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Research Article

PERSPECTIVES OF THE RESIDENTS IN PROXIMITY TO THE ROOPPUR NUCLEAR POWER PLANT IN BANGLADESH

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ABSTRACT

This study aims to explore the awareness, attitudes, and trust of residents living near the Rooppur Nuclear Power Plant regarding nuclear energy. The research specifically targets the community of BBC Bazar, a locality positioned near the boundary of this significant nuclear initiative and situated within the government-designated 3 km precautionary zone. For this analysis, eighty-three permanent residents—who are not involved with the nuclear power plant project and are aged 18 or older—were chosen as participants for data collection through structured questionnaires. Employing quantitative research methods, the study utilized statistical tools, including the chi-square test, Friedman's test, and descriptive statistics, to analyze the gathered data. The findings reveal a predominant concern among residents for a reliable, cost-effective power supply, while their attitudes towards nuclear energy are markedly mixed. Notably, individuals with higher levels of education and income demonstrate a greater awareness of, and caution regarding, the potential risks associated with nuclear power. A significant number of participants reported a lack of familiarity with the emergency response plans in place and expressed a strong preference for evacuating the area in the event of a nuclear accident, highlighting underlying anxieties related to safety concerns. Interestingly, despite many respondents expressing general support for nuclear energy generation as a concept, there is a prevalent reluctance to host such projects in their immediate surroundings—a clear reflection of the NIMBY (Not in My Back Yard) sentiment. The study emphasizes the critical need for enhanced public engagement, transparent communication, and increased awareness programs to foster greater acceptance and ensure the safety of nuclear power plant projects throughout Bangladesh. By addressing these factors, the research aims to bridge the gap between community concerns and the advancement of nuclear energy initiatives.

Keywords: *nuclear, energy, perceptions, Rooppur, Bangladesh*

Introduction

The energy demand worldwide is rising continuously due to the ongoing growth of population and industry, with an expectation that consumption will double within the next century (Gulagi *et*

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al., 2020). As Bangladesh's economy rapidly expands, it is under significant pressure to satisfy its growing electricity needs (Karim *et al*., 2018), with an energy production growth rate of 19.02% recorded in 2017-2018 (Goswami *et al*., 2022) and a projected demand of 3370 MW by 2030 (Karim *et al.*, 2018). To elevate the economic development of Bangladesh to the desired level, the government is focusing on generating sufficient electricity and utilizing it effectively. About 90% of the population has access to electricity, with per capita electricity generation at 484 KWh (Goswami *et al*., 2022). The government has recently initiated the construction of multiple new power generation facilities to address the increasing electricity demand. A key action implemented by the Bangladeshi government to confront this challenge and guarantee a dependable power supply is creating a nuclear power plant. On December 25, 2015, a general contract was signed between Atomstroy Export, a subsidiary of the Russian Federation's Rosatom State Energy Corporation, and the Bangladesh Atomic Energy Commission for the construction of a nuclear power facility in Rooppur (24°04′00″ N, 89°02′50″ E, located 160 km from Dhaka) in the Pabna district (Hosan *et al*., 2022; Ahmed *et al*., 2020). The construction of Bangladesh's largest budget project commenced in November 2017. This nuclear plant, with a capacity of 2400 MW, will be built by the Russian Federation. The first reactor, a 1200 MW VVER-1200 model (generation III+), is set to begin operations in 2024 after a seven-year construction period. The second reactor, also 1200 MW, is expected to commence operations one year later. Therefore, by 2025, the national grid of Bangladesh will benefit from an additional 2400 MW of electricity (www.rooppurnnp.gov.bd). The Rooppur nuclear power plant is projected to contribute at least 10% of Bangladesh's electricity needs. This project stands out in the country in terms of investment and the integration of advanced and cutting-edge technology. However, the historical records of major nuclear accidents have made people skeptical worldwide about the safety of nuclear power plant projects (Filburn and Bullard, 2016). Although nuclear power plants are an effective and sustainable method of generating electricity, they have various impacts on the surrounding communities. Several studies on RNPP ignore the local community of Rooppur (Hosan *et al*., 2022; Islam *et al*., 2021; Goswami *et al*., 2020; Gulagi *et al*., 2020; Ahmed *et al*., 2020; Karim *et al*., 2018). The surrounding communities of nuclear power plants are vital because they are directly related to safety, health, the environment, and the economy. Therefore, the welfare of local communities is of utmost importance when implementing any nuclear project. It is possible to ensure the safety of communities by mitigating the risks associated with nuclear power plants through proper planning, advanced technology, and effective management. The prime objective of the study is to analyze residents' perspectives, awareness, and risk-taking attitudes in the area adjacent to the RNPP. It aims to derive answers to questions such as, How much do residents know about nuclear power generation? How do they evaluate the RNPP project? What are the differences in perspectives on nuclear power among different socio-economic classes? What are the public's opinions on policy priorities related to power supply, pricing, environmental protection, and public health? What would the respondents' response be in case of a nuclear accident? Through these questions, it is possible to determine how the government and relevant authorities can take practical steps in nuclear power management by analyzing the perspectives of local people.

