

The Pros and Cons of Selective Renewable Energy Technologies for Generating Electricity in the Perspective of Bangladesh: A Survey-Based Profiling of Issues

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ABSTRACT

Energy consumption is the indicator of the development of a country. An adequate power supply is a prerequisite of sustainable development, where Bangladesh has been struggling. This study focuses on the technological barriers of renewable energy implementation in Bangladesh, which has salient renewable energy sources: biomass, solar power, solar photovoltaic (PV) cells, wind energy, and hydroelectricity. Despite having rich renewable energy resources, the country still depends on its gas and oil reserve for power generation. The geographic significance of installing new sustainable technologies like wind power and biomass power plants has been studied in this research. Besides, to profile the socio-economic barriers provoking behind the insurance of renewable energy sources for the mass population, a comprehensive survey was conducted with 200 individuals, including 50 experts on renewable energy research. Quantitative analysis of issues like the monthly electricity bill, types of power sources used up, public satisfaction, and consciousness, along with their concepts regarding sustainable technology fabrication to synthesize renewable energy, were conducted. Finally, all qualitative and quantitative outputs were statistically analyzed to figure out the actual status of renewable energy usage in Bangladesh's perspective simultaneously, which is vital for us to ensure new renewable energy sources to achieve environmental sustainability for the future.

Keywords: Electricity, renewable energy, solar-wind biomass-hydro energy, sustainable technologies.

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I. INTRODUCTION

Bangladesh is a natural resource country, though it has been suffering from an energy crisis for a couple of years as its dependence on fossil fuels [1], [2]. Only renewable energy can ensure a better electricity supply for all if implemented and the existing energy sources. To meet up the continuous energy maintaining all energy securities, sources like-biomass, solar power, solar photovoltaic (PV) cells, wind energy, and hydroelectricity can be the viable options [3].

Like the extent of energy consumption. Modern energy demands are still mainly occupied by fossil fuels like coal, oil, and customary gas [4]. The most critical problem is that, the measurement of development in any society today is over the subsequent 20 years, the anticipated energy consumption

would require installing an equivalent power generation capacity installed across the 20th century. That interprets the shocking number of 1,000 megawatts (MW) energy plants established every 3.5 days within the subsequent 20 years [5]. A stable energy supply is a prerequisite for economic growth. Biomass energy and wind energy can reduce the dependence on fossil fuels and create new job opportunities [6]. Bangladesh needs a long-term economic growth model due to its high population density, where appropriate renewable energy sources are formed. Cost-effectiveness, technical issues, and market barriers got to be solved to extend the utilization of renewable energy [7]. Current renewable energy resource awareness is sparse and difficult to get due to a central knowledge point [8].

There are still significant obstacles within the way of large-

scale solar PV project growth in Bangladesh, including shortage of suitable land, environmental issues, an underdeveloped local equipment market, the drought of well-established technological laws and requirements; a scarcity of a supportive policy atmosphere and incentives; a scarcity of adequate integrated project knowledge and skills; and a scarcity of a solid financial and financial infrastructure [9]. Inadequate access to institutional finance, low demand, relatively high prices, and lack of skilled labor are the most common barriers to renewable energy in developing countries [10].

In Bangladesh, the prevailing alternative technologies face obstacles like enormous initial costs, weather influence, unawareness, a scarcity of existing high-volume supplier-dealer chains, high component prices, and insufficient funding [11]. Developing nations, where huge populations still lack access to energy, can hold enormous potential for expanding renewable energy sources. The barriers can vary from country to government. However, regardless of the obstacles, they should be identified, recognized, and conquered [12]. Like ours' the neighboring government is now focusing on renewable energy to meet the electricity demand of the country along with environmental protection [13].

Sustainable social and economic development depends on the adequate power generation capacity of a country. As a developing and emerging country, Bangladesh is now on the verge of providing 100% electricity to its population by the top of this year. Bangladesh Power Development Board (BPDB) has stated on its official website that the country's actual power generation was 9540 MW on March 2nd, 2021. At present, Bangladesh has the capacity of manufacturing 20929 MW of electricity [14]. However, the alarming thing is that nearly 92.94% of this power comes from fuel (gas-50.12%, heavy fuel oil-28.61%, high-speed diesel-6.14%, and coal-8.07%). In contrast, 1.52% of the total energy is generated from renewable sources (Hydro-1.1% and Solar-0.42%). It is evident from the given statistics that, power sector of Bangladesh is not sustainable in the least. It heavily depends on its gas and oil reserve for power generation. There will be a time when the country's gas and oil resources will run out. Thus, it is high time Bangladesh should specialize in the renewable energy sector more and more from now on. However, the geographic location of Bangladesh has made it challenging to supply much electricity from wind generation. Still, there are other potentials like solar power, biomass energy, and so on.

The current research aims to figure out the challenges toward implementing renewable and sustainable energy sources in Bangladesh and how renewable energy will be feasible to impact the country's socio-economic growth and development. In addition, GIS-based approaches have been emphasized in surveillance of assessing the present renewable energy hotspots and site-planning for new renewable energy power plant construction for mitigating future energy demands [15].

II. MATERIALS AND METHODS

A. Survey on Expert's Opinion

A factual survey comprising 200 individuals, including 50 renewable energy experts, was conducted to profile the diverse socio-economic impact of sustainable energy on their personal and professional surfaces. Their analysis disclosed the challenges in establishing renewable energy in Bangladesh. Numerous suggestions have come out of their opinion to unify probable approaches of problem shooting in new renewable energy plant installation.

