countries have to rely on imported fuel to meet their electricity demand. In Bangladesh, 24% of commercial energy is produced from imported petroleum products which accounts for about 70% of total export earnings[7]. Much of the energy need for producing electricity is met

---

2 Ministry of Energy and Mineral Resources, *Renewable Energy Policy of Bangladesh (Draft)*, Government of the People's Republic of Bangladesh.

3 M. Ibrahim, *et al.* 'Demonstration of PV micro utility system for rural electrification', quoted in M. J. Khan, *et al.*, 'A wind map of Bangladesh', *Renewable Energy*, Vol. 29, 2004, p. 644.

4 Question-answer session in the Parliament, *The Daily Star*, 30 April 2004.

5 Margot Roosevelt, 'The Winds of Change', *Time*, September 2, 2002.

6 United Nations Development Program, 2000, quoted in Akanksha Chaurey *et al.*, 'Electricity access for geographically disadvantaged rural communities-technology and policy insights', *Energy Policy*, Vol. 32, Issue 15, October 2004, p. 1694.

7 M. Hussain, 'Bangladesh energy resources and renewable energy prospects', *Energy*, Vol. 12, Issue. 5, May 1987, pp. 369-374.

from indigenous natural gas. A Petrobangla assessment finds that Bangladesh has a recoverable reserve of 10.4 trillion cubic feet (TCF) of gas[8]. It has been calculated that with an annual 10% growth rate in consumption, the present reserve is not adequate to meet the demand after 2020[9]. Even there is a possibility that the country could turn into a net importer by 2030. Therefore, over-reliance on natural gas as the source of energy might hamper the country's long-term energy security.

Recently, several potential solutions to the fore-mentioned economic, environmental and social problems have been proposed. This includes renewable energy technology (RET), energy conservation and energy storage technologies. This paper would focus on RETs as the burning of fossil fuel causes environmental pollution both at local and global levels. Over utilisation of biomass, the most commonly used renewable energy resource in rural Bangladesh, puts pressure on the natural resource base.

The draft Renewable Energy Policy of Bangladesh does not provide any definition of renewable energy. However, Texas Renewable Energy Industries Association (TERIA) has defined renewable energy as: "Any energy resource that is naturally regenerated over a short time scale and derived directly from the sun (such as thermal, photochemical, and photoelectric), indirectly from the sun (such as wind, hydropower, and photosynthetic energy stored in biomass), or from other natural movements and mechanisms of the environment (such as geothermal and tidal energy). Renewable energy does not include energy resources derived from fossil fuels, waste products from fossil sources, or waste products from inorganic sources."[10] In simpler definition, renewable energy resources are those which are continually renewed by nature. For example, solar

---

8 Only 4% of the population have access to piped natural gas.

9 A. S. M. Bashirul Huq, (2003), 'Energy Security for Bangladesh: The case of Oil and Gas' paper presented at the Seminar on Power, Energy and National Security of Bangladesh.

10 Texas Renewable Energy Industries Association (TERIA), available from http://www.treia.org/redefinition.htm [Accessed on 06/01/04].

cells get continually powered by the sun, geothermal systems get powered by earths heat and hydroelectricity being powered by water flow from dams. Shea cautions on the definition of renewable resources and states, 'An energy resource is only renewable if, with proper management, its sustained use will not deplete supplies.[11]' A resource can no longer be called renewable if its yield is lesser than its level of consumption. Therefore, for the success of renewable energy projects, the calculation of sustainable limit of resource usage is important.

The US Department of Energy's Energy Information Portal lists seven types of renewable energy resources. They are: 1. Biomass; 2. Geo-thermal; 3. Hydrogen; 4. Hydropower; 5. Ocean; 6. Solar; and 7. Wind. In the context of Bangladesh, out of these renewable energy resources solar, biogas or biomass, wind energy and to a more limited extent hydropower can be effectively used. The limited potential of hydropower has also been recognised in the National Energy Policy (NEP) of 1995. In the context of Bangladesh, RETs can serve two major purposes, electricity production in the non-grid areas and fuel for domestic and commercial cooking and various other commercial use.

Recently, due to growth in environmental consciousness as well as the realisation of the negative impacts of the conventional energy production systems, lot of interests on RETs have been generated in the academic as well as the applied level. A number of papers have been published on the socio-economic and technological aspects of RETs. These papers, however, have dealt with particular RETs on a piecemeal basis, no holistic approach in looking into the prospect and opportunities of RETs in Bangladesh perspective has been dealt with. Therefore, the purpose of the paper is to study the state of RET in Bangladesh and record the opportunities and challenges faced in promoting and installing RETs. The paper puts emphasis on the need for strong legislative structure. Finally, the

11 Cynthia Pollock Shea, 'Renewable Energy: Today's Contribution, Tomorrow's Promise', *Worldwatch Paper 81*, January 1988, p. 6.

paper concludes with some suggestions that would ensure the energy security of the country through the introduction and use of RETs.

Assessment of Feasibility of different RETs in Bangladesh

Mini/Micro Hydropower:

Flowing water creates energy that can be captured and turned into electricity. This is called hydropower or hydroelectric power. The most common type of hydropower plants uses dam on a river that stores water in a reservoir. Water released from the reservoir flows through a turbine, spins it and activates the generator to produce electricity.