Materials and Methods

This study investigates the general public's perception of the Rooppur nuclear power plant in several areas. Specifically, it aims to explore the public's understanding of nuclear power generation, their level of acceptance of nuclear plants, and their perception of the associated risks. The BBC bazaar settlement area was purposefully selected for this study. The settlement is the nearest one within a 3 km radius of the Rooppur nuclear power plant and alongside its boundary wall (**Figure 1**). One reason for making this selection is that the government of Bangladesh has declared a precautionary action zone (PAZ) with a 3 km radius (**Figure 2**) around the Rooppur nuclear power plant (www.rooppurnnp.gov.bd). As a result, the people in these areas are more likely to be directly exposed to the environmental, health, and safety impacts of nuclear power plants. Therefore, it is crucial to understand their perspectives and risk-taking mindsets.

This study finds 452 households in the selected area through a reconnaissance survey, of which 314 are permanent residents. The rest are the tenants, dominated by groups of construction workers from the RNPP project. The tenants are temporary inhabitants of this area. This study incorporates several selection criteria for respondents, including the following: respondents must be over 18 years old, be a permanent resident of the selected area, have no professional relationship with the RNPP project, and be willing to participate in the study. Several essential rationales exist for determining the criteria for selecting respondents in the study. The study aimed to analyze the perspectives of ordinary and neutral individuals living near the RNPP, so that the respondents' experiences could relate to the project's impact. They can express their views

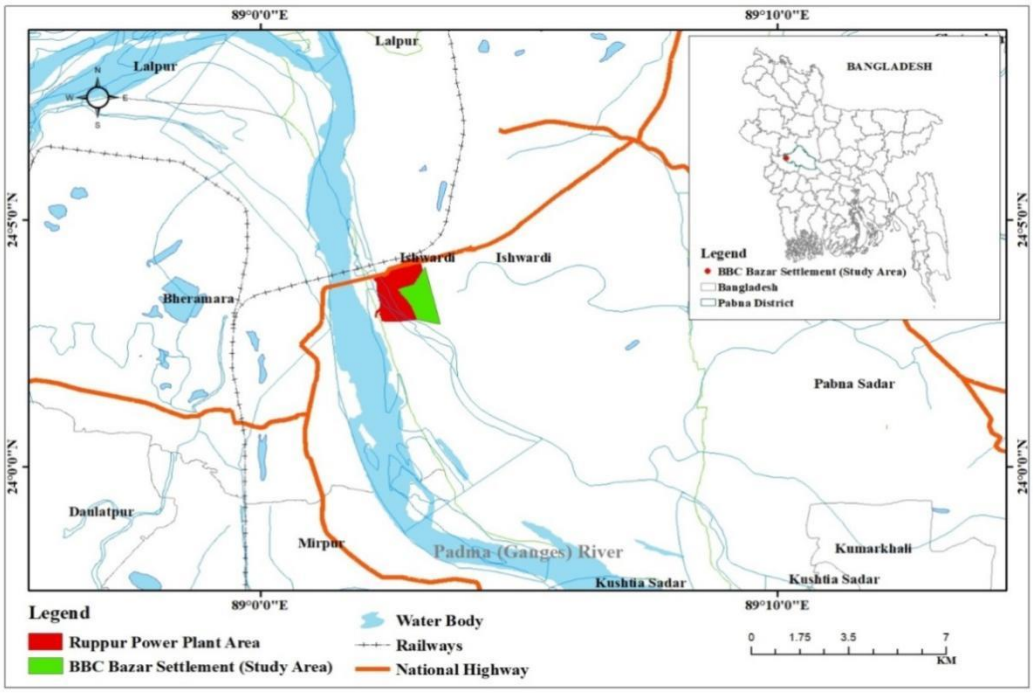

Figure 1: Location of the RNPP and the study area

Figure 2: Areas within a three-kilometer radius of Rooppur NPP on Google Maps.