B. Survey Parameters

The data collected from the survey portray the image of elementary thinking of the general people from various professions such as teachers from the different universities, students from the different colleges and universities, an employee from the different job sectors, and others group of people that know renewable energy along with the experts of sustainable technologies directly involved in renewable energy projects. The purposive sampling method was used in selecting the participants of this survey. The survey questionnaire was designed by reviewing the relevant works of literature on renewable energy in developing countries. The parameters were- monthly electricity billing, types of energy source used by the invitees, their basic ideas about sustainable and renewable energy, the importance of government policies and partnership with the private and NGOs', potential impact on socio-economic development, significance in quality life, necessary expertise in these fields, technical issues, local and exotic subsidiaries, public satisfaction, economic feasibility, and environmental conservation. Thus, the parameters helped us possess relevant ideas about the current scenario of renewable energy technologies in Bangladesh.

C. Statistical Assessment

The statistical analysis and graphical introduction of the analyzed information were created to use 'R programming' (Version R-4.0.2 for Linux) [16-19] and 'GraphPad Prism' (Version 8.2, for Mac OS) [20-23].

D. Geographic Information system (GIS)

Understanding and studying the geographic annotations and significances 'ArcGIS' (Version 10.3) was preferred for illustrating geological information [24]. The prevailing and future project areas of installing sustainable and renewable technologies in Bangladesh are portrayed side-by-side comparing to each other. The hot spot areas of present and upcoming renewable technology projects are depicted simultaneously in real-time.

III. RESULTS

The reaction of the individuals on the status of renewable energy and sustainable technologies within the perspectives of Bangladesh supported selective factors like the transparency of ideas about renewable energy is illustrated in (Fig. 1A). Most of the feedback on clarity was received from the age range of 21-30. For the transparency level of the thought of renewable energy, the figure demonstrated that 13.43% of individuals have a highly transparent idea on

renewable energy, 62.68% people have a clear notion on renewable energy, 15.42% people have a nuanced partial picture, and 3.98% have non-transparent or less considered renewable energy and sustainable energy in Bangladesh. Also, another noticeable thing is that the people from the age ranged between 21-30 have superior knowledge during this sector (Fig. 1A). Within the current research, the rate of using sustainable energy is 15.42%, and unsustainable energy is 48.25%. Also, 13.93% of individuals among those 201 people use both energy sources, and 19.90% do not use them. Another mentionable fact is that the response for using sustainable energy aged 11-20 and 40+ people is zero. Most answers for using sustainable energy are from people aged between 21-30 years (Fig. 1B).

The range of monthly billing for energy used domestically for all age mentioned above groups. Here we will see that the speed of getting energy expenses for quite 1000 BDT is that the highest. Almost 56.71% of individuals pay quite 1000BDT for his or her regular energy expenses. Again, 21.89% of individuals usually pay between 701 to 1000BDT; 12.43% people pay 301-700BDT. On the other hand, only 2% of people pay 100-800BDT for their energy expenditure because of the lowest individuals among all the groups (Fig. 1C). The exemplification of the sort of productive energy sources that folk's use the foremost was analyzed (Fig. 1D). The categories for this analysis are biogas, solar, wind, and biomass energy. It represents that solar power is more famous than other energy forms in Bangladesh as 62.68% use solar power. Then, biogas is relatively more prominent than wind and nuclear energy. Almost 20% of individuals use biogas, and 4.47% use wind energy, and 2.48% use nuclear energy as their energy source

(Fig. 1D). It has portrayed that the complications in sustainable technology installation for energy sectors which include improper planning, lacking sufficient technology, lack of consciousness, and insufficient expertise, were mentioned there. Among 201 people, 58.20% of individuals think the obstacles we face are for improper planning, 17.91% of individuals think it is for the scarcity of the latest technology, and 14.42% think it is for our unconsciousness, 6.46% think it is for insufficient expertise. This reflects that most people think the major drawback for the issue lacks proper planning in this matter (Fig. 1E). In the current research, around 34.82% of people believe that using renewable energy can fulfill the entire energy demand, 25.37% of people think it can bring environmental stability/sustainability. Whereas 17.91% think renewable energy can reduce inequality in society, the other 16.41% believe that using renewable energy can revolutionize the work industry (Fig. 1F). The present study indicates that the intended impacts of the political influences within the renewable energy sector. Furthermore, 45.77% asserted that establishing new policies regarding the utilization of renewable energy can bring an exciting outcome to the renewable energy sector. According to around 30% of individuals, social media can play a significant role in creating the renewable energy technological revolution. Also, the opposite 30% think private investment would be the better way to make such a significant impact. On the opposite hand, almost 9% of individuals asserted that the filling of subsidiary lacking would be a far better choice to cause the renewable technological revolution (Fig. 1G).

