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Prospects and Constraints of Renewable Energy Sector in Bangladesh: An Analytical Exercise

Sakib B. Amin[1], Shaika L. Islam[2], Tanvina Z. Kamal[3] and Nuzhat N. Mithila[4]

Bangladesh has a mere amount of nonrenewable resources of its own. To meet the growing energy need of the country, major portion of the fossil fuel consumed has to be imported from abroad. Among the indigenous fuel resources, the country has become increasingly dependent on Natural Gas. The structure of the energy consumption over the years has got to be 'Mono-Fuel' dependent. With the looming exhaustibility of the nonrenewable energy sources and the rapidly growing energy demand, the policy-makers of the country in various policies and institutional arrangements have shifted their focus to renewable energy sources. It is expected that the renewable energy options like solar-power, wind-power, hydro-power and bio-mass will be essentially useful to increase the accessibility to energy and power for all the socio-economic sections of the country. The aim of this paper is to review the renewable energy resources being practiced in Bangladesh in terms of its implementation, research and development activities.

Field of Research: Renewable Energy

1. Introduction

Energy plays a key role for the economic development of human societies. It has a huge potential and pool of resources, in the light of increasing its productive capability. But this needs to be aptly backed up by the increasing supply of energy factors. Many economists have considered energy as an additional variable in the production function. They believe that the typical factors of production like capital and labor can't perform to their fullest potential if there's an inefficient use of energy. Moreover, energy is vital for the necessary transition to a more equitable and sustainable world and one where all have access to the energy services required for comfort and for a secure and healthy livelihood.

Bangladesh has shown significant economic performances in recent past maintaining an average of 6.01 % GDP growth rate since 2010. However, Bangladesh continues to face challenges such as infrastructure deficits and energy shortages. It is widely believed that the country's growth might even achieve a higher figure if it could mitigate the energy crisis. Analyzing the energy consumption trend of Bangladesh, it can be seen that the per capita energy use of Bangladesh is

[1] Assistant Professor, School of Business and Economics, North South University, Bangladesh, Email: sakib.amin@northsouth.edu
[2] BSS Student, School of Business and Economics, North South University, Bangladesh, Email: shaika.islam@gmail.com
[3] BSS Student, School of Business and Economics, North South University, Bangladesh, Email: tanvinazafrin25@yahoo.com
[4] BSS Student, School of Business and Economics, North South University, Bangladesh , Email: menuzhat46@gmail.com

very low, at around 205 kilograms of oil equivalent in 2009. This figure is near to the ground compared to its neighbors and counterparts like Nepal, India and Sri Lanka which have per capita energy usage at respectively 381, 615 and 477 kilograms of oil equivalent. According to US Energy Information Administration, the total energy use in Bangladesh in 2009 was only 0.20% of the world consumption. All these facts suggest that Bangladesh still couldn't reach to its required productive potential.

Both energy usage and energy production are inefficient in Bangladesh. Even though there are some reserves of commercial energy, due to outdated technology and economic constraint, it cannot get the most out of these reserves. Also, over usage of fossil fuel can impose a negative impact on the environment. Approximately 51% of Bangladesh's population particularly in the off grid areas is without any access to electricity (Bhattacharyya, 2015). Moreover, being a country which is highly dependent on natural gas, it is facing immense pressure due to energy shortage. This gap between energy demand and supply is expected to widen even more over the coming years.