as adult citizens. The possibility of self-interest or bias in providing information is minimized, the data collection process is ethically sound, and high-quality, credible data are obtained. The reconnaissance survey results in 83 respondents as the final sample size for this study. It also includes pre-testing the semi-structured survey questionnaire, which was developed in the local language. The study administered the questionnaire survey to the selected 83 households. Data were collected from any family member aged 18 years or older if the household head was absent from the household. The data collection, along with the reconnaissance, took place in November 2024. The initial part of the questionnaire focused on collecting socioeconomic details, including age, gender, educational attainment, household size, and income. The following section of the questionnaire focuses on respondents' perspectives regarding their energy preferences in light of fossil fuel scarcity, their views on nuclear power generation, their attitudes toward the RNPP, and their perceived risks associated with living near the RNPP. The survey statements and response (T**able 1**) formats have been developed from a literature review and categorized based on the findings from the questionnaire's pre-testing (Hosan *et al*., 2022; Islam *et al.*, 2021; Ahmed *et al*., 2020; Chung and Kim, 2018; Yuan *et al*., 2015; Chung and Yeung, 2013).

Table 1: Survey statements and response types

Category		Statement	Response
Acceptance of nuclear power plant	Nuclear energy perception	Preferences in energy policy	Low price/Continuous supply/Environmental protection/Public health/Climate change mitigation/Energy saving/Industrial development
		Concept of nuclear power generation	Adequate knowledge/Know a little/Heard of it/No idea.
		Idea of carbon emission from nuclear power plant	No/Yes
		Acceptance of construction of nuclear power plant to improve energy security	No/Yes
		Acceptance of construction of nuclear power plant to present location	No/Yes
		Causes of not accepting construction of nuclear power plant to present location	Chance of accident or leakage/Radioactive waste disposal challenges/Lack of awareness/Socio political condition
	Risk perception	Risk of living adjacent to nuclear power plant	Likert Scale
		Idea of accident/leakage	No/Yes
		Idea of the precautionary action zone	No/Yes
		Possible reactions in case of nuclear accident/leakage	Leave the place/Stay/Watch media news/Call natives and friends/Stock food/Sell stock/Call police/Do not know
		Level of confidence about the government to regulate the plant safely	Likert Scale

Plan of living	Intention to sell property	No/Yes
	Reasons behind property selling intentions	Poor financial condition/Risk of decreasing the value of property/Shifting of home due to risk of nuclear incident/To start a business to provide goods and services to nuclear power plant project workers to benefit
Benefit perception	Perceived benefits of Rooppur nuclear power plant	Improved energy security/Low carbon emission/Technological advancement/Employment opportunities

This study employs descriptive statistics and frequencies, along with the Chi-square test for significance, to illustrate the socio-demographic characteristics of the respondents. Additionally, bar charts and spider diagrams depict the frequency of preferences for alternative energy sources and risk perceptions. The respondents' perspectives on energy policy priorities are analyzed using Friedman's test for ranking and comparison. The study employs Microsoft Excel and SPSS version 26 software for statistical analysis. Several vital reasons justify the selection of the methodology used in this study. First, it was necessary to collect quantitative data to analyze the views, awareness, and risk perception of the local people near the RNPP, which was assessed accurately using a semi-structured questionnaire-based survey method. Second, the study aimed to gather the opinions of people within a specific area, so thorough area-based observation and the selection of respondents according to particular criteria were carried out to maintain the reliability and relevance of the data. Third, since the questionnaire included various response options (yes/no, Likert scale, preferred options, etc.), statistical analysis methods such as descriptive statistics, the chi-square test, and the Friedman test were employed. As a result, it was possible to analyze the data in a structured manner and determine the relationship between people's attitudes and socio-economic variables.

Results and Discussion

3.1 Demographic information of the respondents

The following section represents the socio-demographic characteristics of the respondents (**Table 2**). The mean age of the study participants was 36.49 years (SD = 11.8), with the majority of respondents aged 30-50 (54.2%). This indicates that the working and adult population was the leading group that expressed their opinion on nuclear power. The participation of women (61.4%) was higher than that of men (38.6%), indicating the importance of gender differences in the analysis of public opinion ($\chi^2 = 4.349$, P = 0.037).

Table 2: Demographic information of the respondents

Categories	Groups	Frequency	Percent	χ^2	P value
Age Mean=36.49, SD=11.8	Less than 30	31	37.3	26.699	<0.001
	30-50	45	54.2		
	More than 50	07	09.4		
Sex	Male	32	38.6		

	Female	51	61.4	4.349	0.037
	Below Secondary	33	39.8		
	Secondary	22	26.5		
Education	Higher Secondary	14	16.9	29.47	<0.001
	Undergraduate	7	8.4		
	Postgraduate or higher	7	8.4		
Family size	Less or equal to 4	47	56.6		
Mean=4.77, SD=1.734	More than 4	36	43.4	1.458	0.227
Monthly income of the	Less or equal to 30000	56	67.5		
households (BDT)	30001-50000	19	22.9	45.711	<0.001
Mean=31385.54, SD=22652.64	More than 50000	8	9.6		

