Journal of Global Knowledge and Innovation (JGKI), Volume 3, Issue 1, February-2025
ISSN 3079-1995

JGKI: Volume 3, Issue 1, February 2025, online: ISSN 3079-1995
www.jgkijournal.com

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An Analysis of the Renewable Energy Development and its resolution to the Energy Crisis of Bangladesh

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Abstract
At present, renewable energy resources are very important for sustainable development as an alternative way of fossil fuel for energy crisis. The aim of this research is to investigate the potentials of renewable energy resources. The research also tried to find out the way to support and improve the growth of renewable energy resources in Bangladesh. About 70% of the people of Bangladesh live in rural areas and renewable energy is considered right choice for their power supply. Bangladesh produces electricity is mainly from natural gas and coal. Some electricity is imported from near neighboring countries. However, the total power generation capacity of Bangladesh (captive power and renewable energy) has increased 17,340 MW with only 3.02% share renewable energy which can't fulfill country's whole demand. Bangladesh government has planned to produce 10% of total electricity from renewable energy resources within 2021. Climate change caused by carbon emissions and environmental pollution has attracted worldwide attention and as forced the government to formulate new policy. So, fossil fuel is not only main concern of Bangladesh, also along with will adapt and switch to the use of renewable energy resources. This problem can be reduced by organizing renewable energy resources (e.g. solar, wind, hydro, biomass, biogas etc.) and contributing to the country's energy crisis. Renewable energy is considered as clean energy and can serve the electricity demand in the rural areas where grid connection is not possible.

Keywords: Renewable energy resources, Solar, Wind, Biomass, Hydro, Energy crisis, Development.

INTRODUCTION

Background

Electricity is the pillar of modern civilization and the most crucial element in our daily life. So, the energy from where electricity produced is a significant and vital issue for economic development. Industries, householders and other institution cannot work without electricity. There is no doubt without electricity can do industrialization, urban-rural development and development of the agriculture sector. Mainly, the contribution of two sectors to the economic development of Bangladesh is significant. One is the industry, and the other is the agricultural sector. So electricity is the primary source for development in these sectors. Bangladesh is a South Asian country and one of the populated countries in the world. The country got its independence from Pakistan in 1971. The west, east and north of the country is India, south-east of the country is Myanmar and south of the country is Bay-of-Bengal. The total population of Bangladesh is around 160 million and the total area about 1, 47,570 Square kilometers. The population lives within 1015 square kilometer. Present GDP of the country is 7.86%, and per capita income is $1,751. Bangladesh power plant heavily depended on fossil fuel such as gas. According to Bangladesh Power Development Board (BPDB), the country has total power generation capacity is 17,340 MW (including captive power and renewable energy) and only 3.02% share of renewable energy. It understood from the data that the contribution of renewable energy of the power sector is still insufficient. Although the Bangladesh government has a plan to generate 24000 MW from nuclear and coal but that might not be enough to reduce the gap between supply and demand. Also, these natural resources (Especially, coal) are not good for the environment and ecosystem. Nuclear power might be a threat for a small and densely populated country like Bangladesh.

According to the generation and demand gap, of load shedding in Bangladesh electricity is about 600-1200 MW. This energy crisis is a big problem from a long time in the country. Bangladesh has many natural resources like coal, gas, and petroleum. However, these natural resources become already depleting and it will be end very soon. So there is an urgent need to alternative way face this crisis. Renewable energy is one of the most critical solutions which may solve the problem. It can be sustainable development.It is not only sustainable but also clean and environmentally friendly. It also produces less GHG emissions compared to other conventional power generating system. Renewable energy resources are considered to be useful for survival in the 21st century. Generally, biogas, hydro, solar and wind are the most common renewable energy resources in the country. It is safe and reliable and can save much money for the national budget. Bangladesh government has taken 2000 MW produce electricity initiative from renewable energy to implement by 2021. Recently, the government also declared renewable energy policy to increase 10% electricity production from the renewable sources. It indicates the foresight vision of the government. But the progress of renewable energy development is not rapidly. To develop the use of renewable energy in rural areas, the Bangladesh government and World Bank agreed on 30 May 2018. Since 2003, World Bank uninterruptedly giving support for renewable energy uses of the public and private company. The bank is also providing additional help for financial support, new job opportunity, climate change and many other facilities for rural people. Bangladesh government have the plan to increase hundred percent (100%) cook stove uses from renewable energy in 2030 and the country will be the first country to get all the benefits from the World Bank in this area. It proves the achievement of the power sector of the Bangladesh government. However, it also raises the question that whether the dependency on foreign donors from a long time is good not for the economy. Solar energy is the most common renewable resources in Bangladesh. Around 2.9 million people use the solar home system (SHS) in the country, and the amount of electricity is 122.2 MW. Generally, most solar power produces by the private organization. Wind power is also another renewable resource, but it is not sufficient. Mainly it is efficient in coastal areas. Also hydropower is another resources but it's very expensive and difficult to use for place. So whatever produced, it is minimal. Biogas is another renewable energy resource. Bangladesh can easily generate electricity from biogas due to their availability. However, more research is needed to find for an optimal and feasible solution.

The use of alternative energy has become impregnable due to the limited consummation of natural sources such as gas, coal res. In that case, the government's vision is to fillip the electricity shortage by using renewable energy resources. There is no alternative to renewable resources for this load shedding back-up. Most of the people live in the village, and they use wood, kerosene as a fuel which

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is a severe harmful to the environment. Hence the Bangladesh Rural Electrification Board (BREB) plan is to bring electricity to every rural area of Bangladesh. That's why they have announced that by the next 2021, will connect electricity about 2.7 million households. The various countries of the world have emphasized the use of renewable energy resources to generate their electricity. Because of, they have mentioned the limitations of fuel shortage, adverse weather, and natural sources. The international organization has made significant contributions in this regard. For example- China has become one of the biggest countries of this world which leading produce electricity from renewable energy. However, many organizations in Bangladesh are generating electricity using renewable energy from the business point of view, but it is not sufficient for national economic development. Bangladesh government and others need to find a permanent solution for national economic development and have to make a new policy for renewable energy. So, there is no alternative to renewable energy as an alternative to natural resources.

Research Framework

This study focuses on the practice of renewable energy development of Bangladesh and emphasizes the issues of participation and cooperation in electricity crisis solution. According to the research focus, there are two main components like people and policy that constitute the scope of the study. The first part, people are participated in Division wise (Dhaka and Rangpur division) with their performance analysis. Basically, the performance analysis includes the level of knowledge, awareness and attitude regarding renewable energy development of Bangladesh. These three components have their own opinion by questionnaire with survey based. In the second part, policy isparticipated in experts of companies. The expert isan authority who makes policy to the solution of renewable energy development. In here to approaches on the experts by qualitative questions which can help to make policy for solution of electricity crisis.