In order to overcome this barrier, renewable energy should be used significantly more than the current usage level. In this regard it can be mentioned that renewable energy is that form of energy which is derived from resources that are naturally regenerative or are practically inexhaustible, such as biomass, geothermal, solar, thermal gradient, hydro, tidal and wave power and wind energy

Bangladesh is endowed with plentiful supply of renewable sources of energy. The renewable sources include solar, biomass, wind, and hydro-power. Amongst all these, solar and biomass have the most potential prospects in a country like Bangladesh. There had been significant usage of hydro-power in the past but due to flat terrain its potential had been reduced substantially for future usage. On the other hand, wind energy is only limited to coastal areas. The main benefit of renewable energy lies in the fact that it can be easily replaced by natural processes and capturing it by plants, animals and humans does not permanently deplete the resource. On the other hand fossil fuels, while theoretically renewable on a very long time scale, are exploited at such rates that may deplete these resources in near future. Renewable energy resources may be used directly such as in solar ovens, geothermal heating and water and windmills. It can also be used to create other more convenient forms of energy like electricity generation, through wind turbines or photovoltaic cells or even production of fuels such as, ethanol from biomass. Although, the initial cost of investment in renewable energy usage is quite high, however after the cost is recovered, it is seen to be more cost effective than commercial energy.

A major challenge for Bangladesh is to make a shift from mono-fuel based energy sector towards renewable energy sources. This will be possible through an appropriate and supportive government policy and investing more on renewable energy technologies. So far the government has formulated a renewable energy policy in 2008 to promote renewable energy sector aimed to generate 5% by 2015 and 10% of energy from renewable sources by 2020 (Hamid, 2013). Unfortunately, Bangladesh is still far from achieving its goals. There is only one inter-governmental agency, International Renewable Energy Agency (IRENA), which works mainly on encouraging development of renewable energy. In order to achieve the target of 10% of energy from traditional sources by 2020, more private and public investors and agencies needs to be attracted to this given sector. There is no doubt about the fact that renewable energy will take a

crucial role not only for off grid electrification in the country but also for future electricity generation as a whole.

It is obvious that energy security in Bangladesh is threatened due to number of reasons including lack of domestic energy resources, high dependence on imported transportation fuels and poor energy infrastructure, etc. Renewable energy has a lot of potential and can play a vital role in mitigating the energy crisis. However, the existing literatures do not pay much attention on the role of renewable energy to tackle energy crisis and to energy security in Bangladesh. Policymakers are also concerned about this issue and stress on the fact that renewable energy should lead Bangladesh energy sector in future. Therefore it is very essential to know the details of renewable energy sector. One important aspect of this paper is that it tried to make a link between energy security and renewable energy which will ensure energy sustainability in the future. The paper overviewed the whole renewable energy scenario in Bangladesh and its potential prospects and constraints. The paper also aims to make long-term contribution in the energy sector in Bangladesh by suggesting some policy recommendations regarding the contribution of renewable energy sector to our total energy supply. The identification of barriers in implementation of renewable energies is necessary first to suggest any policy. Hence, the paper aims to analyze the total energy scenario in Bangladesh followed by critical analysis of renewable energy sector. By incorporation of some policy recommendations for renewable sector the paper would like to make significant contribution in the energy sector of Bangladesh. To the best of our knowledge, there is no study done so far which critically analyzes the prospects and constraints of renewable energy in Bangladesh.

The rest of the paper has organized as follows. Section 2 contains the literature review where a detailed analysis or previous literature has been briefly analyzed. Section 3 discusses about the renewable energy scenario of Bangladesh. Section 4 examines the prospects and constraints of renewable energy in Bangladesh. This is followed by the main findings that have been established from this paper in section 5. Lastly we conclude the paper in section 6 in the conclusion.

2. Literature Review

Bangladesh is highly dependent on fossil fuels which are estimated to run out of stock by the end of 2020 (Sharif, 2009). The current demand for electricity is about 7% per year which exceeds the energy supply of 5000 MW (Ahmed *et al*., 2013). The energy supply is not sufficient for an over populated country like Bangladesh. Hence, Bangladesh is still struggling to secure its energy which is quite necessary to maintain a stable economic growth. The country can meet the energy demand by depending more on renewable energy rather than fossil fuels.