The analysis of education levels shows that the number of people with lower secondary education is the highest (39.8%), followed by secondary education (26.5%), higher secondary education (16.9%), and only 8.4% hold undergraduate and postgraduate degrees. The number of people who have reached higher levels of education is relatively low, which may affect awareness of technology and science-based policies ($\chi^2 = 29.47$, $P < 0.001$). The mean family size is 4.77, with 56.6% of families having four or fewer members, reflecting the modern family structure. The income-based analysis shows that 67.5% of respondents earn less than BDT 30,000, 22.9% earn BDT 30,000-50,000, and only 9.6% earn more than BDT 50,000, indicating a preponderance of low-middle income earners and may influence the acceptability and economic viability of nuclear power projects ($\chi^2 = 45.711$, $P < 0.001$).

Table 3 represents the cross-tabulation results between suitable demographic variables. This study found no significant statistical association between the demographic variables.

Table 3: Tabulation of age group and level of education of respondents with sex

Categories	Groups	Sex of the respondents (%)	
		Male	Female
Age of the respondents	≤ 20	4.8	2.4
	21-30	4.8	25.3
	31-40	10.8	16.9
	41-50	12.0	14.5
	51-60	2.4	2.4
	> 60	3.6	0.0
The level of education of the respondents	Below secondary	13.3	26.5
	Secondary	13.3	13.3
	Higher Secondary	7.2	9.6
	Undergraduate	2.4	6.0
	Postgraduate or higher	2.4	6.0

3.2 Nuclear energy perceptions

The answer to the question about the preferable energy source against the scarcity of fossil fuel revealed that solar power is the ultimate choice of most respondents (68.7%). In contrast, nuclear power only has a valid percentage of 7.2. Table 4 provides the details about preferable energy sources. This choice depends on the number of approaches in the demographic categories (e.g., age, sex, education level, and family income). In contrast, it was found that all highly educated respondents (8.4%) preferred solar energy as both higher and lower income groups do not prefer an alternative source against fossil fuel scarcity and nuclear energy.

Table 4: Preferable energy source against fossil fuel scarcity

		Number of respondents and percentages			
Categories	Groups	Nuclear	Solar	Wind	Hydroelectricity
Age	≤ 20	2 (2.4%)	4 (4.8%)	0 (0.0%)	0 (0.0%)
	21-30	3 (3.6%)	18 (21.7%)	0 (0.0%)	4 (4.8%)
	31-40	1 (1.2%)	14 (16.9%)	1 (1.2%)	7 (8.4%)
	41-50	0 (0.0%)	15 (18.1%)	0 (0.0%)	7 (8.4%)
	51-60	0 (0.0%)	3 (3.6%)	1 (1.2%)	0 (0.0%)
	> 60	0 (0.0%)	3 (3.6%)	0 (0.0%)	0 (0.0%)
Sex	Male	1 (1.2%)	22 (26.5%)	2 (2.4%)	7 (8.4%)
	Female	5 (6.0%)	35 (42.2%)	0 (0.0%)	11 (13.3%)
Level of education	Below secondary	0 (0.0%)	25 (30.1%)	1 (1.2%)	7 (8.4%)
	Secondary	2 (2.4%)	12 (14.5%)	0 (0.0%)	8 (9.6%)
	Higher secondary	2 (2.4%)	9 (10.8%)	1 (1.2%)	2 (2.4%)
	Undergraduate	2 (2.4%)	4 (4.8%)	0 (0.0%)	1 (1.2%)
	Postgraduate or higher	0 (0.0%)	7 (8.4%)	0 (0.0%)	0 (0.0%)
Monthly income of the households	≤ 20000	0 (0.0%)	16 (19.3%)	1 (1.2%)	12 (14.5%)
	20001-30000	3 (3.6%)	21 (25.3%)	1 (1.2%)	2 (2.4%)
	30001-40000	3 (3.6%)	6 (7.2%)	0 (0.0%)	2 (2.4%)
	40001-50000	0 (0.0%)	6 (7.2%)	0 (0.0%)	2 (2.4%)
	> 50000	0 (0.0%)	8 (9.6%)	0 (0.0%)	0 (0.0%)

Respondents were asked to choose any three of Bangladesh's energy policy priorities out of seven options. After adding all the answers, this study found that continuous supply (85.5%, Rank 1), low price (81.9%, Rank 2), and environmental protection (57.8%, Rank 3) were the choices for the majority of respondents, and the ranking is statistically significant (Figure 2 and Table 5).