Presently, the only 230 MW Karnaphulli Hydropower station is the only hydro-electricity plant in the country. This plant is operated by the government. The other micro-hydro power plant with indigenous technology has been installed in the tribal areas in the southeast part of the country. This unit produces 10 MW of electricity. Because of the flat terrain, Bangladesh has very limited capacity of producing hydroelectricity. The limited potential of hydroelectricity in Bangladesh has been recognised in the National Energy Policy of Bangladesh. It reports[12] that annually Bangladesh has the potential to produce 10 giga watt hour (GWH) of electricity.

Wind Energy:

Winds are created by unequal heating of earth's surface and atmosphere which results in regional differences in pressure. The shape of a particular terrain further influences the wind pattern. Therefore, all the areas of Bangladesh do not have the same potential for installing wind turbines for the generation of wind energy. However, various studies have found the long coastal belt of the country is appropriate for harnessing the power of the wind through the installation of wind turbines. There is, however, no reliable

12 Power, Energy and Mineral Resources Ministry, 'National Energy Policy', Government of Bangladesh, January 15, 1996.

source of data that records seasonal and spatial variations in wind speed throughout the country. Reports record strong seasonal cycle in wind speed lower during September to February and higher during March to August due to monsoon wind. There is also a diurnal cycle in wind speed, which peaks up in the afternoon and becomes the weakest at night.

Since 1995, the world market for wind turbine has grown by an average of 40% annually. During 2001 alone generating capacity worldwide had jumped up almost by a third. Alongside the market for wind turbines, the power of these turbines are growing day by day. These days, one standard issue of wind turbine can produce at least one megawatt of electricity. This amount is sufficient for providing electricity for 800 modern households[13].

One of the major drawbacks of wind energy is the expense related with it. Since fuel is literally free, the chief expense is in setting up a turbine farm. This expense, however, is too high to drive fossil fuel plants out of business. The other major weakness involving wind energy is that sometimes when wind stops blowing, the supplier needs dependable backup power.

13 William Underhill, 'Catching the Wind', *Newsweek*, April 8-15, 2002, p. 50.

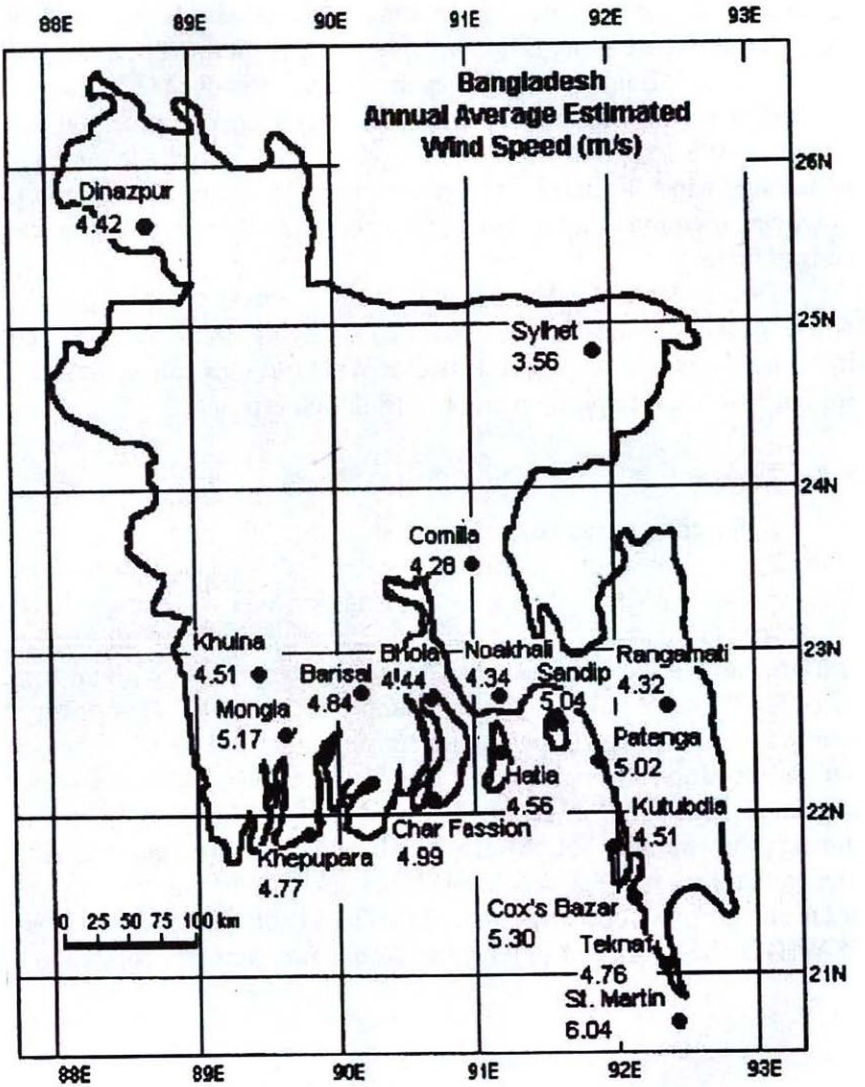

Figure: Wind Map of Bangladesh, Khan, M. J. *et al.*, 'A Wind Map of Bangladesh', *Renewable Energy,* Vol. 29, 2004, p. 659.

The American Wind Energy Association claims wind as the fastest-growing energy resource with 30% annual increase in

installation and annual investment totalling $7 billion. However, data from earlier measurements and upper air data mentioned in the Local Government Engineering Department's Renewable Energy Information Network portal shows that wind energy potential for Bangladesh is less than 7miles/hour. Such a speed is not adequate for installing wind turbines for generating electricity. The report, however, mentions that small wind turbines can be installed in the coastal areas.