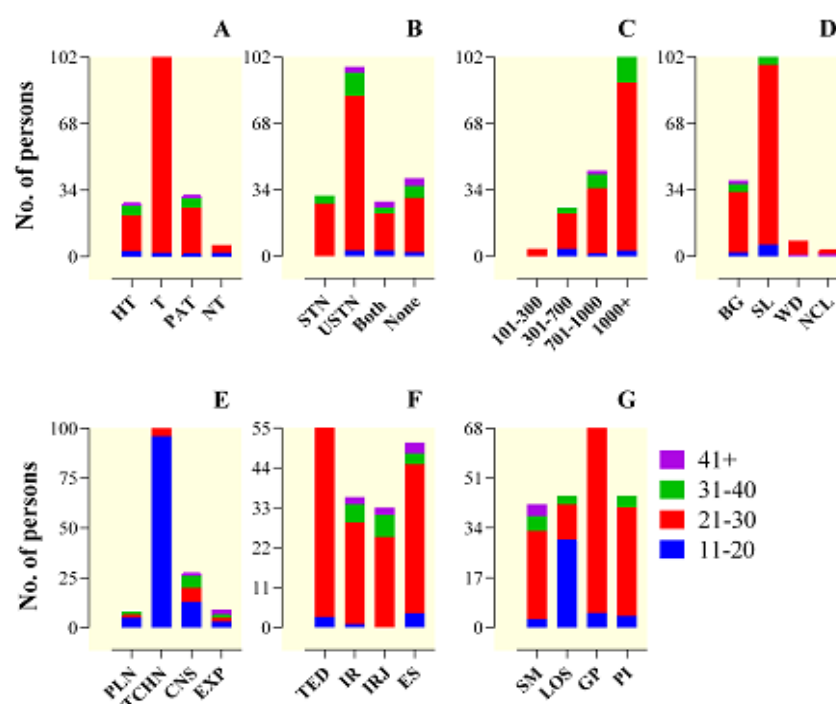


Fig. 1. The illustration represents the reaction of the individuals on the status of renewable energy and sustainable technologies in the perspectives of Bangladesh based on selective factors such as transparency of idea about renewable energy (A); individuals' energy sources at home and working space (B); range of monthly billing for energy used domestically (C); type of efficacious energy sources (D); the complications in sustainable technology installation for energy sectors (E); the intended impacts of renewable energy in society (F) and the various influences in the renewable energy sector (G).

Legends: HT (Highly Transparent), T (Transparent), PAT (Partially Transparent), NT (Not Transparent); STN (Sustainable), USTN (Unsustainable); BG (Biogas), SL (Solar Energy), WD (Wind Energy), NCL (Nuclear Energy); PLN (Planning), TCHN (Technology), CNS (Consciousness), EXP (Expertise); TED (Technological Developments), IR (Increased Renewability), IRJ (Increased Jobs), ES (Environmental Stability); SM (Social Media), LOS (Lack of Skills), GP (Govt. Policy), PI (Private Investment).

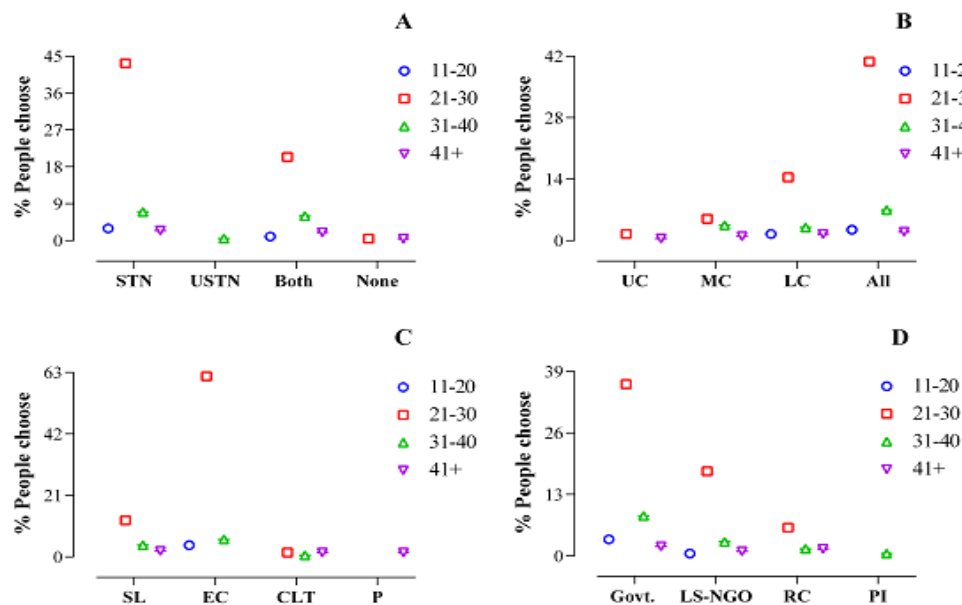


Fig. 2. The graphical representation portrays the individuals' suggestions to the government and policy makers in establishing diversified energy sources and technologies (A); the intended classes of people to be benefitted through renewable energy in future (B); the sectors going to be stimulated through sustainable technologies (C) and consent about whom to take the responsibility of developing renewable sources in the near future taking all necessary initiatives in consideration (D).