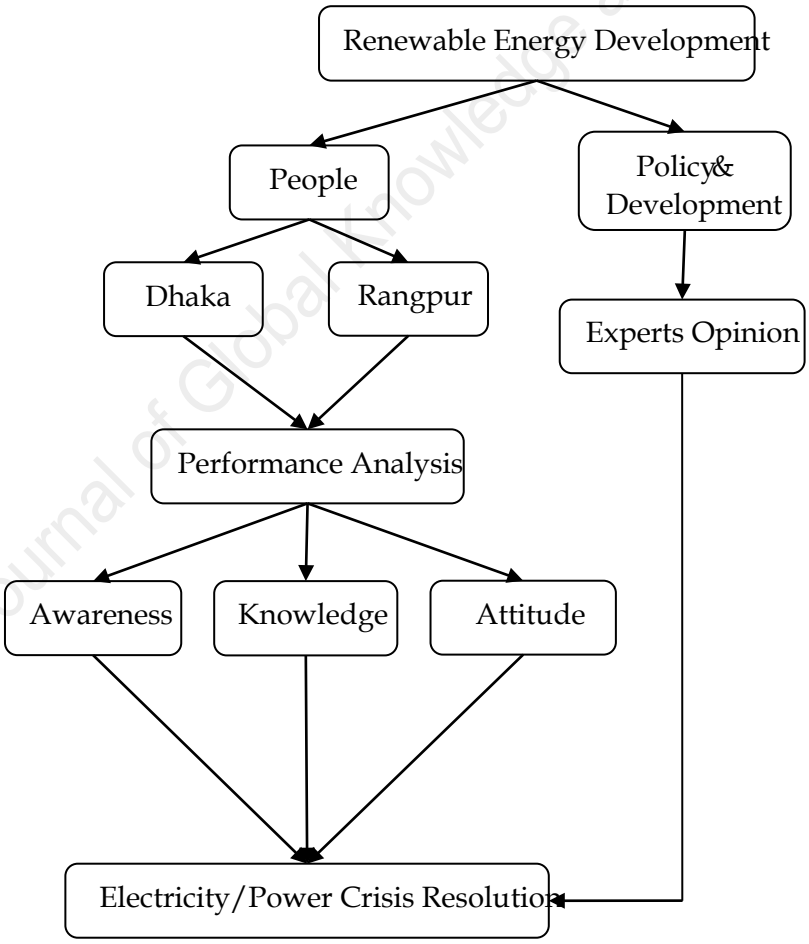

Figure 1: Research Framework

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ISSN 3079-1995
www.jgkijournal.com
DOI: HTTPS://DOI.ORG/10.7910/DVN/UPIL73

Methodology

This chapter are described the procedure of analysis. The first paragraph explained the study location. Then participants and their demographic information were discussed. Sampling included in this chapter which showed the total number of questionnaire and participants. Instrument was another important part which described the coding of the responses. The quantitative and qualitative questions were selected by the experts for pre-testing. Finally statistical analysis was performed.

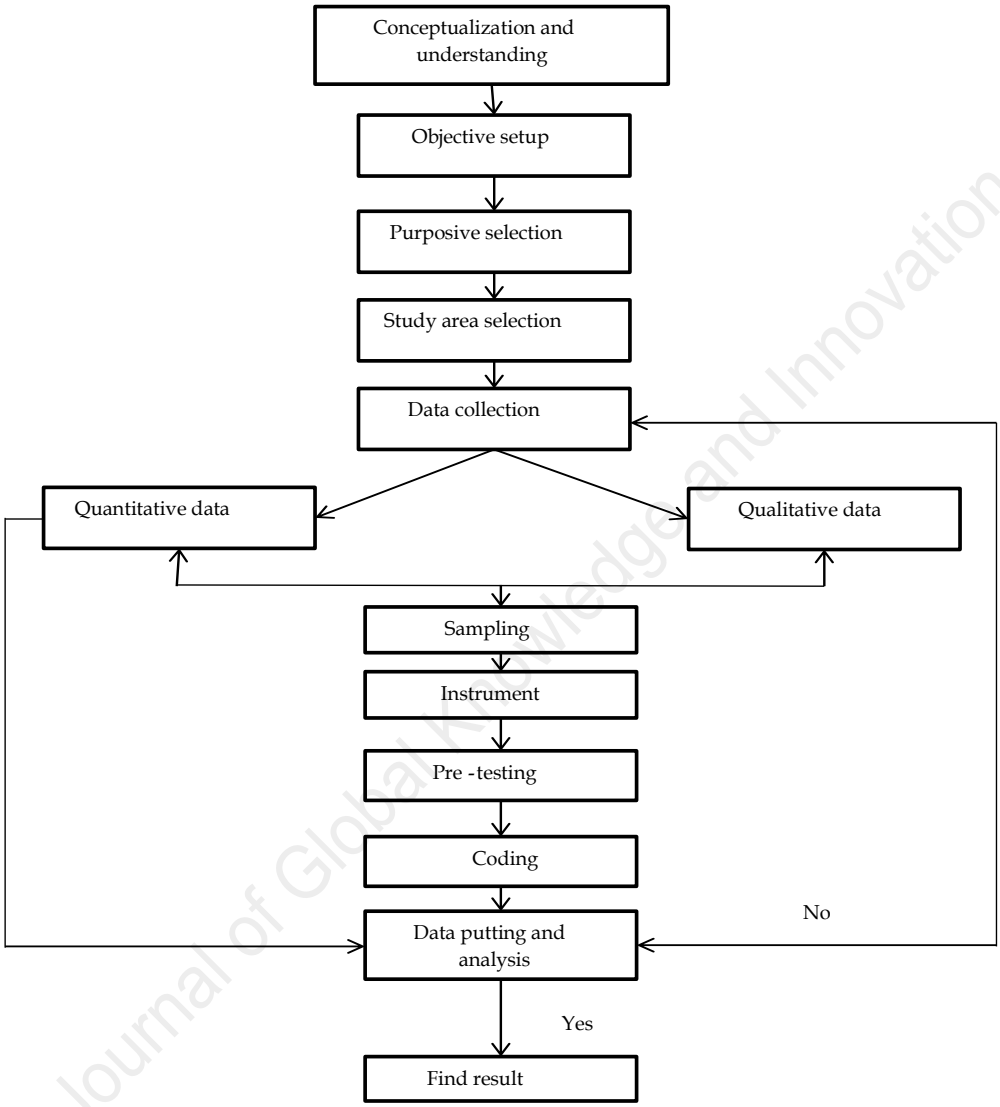

Figure 2: Flow chart of the research methodology

Study Location

Dhaka is the capital of Bangladesh which is connected all over the country. The city is expansion towards the nearest some area. According to the census data, the population is growing rapidly. There are various kinds of population live in this city. Dhaka was selected for the study purpose due to its dynamic nature. Moreover, the city student, service holders are aware of the renewable energy development in Bangladesh. There are different types of industries in this region for supplying local and international products. As a result, people from different ethnic groups and economic perspectives

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configured the city's inhabitants. The city of Dhaka is maintaining of all work with others cities. That's why Dhaka and Rangpur have been selected for difference the purpose of research. On the other hand, Rangpur is another city of Bangladesh. It is situated is the northern part of Bangladesh. Rangpur city is located about 300 kilometers away from Dhaka. There are mills, industries but they are very inadequate compared to the demand. All kind of people like educated, uneducated live here. There are some places in Rangpur where electricity didn't reach. It is said that they are depended renewable energy resources. The people in this city were selected for their opinion to help renewable energy development.