Due to lack of adequate wind flow through out the country, where possible wind turbines powered by hybrid generators can be installed. However, widespread use of wind turbines can be ensured for irrigation and to pump water for drinking purposes.

Solar Energy:

Solar energy has been described as the only sustainable form of energy. It has been calculated that the Earth receives a total of 175,000 Terra Watts (1 Terra Watt = 1 million Watt) of energy daily. However, the current total commercial energy used for all human activities in the world is less than 15 TW[14]. Bangladesh with an area of 147,500 km^2 receives a constant supply of 28 TW of solar energy. Compared to the present per capita consumption of 0.05 KW, the per capita allocation through proper use of solar energy in Bangladesh stands at 235 KW[15]. Maximum amount of radiation is available during the months of March-April and the minimum during December-January. An article by E. Check[16] finds that the cost of solar energy production might go down to 8 cents per kilo watt hour (KWH) in the next eight to ten years from a previous 15 cents/kwh.

---

14 Saiful Islam and Ain Ul Huda, 'Proper utilisation of solar energy in Bangladesh: Effect on the environment, food supply and standard of living', *Renewable Energy*, 1999, Vol. 17, p. 255.

15 *Ibid.*

16 Erika Check, 'Sun in the Forecast', *Newsweek*, April 8-15, 2002, p. 56.

Month	Daily Mean	Maximum	Minimum
January	8.7	9.9	7.5
February	9.1	10.7	7.7
March	8.8	10.1	7.5
April	8.9	10.2	7.8
May	8.2	9.7	5.7
June	4.9	7.3	3.8
July	5.1	6.7	2.6
August	5.8	7.1	4.1
September	6.0	8.5	4.8
October	7.6	9.2	6.5
November	8.6	9.9	7.0
December	8.9	10.2	7.4
Average	7.55	9.13	6.03

Source: Meteorology Department, adopted from Islam, M., (2002), "Assessment of Renewable Energy Resources of Bangladesh", available from http://shakti.hypermart.net/publications/ebook1.pdf

The data given above and most of the data available from different sources in Bangladesh have been collected from the cities. Cities, however, are already connected with grid and are not considered to be a prospective site for RET application. It has already been mentioned that rural and remote areas are most appropriate for RETs and adequate data is necessary as surface typology of each sites have major influence on micro-climate which results in variable solar resources in small areas[17]. Satellite Remote Sensing technologies can be used to assess RET projects in the remote and off-grid areas of Bangladesh.

One of the biggest allegations that hinders the growth of PV technologies is regarding the costs of the technology vis-à-vis

17 M. Islam, 'Assessment of Renewable Energy Resources of Bangladesh', available from http://shakti.hypermart.net/publications/ebook1.pdf, 2002, p. 3.

conventional ones. A study by Bhuiyan *et al.*[18] shows that the life cycle cost (LCC) of one unit of energy from grids that are 1 km away from a village is much higher than the cost of energy from a PV system. The study shows that the LCC of electricity for a village 1 km away from the grid line is Tk. 125.00/kilo Watt hour (kWh), Tk. 50/kWh for petrol generator, Tk. 46.10/kWh for diesel generator and Tk. 43.40/kWh for PV systems. This analysis show that the use of PV system, which does not need fuel input and has low maintenance cost, is not only environmentally beneficial but also economically feasible for rural and off-grid areas.

A survey conducted by World Bank found that a market of 0.5 million households exist for solar home systems (SHS) in the off-grid areas of Bangladesh. The same study also found that nearly 4.8 million households can afford for a solar home system. Electricity, in these off-grid areas are provided by small entrepreneurs with diesel generators. Another study by World Bank found that 82% of these entrepreneurs were "interested in marketing SHS if some sorts of financial arrangements are available"[19]. In the Seminar titled 'How Renewable Energy can Help Solve the Energy Gap – with a Public-Private Partnership' held on April 07, 2002, Farid Bakht in his keynote paper predicted, "500,000 households will be potentials customer of renewable energy and four million more will go for solar system, indicating one in six households of Bangladesh. Where only 25 % of total population have access to electricity to get benefit"[20].

A survey conducted by Engineer Khurshidul Islam[21] finds that stand-alone PV home systems are more popular than Deep Cycle

---

18 M. M. H. Bhuiyan *et al.*, 'Economic evaluation of a stand-alone residential photovoltaic power system in Bangladesh', *Renewable Energy*, Vol. 21, Issue 3-4, November 2000, pp. 403-410.

19 'Market potentials of different renewable energy technologies', available from http://www.lged-rein.org/ret_market/mrkt_poten.htm [accessed on 19/02/04]

20 Available from: http://lged.org/sre/seminar-ret.htm [Accessed on 03/01/04].

21 K. Islam, 'Commercialisation of Solar PV technology- Global constraints – past, present & future' available from http://www.sdnbd.org/sdi/issues/energy/index.htm

Storage Batteries. The reason lies in the difficulty of transporting the Batteries to and from a Central PV Battery Charging Station.

During a survey[22], some of the consumers commented that their PV systems are better than the grid, because the entire system is under their control and there is no fear of unwanted blackout because of load shedding. They know how to plan the duration of different appliances to get the maximum benefits.

The above analysis shows that solar energy might not be feasible in the gridline areas but in the off grid rural areas solar electricity as well as solar cookers are viable energy options.

Biogas:

Bangladesh is facing deficiency in both food and fuel, two basic necessities of human life. Supply of fuel has direct bearings upon the production of food. Experts suggest that these two deficiencies as well as better hygienic conditions can be properly addressed through the introduction of biogas technologies in Bangladesh[23]. Biogas technology which uses animal and agricultural waste for producing fertilizer and energy as a bi-product has been termed as the most appropriate RET for an agricultural country like Bangladesh.