Bangladesh is still far behind than its expected growth of renewable energy, i.e. target 1000-1200 MW to ensure the electrification for all (Ahmed *et al*., 2013). Only 40% of the people have access to electricity (Jamaluddin, 2008). According to the paper by Bhuiyan *et al.* (2002), renewable energy is essential for economic growth, sustainable development of the country, and for socio economic development.

Renewable energy such as biomass, solar power and wind power has been used in Bangladesh since traditional times but on a very small scale (Ullah *et al*., 2012). Approximately 6% of power

and energy belongs to renewable energy and the rest 94 % from fossil fuels (Sharif, 2009). More usage of renewable energy and Renewable Energy Technologies (RET) could increase the availability of electricity leading to an improvement in the standard of living of the people (Uddin and Taplin, 2008). However, the cost of renewable energy is very expensive especially for the ones who are already in poverty.

Mondal (2010), mentions about the possible potential of solar photovoltaic and wind energy are estimated at 50174 MW and 4614 MW, respectively (Mondal, 2010),while the potential of energy from biomass and small hydro power plants is estimated to be 566 MW and 125 MW respectively. RET, especially solar PV, plays a significant role in achieving acceptable energy security. He indicates that Bangladesh could receive approximately 3000 times higher than the electricity generation in the country during 2006.

Solar pumps, mini grids and biogas plants could be promoted through introduction of village based small and medium entrepreneurs who can then invest in the technology and earn a profit by renting it to others. The government can also create village based women entrepreneurs and encourage them to promote improved cooking stoves which help to reduce household smoke levels and would also be responsible for assembling, repairing solar accessories and providing after sales service (Islam *et al*., 2011).

According to Monju and Ullah (2014), the Government of Bangladesh will need to attain an effective power generation capacity of 17000 MW to reach the very ambitious national goal of providing electricity to every citizen by 2020. They also mentions that this goal seems quite impossible since there had been an increase of only 500 MW of electricity from 2001 to 2008.

Ahmed *et al*. (2013) mentions in their study that the initial investment cost of RET, lack of infrastructure and lack of awareness are the main reasons behind why Bangladesh is still lagging behind from using renewable energy as the main contributor. The major constraints of renewable energy mentioned in their paper are economic, financial, political and technological. In order to overcome the barriers of using renewable energy, proper investment on RET is essential along with policies that favors renewable energy. This will help to reduce the country's energy crisis.

The current issues regarding renewable energy policies can be solved with the creation of a comprehensive energy strategy which would include expert and unbiased policies (Monju and Ullah, 2014). Bangladesh needs suitable measures for sustainable energy development. Detailed and accurate strategies and instruments are necessary to obtain actual benefits from the introduction of new technologies (Uddin and Taplin, 2006). However, we are still falling far behind in the scientific use of this renewable energy due to reasons such as lack of technology and expertise in this field (Ullah *et al*., 2012).

There is an absence of skilled engineers who can construct cost effective and efficient Solar Home System (SHS) models particularly for productive utilization. This system not only provides reliable, clean, and eco-friendly energy but it could also create new employment opportunities. Workers should be trained on how to handle and maintain solar equipments and also installation of photovoltaics (Islam *et al*., 2011).

Asaduzzaman *et al*. (2008) states various private agencies, such as Grameen Shakti, have more practical knowledge in providing micro-finance and in reaching at the community level than the public sector. In particular, Grameen Shakti has played an important role in the spreading of SHS in rural Bangladesh and its credit program has reached many low-income households.

It is perceived that foreign direct investment in the energy sector would help to contribute necessary resources including financial backing as well as the latest technology (Monju and Ullah, 2014). Government of Bangladesh should also try to attract foreign investment and R&D in this sector (Islam *et al*., 2011). All of these need to be done keeping long-term benefits in mind so that it can become self reliant in all the activities of the energy sector rather than relying more on imports (Monju and Ullah, 2014).