Legends: STN (Sustainable), USTN (Unsustainable); UC (Upper Class), MC (Middle Class), LC (Lower Class); SL (Social), EC (Economic), CLT (Cultural), P (Political); RC (Rural Cooperatives), PI (Personal Investment)

People of all ages who participated in the survey-based research were cheerful and optimistic in setting up sustainable technologies for generating next-generation renewable energy. The response of the B categories was significant (43.28%). Only 0.49% think to be benefitted from conventional sources, which proves the intention of the people to maneuver towards renewable energy within the coming years (Fig. 2A). Similarly, all groups selected sustainable and unsustainable sources simultaneously, but the (%) responses were far inferior to the sustainability acceptors. Most surprisingly, no participants suggested biomass together with renewable energy sources (Fig. 2A). The respondents were very optimistic regarding the advantages of renewable energy, where 40.79 conditional reflexes of category B opined that each class would receive the benefits of renewable energy in the future.

On the contrary, only 0.49 % of participants within the D category were rich people. According to Category C, the middle and lower classes will benefit from 3.48 % and 3.98 %, respectively (Fig. 2B). The general economic improvement due to the establishment of renewable energy was highly anticipated by the respondents of category B (61.69 %). The remainder of the categories were at 3.98% social and 1.49% cultural, as opined by 31 to 40 and over 40 years old. Surprisingly, 11 to 20-year-olds were uninformed of the political impact of renewable energy (Fig. 2C). The government plays a significant leading role within the expansion of renewable energy, which is 36.31%.

Additionally, age category B also thinks (Local and Foreign non-governmental organization) plays a vital role in expanding renewable energy by 17.91%. On the opposite hand, rural cooperatives play a 1.49% role in the development. It was studied by the age groups 31-40 years old. Age groups 11-20 and 40 upwards were not conscious of (Personalized/private investment) role to expand renewable energy (Fig. 2D).

In this current research, the geographic information system reveals that the central region of Bangladesh, especially the capital Dhaka and therefore the surroundings, is holding the major project of sustainable technology. In contrast, the North Bengal region is that the second most.

In contrast, the southwestern part of Bangladesh is undertaking no project in the least (Fig. 3A). Surprisingly, the government is getting to decentralize the projects emphasizing the southern and northern areas of Bangladesh. More interestingly, the North-western region will be more negligible than the other locations within the coming decades, consistent with the national policy and planning (Fig. 3B). The wind power projects will mainly dominate the southern and southeastern regions of Bangladesh. The sole biomass plant is functioning in the northernmost area, but within the future, no similar projects are going to be conducted on biomass energy (Fig. 3A).

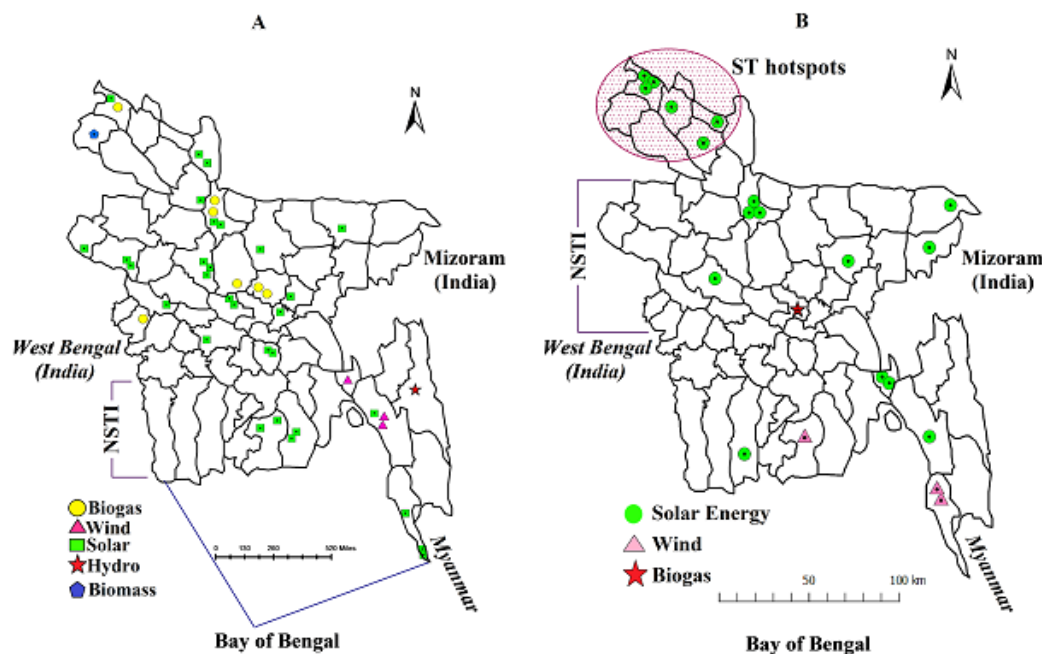


Fig. 3. Illustration of the present (A) and upcoming projects (B) of installing new power plants based on sustainable technologies for producing renewable energy, depending on the planning of the Government of Bangladesh [48].

Legends: The hotspot areas selected for the next renewable power plant setup are mentioned inside the circle (B), whereas the present and future of the deprived locations from renewable energy uses are referred as the rectangular boxes in A and B respectively.