Biogas is obtained through anaerobic fermentation of animal droppings, droppings of human excreta and other organic matters. The gas produced through the fermentation process, consists of 55-65% of methane and carbon dioxide. Calorific value of the gas is 550-650 Btu/ft^3 (British thermal unit per cubic feet)[24]. It is used for cooking, lighting and other purposes.

---

22 K. Islam, , 'Practical Application of Solar Photovoltaic in Bangladesh', available from http://www.sdnbd.org/sdi/issues/energy/index.htm

23 Country Report Bangladesh: Renewable Energy Technology, (2004), available from http://www.worldenergy.org/wec-geis/publications/reports/renewable/country_reports/chap_2_1_2.asp

24 *Ibid.*

According to official estimates, Bangladesh has a cattle population of 24 million, poultry of 75 million. With an average of 240 million kg per day, cattle dung can provide for 2.97billion m^3 (cubic metre) of biogas. At present there are about 100,000 poultry farms in the country and the number is increasing. According to an estimate about 100 Mega Watts of electricity can be generated from these farms. Electricity generated from the poultry farms alone can annually save about US$ 100 million of new power plant installation cost and avoid fuel and other operational and maintenance costs. The estimation also records that if each family of the country could be associated with the biogas plant, it would daily produce 3.36 million m^3 and 1226.4 million m^3 annually[25].

Implementation of biogas technology is related with the with the land distribution pattern as it has strong relationship with ownership of cattle. According to the current state of technology, 4-5 cattle are needed to run a family size biogas plant. Only upper 20% of the rural households own four or more cattle. According to IFRD, there is the potential of establishing 4 million biogas plants in Bangladesh.

A survey conducted by IFRD and the World Bank shows that gas was used by all the owners for cooking purpose, only a few people were using it for lighting. The reasons for not using the gas for lighting purpose has been attributed to insufficient availability of gas, high price of the lamp and availability of electricity in some areas[26].

Experiences from the ongoing biogas projects show that although it has tremendous potential for development in Bangladesh, economic, social, cultural and technological backwardness is hampering its growth. Unless these issues are addressed properly, holistic development of biogas technologies in Bangladesh might not be possible.

---

25 *Ibid.*

26 *Ibid.*

An assessment of the appropriateness of the RETs based on terrain condition, availability of the renewable resource and technological feasibility shows that biogas and solar power are most appropriate technologies for Bangladesh. To a limited extent, wind power also has potential for Bangladesh.

Opportunities

Achieving development that is sustainable is one of the cornerstones of Bangladesh government's policies. A review of the factors contributing to achieving sustainable development (SD) shows that one of the major requirements is the supply of energy resources that is sustainable by itself. Besides effective and efficient utilisation of energy resources, a sustainable supply of energy which in the long term is readily and sustainably available at reasonable cost and can be utilised without negative social and environmental impacts is necessary to ensure sustainable development of a society. In this regard the need for energy resources that are indigenous and renewable becomes pertinent in the context of Bangladesh.

RETs produce marketable energy by converting natural phenomenon into useful energy forms. RETs use the energy inherent in sunlight which has direct and indirect bearings on earth (photons, wind, falling water and heating effects), gravitational forces (tide) and the heat of the earth's core. These energy resources not only represent a huge energy potential which is far greater than the fossil fuel resources but also the supply is replenishes itself. Therefore, unlike conventional source of energy renewable resources are inexhaustible.

Studies have found that non-access to electricity and rural poverty are closely related. Electricity has been an indispensable input for productive and economic activities and hence a pre-requisite for improving living standards. Positive contribution of electricity for the first kilowatt-hour to the Human Development

Index has been recognised in the literatures[27]. Studies have also found that even minimal electricity inputs are most likely to benefit the poor. Therefore, electricity input in rural areas is essential to further the development of the country.

Renewable resources have been popular for ages. Presently, nearly 83% of the fuel consumption in the country is met by bio-mass. Bio-mass fuel is composed on fuel wood, charcoal, twigs and leaves, agricultural residues such as plant residues, paddy husk and bran, bagasse, jute sticks and animal dung especially cow dung. 63% of the fuel-wood is consumed for domestic purposes while the rest is used for industrial and commercial purposes. The bulk of the fuel wood used in the country is obtained from non-forest lands but not from natural forests, plantations or unclassified state forests. Although biomass is considered as a renewable resource, its unsustainable use in this context has turned it into a non-renewable one. One way of resolving the problem of deforestation is to provide electricity to these areas. Here again, connecting the rural areas of a riverine country like Bangladesh is very difficult. So to stop the decrease in forest cover loss and that of bio-diversity decentralised renewable energy (DRE) projects can play a major role.

According to the Intergovernmental Panel on Climate Change (IPCC), carbon dioxide (CO_2) accounts for over half of the heat trapped, causing global warming. Roughly 45% of the heat trapped from 1980 to 1990 was attributable to conventional energy production and use[28]. Environmental problems with energy supply and utilisation are not limited to global warming only but also to other environmental concerns as air pollution, acid precipitation, forest depletion and emission of radioactive substances. Emission-

---

27 Electricite de France (EDF), 2002, 'Electricity for all: Targets, Timetables, Instruments' quoted in A. Chaurey *et al.*, 'Electricity access for geographically disadvantaged rural communities – technology and policy insights', *Energy Policy*, Vol. 32, No. 15, 2004, p. 1705.