The renewable energy sector should be provided with incentives so that they get the opportunity to create a steady environment for production of renewable sources and materials (Islam *et al*., 2011). The diversified, abundant, vast number of prospective locations and widespread availability of the renewable energy sources are good enough reasons why they deserve efforts for research and development work. Hence, it is the responsibility of all the countries including Bangladesh, to contribute to a comprehensive research and development of renewable energy Sources, as the new technologies and results will benefit everyone (Rasel *et al*., 2012). Achieving these promising objectives will require long term visions, strong policy that encourages renewable energy usage and the recognition that the higher near-term investment costs will be paid back in the long run with significantly lower costs for imported fuels, cleaner air and reasonable energy security for Bangladesh.

3. Renewable Energy Scenario in Bangladesh

With the growth rate in GDP nearing to 7% in 2015, Bangladesh is one of the fastest developing economies in the world. Keeping pace with the global trend, Bangladesh has also attached its due importance to the development of renewable energy. Focus has been put on the development and usage of renewable energy by the government to mainly serve the purposes of reducing poverty, aiding in energy shortage by diversification of energy sources and to ameliorate the condition of environmental degradation. To this end, effective utilization of renewable energy resources has been adopted as a policy of the Government of Bangladesh. National plans like the Five Year Plan, Power System Master Plan and policy documents including National Energy Policy 1995, Industrial Policy 2010 have underscored the growing importance of renewable energy in Bangladesh economy. Presently renewable energy options have also been included in the Bangladesh National Building Code. A dedicated policy, Renewable Energy Policy of Bangladesh has been in force since 2009, which envisions having 5% power from renewable energy sources by 2015 and 10% by 2020. Different government, semi-government and nongovernment organizations have been working separately or jointly to disseminate RET throughout the country over a significant period. All these endeavors manifest Bangladesh's commitment towards the development of renewable energy. Presently, the different categories of renewable energy which have been used in Bangladesh, in somewhat of extensive or limited form are:

a. Solar Energy
b. Biomass

c. Hydropower
d. Wind Energy.

Bangladesh is mainly dependent on solar energy and biomass. Table 1 represents the renewable energy consumption that took place on 2014.

Table 1: The implemented Renewable Energy in Bangladesh

Sl. no	Category	Achievement(2014)
1	Solar Home System (3.3 million)	150MW
2	Solar System at roof top of Govt./non govt. building	03MW
3	Solar System at Commercial building and shopping mall	01MW
4	Solar PV for new connection at roof top of buildings	11MW
5	Solar Irrigation (193)	01MW
6	Wind based power generation	02MW
7	Bio-mass based power generation	01MW
8	Bio-gas based power generation	05MW
9	Hydro Power	230MW
Total		404 MW

Source: Power Division, 2014

a. Solar Energy

Solar energy has great prospects especially in a country like Bangladesh. This is mainly because of its geographical location which is situated between 20.30 to 26.38 degrees north latitude and 88.04 to 92.44 degrees east (Biswas et al., 2011). This is considered a very ideal location for supply of solar energy. Bangladesh receives a daily solar radiation intake of about 4 to 6.5 kWh/m^2 (Muzzammir, 2014).

The transformation in the renewable energy sector can be clearly visible especially in the rural parts of Bangladesh. These off grid areas are gradually shifting from kerosene based devices towards higher solar panel usage. Over the past few years, both Government of Bangladesh and some private companies have successfully achieved to bring electricity to over 65,000 homes every month through the direct use of solar panels (Roy, 2015). Other than rural areas, solar panels have expanded their horizon at a very small scale in some parts of Dhaka city and five other major cities of Bangladesh to power electricity lights.

Cost-Benefit Analysis of Solar Energy

Solar power is an alternative clean energy solution with potential economic benefits. It not only reduces energy dependence on fossil-fuels but also ensures energy sustainability. The cost-benefit analysis of solar power can be an effective analyzing tool to determine its potentiality against non-renewable sources. Approximately, 1.4 million solar home systems have been installed in Bangladesh by the end of January 2013. In most of the rural areas of Bangladesh, 40 to 85 WP (Watt-power) systems are mostly used. The cost of a 40 WP system is around 24,000 BDT, whereas 85 WP system costs about 45,000 BDT. It has also been found that solar panel contributes to only 28%, of the total cost whereas battery accounts for 30%.