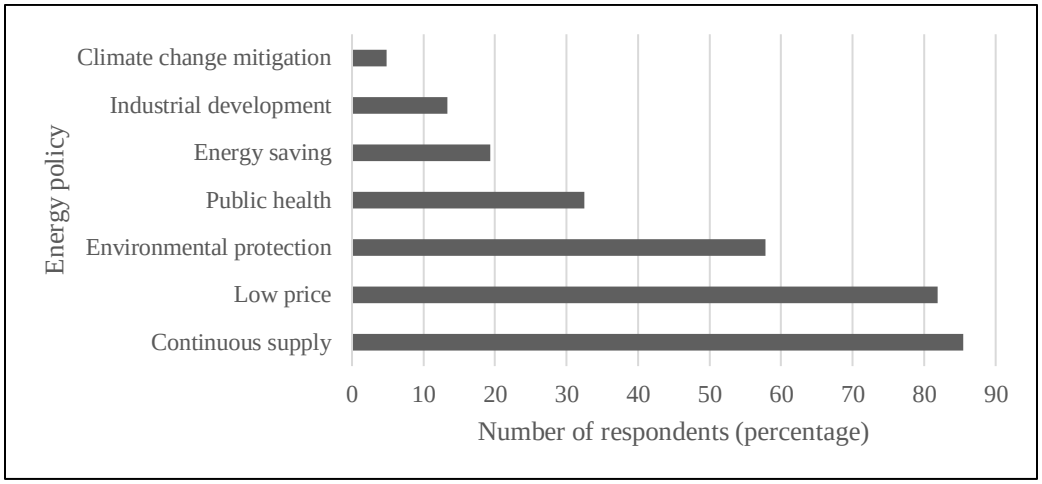

Figure 2: Energy policy priorities of the respondents

Table 5: Friedman's test of Energy policy priorities

Energy Policy Priorities	N	Mean Rank		SD	Friedman's Mean Rank	Chi-square	Sig.
Low Price	83	.82	2	.387	5.39	192.727	.000
Continuous supply		.86	1	.354	5.51		
Environmental protection		.59	3	.495	4.58		
Public health		.33	4	.471	3.66		
Climate change mitigation		.05	7	.215	2.69		
Energy saving		.19	5	.397	3.19		
Industrial development		.13	6	.341	2.98		

This study found 37 (44.6%) respondents who learned about nuclear power generation. Only 6 (7.2%) respondents answered that they have adequate knowledge about nuclear power generation. 22 of 37 respondents said that they had heard of it.

Table 6: Concept of nuclear power generation

Concept	Frequency	Percentage of total
Adequate knowledge	6	7.2
Know a little	9	10.8
Heard of it	22	26.5
No idea	46	55.4

Out of 37 (100%) respondents, 20 (54.1%) got the idea of carbon emission during the normal operation of a nuclear power plant. 9 (24.3%) of them are between 21-30 years of age. 15 (40.5%) females said yes to the question regarding the idea of carbon emission. Among the 20 respondents, 12 (32.1%) are from undergraduate and higher education groups.

Table 7: Concept of carbon emission from a nuclear power plant during normal operation

Categories	Groups	Respondents	
		No	Yes
Age	≤ 20	2 (5.4%)	2 (5.4%)
	21-30	2 (5.4%)	9 (24.3%)
	31-40	5 (13.5%)	4 (10.8%)
	41-50	5 (13.5%)	4 (10.8%)
	51-60	2 (5.4%)	0 (0.0%)
	> 60	1 (2.7%)	1 (2.7%)
Sex	Male	10 (27.0%)	5 (13.5%)
	Female	7 (18.9%)	15 (40.5%)
Level of education	Below secondary	2 (5.4%)	0 (0.0%)
	Secondary	5 (13.5%)	4 (10.8%)
	Higher secondary	9 (24.3%)	4 (10.8%)
	Undergraduate	1 (2.7%)	5 (13.5%)
	Postgraduate or higher	0 (0.0%)	7 (18.9%)
The monthly income of the households	≤ 20000	4 (10.8%)	1 (2.7%)
	20001-30000	6 (16.2%)	8 (21.6%)
	30001-40000	2 (5.4%)	4 (10.8%)
	40001-50000	2 (5.4%)	2 (5.4%)
	> 50000	3 (8.1%)	5 (13.5%)

3.3 Acceptance of construction of nuclear power plant

The question may arise as to why the issue of acceptance is coming up when the government is already constructing it. That is because of the safe operation of the nuclear power plant, as stated earlier in this study. According to the findings of this study, 27 (73%) out of 37 respondents said yes to a nuclear power plant to improve energy security. Cross-tabulation results are nothing special; the number of females is higher than prior perceptions due to several approaches (see Table 2).