Figure 3: Study location

Participants

The study was focused overall people in the Dhaka and Rangpur division. The participants were male, female and also, they student, job holder, business man. The numbers of participants were same in Dhaka and Rangpur division. The participant was students who Study College, university graduate. It has all kind of service holder and businessman. They had proper knowledge and sincere of this study. The participants of this study were selected ten (10) experts who are government and nongovernment companies' authorities. The expertise was professionally involved for make policy and development. The name of expertise organization is BPDB (Bangladesh Power Development Board), SREDA (Sustainable and Renewable Energy Development Authority), IDCOL (Infrastructure Development Company Limited), non-government organization is GS (Grameen Shakti), BRAC (Bangladesh Rural Advancement Committee).

Sampling

There are twenty-four (24) questions were selected for survey in Dhaka and Rangpur division. A total of 512 questionnaires were distributed among the general people. The researcher is tried to whole number of sample use of this purpose. But some responds were busy have their own work. For these reasons finally there are about 400 people responds of this questionnaire. This is the 78.12% of 512. In the qualitative part total 10 experts were selected for policy making. Around 7 experts from 10 responded on this approach. Some of experts were outside in the country. I did to tried contact with

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them, but they were very busy. The experts hold in the company high position. The percentage of experts responded 70 % out of 10.

Instrument

The research accomplishes using a semi structured questionnaire as data collection instrument. It was consists of 24 closed-ended questions which fill-up various aspects of current renewable energy issues at global and country's position. The instrument was designed set up by the company expertise some study area of renewable energy resources. The questionnaire was developed for this thesis with three type sections. The questionnaire consisted of three sections, knowledge, awareness and attitude regarding renewable energy development among the people in Bangladesh. The knowledge section was included eight (8) questions that directly measured the responds knowledge about renewable energy resources of Bangladesh. The instrument development for a studied made three sub options like True, False and Unable to decide to evaluate the respondents. The participants used this method by carefully answer the questions. The awareness section has included same eight (8) questions that was measured the responds awareness about renewable energy recourses of Bangladesh. It was very important to find out the solution of renewable energy. The scale of awareness questions consisted of three sub options like Yes, No and Not so sure. These terms also help to answers this question. On the other hand, the attitude had eight (8) questions to evaluate respondents and anthropocentric points of view and their social responsibilities about renewable energy. It's to investigate the respondent's attitude towards the renewable energy usages on the future of Bangladesh. The attitude was another important part to the questionnaire. This instrument established in this study consists of a question using three likert-type response scales like Disagree, Agree and Strongly Agree. The close ended type questions were very co-operative for respondents by the questions answers. A copy of the full questionnaire was both English and Bangla. It was available from the corresponding author upon request. The qualitative questions were basically open-ended type questions. Some expertise was made of type of questions. The expertise gave a lot of questions. Finally, the researcher has selected eight (8) questions.

Pre-testing

First, the draft questionnaire sent to experts in the field of power and renewable energy companies' authority. Then the following a series of meetings the English type of the questionnaire was settled and recognized for testing. Then finally twenty-four (24) questionnaires were selected for all section. The researcher translatedall questionnaires into Bangla and particularly was given for understanding that any technical terminology was consisted that with used properly. There are governments and non-government companies experts were selected for qualitative type questions. Every expert was made many questions and answer. The researcher was discussed about the questions and answer with the expert of renewable energy. They were gave the suggestions to take which kind of questions, answer to best for making policy and development renewable energy solution. In fact, experts were considered significant contributions to the renewable energy policy and development solution of Bangladesh renewable energy sector. Finally eight (8) questions were selected, answer include researcher opinion which were very significant for policy and development of renewable energy. The expertise made sure that is very successful to make policy and development for renewable energy of energy crisis in Bangladesh.

Results and Discussion

The chapter six has been studied the result and discussion. Firstly, shows the comparative analysis of the renewable energy development indicators like awareness, knowledge and attitude. Secondly, there are discussion about the correlation analysis among awareness, knowledge and attitude with testing of hypothesis. Renewable energy policy and development of expert opinion have in this chapter. Success of the study, results of the research and recommendation have in this chapter.

Comparative Analysis of the Renewable Energy Development Indicators

Knowledge

The table number 6.1 knowledge was shown comparative results which is find out the statistical

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www.jgkijournal.com
DOI: HTTPS://DOI.ORG/10.7910/DVN/UPIL73

analyzed.

The questions number one the Dhaka division gave the 'True' answers about 81.5%, false answers 8.5%, unable to decide 10% and the same questions the Rangpur division gave the correct answers 74%, 'false' answers 16.5%, 'unable to decide' 9.5%.So it seems that in the case of the knowledge Dhaka is much ahead from the Rangpur.
The questions number two and three in the Dhaka division that the almost same but they Rangpur division lower than Dhaka.
Similarly, from questions four in the Dhaka division were greater from the Rangpur division which is significant difference between that knowledge.
It was found that the answer to the questions number five of Dhaka 80.5% higher from Rangpur 58% but 'false' and 'unable to decide' answer almost same.
The questions number six of the responds between Dhaka and Rangpur were understand medium, not like the above questions.
In the questions number seven Dhaka and Rangpur division was same no difference.
Finally, the questions number eight has been found that Dhaka is comparatively better from Rangpur.

The bar chart showed in figure 6.1 the level of knowledge of Dhaka, Rangpur division by percentage into three rank like 'excellent', 'good' and 'poor'. Summarize the information by selecting and reporting main points and make comparisons where relevant. The responds were able to answer the questions for the percentage rate of knowledge about renewable energy. Overall, Dhaka experienced an upward trend, while Rangpur showed a downward trend throughout the period. Both place knowledge rates had some fluctuations. Although Dhaka initially had a higher rate, it outraced Rangpur at the end of the period. Dhaka 'excellent' of knowledge rate was about 77%, being higher than Rangpur rate by approximately 13%.
Similarly, Dhaka and Rangpur 'good' of knowledge rose to almost same. Then, the figure showed a 'poor' of knowledge had double increased around 11% to 23%. Table 6.1: Knowledge

No.	Knowledge	Dhaka Division			Rangpur Division		
		True	***False***	***Unable to decide***	***True***	***False***	***Unable to decide***
1.	Biogas produces methane gas.	81.5%	8.5%	10%	74%	16.5%	9.5%
2.	Solar cell is a kind of device.	79%	10%	11%	50%	39.5%	10.5%
3.	Non-renewable sources of energy pollute most.	79.5%	9%	11.5%	73%	15%	12%
4.	When light falls on a photo-electric cell, it produceselec-tricity.	78%	11.5%	10.5%	64.5%	22%	13.5%
5.	Renewable energy is- cheap.	80.5%	11.5%	8%	58%	26.5%	15.5%
6.	Hydro power plant is an-other type of renewable en-ergy.	69%	10.5%	20.5%	58%	29.5%	12.5%
7.	"Affordable and clean en-ergy" is one of the sustaina-ble development goal.	73.5%	10.5%	16%	72.5%	16%	11.5%
8.	Tidal and wave energy are different.	75%	12.5%	12.%	68.5%	18.5%	13%