IV. DISCUSSION

In recent times, civilized people worldwide have faced severe physical, environmental, and economic unrest in using conventionally prepared fossil fuels due to having no promising other ways of generating power for familial, automobile, and industrial uses [25]. Researchers are working restlessly to figure out diversified, sustainable technologies to synthesize renewable energy because of the innovations of the net level [26]. Peoples' choices and government policies are directly involved in many cases for initiating sustainable technology projects for the power and energy sectors, especially for the countries like Bangladesh [27]. In this current study, the researchers tried to isolate and analyze general concepts and their suggestions about the complications of putting in sustainable technologies in Bangladesh and their socio-economic, geopolitical, and environmental impacts through a comprehensive survey comprising more than 200 experts on the belonging fields. It has been found that 76.11% contain transparent ideas about the advantages and challenges of renewable energy and sustainable technology, where 13.43% of individuals were highly notifiable (Fig. 1A). Public awareness plays a crucial role in inspiring govt. Moreover, private groups and organizations put in new technologies and innovations [28]. In the present study, the rate of using traditional energy is found higher at 48.25%, and 15.42% of people use sustainable energy (Fig. 1B). Renewable energy had become an issue of grievous priority in developing countries [29]. Bangladesh has limited affordability of renewable energy alongside economic, political, and financial constraints [30]. This study demonstrated that 56.71% of individuals pay quite 1000BDT electricity bill and only 2% people pay 100-800BDT for his or her energy expenditure because of the lowest individuals among all the groups (Fig. 1C). The

electricity cost is higher within the remote areas due to the high fuel cost and extra transportation cost [31]. Among the various renewable energy sources, it has been found that 62.68% of individuals use solar power. Therefore, the remainder of the people uses biogas, wind energy, and nuclear energy. Only 2.48% use nuclear energy as their energy source (Fig. 1D). Solar power is the most explored renewable energy option in Bangladesh as Bangladesh features a supportive average solar radiation rate [32]. Improper training, scarcity of technology, lack of awareness, insufficient expertise are the identified barriers by the participants in the deployment of renewable energy - 58.20%, 17.91%, 14.42%, 6.46%, respectively (Fig. 1E). Lack of institutional platform and technical knowledge among stakeholders, low level of technology transfer, lack of involvement of the financial sector because of the critical challenges of implementing renewable energy in Bangladesh [33]. On the contrary, technical and institutional barriers are still impeding the implementation of renewable energy in Bangladesh [34]. This study has found that folks are highly optimistic (34.82%) about using renewable energy to fulfill Bangladesh's energy demand. Additionally, the participants addressed environmental stability, reduced gender inequality. They established more job opportunities because of the establishment of sustainable energy (Fig. 1F).

Socio-economic issues, environmental issues, energy security issues like jobs, income level, poverty, and access to agricultural production are directly linked to renewable energy development [35]. This study demonstrated that about 45.77% of people hope to achieve significant outcomes by establishing renewable energy-related policies. The rest are believed that social media, private investment, and filling up subsidiary lacking are essential (Fig. 1G). The existing policies that facilitate centralized energy production must be modified to develop renewable energy sectors [36]. Again,

introducing new technologies at different levels can increase the spread of renewable energy in developing countries [37]. It is being discovered that individuals of all ages are exceptionally positive and hopeful in setting up sustainable technologies for producing next-generation renewable energy; the response is notable at 43.28 %. As it stands, only 0.49% of people believe they need to benefit from nonrenewable sources. That illustrates the public's desire to transition to renewable power within the near future (Fig. 2A). The government and several non-governmental organizations (NGOs) have sought to analyze and address the energy problem. In terms of application, research and development, this study examined the renewable energy resources and renewable energy technologies (RETs) used in Bangladesh. Donor agencies have financed mainly implementing and testing systems in partnership with the government and NGOs [38]. People are getting concerned about the importance of using renewable sources of energy [39]. It is found that 40.79% of age groups found that all classes will benefit from the proper utilization of renewable energy (Fig. 2B). Sustainable energy practices are a powerful source of autogenic bliss since they help nature, the environment, and others' well-being, including future generations [40]. On the power showcase, little control buyers bear an expansive share of the arrangement costs. In contrast, others might indeed benefit from renewable vitality advances utilize [41]. Most mature 21 to 30 years old in Bangladesh believe that the utilization and improvement of renewable energy have the most significant impact on the overall scenario of the country's economy at 61.69% (Fig. 2C). Increasing monetary efficiency and GDP (Gross Domestic Product) through more straightforward generation forms [42]. Besides mitigating the negative consequences of global climate change, the utilization of renewable energy would also offer direct or indirect economic benefits [43].

This has been found that 36.31 % contain transparency about the government plays a crucial role in developing renewable energy. Instead, 17.91% of individuals think (Local and outside nongovernmental organization) plays an imperative role in the progression of renewable vitality (Fig. 2D). Bangladesh has adopted a more commercial approach than other countries where the number of systems deployed is significantly higher. However, the government and donors highly support the programs [44]. On the contrary, the environmental NGOs could play a task as vetoers of renewable energy because it may cause some negative ecological consequences, including noise, visual intrusion [45].

GIS innovation has uncovered numerous fundamental parameters specifying their parts from multi-faceted perspectives. The ArcGIS (Adaptation 10.3) depicts the absolute highlights of renewable energy in Bangladesh [46]. The present and future of renewable energy sources throughout the country have been mentioned in the GIS and the locations of interests for initiating new technologies for renewable energy by the Govt. It is pretty transparent that the central and north-western parts of Bangladesh possess significant renewable energy sources. In contrast, the southwestern part is seriously deprived of opportunities (Fig. 3A). The southern part has only one-sixth of the renewable

energy sources of the country.