28 R. T. Watson and the Core Writing Team, (2001). *IPCC climate change 2001: synthesis report*, available from http://www.grida.no/climate/ipcc_tar/syr/008.htm [accessed on 29/08/02].

free RETs can play a key role in reducing emissions at both global and local levels and helps in accessing local energy resources that can facilitate sustainable development and meet international development targets.

Since all of the conventional energy resources are non-renewable, there is the question on the sustainability of that particular resource both at local and global levels. Calculations reveal that at present day consumption rate, oil reserve would run out by 2046[29]. Once the hydrocarbon reserves run out, nuclear and RETs would be the only sources of energy. In future, the environmental and security impacts of nuclear energy would limit its scope. Therefore, preparations should already be undertaken to promote and further the use of RETs.

The distributions of fossil fuel based energy resources are inequitably concentrated in spatial locations in which a large section of world population has no direct access. These people are denied of the standard of living that are being enjoyed by the people of developed countries. Therefore, one of the benefits from RERs is that theoretically, it delivers social equity among different segments of the society. Furthermore, the unequal geographical location of fossil fuel based resources causes political tension and has been the root of many of the recent military conflicts (e.g. the Middle East). On the contrary, since renewable energies use local and decentralised forms it also create the opportunities for peaceful development and greater global security through cooperation.

29 T. Emerson, 'The Thirst for Oil', *Newsweek*, April 8-15, 2002.

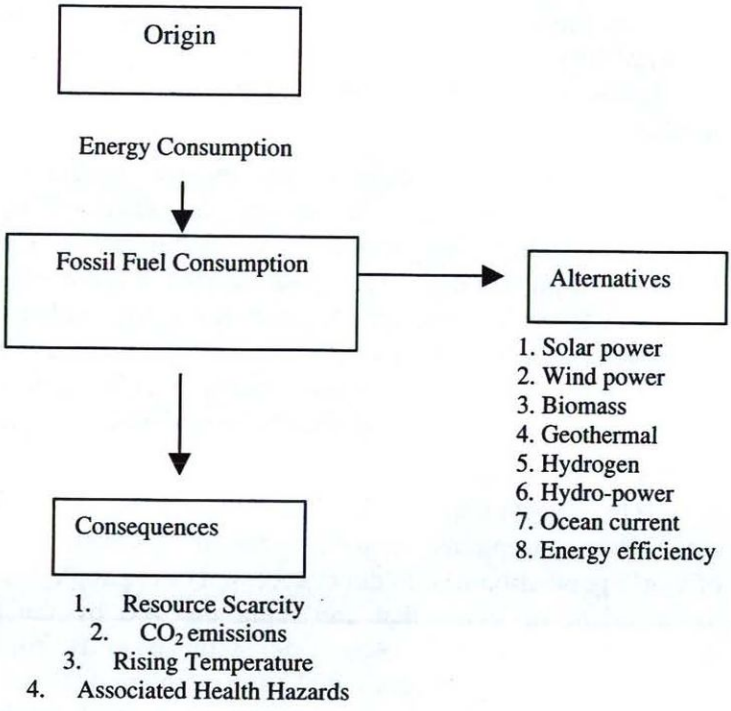

Figure 1: Energy and Environment Interactions.

The experience of Grameen Shakti for the promotion and distribution of RETs show that these technologies not only provide electricity, it becomes a stimulant for other development activities[30]. The Grameen Shakti RET programme creates jobs[31], income generating activities for housewives, eliminates health hazards caused while using traditional energy resources, improves literacy rate and provides security for the women. A recent study on the impact of rural electrification shows that electrification increased

30 D. C. Barua, 'Strategy for Promotions and Development of Renewable Technologies in Bangladesh: Experience from Grameen Shakti', *Renewable Energy*, Vol. 22, 2001, pp. 205-210.

31 RETs are nearly three times more labour intensive than fossil fuel or nuclear power options. A survey by Danish wind energy manufacturers show that 17 workers are created for every megawatt of wind turbine manufactured and five worker years for every wind power installed.

income, working hours, reading habits, children's study time, amusement and security[32]. RETs can improve healthcare through proper lighting and vaccine refrigeration and family planning[33].

As outlined in the Bangladesh government's Renewable Energy Policy, RETs can help improve access to basic health care for poor people in un-electrified areas through provisions of renewable energy systems in health clinics and using it in vaccination and immunization programs, improve the quality of education in un-electrified areas by providing electricity, ensure supply of safe drinking water through tube wells. Availability of electricity in remote areas would also enable the dissemination of information thorough the Information and Communication Technology (ICT) centres

BPDB records that the uniqueness of solar energy stems from its non-requirements of fuel, high durability and reliability as well as lower maintenance costs makes it economical for remote applications. Presently 24% of the commercial energy requirements is managed by petroleum products[34]. Since, Bangladesh does not have any indigenous petroleum resources, it has to depend on imported sources. The total petroleum products consumption in 2002 amounted to 3.3 million tons. Such import not only involves costs in terms of finance but also from the supply of it. Financial costs involve not only the price of the product but also the fluctuation in price in international market. In addition to financial volatility, the security of supply remains another cause of concern. Moreover, small scale RET projects with short construction time provide higher adoptability in responding to unpredictable growth in power demand. Therefore, the use of indigenously available renewable energy

---

32 M. Islam, *Ibid*, p. 3.

33 A study shows that fertility rate among women in electrified households is 0.67% while that stands at 1.17% in non-electrified areas.