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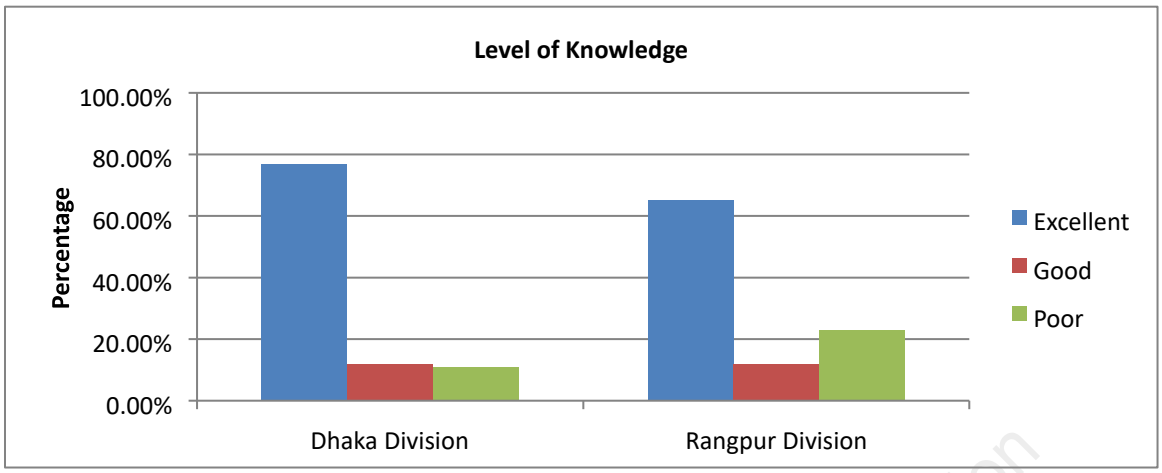

Figure 6-1: Measurement of the level of knowledge

Awareness

The table 6.2 presents awareness questionnaire data of statistical analyzing about renewable energy from Dhaka and Rangpur division. The information is presented in terms of average responds as a percentage of participants. Overall, it is clear that the most responds from of questions answers in Dhaka and Rangpur division was true. The others were varied on this depend on questions. Awareness was performing on the table number 6.2 comparatively good results. The response of the first questions showed that Dhaka division gave the 'Yes' answer 83%, being higher than Rangpur division rate by 12.95%. The 'No' answer was Dhaka and Rangpur division respectively 11% and 12.5%. Then the 'not so sure' was 6% and 17% of Dhaka and Rangpur. In the second question Dhaka was 'Yes' 77.2% large from Rangpur 60.66%. But the 'No' answered were far difference between Dhaka, Rangpur and 'Not so sure' almost same.

The questions three and four of Dhaka division answer 'Yes' was much bigger than from Rangpur division. But the 'No' answered were more difference between Dhaka and Rangpur. The answers 'Not so sure' of Dhaka are higher from Rangpur.
Similarly, the questions number five of Dhaka and Rangpur division responds was almost same at the question number three.
It was found that the questions number six answered 'Yes' of Dhaka to slightly higher of Rangpur and 'No, 'Not so sure' around nearly same.
On the other hand, the question seven was carried out of the responds have no difference answered like above questions.
The last question on the table was gave the 'Yes' answered of Dhaka division highly better from Rangpur division. But the other answered less difference between Dhaka and Rangpur.

The bar chart provides information about the percentage of awareness in the renewable energy resources of Dhaka and Rangpur division. In here the percentage also divided into three ranks like 'High', 'Medium', 'Low'. The overall experienced of Dhaka at upward trend while Rangpur at downward trend. Between of the division rate had some fluctuations. Although Rangpur initially had a lower rate, it outraced Dhaka at the end of the period. Dhaka 'High' of awareness rate about 71% which was higher than Rangpur rate. And it was approximately 15%. Percentage of the 'Medium' in Dhaka was less than 15% from Rangpur. It was rapidly decreased. However, the figure experienced a steady during the time was slightly decreased from Dhaka to Rangpur.

Table 6.2: Awareness

No.	Awareness	Dhaka Division			Rangpur Division		
		Yes	*No*	*Not so sure*	*Yes*	*No*	*Not so sure*

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1.	Do you know about renewable energy?	83%	11%	6%	70.5%	12.5%	17%
2.	Do you know that Biogas technology is solving fuel crisis significantly in Bangladesh?	77.2%	9.52%	13.54%	60.66%	30.08%	9.02%
3.	Do you think government should support clean energy projects?	64%	14%	22%	44%	45%	11%
4.	Do you know that ministry of power; energy and mineral resources of Bangladesh arranged national energy invention competition in 2017 for the school, college and university students?	76%	11%	13%	61.5%	28.5%	10%
5.	Do you think it is important that families install solar or wind energy in their home?	76%	11.5%	12.5%	60.5%	30%	9.5%
6.	Do you think that solar power is changing the rural life style in Bangladesh?	79.5%	9.5%	11%	70.5%	16%	13.5%
7.	Have you ever visited any renewable energy power plant (Solar, Wind, Hydro and Biogas) in Bangladesh?	38.5%	40.5%	21%	31%	56.5%	12.5%
8.	Do you think using the solar irrigation pump instead of diesel irrigation pump helping a lot to the Bangladeshi farmers in terms of cost and environment?	77.5%	12%	10.5%	50%	23%	27%

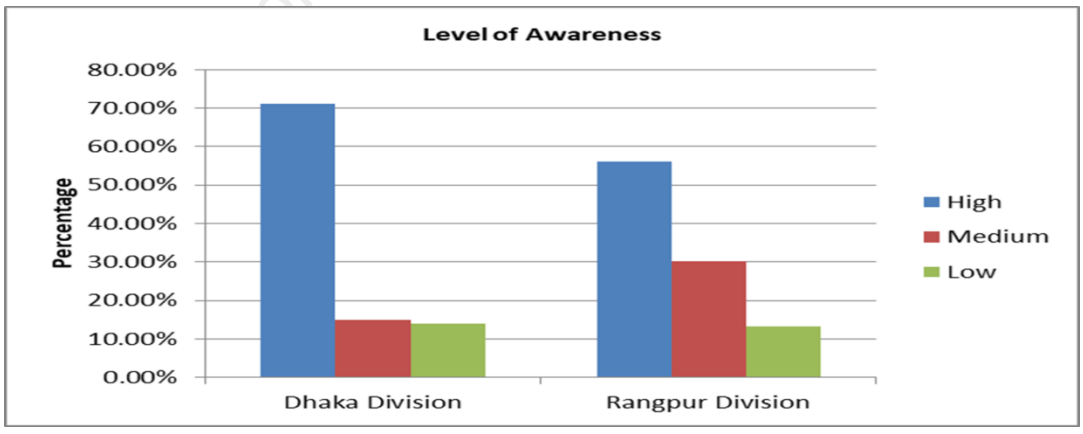

Figure 6-2: Measurement of the level of awareness

Attitude

The tables 6.3 Attitudes were shown the comparativeresult which isfound out the statistical analyzed. The results show the percentage of responds.