The payback period and net present value are the two determining variables to analyze the long term benefits of solar power in Bangladesh. Generally, payback period means that the number of years required to recover the cost of the investment. The average payback period for an average 40 WP and 85 WP solar system is 4.2 years and varies between 3.1 and 6.5 years. On the other hand, Net Present Values (NPV) determines the profitability of a projected investment by calculating the present value of an investment by the discounted sum of all cash flows received from the project. The net present value of this system varies between 34,500 BDT to 14800 BDT (Hoque and Das, 2013).
So from the cost-benefit analysis of the respective solar system, it can be concluded that solar power will be a potential long term solution to mitigate energy crisis in Bangladesh.

b. Biomass

In Bangladesh, the most promising renewable energy is biomass, which can be found in fuel woods, agricultural residues, municipal wastes and animal dungs. Most rural households in Bangladesh use biomass fuels. However, there is a limitation of supply from biomass sources due to scarcity of land.

Biomass energy does not emit much harmful gases compared to most non-renewable energy sources. It emits two gases which are carbon dioxide and ethanol. The carbon-dioxide released by biomass energy is captured back for its own use whereas fossil fuels release it in the environment causing harm to it. This source of renewable energy is abundant in our country. It is a versatile form of renewable energy as different types of organic matter can produce various products.

c. Hydropower

Hydropower is an environment friendly energy source. However, Bangladesh has limited possibility of hydropower due to its terrain being flat with exception of few regions. Primary rivers of the country have a high rate of water flow for 5 to 6 months during the monsoon season, which is considerably reduced in winter season (Ahmed et al., 2012). Hydropower plants can be divided into two categories: large hydropower plants and small hydropower plants.

In Bangladesh, micro-hydro and mini-hydro have some constraints with the exception of Chittagong and the Chittagong hill tracts. Hydropower assessments have determined some available sites but installments of any type are yet to be done. The Karnafuly Hydro Power

Station is located at Kaptai and it is the only hydropower plant in the country, operated by BPDB (Bangladesh Power Development Board), with a capacity of 230 MW by 5 units. Two sites have been identified for two more Hydro power plants at the Sangu and Matamuhuri rivers know as the Sangu project (140MW) and the Matamuhuri Project (75MW) (Rasel *et al*., 2012).

d. Wind Power

Bangladesh has a coastal line of 724 km along the Bay of Bengal (Rasel *et al*., 2012). Due to large coastal belt along with wind speed in some regions, the potential of wind power is enormous in Bangladesh (Baten *et al*., 2009) However, due to limited land availability, small wind turbines would be the most reasonable option for Bangladesh. This small wind turbines (SWTs) can be transported and installed with minimal land and infrastructure requirement. The cost generated from SWT is comparatively lower than the cost of solar photovoltaic electricity. On the other hand, large utility scale turbines may be implemented in coastal and higher altitude areas. The maximum amount of power is produced by the Kaptai Hydro-electric power station which is very close to the coastal area (Rasel *et al*., 2012).

4. Prospects and Constraints of Renewable Energy in Bangladesh

As discussed in section 1, this paper aims to introduce some policy recommendations regarding the utilization of renewable energy in Bangladesh for the future energy security. The importance of country specific case studies in energy literature is well established. Case studies are an important tool for research as it often tends to critically examine situations that may not be a part of other empirical research methods. In this paper the problems of renewable energy have been focused upon specifically. This kind of analytical exercise can provide a very detailed information about a particular subject which otherwise would not be possible to acquire through a different type of experimentation. In this case if the problems regarding different aspects of renewable energy in Bangladesh can be identified, it would be helpful for future references and can also be used to propose efficient policies. The potential benefits (which may include economic, socio-economic or environmental benefits of renewable energy) need to be discovered so that it can be utilized to compare the costs and benefits. This would further assist the policymakers to estimate the net social gains from using the renewable energy. Since case study research brings reader to a better and deeper understanding of an existing issue which is already somewhat known through previous studies, the concept of hypothesis testing is irrelevant here.