34 A. S. M. Huq, 'Energy Security for Bangladesh: the Case of Oil & Gas', paper presented at the BIISS & BPC seminar on Power, Energy & National Security of Bangladesh on 20 March 2003.

resources can reduce such financial and supply disruptions as well as improving environmental quality.

For the rural population of Bangladesh, energy for cooking constitutes one of the basic needs. Statistics in the use of wood as fuel shows a steady decrease. Its share as a percentage of biomass has declined to 22% in 1990 from 63% in 1981[35]. The calorific value of other types of fuel used in the villages in the forms of agricultural and animal residue is low. Apart from the energy need for cooking, one major application of electricity is to power the irrigation pumps. Most of the pumps are diesel driven as they could not be connected with the national grid. During each irrigation season, the price of diesel goes up, making it difficult for the peasants to irrigate the high input agricultural fields. Since these rural areas could not be connected with grid line electricity, decentralised and indigenously produced renewable energy resources like solar cell, wind power or biomass can be the appropriate tool for rural electrification. This has already been endorsed by the Rural Electrification Board, the state-owned organisation tasked to provide electricity in the rural areas of Bangladesh.

The above discussion shows that renewable energy constitutes one of the major planks for SD. Advantages of renewable energy are manifold. Such resources can supply the energy needed for indefinite period of time accounting for far less pollution than fossil fuels. They play a major role in enhancing the energy supply market as well as securing long term sustainable energy supply because unlike fossil fuel they do not require importation. Moreover, they create new employment opportunities by offering possibilities for local manufacturing.

---

35 W. K. Biswas *et al.* 'Model for Empowering Rural Poor through Renewable Energy Technologies in Bangladesh', *Environmental Science & Policy*, Vol. 4, 2001, p. 335.

Challenges

Lack of proper institutions:

Absence of proper institutions on the part of the government has been identified as one of the major hurdles in promoting RETs. Presently, there is no national coordinating agency for RETs in Bangladesh. The Ministry for Electricity and Mineral Resources is responsible for looking after energy related activities in the country. The government organisations responsible for generation of electricity are – (1) Bangladesh Power Development Board (BPDB), which is the largest authority to generate electricity from the conventional sources (like indigenous gas, hydro, diesel, furnace oil) and through Independent Power Producers, and (2) Rural Electrification Board (REB) generating electricity through Rural Power Company. Transmission of electricity from different power plants are done by BPDB and it's subsidiary company Power Grid Company of Bangladesh (PGCB). Distribution of electricity to the consumer end is performed by - BPDB, Dhaka Electric Supply Authority (DESA), Dhaka Electric Supply Company Ltd. (DESCO) and REB.

Absence of adequate data:

RERs are highly site specific. Therefore, a proper renewable energy policy is important for the higher utilization of RER. Like that in many developing countries, the renewable energy planning in Bangladesh suffers from various barriers. The foremost one is the lack of adequate data on renewable energy resources. Although the meteorological department of the country provides national data on solar and wind energy systems, they are not adequate for formulating policies on RET. Availability of adequate data is important to plan and make pragmatic use of renewable energy resources. To ensure the effective use of RERs and to identify the appropriate technology, better data in a longer time series is needed which might be helpful in making decisions on determining variations of different times of

the year. Besides national-level data, micro-level data is also required to understand local conditions.

Problems in energy pricing:

Despite receiving a great deal of attention in recent times, the most important barrier is perceived to be the poor economics of the resource compared to fossil fuels[36]. This is resultant from the traditional pricing structure which fails to internalize the social and economic costs of fossil fuel. Since governments do not follow the system of environmental accounting in their planning process, the contribution of traditional resources remain unnoticed. The main reason for that is the non-monetisation of renewable resources and their contribution to national economy. The non-monetisation of renewable resources also gives rise to problems in policy planning. Most of the developing countries fail to add any monetary value to renewable resources and fail to develop specific policies for their proper utilisation. Environmental concerns, however, calls for higher utilisation of these resources which has to be safe guarded by proper planning mechanisms. According to Global Environment Facility (GEF), a major financier of RET projects in the developing countries - "A transition to renewable energy is inevitable, not because fossil fuel supplies will run out .... but because the costs and risks of using these supplies will continue to increase relative to renewable energy. Costs will increase as the environmental impacts of fossil fuel use are increasingly incorporated into the costs of energy and as the cheapest reserves are depleted". Since 1980 fossil oil consumption has been higher than the discovery of new reserves[37] and once these cheap reserves run out fossil fuel would no longer be cheaper than renewables.

---

36 World Energy Council, 'Focus on Renewable Energy', available from http://www.worldenergy.org/wec-geis/focus/renew/ [accessed on 01/04/04].

37 P. Maegaard, 'From Fossil Fuels to the Energy Solutions of the Future', available from http://www.world-council-for-renewable-energy.org/downloads/FromFossilFuels.pdf [Accessed on 10/04/04]

Lack of coordination between organisations for promoting RETs:

Although several organisations at governmental, private and NGO levels are working to promote RETs in Bangladesh, the lack of coordination between them hampers the designing and implementation of RET policies. For example, although rural areas have the most potential for renewable energy utilisation, it is not linked with various programmes concerning to rural development. There is the need for greater synergy between government, private and NGOs for the promotion of appropriate RET in Bangladesh.

Faulty institutional structures:

Apart from the absence of proper policies, the other hindrance is the institutional mechanism for energy development and utilisation. The existing institutional structure in Bangladesh is not conducive for the development of RETs. In the present shape, renewable energy policies and strategies are handled along with commercial energy policies and planning. Such a planning structure has although highlighted the importance of RETs, has created hindrance towards understanding of the important factors that might provide a greater role for renewables. As a part of its energy sector reform policy, Bangladesh government was required to create an independent energy sector regulatory commission. The proposed commission, however, is yet to come into operation. Once operational, it is expected that the commission would handle renewables separate from conventional sources of energy.