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www.jgkijournal.com
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The number of the first questions showed that Dhaka division gave the 'Disagree' answer 13%, 'Agree' answer 64.5%, 'Strongly agree' answer 22.5% and the Rangpur division gave the 'Disagree' answer 25.5%, 'Agree' answer 59%, 'Strongly agree' answer 15.5%. This questions answer is not much difference.

The second questions of the Dhaka division 'Disagree'38% which is higher than Rangpur division and the same situation of the 'strongly agree' answers. But the 'Agree' answer same to same of Dhaka and Rangpur division.
The third questions of the of Dhaka division was 'Disagree' 18.5 lower from Rangpur division 24% but the 'Agree' answer were more 20.5% from Rangpur to Dhaka. The 'Strongly agree' answer was double from Dhaka to Rangpur.

The questions number four Dhaka and Rangpur division answer the 'Disagree', and 'Strongly agree' was 12.5%, 23% and 20.5%, 12.5%. It was far differences. But the answer 'Agree' were near about same.
It was found that answers the questions number five of Dhaka and Rangpur division 'Disagree', 14%, 30%, 'Agree', 59.5%, 27%, 'Strongly agree' 26.5%, 43%. The result was in this question more difference.
The questions number six of the answer 'Disagree', 'Agree' between Dhaka and Rangpur was around same no difference. But the Dhaka and Rangpur division 'Strongly agree' answer was 12%, 19%.
Similarly, the questions number seven of the Dhaka and Rangpur division 'Disagree' answer were highar from Dhaka to Rangpur but the 'Agree' answer was slightly bigger Rangpur from Dhaka. The 'Strongly agree' answer almost same.
Finally, the questions number eight has been found that Dhaka and Rangpur division was 'Disagree', 'Agree', 'Strongly agree' answers respectively 10%, 71.5%, 18.5% and 15.5%, 61.5%, 23%.

The bar chart showed in figure 6.3 the level of attitude of Dhaka and Rangpur division by the percentage into three ranks like 'Positive' 'Moderate' and 'Negative'. Summarize of the results has been made main points and comparison where relevant. Overall of the experienced Dhaka shows the upward trend and Rangpur shows the downward trend throughout the period. Dhaka and Rangpur division rate had fluctuations. Dhaka had a high rate when Rangpur was law rate end of the period. In the Dhaka division 'Moderate' of attitude rate was around 64%. It was bigger than Rangpur rate by approximately 10%. The percentage of the 'Positive' Dhaka division was less than from Rangpur. It was slightly increased and the 'Negative' on the figure experienced a steady during the time slightly increased from Dhaka to Rangpur. Table 6.3: Attitude

No.	Attitude	Dhaka Division			Rangpur Division		
		Disagree	***Agree***	***Strongly Agree***	***Disagree***	***Agree***	***Strongly Agree***
1.	I will prefer to use renewable energy rather than non-renewable energy.	13%	64.5%	22.5%	25.5%	59%	15.5%
2.	I will support to buy electricity from a renewable source even if it is slightly expensive.	38%	51.5%	10.5%	26.5%	51%	22.5%
3.	I am in favor of Bangladesh government policy to generate 15% of the total electricity supply from clean energy resources by 2020.	18.5%	63%	18.5%	24%	40%	36%

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4.	In future I want to contribute in the development of the Bangladesh renewable energy sector.	12.5%	67%	20.5%	23%	64.5%	12.5%
5.	I think renewable energy can ensure greener and healthier lifestyle.	14%	59.5%	26.5%	30%	27%	43%
6.	I would like to take part in any kind of awareness program of renewable energy.	24.5%	63.5%	12%	24.5%	64.5%	19%
7.	I think renewable energy will create more job opportunities and contribute to reduce the poverty of the country.	9%	71%	20%	19.5%	57.5%	23%
8.	I think the cost of solar energy will decrease more and more.	10%	71.5%	18.5%	15.5%	61.5%	23%

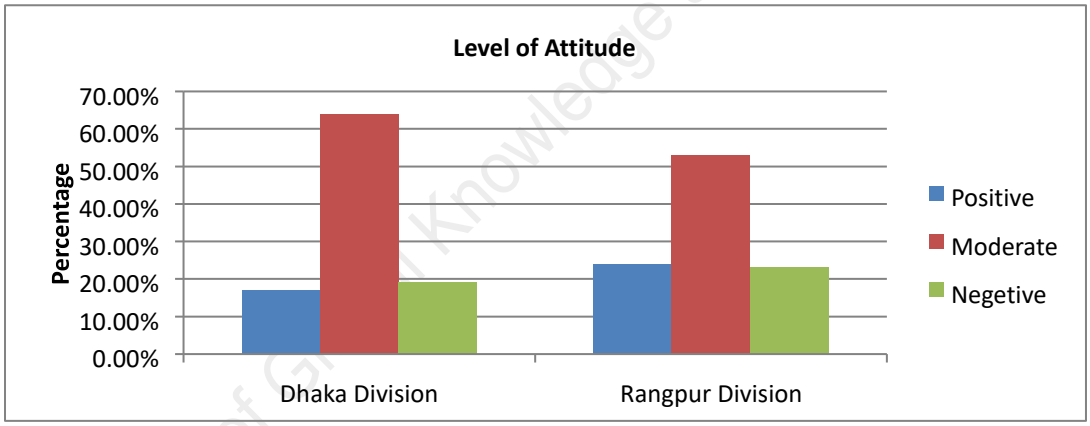

Figure 6-3: Measurement of the level of attitude

Correlation Analysis among Knowledge, Awareness and Attitude

Correlation between Awareness and Knowledge

The value of Pearson correlation between awareness and knowledge is 0.60, which is less than 1 but more than 0.50. Therefore, the two development indicators of renewable energy awareness and knowledge are positively strongly correlated.The result showed that there was awareness and knowledge strongly positively correlated about renewable energy development. It is presented that the responds include more knowledge and awareness might be increasing about renewable energy development.

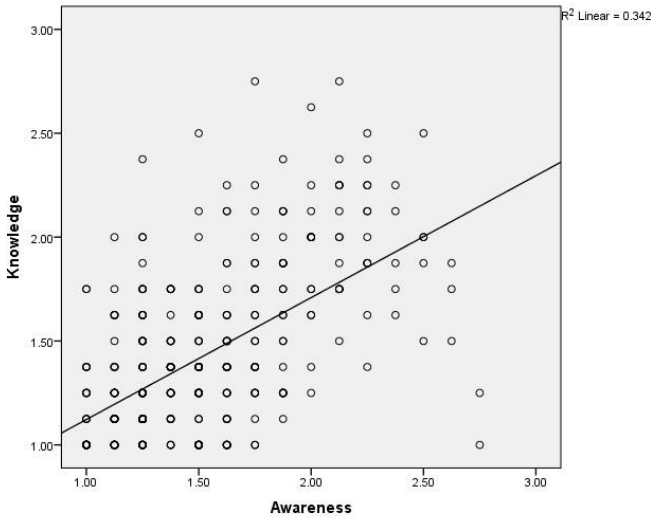

Figure 6-4: Scatter plot of awareness and knowledge

Correlation between Awareness and Attitude

The value of Pearson correlation between awareness and attitude is -0.285, which is not only less than 1 but also less than 0. Therefore, the two development indicators of renewable energy awareness and attitudeare negatively strongly correlated.A common misconception is interpreted was assuming that the negative correlation coefficient points out there are no relationshipbetween awareness and attitude whiles the correlation between awareness and knowledge was strong. For negative correlation variables, high values of one variable are associated with low values of another variable. The results presented that the no relationship between awareness and attitude for renewable energy development.