Table 8: Acceptance of the construction of nuclear power plant to improve energy security

Categories	Groups	Respondents	
		No	Yes
Age	≤ 20	0 (0.0%)	4 (10.8%)
	21-30	3 (8.1%)	8 21.6%)
	31-40	4 (10.8%)	5 (13.5%)
	41-50	3 (8.1%)	6 (16.2%)
	51-60	0 (0.0%)	2 (5.4%)
	> 60	0 (0.0%)	2 (5.4%)
Sex	Male	4 (10.8%)	11 (29.7%)
	Female	6 (16.2%)	16 (43.2%)
Level of education	Below secondary	0 (0.0%)	2 (5.4%)
	Secondary	2 (5.4%)	7 (18.9%)
	Higher secondary	4 (10.8%)	9 (24.3%)
	Undergraduate	1 (2.7%)	4 (10.8%)
	Postgraduate or higher	3 (8.1%)	5 (13.5%)

Monthly income of the households	≤ 20000	2 (5.4%)	1 (2.7%)
	20001-30000	3 (8.1%)	11 (29.7%)
	30001-40000	1 (2.7%)	5 (13.5%)
	40001-50000	1 (2.7%)	3 (8.1%)
	> 50000	3 (8.1%)	5 (13.5%)

The next question concerned the acceptance of a nuclear power plant being constructed in the present location where they live. The acceptance of nuclear power plants in local areas can be affected by the inhabitants' 'not in my backyard' attitude (Yuan *et al*., 2015; Horst, 2007). In this study, a percentage of respondents, 73% (27 out of 37),oppose the nuclear facility in their locality. 7 (18.9%) of the respondents who accepted the power plant's presence at its current location are those who had only heard of nuclear power generation. Maybe it results from their lack of knowledge.

Table 9: Acceptance of nuclear power plant to present location

	Number of respondents accepting nuclear power plant to present location	
Concept of nuclear power generation	No	Yes
Adequate knowledge	4 (10.8%)	2 (5.4%)
Know a little	8 (21.6%)	1 (2.7%)
Heard of it	15 (40.5%)	7 (18.9%)

Respondents who did not accept the construction of a nuclear power plant in the present location were asked to choose the reasons behind it. This study found that all of them (100%) have chosen the chance of accident/leakage. After adding all the answers, the following figure represents the valid percentages of causes of not accepting the nuclear power plant to the present location. The ranking of causes obtained from adding all answers is statistically significant as per the outcomes of Friedman's test (table 10).

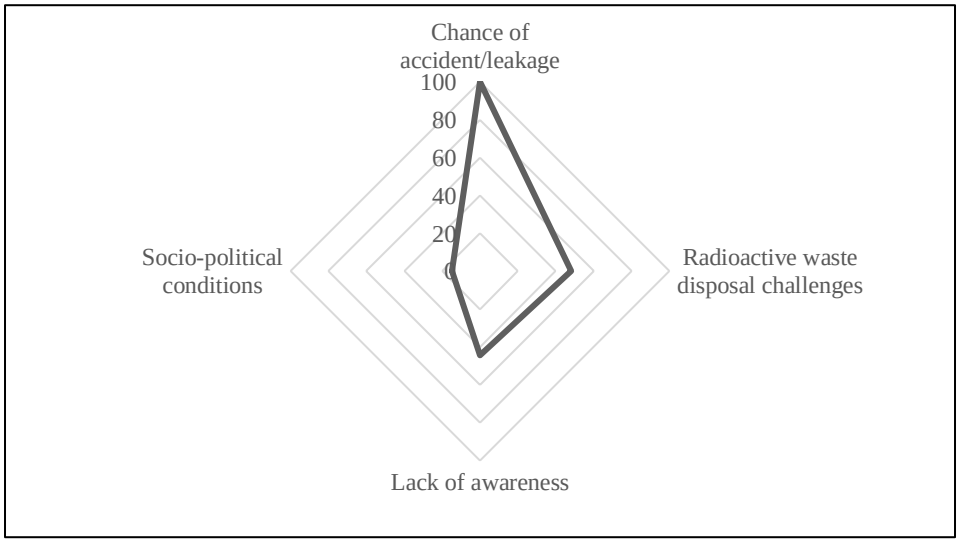

Figure 3: Causes of not accepting the nuclear power plant to present location

Table 10: Friedman's test of Causes of not accepting the nuclear power plant to present location

Causes	N	Mean	Rank	SD	Friedman's Mean Rank	Chi-square	P
Chance of accident/leakage	24	1.00	1	.000	3.42	40.364	.000
Radioactive waste disposal challenges		.54	2	.509	2.50		
Lack of awareness		.50	3	.511	2.42		
Socio-political conditions		.13	4	.338	1.67		

3.4 Risk perceptions

This study employed five questions (see Table 1) to investigate the risk perceptions of the people of Rooppur. The responses are cross-tabulated with the concept of nuclear power generation and represented in Table 11.