Failure in apparently successful projects:

Several government organization and affiliates (BPDB, LGED, REB, and Institute of Fuel Research Development), academic institutions (Bangladesh University of Engineering & Technology, Dhaka University and other science and technology universities), non-government organizations (Grameen Shakti, Bangladesh Renewable Energy association, Bangladesh Centre for Advance Studies, Centre for Mass Education in Science, Bangladesh Rural Advancement Committee) and private companies like

Prakaushali Sangsad, Rahimafrooz are involved in renewable energy technologies in the country. Venema *et al.*[38] note that NGO movement in promoting RETs in Bangladesh has been extremely successful. Despite such success, seemingly there are no systematic mechanisms to study and analyse the reasons for success and to follow it up through human resources training programs.

Lack of funds for Research and Development (R&D):

As discussed earlier, one major hindrance is price of the RER. One major reason for the high price of the RETs is lack of research and development (R&D). It has been reported that for the last one decade research on fossil fuel and nuclear are receiving ten times more public support than renewables. In the developed countries, only 7% of the research funding is used to finance research on RET and on comparison nearly 70% of the fund is used for nuclear R&D. developed countries, who provide the major impetus for research in RETs are embroiled in their own imperatives. The present technical and economic structure of the developed countries support further use of nuclear and fossil energy. The companies, interest groups and political decision makers, who benefit from the use of such resources are identified as the major hindrance towards the change of structure that support the centralised structure of the supply and distribution system of non-renewable resources. In addition, annually fossil fuel based energy receives nearly US$ 300 billion through several direct and indirect subsidy schemes[39].

In 2000, only 13.33% of the total world consumption of energy was met by renewable resources[40]. This low utilisation of renewable resource creates hindrances in the way of further

38 H. Venema and M. Cisse (eds.), *Seeing the Light*, 2004, International Institute For Sustainable Development, Canada.

39 P. Maegaard, 'From Fossil Fuels to the Energy Solutions of the Future' available from http://www.world-council-for-renewable-energy.org/downloads/FromFossilFuels.pdf [accessed on 13/02/04]

40 Jose Goldemberg & Suani Teixeira Coelho, 'Viewpoint: Renewable energy – traditional biomass vs. modern biomass', *Energy Policy*, Vol. 32, 2004, pp. 711-712.

innovation and effectively driving out hydro-carbon based energy resources.

Lack of R&D in appropriate fields:

In Bangladesh, the government funded research organisations like Bangladesh Council of Scientific & Industrial Research (BCSIR), Institute of Fuel Research & Development (IFRD) and public organisations like different science and technology universities carry out research on RETs. Their research, however, is mainly concentrated on the improvement of biomass as fuel, construction of solar cookers or ovens and some other energy efficiency measures. Like other developing countries, Bangladesh does not have the capability to undertake substantive research, ranging from basic to learning from a wide range of field demonstration facility, for the development of RETs. They have to rely on technological transfer from the developed countries for the promotion of renewables. Since many of the RETS are quite immature and relatively costly many of the developing countries do not make necessary investments in the R&D of them. One side effect of the reliance over technology transfer is that it lacks site specific conditions and its demonstration. The study conducted on South Asian region by World Energy Council reports that regional and sub-regional cooperation in know how sharing and training

Improper dissemination of the benefits of RETs:

The most of the cases it has been found that the information on the RET's potential as well as its technological opportunities and economic potentials are not properly disseminated. In some cases, even the political leaderships of countries were found to be lacking proper knowledge on RETs. There is also the element of deliberate misinformation campaign directed at decision makers and the mass.

Funding constraints for developing countries:

For the production of per units of energy, renewable energy systems require higher capital investment than conventional energy

systems. Funding for renewable energy projects are highly difficult. From the governmental side, it requires higher public budgetary allocations. Governments in developing countries face difficulties in funding these projects. On the other hand, higher capital cost and longer gestation period of RETs do not make it attractive for private sector investment. Clean Development Mechanism (CDM) of the Kyoto Protocol allows for some fund for the non-Annex I countries. As a signatory to the climate change convention, Bangladesh would receive grants from Global Environmental Facility (GEF) and other climate change abatement funds to support its renewable energy initiatives. It needs mentioning that this support is not limited to financial assistance only but also transfer of clean energy technologies[41].

Absence of support service in the areas where RET projects has been undertaken:

By policy, as enunciated in the NEP, the Bangladesh government along with NGO and private sector participation has undertaken renewable energy projects. One of the major problems that have been found in the areas where RETs has been installed is that it has not been followed up by effective servicing and maintenance support. However, this lack of servicing and support service makes the whole project unsustainable.

Importance of Legislative Structure

Before focusing on the importance of legislative regime for the promotion of RETs, it is important to shed some light on the Bangladesh government's efforts in promoting those technologies. The National Energy Policy of 1996 proposed the establishment of a separate Renewable Energy Development Agency (REDA) for the development of RETs. This agency, however, is yet to be formed. A draft Renewable Energy Policy has been drafted by the Power Cell of the Ministry of Energy and Mineral Resources. This report is

41 H. D. Venema, and M. Cisse, (eds.) *Ibid.*

awaiting approval by the lawmakers. Value Added Tax(VAT) on the import of solar photovoltaic (PV) cells and wind turbines has been lifted in 1998. Alongside, the government provides subsidies of different government bodies like Bangladesh Power Development Board (BPDB), Rural Electrification Board (REB) and Local Government and Engineering Department (LGED). Small Power Generation Policy of 1998 which has been enacted to provide support for independent power producers (IPP) provides some incentives for renewable energy based power generation.