In contrast, around 52.3 million people live, around one-fourth of the country's total population, which is a matter of great regret [47]. There is no wind power plant where a huge coastline is present in the Khulna and Barisal divisions. Barisal mainly contains only solar power plants like Rajshahi and Sylhet divisions. Despite hilly areas, Sylhet has not been selected under wind power projects, emerging controversy among the critics [48-49]. Hydropower energy for the mass population has been implemented only in the Rangamati district (Fig. 3A). Sylhet division is a potential spot for installing hydropower plants for huge hilly areas with fountains and hilly rivers but no concentration.

Furthermore, private organizations have experienced. The sole biomass-based power plant is functional in the north most area of the Rangpur division (Fig. 3A). Unfortunately, there will be no biomass-based energy as mentioned in the govt. Plan about renewable sources of energy. The economic feasibility and environmental significance of biomass in the perspectives of Bangladesh are fundamental. However, still, it has been considered minor [50], according to the govt. Plans for the subsequent decades, the northwest and central area of Bangladesh will get the minor concern for having new typical renewable projects. In contrast, most north and southeast areas will be the hotspots of new sustainable power plant installation to ensure renewable energy (Fig. 3B). The sole solar power plant will be established in the south most district Bagerhat in a few years to contribute to the national power grid. It is essential to mention that the Cox Bazar district will be the wind power hub within a decade (Fig. 3B). Considering all types of power plant set up, the southwestern districts have been on the ever-neglected sites, especially from Kushtia to Sathkhira district, including Khulna and Jashore (Fig. 3B).

V. CONCLUSION

Energy has been an essential demand for sustaining and developing our daily lives since civilization has begun. There are various forms of energy sources in the universe- natural and artificial ones, thrown in for good measure. After all, energy can be classified into two types based on its regeneration: renewable and nonrenewable sources. Renewable energy comes from a variety of natural sources. Non - renewable energy sources have continued to provide consistent energy all across the planet. This is due to their tremendous access. The primary goal of this study was to determine the current state of renewable energy utilization in Bangladesh. We discovered the current situation of utilizing sustainable energy among all types of individuals in Bangladesh by gathering data and what individuals believe are the barriers to utilizing renewable energy and the efforts required to be considered to overcome such barriers. In this study, individuals of all ages have been extraordinarily optimistic and eager to develop sustainable technology for producing next-generation renewable energy. A significant percentage of people believe they must rely on nonrenewable resources to survive. The majority of Bangladeshis aged 21 to 30 believe that the application and improvement of renewable energy have the most significant impact on the

country's overall economic situation. The spread of renewable energy in developing nations can be boosted by introducing new technology at various levels, especially in the perspective of Bangladesh. Individuals believe that the government, municipal and non-governmental organizations can play essential roles in advancing renewable energy.

LIST OF ABBREVIATIONS

“HT” (Highly Transparent), “T” (Transparent), “PAT” (Partially Transparent), “NT” (Non-Transparent), “TED” (Total Energy Demand), “IR” (Inequality Reduction), “IRJ” (Industrial Revolution and Jobs), “ES” (Environmental Stability/Sustainability), “SM” (Social Media), “LOS” (Lack of Subsidiary), “GP” (Government Policy), “PI” (Private Investment), “Govt.” (Government), “LF-NGO” (Local and Foreign Non-Governmental Organization), “RC” (Rural Cooperatives), “PI” (Personalized/Private investment).

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AUTHORS' CONTRIBUTION

Conceptualization, methodology, and supervision: Parag Kumar Paul; Project administration: Tanjum Tushi; Resources: Parag Kumar Paul, Husain Rakib Swadhin; Data curation: Bristy Das, Mithun Bairagi; Writing original draft: All the authors participated equally; Visualization, Investigation, and software validation: Mst. Umme Habiba; Correspondence: Parag Kumar Paul.

DATA AVAILABILITY

All the data collected from the public survey along with the personal details of each of the individuals are conserved properly by the corresponding author which will be shared to the editor upon reasonable request.

CONFLICT OF INTEREST

The authors' have no competing interest at all.

CONSENT FOR PUBLICATION

The authors' have full consent for publication of this manuscript.

FUNDING OF THE RESEARCH

The study was fully based on survey, where every

individual participated cordially. Thus, no issue about enforcement should arise in this aspect. Besides, all the information of the participants (including experts and different university students) has been conserved very carefully, which will be shared upon conditional requests from the journal.