The prospect of renewable energy is huge for a country like Bangladesh. This is mainly due to its geographical location. The energy from the sun reaching the country can be used for electricity production by the use of PV technology. The best part of using PV technology is that no additional resources are required. Low maintenance is needed for this technology. Energy generation using renewable energy offers a promising solution to environmental problems by reducing the emission of common greenhouse gases. This is very important since greenhouse gases can contribute to climate change which is a major problem for all the countries all over the world. Although investment costs of renewables are generally higher compared to fossil fuel, this option becomes economically feasible when all externalities, e.g. environmental cost, health hazards, etc. and lower operating costs are taken into account (Khan et al., 2004).

Despite its huge prospects, Bangladesh faces some challenges in the renewable energy sector. These major constraints of renewable energy sector may be the reason due to which it cannot be properly exploited in Bangladesh. One of the major issues is the cost associated with the implementation of RETs. These high costs of investment in renewable energy sector are associated with the increasing cost of import of various necessary equipments as Bangladesh has no capacity to develop new solar energy equipment based on its own production. Due to high cost, the RET price remains high for the poorer community in Bangladesh, which is unaffordable for most of them.

Another major issue is the lack of information about renewable energy and problems related to accessing past data from reliable and reputable sources. This is a very important requirement for research and development work of renewable energy technology. There is also the problem of limited knowledge regarding costs and benefits of the different categories of technologies available for contributing to renewable based energy services. Lack of awareness, technology and knowledge about renewable energy is also one of the major issues. People living at the rural areas are the ones who mainly go through such problems.

Lack of systematic monitoring and evaluation along with inadequate experience obstructs the creation of policies to back up the renewable sector development in this country. Owners are not properly trained in management of RETs. Hence, there is a need of proper training in this sector. A greater number of people should be taught to maintain and control the RETs suitably with the aid of extended training programs.

Availability for renewable energy resources are extremely site specific. It depends upon a detailed analysis of conditions which are specifically matched with regional requirements, both in terms of solar irradiation and wind speed as well as cultural characteristics and specific demand. Some renewable energy sources are dependent on climate changes. For example: Hydropower is only suitable for sites with large volumes of flowing water. Decreased rainfall, due to climate change, would reduce the electricity available in Bangladesh.

Investment allocated to this sector is too meager to have any impact. Weak regulatory incentives have been unsuccessful in encouraging private sector investments in renewable energy. Till now, most of the wind energy programs and projects have been sponsored by the government and/or foreign donors. Fiscal incentive policies are needed to encourage and support the private sectors for investment purposes in Bangladesh.

5. Main Findings

Growth of the renewable energy sector in Bangladesh needs to be generated rapidly due to the present insufficient energy supply in the country. In Bangladesh, the number of solar-powered homes is expanding. This may help to secure energy and solve the existing energy crisis. Now many households have electricity due to SHS. The number of SHS is expected to increase even more in the near future.

Our studies reveal that Bangladesh can be very prospective for generating solar energy in the near future for its geographical location. Higher usage of solar energy is not only sustainable and

convenient way to power household, it is renewable and this means that we will never run out of it. It is about as natural a source of power as it is possible to generate electricity. It supplies high quality, clean and environment friendly energy services (Bhattacharya *et al*., 2002). It produces zero emissions and helps to keep the global warming under control. The main advantage of using solar photovoltaic (PV) is that each unit price of solar PV is decreasing over the years and hence a developing country like Bangladesh is slowly gaining economies of scale and becoming more cost effective. It provides a huge positive externality on the lives of the rural people in Bangladesh by providing them with numerous direct and indirect socio-economic benefits.