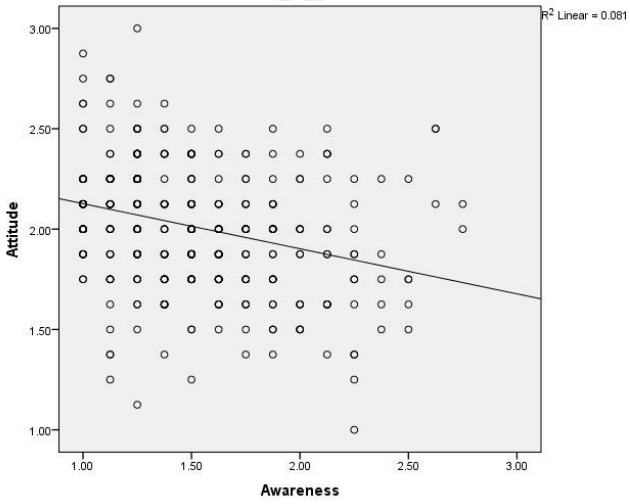

Figure 6-5: Scatter plot of awareness and attitude

Correlation between Attitude and Knowledge

The value of Pearson correlation between attitude and knowledge is -0.270, which is almost same as the correlation between awareness and attitude. So, the two development indicators of renewable energy attitude and knowledge are negatively strongly correlated.Correlation between two indicators attitude and knowledge is also same awareness and attitude. There is no relationship between attitude and knowledge. The results showed the attitude and knowledge was negatively very high in the analysis. So, there is no relationship between attitude and knowledge of renewable energy development.

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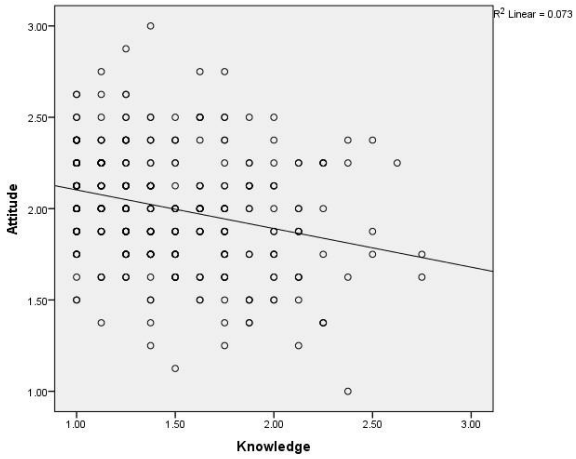

Figure 6-6: Scatter plot of knowledge and attitude

Testing of the Hypothesis

To test the hypothesis Pearson Chi-Square test was performed.

Table 6.4: Chi-Square results of the peoples' ability to understand the renewable energy development

Serial No.	Dependent Variables	Independent Variables	Null Hypothesis	Alternative Hypothesis	Pearson Chi-Square Value	Decision
1.	Place	Knowledge, Awareness and Attitude	H01	Ha1	0.000	P<0.05
2.	Occupation		H02	Ha2	0.040	P<0.05
3.	Gender		H03	Ha3	0.025	P<0.05
4.	Marital Status		H04	Ha4	0.392	P>0.05
5.	Monthly Income		H05	Ha5	0.284	P>0.05
6.	Age		H06	Ha6	0.365	P>0.05

It is evident that the values of Pearson Chi-Square in serial no.1, 2 and 3 are 0.000, 0.040 and 0.025 accordingly. It indicates that P<0.05. Therefore, in all these three cases Null Hypothesis will be rejected and Alternative Hypothesis will be accepted. In a nutshell it could be said that place, occupation and gender has a statistically significant impact on the performance of the renewable energy development. However, the values of Pearson Chi-Square in serial no.4, 5 and 6 are 0.392, 0.284 and 0.365 accordingly. It shows that P>0.05. As a result, in all these three cases Null Hypothesis will be failed to rejected. Thus it could be said that marital status, monthly income and age don't have a statistically significant impact on the performance of the renewable energy development.

Renewable Energy Policy and Development Analysis (Expert's Opinion)

Policy analysis of renewable energy was a qualitative analysis. After interviewing the experts following answers were summarized, where experts suggest about their opinion about renewable energy development, policy and other related issues.

i. Experts opinion about present renewable energy situation and renewable energy generation capacity in Bangladesh-

Nowadays in Bangladesh, the energy sector is increasing day by day with the huge demand for power for its economic development. To meet the continuous demand, the coal, gas, and diesel based power generation is not sufficient, although, more than 16000 MW of electricity is being generated with these sources. But these natural resources are depleted with time and it is therefore necessary to look into more sustainable renewable sources for power generation. Bangladesh is a land of rivers and has

DOI: HTTPS://DOI.ORG/10.7910/DVN/UPIL73

ample opportunities and options for utilization of renewable sources like sunlight, wind, tide etc. for the generation of electricity. At present, by using renewable sources such as hydropower, solar, wind, and biogas, very few amount of electricity (404MW) is being generated, albeit its manifestation of progress is notable. Currently, the percentage of power generation by renewable sources is infinitesimal and it is at any means could not cope up with the increasing demand of electricity of the country. But the Government takes initiative to accelerate generating electricity through renewable sources.

ii. Experts opinion about the renewable energy development in the rural areas of Bangladesh-

About 70% population lives in rural areas in Bangladesh and access to electricity for all here is the paramount importance for the economic and social development of the country. But due to the high cost of generation, transmission and distribution of electricity, many households still cannot be connected to national grid. Being a South-Asian country, Bangladesh's geographical location and tropical climate is advantageous for continuous solar radiance throughout the year. 'Solar Home System' (SHS) is an alternative energy source and its popularity is increasing day by day in rural areas. Solar energy is nearly inexhaustible, so the price of this alternative energy source is stable and within the grip of rural people. Solar energy has other benefits in comparison with non-renewable energy that, it is simple, efficient, and pollution free. With the help of solar energy, people use solar-powered LED light instead of using kerosene lamps. This smart way increases the business with the extension of evening working hour. Economic development is enhancing in the rural areas because solar-powered lights save time, energy, and money. On the other hand, the rural women are getting more time at evening in sewing, making handicrafts, and doing other commercial activities besides their usual household works. In this way, the renewable energy utilization plays an important role for women empowerment in rural areas.

iii. Experts opinion about the technical difficulties of renewable energy resources in Bangladesh-