While distorted market forces has pushed up the price of the renewables, effective legislative structures can have decisive influence on the implementation of renewable and decentralised forms of energy. The impact of an effective legislative regime can be illustrated by the 1991 German Legislation Act on 'Feeding on Electricity'. This legislature resulted in the production of wind power with 50% of the total European capacity and the promotion and utilisation of other types of RERs. It formed the background of the essential principles of the Renewable Energy Law of 2000, which differentiated the tariff structure to allow compensation for specific RETs on the basis of stimulus required to solve future energy crisis. The impetus to RETs has led to the creation of a large number of small and medium size industries. These industries became an important factor in European crafts and trade and they also provided impetus for a number of industries (e.g. metal industry, electrical engineering, mechanical engineering, biochemistry, building industry). Like Germany, Denmark and Spain has also adopted legislative policies that would allow minimum prices for electricity produced from renewable resources to be distributed though grid. This minimum price guarantee by law stimulated the market development and enabled these countries to become world leaders in wind power technology with an efficient industry and considerable export opportunity.

It has been mentioned earlier that conventional energy supply causes ecological damage. So the field of energy supply is the most

appropriate one for the introduction of the 'polluters pay'[42] principle. The German Renewable Energy Sources Act has been held as the most successful legislative model for the implementation of RERs. This provides for consistent and equal burden sharing of environmental costs of power generation through conventional systems among all power suppliers. Such introduction of appropriate policies for the utilisation of RETs in the three countries show that

The importance of appropriate technologies can be viewed by the example of Brazil, which failed to calculate the pitfalls and promises of renewables. Brazil installed many large hydropower projects without rigorous environmental assessments which caused deforestation and loss of bio diversity. But in the longer run the electricity generated from the dam substituted electricity for the steel industry which previously used biomass as fuel. Thus stopping many environmental hazards connected with deforestation.

Concluding Remarks

At the policy level, four measures can aid the growth of RETs in the country. Firstly, proper institutions with particular focus for the promotion of RETs are felt necessary. Presently, along with other responsibilities the Ministry for Energy and Mineral Resources is in charge of RET installation, development, promotion and dissemination. For political economic reasons the Ministry is biased towards the development of fossil fuel based energy resources. Although the NEP of 1996 proposes to establish Renewable Energy Development Agency, it is yet to be materialised. India has been termed to be the most successful country in South Asia for the promotion and utilisation of RETs. In India two separate institutions, Ministry of Non-conventional Energy sources and Indian Renewable Energy Development Agency is renewable energy is responsible for the promotion of RETs. For the development of RETs, this successful Indian model can also be replicated here.

---

42 With a view to retard the polluter from causing pollution, the polluters pay principle introduces a pricing structure at the expense of the polluters.

Secondly, with a view to reap benefits from the Clean Development Measures (CDM) of the Kyoto Protocol, the proposed renewable energy policy should be target oriented. Such targets for power generation could be 5% of the total power generation by 2010 and 10% by 2015. India, however, plans to raise to contribution of renewables in electricity production to 10% by 2012 from a present share of 3%[43]. These targets are more achievable through the establishment of greater regional cooperation for sharing of renewable energy resources. Apart from the government level cooperation should take place between industries, academics, research institutes, financing organisations and NGOs.

Thirdly, alongside institutions dealing with RETs, there should be specialised institutions dealing with particular RETs, like solar, wind etc. To reap maximum benefit from research on RETs, these institutions could be in government, NGO or private sectors. In India specialised institutions like Solar Energy Centre contributed in the R&D and installation and development of solar technology.

Fourthly, Indian experience shows that economic incentives for the promotion of RETS has brought positive results. On the part of the Bangladesh government, import duty and value added tax (VAT) from solar PV and wind turbines has been removed, subsidises research and solar PV programs of different government bodies, a sum of Tk. 6,500 is provided as subsidy for family-size biogas plants which can be used for cooking and lighting purposes through the biogas plant project. Although these measures have helped the growth of RETs, experts opine that they are not enough. Although there is the provision for tax holiday for power generation projects, it needs to be expanded for power generation from RETs. Other economic incentives might include 100% accelerated depreciation, customs and excise duty relief, facility for soft loans and liberalised foreign investment procedure.

---

43 V. Bhaktavatsalam, *Renewable Energy in New Millennium – Indian Scenario*, 2001, Renewable Energy Development Agency: New Delhi.

At present, the government is undertaking various measures to reform the energy sector. Much of the move for reform has been undertaken under pressure from the donor organisation. The current trends in reform, however, appears to be focused on subsidies and rationalising the tariff structure. Removal of subsidies on electricity pricing might result in higher price even for rural consumers. Moreover, with the policy of return over investments as evolution parameter for new installations might deprive the poorest and the underprivileged sections of the rural society from access to electricity. This policy of financial viability of new projects seems to be biased towards the rich and electricity might reach those areas which are more profitable in the short run. Financial viability of projects should be calculated on a longer term basis and should include issues like fuel cost in terms of its negative impacts, maintenance costs etc. Persuasion of these reform measures contradicts the basic tenants of electrification set in the constitution. While these policies are making governmental investment for RETs project difficult, small scale private sector investment in distributed electricity generation and supply based on renewable resources becomes brighter.