REFERENCES

- [1] Kabir MH, Endlicher W, Jägermeyr J. Calculation of bright roof tops for solar PV applications in Dhaka Megacity, Bangladesh. *Renewable Energy*. 2010; 35(8): 1760-4.
- [2] Islam MR, Islam MR, Beg MR. Renewable energy resources and technologies practice in Bangladesh. *Renewable and Sustainable Energy Reviews*. 2008; 12(2): 299-343.
- [3] Uddin MN, Rahman MA, Mofijur M, Taweekun J, Techato K, Rasul MG. Renewable energy in Bangladesh: status and prospects. *Energy Procedia*. 2019; 160: 655-661.
- [4] *World energy outlook, 2007, International Energy Agency* [Internet]. Available from: https://www.oecd-ilibrary.org/energy/world-energy-outlook-2007_weo-2007-en.
- [5] Lior N. Sustainable energy development: the present (2009) situation and possible paths to the future. *Energy*. 2010; 35(10): 3976-94.
- [6] Rahman S, Azim M. Sustainability and the environment: Prospect and challenges of renewable energy in Bangladesh. Available at SSRN 1951606. 2011.
- [7] Mondal MA, Kamp LM, Pachova NI. Drivers, barriers, and strategies for implementation of renewable energy technologies in rural areas in Bangladesh—An innovation system analysis. *Energy Policy*. 2010; 38(8): 4626-34.
- [8] Chowdhury SA. National Solar Energy Roadmap, 2021-2041.
- [9] Khan KA, Rahman ML, Islam MS, Latif MA, Khan MA, Saime MA, Ali MH. Renewable energy scenario in Bangladesh. *IJARII*. 2018; 4(5): 270-9.
- [10] *Power Generation Units* [Internet]. Available from: https://www.bpdb.gov.bd/bpdb_new/index.php/site/power_generation_unit.
- [11] Amer M, Daim TU. Selection of renewable energy technologies for a developing county: a case of Pakistan. *Energy for sustainable development*. 2011; 15(4): 420-35.
- [12] Painuly JP. Barriers to renewable energy penetration; a framework for analysis. *Renewable energy*. 2001 Sep 1; 24(1):73-89.
- [13] Ellabban O, Abu-Rub H, Blaabjerg F. Renewable energy resources: Current status, future prospects and their enabling technology. *Renewable and sustainable energy reviews*. 2014 Nov 1;39:748-64.
- [14] Gabriel CA, Kirkwood J, Walton S, Rose EL. How do developing country constraints affect renewable energy entrepreneurs? *Energy for Sustainable Development*. 2016; 35: 52-66.
- [15] Resch B, Sagl G, Törnros T, Bachmaier A, Eggers JB, Herkel S, et al. GIS-based planning and modeling for renewable energy: Challenges and future research avenues. *ISPRS International Journal of Geo-Information*. 2014; 3(2): 662-92.
- [16] Dey D, Paul PK, Azad SA, et al Molecular optimization, docking, and dynamic simulation profiling of selective aromatic phytochemical ligands in blocking the SARS-CoV-2 S protein attachment to ACE2 receptor: an in silico approach of targeted drug designing. *J Adv Vet Anim Res*. 2021;8(1):24-35. doi: 10.5455/javar.2021.h481.
- [17] Islam, R., Akter, K. M., Rahman, A., Khanam, N. N., Azad, S. A., Islam, M. R., Farjana, M., Rahman, M. H., Badal, M. N. U., Ahmed, S. and Assaduzzaman, . (2021) “The Serological Basis of the Correlation between Iron Deficiency Anemia and Thyroid Disorders in Women: A Community Based Study”, *Journal of Pharmaceutical Research International*, 33(19A), pp. 69-81. doi: 10.9734/jpri/2021/v33i19A31330
- [18] Sharif A, Hossen S, Shaikat MM, et al Molecular optimization, docking and dynamic simulation study of selective natural aromatic components to block E2-CD81 complex formation in predated protease inhibitor resistant HCV influx. *Int J Pharm Res*. 2021;13(2):3511-3525. doi: 10.31838/ijpr/2021.13.02.408.
- [19] Arefin, A., Ismail Ema, T., Islam, T., Hossen, S., Islam, T., Al Azad, S., Uddin Badal, N., Islam, A., Biswas, P., Alam, N. U., Islam, E., Anjum, M., Masud, A., Kamran, S., Rahman, A., & Kumar Paul, P. (2021). Target specificity of selective bioactive compounds in blocking