Renewable energy based power generation is environmental friendly and profitable. In Bangladesh, the utilization of renewable energy for power generation is commencing but not in full swing. Hence, it undergoes some technical difficulties. First of all, the installation cost is high and even the monthly installment payment is out of reach for the poor people of the country because on daily basis they can manage the price of small amount of kerosene to light the lamp rather pay a gross monthly amount. Since this industry is not well developed, the technical expertise, after sales performance, and maintenance services are poor. Therefore, due to lack of technical knowledge and maintenance, the already installed renewable energy based systems' production becomes reduced. The initiative of Government and non-Government organization has started to escalate power generation process through renewable energy. Some agencies are giving basic training for fixing minor technical problems and maintenance of the system etc. in order to boost power generation output without interruption. Another thing is that in Bangladesh, the hydropower generation has limited potential due to flat surface area and lack of sufficient head and wind speed is not high to establish large scale wind driven power generation.

iv. Experts opinion about the government and private investment of renewable energy in Bangladesh-

Renewable energy sources are clean and sustainable and solar energy and biomass is the most promising potentials for electricity generation in Bangladesh. Nearly two third of the population is out of electricity facility and only 3.5% of the electricity generation is emerged from renewable sources. But the Government sets a target to reach the percentage close to 20% in 2020. To achieve this goal, the government and private investment agencies are working in Bangladesh on different renewable energy projects. With the present Government's good will and good initiatives many foreign investment companies like China has come forward and invest millions of dollars for power generations by clean sources like wind energy. Bangladesh is an agricultural country and agricultural residue, rice husk, forest residue, wood residue, animal waste etc. are good sources of biomass which is renewable source of energy. A number of NonGovernment organizations are working on biogas plants to generate electricity. Sometime bureaucracy creates problem and retards private investors to invest on this sector. It is therefore, necessary more public-private collaboration to facilitate and developed the renewable energy sector in Bangladesh.

v. Experts opinion about the suitability and feasibility of the present infrastructure and political condition for the development of renewable energy in Bangladesh-

The infrastructure development and political stability are the pre-requisite for any development activities of a country. The facility to easy access to the site of construction and individual safety are essential for any private investors to invest on development works. The political situation in Bangladesh has been stable and the political institution has been working well since the couple of years and the present Government is very serious on infrastructure development to attract more foreign and local investors to come. Hence, structural and political safety prevails in Bangladesh to establish more renewable energy plants throughout the country.

vi. Experts opinion about the promotionof renewable energy in Bangladesh-

Renewable energy is the substitute for the exhaustible fossil-fuel based energy. Therefore, its promotion and enhancement is necessary for wide utilization throughout the country. Here are some of the ways of promoting renewable energy in Bangladesh:

- Increase the affordability of renewable energy systems to rural population by adopting easy financial and delivery mechanism.
- Rural hospital and clinic, where electrification has not yet been connected to national grid should be under coverage of solar based electricity and conduct vaccination and immunization programmers to make renewable energy system popular.
- Educational institutions should be electrified through renewable energy system and provide quality education to poor children.
- To facilitate safe drinking water and to provide irrigation facility, renewable sources of energy should be used.
- Establish renewable energy based Information and Communication Technology (ICT) centers in the off-grid areas of the country.
- Encourage local government bodies for inclusion of renewable energy systems to the rural infrastructure projects like rural market, cyclone center, health clinics, schools, training centers etc.
- Encourage community based organizations (CBOs) and Non-Government organizations (NGOs) to satisfy institutional requirements for the implementation of the above local government projects.
- Arrange training program for technology transfer about the utilization of the renewable energy technologies.
- To make this technology popular and useful renewable energy related leaflets, posters, periodicals, journals, best practice guides and books should be published.

vii. Experts opinion about the renewable energy policy of Bangladesh-

Bangladesh is one of the lowest in terms of electricity coverage among the world and most of the electricity generation depends on natural gas (62.2%) which is exhaustible and depleting day by day. The renewable energy source is the only alternative that the country should seek for like other developed and developing countries around the world (eg. China, Germany, USA, Brazil, India etc.). A holistic renewable energy policy should be adopted to enhance its share to the total electricity generation. Bangladesh's policy in connection of this should be updated in the following perspectives:

- Climate change concerns should be the driving for the growth of renewable energy industries. In relation to Global renewable energy policy, solar power generators should be made prominent for the maximum electricity generations around the country.
- Growth in jobs sector by increasing renewable energy investment which is very relevant for Bangladesh as this country is over populated and has acute unemployment problem.
- Implementing innovative policies relating to renewable energy commercialization.

viii. Experts opinion about the costing of renewable energy in Bangladesh-

Bangladesh is in nascent stage in utilization of renewable energy. Current renewable energy

Journal of Global Knowledge and Innovation (JGKI), Volume 3, Issue 1, February-2025
ISSN 3079-1995
www.jgkijournal.com
DOI: HTTPS://DOI.ORG/10.7910/DVN/UPIL73

technologies include solar (Photo voltaic) as Solar Home System (SHS); solar cookers, dryers, water heaters and tunnel dryers for crops; biogas; biomass briquetting machines; and improved cooking stoves. Since millions of rural populations of the country are out of electricity facility and country's prosperity is dependent on the development of living standard of this huge population, alternative renewable energy is the effective way to make difference. But the initial establishment cost of the system such as cost of the solar silicon panel is very high. People resort to take bank loan to buy this expensive solar panel. In order to make renewable energy system cost-effective, the Government should take initiative to : a) reduce VAT/taxes on solar accessories and raw materials especially batteries and solar panel; b) provide loan to rural people for purchasing the system with low interest rate; c) subsidize initial installation costs; d) promote solar energy business by giving more licenses to the businessmen. However, renewable energy is the key component for the development and can play a significant role in achieving the national goal to access of electricity for all population in Bangladesh.

Efficient of the Study

Above all, the researcher believes that the research has been successful because the target people and experts understand and respond to the questionnaire and expert opinion. The researchers were very surprised that responds gave their opinion for improvements and more elaboration for questions and answers to share. Also, the questionnaire and interview questions language and length were very good since the responds did not feel bored with reluctant for answered. The interview question and questionnaire both of them was very consistent aim of the research. The researcher tried to give the overall power sector and renewable energy resources of Bangladesh. The researcher does simplified all data analysis and discuss very effectively. Lastly, this research can be compared with the earlier research findings on the topic.

Results of the research

The purpose of this research was how to support, improve and course of growth renewable energy resources in Bangladesh to close the gap where some people does not access to electricity. Bangladesh is a country that has sufficient conventional and non-conventional energy resources like fossil fuel, renewable energy resources. Encourage the source of energy mix, it is important to focus on fossil fuel conservation. This will help the government to make revenue for a longtime through the ongoing export of the country. After taking the solution of renewable energy with the importance of rural development and the use fossil fuel like coal, oil, gas will gradually decrease. This research discussed about renewable energy in Particular to solar, wind, hydro, biomass, biogas, municipal waste, ocean energy, tidal energy etc.