Table 11: Perceived risk of the people of Rooppur

Categories of responses	Groups	Concept of nuclear power generation		
		Adequate knowledge	Know a little	Heard of it
Perceived risk of living adjacent to the nuclear power plant	Very low risk	2 (5.4%)	0 (0.0%)	2 (5.4%)
	Low risk	0 (0.0%)	1 (2.7%)	4 (10.8%)
	Moderate risk	2 (5.4%)	4 (10.8%)	8 (21.6%)
	High risk	1 (2.7%)	4 (10.8%)	6 (16.2%)
	Very high risk	1 (2.7%)	0 (0.0%)	2 (5.4%)
Idea of accident/leakage	No	0 (0.0%)	0 (0.0%)	1 (2.7%)
	Yes	6 (16.2%)	9 (24.3%)	21 (56.8%)
Idea of PAZ	No	1 (2.7%)	5 (13.5%)	22 (59.5%)
	Yes	5 (13.5%)	4 (10.8%)	0 (0.0%)
Possible reactions in case of nuclear accident/leakage	Leave the place	5 (13.5%)	9 (24.3%)	14 (37.8%)
	Watch media news	1 (2.7%)	0 (0.0%)	4 (10.8%)
	Don't know	0 (0.0%)	0 (0.0%)	4 (10.8%)
Level of confidence about the government to regulate the plant safely	Very unconfident	0 (0.0%)	0 (0.0%)	0 (0.0%)
	Unconfident	2 (5.4%)	2 (5.4%)	4 (10.8%)
	Neutral	2 (5.4%)	5 (13.5%)	12 (32.4%)
	Confident	1 (2.7%)	2 (5.4%)	5 (13.5%)
	Very confident	1 (2.7%)	0 (0.0%)	1 (2.7%)

Table 11 reveals that only 24.3 percent of the respondents who have an idea of nuclear power generation know about the precautionary action zone (PAZ) and its activities. In case of any accident/leakage, 75.7% (28 of 37) will leave the area immediately, and 51.4% stayed neutral about the government's capability to regulate the nuclear power plant safely.

3.5 Perceptions of future plans for living

This study found that 35.1 percent (13 of 37) of the respondents intend to sell their properties due to three major reasons: 'risk of decreasing the value of property because of nuclear project',

'shifting of home due to risk of nuclear accident/leakage', and starting a business to provide goods and services to nuclear power plant project workers to benefit'.

Table 12: Property selling intentions

Categories	Groups	Respondent's intention to sell property	
		No	Yes
Concept of nuclear power generation	Adequate knowledge	4 (10.8%)	2 (5.4%)
	Know a little	7 (18.9%)	2 (5.4%)
	Heard of it	13 (35.1%)	9 (24.3%)
Monthly income of the households	≤ 20000	2 (5.4%)	3 (8.1%)
	20001-30000	12 (32.4%)	2 (5.4%)
	30001-40000	5 (13.5%)	1 (2.7%)
	40001-50000	2 (5.4%)	2 (5.4%)
	> 50000	3 (8.1%)	5 (13.5%)
Household owner's primary occupation	Service	7 (18.9%)	6 (16.2%)
	Business	9 (24.3%)	5 (13.5%)
	Agriculture	4 (10.8%)	0 (0.0%)
	Others	4 (10.8%)	2 (5.4%)

According to Table 12, the highest and lowest income groups are more likely to sell properties in the near future. They are mostly service holders and businessmen. Property selling is not an option for agricultural-based families due to their nearby agricultural lands.

Table 13: Causes of Property Selling Intentions

Category	Groups	Causes of property selling intentions (number of respondents)		
		Risk of decreasing the value of property because of nuclear project	shifting of home due to risk of nuclear accident/leakage	start a business to provide goods and services to nuclear power plant project workers to get benefited
Household owner's primary occupation	Service	1 (7.7%)	5 (38.5%)	0 (0.0%)
	Business	1 (7.7%)	1 (7.7%)	3 (23.1%)
	Others	0 (0.0%)	0 (0.0%)	2 (15.4%)
Monthly income of the households	≤ 20000	0 (0.0%)	0 (0.0%)	3 (23.1%)
	20001-30000	1 (7.7%)	0 (0.0%)	1 (7.7%)
	30001-40000	0 (0.0%)	0 (0.0%)	1 (7.7%)
	40001-50000	1 (7.7%)	1 (7.7%)	0 (0.0%)
	> 50000	0 (0.0%)	5 (38.5%)	0 (0.0%)

Shifting of home due to risk of nuclear accident/leakage is the reason behind property selling intension of the service holders and they are from highest income groups.