- α -dystroglycan receptor to suppress Lassa virus infection: an insilico approach. *Journal of biomedical research*, 35(6), 459–473. <https://doi.org/10.7555/JBR.35.20210111>.
- [20] Rashaduzzaman M, Kamrujjaman M, Islam MA, Ahmed S, Al Azad S. An experimental analysis of different point specific musculoskeletal pain among selected adolescent-club cricketers in Dhaka city.
- [21] Nipun, T. S., Ema, T. I., Mia, M., Rashid, A., Hossen, M., Arshe, F. A., ... & Dey, D. (2021). Active site-specific quantum tunneling of hACE2 receptor to assess its complexing poses with selective bioactive compounds in co-suppressing SARS-CoV-2 influx and subsequent cardiac injury. *Journal of Advanced Veterinary & Animal Research*, 8(4):540–556. <http://doi.org/10.5455/javar.2021.h544>.
- [22] Azad, S. A., Farjana, M., Mazumder, B., Abdullah-Al-Mamun, M., & Haque, A. (2020). Molecular identification of a *Bacillus cereus* strain from Murrah buffalo milk showed in vitro bioremediation properties on selective heavy metals. *Journal of advanced veterinary and animal research*, 7(1), 62–68. <https://doi.org/10.5455/javar.2020.g394>
- [23] Al Azad S, Hossain KM, Rahman SMM, et al In ovo inoculation of duck embryos with different strains of *Bacillus cereus* to analyse their synergistic post-hatch anti-allergic potentialities . *Vet Med Sci*. 2020;6(4):992–999. doi: 10.1002/vms3.279
- [24] Akter KM, Tushi T, Mily SJ, et al RT-PCR mediated identification of SARS-CoV-2 patients from particular regions of Bangladesh and the multi-factorial analysis considering their pre and post infection health conditions. *Biotechnol J Int*. 2020;24(6):43–56. doi: 10.9734/bji/2020/v24i630121.
- [25] *Renewable energy: sustainable energy concepts for the future*. John Wiley & Sons. 2011.
- [26] Rogers JC, Simmons EA, Convery I, Weatherall A. Public perceptions of opportunities for community-based renewable energy projects. *Energy Policy*. 2008; 36(11): 4217–26.
- [27] Hossain MF, Hossain S, Uddin MJ. Renewable energy: Prospects and trends in Bangladesh. *Renewable and Sustainable Energy Reviews*. 2017; 70: 44–9.
- [28] Ahmed F, Al Amin AQ, Hasanuzzaman M, Saidur R. Alternative energy resources in Bangladesh and future prospect. *Renewable and Sustainable Energy Reviews*. 2013; 25: 698–707.
- [29] Islam A, Shahjahan M, Khan RH, Kashem A, Babi KN. Feasibility study of renewable energy resources and optimization of hybrid energy system of some rural area in Bangladesh. *International Journal of Physics*. 2015; 3(5): 216–223.
- [30] Munim JM, Hakim MM, Abdullah-Al-Mamun M. Analysis of energy consumption and indicators of energy use in Bangladesh. *Economic Change and Restructuring*. 2010; 43(4): 275–302.
- [31] Tarik-ul-Islam MD, Ferdousi S. Renewable energy development–Challenges for Bangladesh. *Energy & Environment*. 2007; 18(3–4): 421–30.
- [32] Rahman MZ. Multitude of progress and unmediated problems of solar PV in Bangladesh. *Renewable and Sustainable Energy Reviews*. 2012; 16(1): 466–73.
- [33] Mondal MA, Kamp LM, Pachova NI. Drivers, barriers, and strategies for implementation of renewable energy technologies in rural areas in Bangladesh—An innovation system analysis. *Energy Policy*. 2010; 38(8): 4626–34.
- [34] Sen S, Ganguly S. Opportunities, barriers and issues with renewable energy development—A discussion. *Renewable and Sustainable Energy Reviews*. 2017; 69: 1170–81.
- [35] Tabrizian S. Technological innovation to achieve sustainable development—Renewable energy technologies diffusion in developing countries. *Sustainable Development*. 2019; 27(3): 537–44.
- [36] Islam MR, Islam MR, Beg MR. Renewable energy resources and technologies practice in Bangladesh. *Renewable and Sustainable Energy Reviews*. 2008; 12(2): 299–343.
- [37] Shahzad U, Lv Y, Doğan B, Xia W. Unveiling the heterogeneous impacts of export product diversification on renewable energy consumption: new evidence from G-7 and E-7 countries. *Renewable Energy*. 2021; 164: 1457–70.
- [38] Steg L, Shwom R, Dietz T. What drives energy consumers? Engaging people in a sustainable energy transition. *IEEE Power and Energy Magazine*. 2018; 16(1): 20–8.
- [39] Breitschopf B, Held A, Resch G. A concept to assess the costs and benefits of renewable energy use and distributional effects among actors: The example of Germany. *Energy & Environment*. 2016; 27(1): 55–81.
- [40] Menegaki A. Valuation for renewable energy: A comparative review. *Renewable and Sustainable Energy Reviews*. 2008;12(9): 2422–37.
- [41] Vasylieva T, Lyulyov O, Bilan Y, Streimikiene D. Sustainable economic development and greenhouse gas emissions: The dynamic impact of renewable energy consumption, GDP, and corruption. *Energies*. 2019; 12(17): 3289.
- [42] Khan KA, Rasel SR. Prospects of renewable energy with respect to energy reserve in Bangladesh. *IJARII*. 2018; 4(5): 280–9.
- [43] Del Río P, Burguillo M. Assessing the impact of renewable energy deployment on local sustainability: Towards a theoretical framework. *Renewable and Sustainable Energy Reviews*. 2008; 12(5): 1325–44.
- [44] Mollalo A, Vahedi B, Rivera KM. GIS-based spatial modeling of COVID-19 incidence rate in the continental United States. *Science of the Total Environment*. 2020; 728: 138884.
- [45] *Demographics of Bangladesh* [Internet]. Available from: https://en.wikipedia.org/wiki/Demographics_of_Bangladesh.
- [46] Montasir R, Rahman MM. Potential Energy Sources from Highway Wind Turbine and Solar Panel: A review work for the perspective of Bangladesh.
- [47] Debnath SB, Barua B, Islam MR, Alam S, Afroz F. A feasibility study & simulative development of hybrid power plant using renewable energy at isolated island Kutubdia in Bangladesh. *In 2016 3rd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT)* 2016: 1–5.
- [48] Halder PK, Paul N, Beg MR. Assessment of biomass energy resources and related technologies practice in Bangladesh. *Renewable and Sustainable Energy Reviews*. 2014; 39: 444–60.
- [49] Chowdhury N, Akram Hossain C, Longo M, Yaïci W. Feasibility and Cost Analysis of Photovoltaic-Biomass Hybrid Energy System in Off-Grid Areas of Bangladesh. *Sustainability*. 2020; 12(4): 1568.
- [50] *Sustainable and Renewable Energy Development Authority (SREDA)* [Internet]. Available from: <http://www.sreda.gov.bd/>.