The government will have to work to their target fulfill renewable energy capacity to 10% and 24000 MW of total power generation.In this study the researcher found that electricity demand in Bangladesh is much higher but there are some restrictions of electricity generation. Though government and non-government organizations try alternative way to generate electricity but it's not sufficient enough to meet demand. Usually conventional energy production systems are very expensive and not suitable of environment.

Bangladesh has a huge amount of renewable energy resources yet energy crisis is dealing with it. Although there are some limitations, the main advantage of renewable energy solutions is the ease of maintenance, simplicity of technology and proper use of fossil fuel. In this research various impacts of renewable electricity generation have been identified and concept of the position of people and institutions. Apart from the renewable energy resources like solar (SHS, solar PV, solar irrigation etc.), wind energy, hydro energy, municipal waste government and nongovernment organization have been marked for various steps to development and usages.Solar, wind, hydro and biomass have significant potentiality development off-grid areas of Bangladesh to access the electricity. The use of renewable energy resources in rural areas can be emphasized for the acceptability and sustainability electricity development of Bangladesh. For the development of renewable energy significant barriers such as technical, information, maintenance, operation can solve the problem and the government can implement at the rural and urban level. Though another barriers such as socio-economic barrier, institutional barrier, environmental barrier, lack of skilled workforce and training facilities is very vital issue for renewable energy development and solution of energy crisis which can the government and non-government organization taking responsibility. The renewable energy technology efficiency make a satisfaction for their economic and environmental value include the development of country nation. Bangladesh economic and social impact on the use and growth of renewable energy sources and also

technical related problems companies faces in building an alternative source of energy in Bangladesh to achieve more reliable results. In this research, two research methods were used to improve the current situation of renewable energy resources in Bangladesh and further improvement in the future. In this method questionnaire had 24 questions and expert opinion was 8 questions which provided new and variable information about renewable energy issues of Bangladesh. The validity and reliability of this research gives more importance to these two research methods.

Recommendation

Based on the results of the research, it is recommended to follow the below necessary steps.
At present, the renewable energy resources solutions are very clear in terms of energy crisis. To solve the problems of knowledge, awareness at urban and rural level will be increased more. However, the renewable energy resources are need for development and use especially rural development needed. With this goal, there is a need for overall cooperation and investment of both government and private organization in the new research and development sector which can takeeffective measures for more of power generation. To improve the existing research and development centers should be supported and excellent with accomplished quality research and progress activities.
Due to the uncertainty of production and commercialization of local manufactures and entrepreneurs of the renewable energy system, there is a need to make more efforts on the construction and maintenance of various renewable energy technologies en-use devices for local reconstruction. In this regard should be given to the absence of skilled workface and training facilities local manufacturers and the end-users of renewable energy electricity with setting more emphasis to the rural areas.The policy makers need to create a new policy to reach the government and the elements of renewable energy technology. Bangladesh Power System Master Plan (PSMP) in Bangladesh energy policies for sustainability of renewable energy electricity resources can be promoted to the people about environmental issues.

Conclusion

The comparative analysis of three indictors is like awareness, knowledge and attitude finding the responds percentage of the questionnaire answers. The result shows by the table and bar chart which is very significant renewable energy development. From the correlation analysis with three indictors gave the results have or haven't relationship for renewable energy development. The hypothesis has been shown which variable is very connected and more important of renewable energy development. The expertise gave their opinion with researcher has discussion about the renewable energy development. And finally shows the renewable energy policy and development in this chapter. The solution of the energy crisis of Bangladesh has also way in the renewable energy policy and development.It was amazing for researcher to identify the place, people and their support for renewable energy development.

Conclusion and Future Work

Conclusion

Energy is a vital issue for human needs. So electricity is very important in our daily life. Apart from industrial, agricultural, there is no alternative to electricity for rural and urban development. Bangladesh is a populated and small country. At present gross domestic product (GDP) of Bangladesh is about 7.86%. Bangladesh electricity is totally dependent on fossil fuel like gas, coal, oil, petroleum. According to the demand of electricity currently production is insufficient. It has seen here that all the different organization like government or non-government of Bangladesh produce electricity. But they have some financial, technical and other limitations. As a result the dependency on renewable energy is growing. Therefore, the renewable energy resources can become an alternative way to solve energy crisis. In Bangladesh there are many renewable energy resources such as solar, hydro, wind, biogas, biomass, tidal energy etc. The whole information of various renewable energy resources and their utilization needs shows to compiled to understand the entire scenario of the renewable energy sector of Bangladesh. In this study various impacts of renewable electricity generation have been identified and concept of the possibility of resources and institutions.
The solar, wind, hydro and biomass can use significantly where not reached electricity of Bangladesh. There are many obstacle of renewable energy development like technical, financial, socio-cultural, non-skilled workforce etc. The government of Bangladesh has to plan to solve the problem and encourage renewable energy resources. In this research, researcher used two types of research methods

DOI: HTTPS://DOI.ORG/10.7910/DVN/UPIL73

which find out the solution of energy crisis from renewable energy resources. The results of this research can help the development and solution of energy crisis.

Future Work

The researcher made thefollowing suggestionfor future work on the topics.
One of the limitations of this research, the sample size is small like 400. Due to the population size, the number of responds cannot effectively represent the general population opinion. So, more than 400 sample sizes for future work could be more effective for the solution. The researcher worked two divisions but in future more than two divisions can be worked out. It does not fulfill 100% of the responds. So, if want to fulfill 100% can take more sample size. The researcher selected three indicators in this research but in future can take four or five more indicators. They are expertise time, money and interconnections of subject matter also plays significant limiting role on the research. The researcher did the study of the Bangladesh. The study place could be also in china. However, the researcher couldn't do it in china because of language barrier, time and money etc. It can do it the researcher future where they study to collect the data and use same methodology. A focus more contribution new technology to achievement more in depth forecast to take such technology gas, wind, hydro, biomass and others into account. The researcher can do for future research by factor analysis, SEM (structural equation modeling) and more statistical tests. The renewable energy resources like biomass, municipal waste is very available in this country that is easy to long-term research for future researcher.

Acknowledgements

First of all, I would like to thank to Almighty Allah who is great full and merciful. I would also like to express my special thanks and gratitude to my supervisor, Associate Professor Jin Ping for the valuable instructions and guidance. Without his support the thesis could be difficult to accomplish. I would also like to thank teacher Yujing GUO for supporting me thought out my study period. I would also like to express my deepest gratitude to all of the lectures, professors of the College of Energy and Electrical Engineering. I am thankful for their enthusiastic lectures and encouragement. I also would like to give special thanks to Mr. Tausif Ali, Mr. Mohammad Anwar Sadat, Md. Tazul Islam who gave me support during my study. I would also like to thank my father, mother, siblings and all my wonderful families and friends, who gave me moral support during my study. It has been a great and wonderful experience of this study. I have learnt a lot during the research, epically in the area of renewable energy. I hope this research will provide some useful ideas to the readers and future researchers.

Funding

No funding was received for conducting this research.

Availability of data and materials

All data and models used in this research are available upon request

Declarations

The authors declare no competing interests.

Ethics approval and consent to participate

Not applicable.

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Received: 27 December 2024 **Published: 20 February 2025**