Even though biomass was being used significantly more in the past, however, due to high carbon emissions it is being used less nowadays. This is because carbon emissions create pollution which degrades the environment. Hydropower, on the other hand, has limited possibilities due to flat terrains in Bangladesh. Wind power has more potential compared to hydropower but this energy source cannot be fully taken advantage of due to limited land space. Also it can only be implemented in coastal areas which are a major limitation.

Therefore, from our analytical study it can be deduced that SHS has huge prospects in a country like Bangladesh out of all the renewable energy. We comprehend from the literature that Bangladesh can be very prospective for generating solar energy in the near future for its geographical location. Higher usage of solar energy is not only sustainable and convenient way to power household, it is renewable and this means that we will never run out of it. It is about as natural a source of power as it is possible to generate electricity. It supplies high quality, clean and environment friendly energy services. It produces zero emissions and helps to keep the global warming under control. The main advantage of using solar photovoltaic (PV) is that each unit price of solar PV is decreasing over the years and hence a developing country like Bangladesh is slowly gaining economies of scale and becoming more cost effective. It provides a huge positive externality on the lives of the rural people in Bangladesh by providing them with numerous direct and indirect socio-economic benefits.

If the potential barriers of using solar energy can be tackled efficiently then policies can be implemented properly. This paper provides knowledge to the policy makers by critically examining the details of available renewable energy in Bangladesh. It suggests that if solar energy is properly utilized then it is the most efficient choice for this country and hence should be the energy used more widely for a brighter future.

6. Conclusion

Energy crisis and possible alternative energy sources are considered two really big issues for Bangladesh. There is a high potential of renewable energy contributing to the society by providing a security for energy. Shifting to renewable energy sources will not only increase the supply of energy, it will also cause less harm to the environment. Therefore, the government of Bangladesh must take sufficient level of initiatives to make this sector sustainable and prosperous for the creation of higher economic growth.

Renewable energy is one of the most sustainable solutions to avoid the power crisis. Bangladesh has already started the journey to invest in renewable energy sector development. It is a difficult and time consuming task for Bangladesh to make the transformation and switch from non-

renewable to renewable sources. The change will take place gradually. However, barriers will always be present in order to bring a positive change to the country. Adequate methods can only be applicable if we determine the constraints first and prepare our plan accordingly. It is quite obvious that RETs present great possibilities for contributing to a sustainable energy mix in Bangladesh.

Both energy usage and energy production are inefficient in Bangladesh. Even though there are some reserves of commercial energy but due to outdated technology and economic constraint, it cannot get the most out of these reserves. Also, over usage of fossil fuel can impose a negative impact on the environment. In order to overcome this barrier, renewable energy should be used significantly more than the current usage level.

Bangladesh is endowed with plentiful supply of renewable sources of energy. The renewable sources include solar, biomass, wind, and hydro-power. Amongst all these, solar has the most prospects in a country like Bangladesh. There had been significant usage of hydro-power in the past but due to flat terrain its potential had been reduced substantially for future usage. On the other hand, wind energy is only limited to coastal areas.

Solar energy resources are quite high in Bangladesh. Hence, higher usage of solar energy in the national energy context will develop the sustainability and socio-economic development of the country. We can conclude by saying that Bangladesh already has some experience with RET projects which have a high potential. These projects needs to be extensively carried out with the help of research and development and usage of proper equipments so that the benefits can be reaped, particularly by those in need, in a developing country like Bangladesh.

One of the main limitations of this paper is the lack of sound empirical underpinning to establish the importance of renewable energy in Bangladesh economy due to data constraints. Further research could be done to test the causality between renewable energy at disaggregate level and energy consumption in Bangladesh economy. Another direction for future research is to review the Renewable energy Technologies (RETs) being practiced in Bangladesh in terms of its implementation, research and development activities.

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