3.6 Perceptions of benefits

Improved energy security, low carbon emissions, technological advancements, and employment opportunities were the choices provided to respondents. The following figure represents the valid percentages of the respondents' choices after combining all the answers. Improved energy security, followed by low carbon emissions, employment opportunities, and technological advancement, are the perceived benefits of 37 respondents who have knowledge of nuclear power generation.

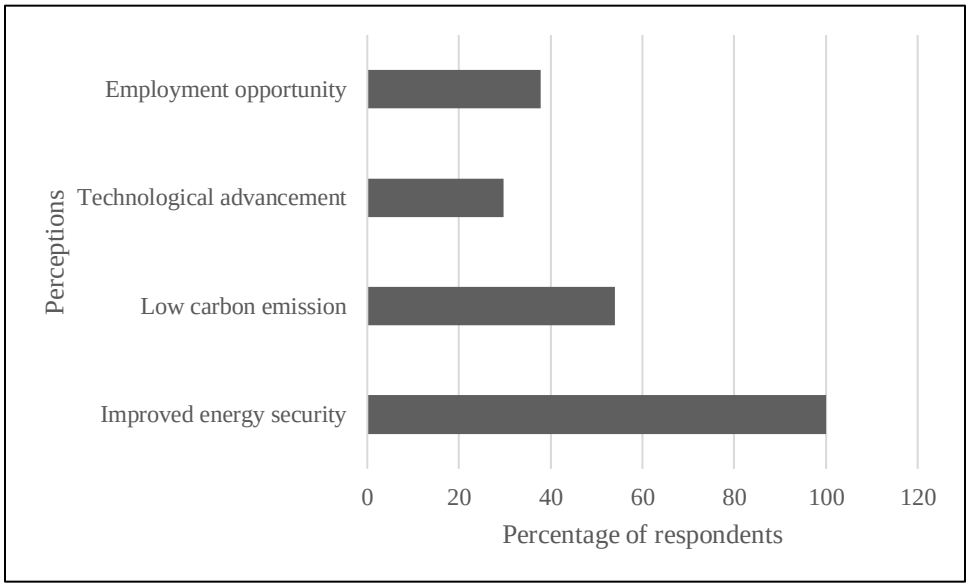

Figure 4: Perceived benefits of Rooppur nuclear power plant

Table 14: Friedman's test of Perceived benefits of the Rooppur nuclear power plant

Causes	N	Mean	Rank	SD	Friedman's Mean Rank	Chi-square	Sig.
Improved energy security	37	1.00	1	.000	3.39	45.849	.000
Low carbon emission		.54	2	.505	2.47		
Technological advancement		.30	4	.463	1.99		
Employment Opportunity		.38	3	.492	2.15		

Bangladesh faces the challenge of high population density, and this study highlights a lack of familiarity with nuclear radiation among its people. Concerns about the safety of nuclear power plants are not without merit. However, there are several compelling reasons why nuclear power could be a better fit for Bangladesh than other energy sources. Firstly, nuclear power plants require relatively small amounts of land, which is crucial in a country as densely populated as

Bangladesh, where preserving agricultural land for food production is of paramount importance. Secondly, investing in nuclear power plants, such as the Rooppur project, can catalyze raising awareness about nuclear radioactivity among the population. This knowledge will benefit the machinery and the people involved, enhancing safety measures. Thirdly, nuclear fuel is considerably more cost-effective than fossil fuels for generating electricity, making it a viable economic choice. Fourthly, nuclear power generation is known for its minimal environmental impact, as it does not contribute to pollution, ensuring a cleaner environment. Lastly, adopting nuclear reactors can open up new avenues for research and development, driving innovation and progress in the country. While concerns about nuclear safety are valid, the unique advantages of nuclear power make it a viable and potentially beneficial energy source for densely populated Bangladesh.

This study presents a comprehensive analysis of the perceptions, knowledge levels, risk-taking attitudes, and trust in the government of the local people living around the RNPP. In this section, various issues will be reviewed in the light of data analysis and interpreted in the light of existing theoretical frameworks and previous research. The study's results indicate that the people's main concerns include uninterrupted power supply, electricity price, environmental conservation, and public health. It was found that most respondents prioritized a low-cost and continuous power supply, which is consistent with the existing reality in Bangladesh's power sector (Ashraf and Islam, 2018). Although environmental conservation was also considered important, long-term issues such as climate change mitigation were given relatively low priority, highlighting the subconscious psychology of people and the reality of their daily needs. This trend is characteristic of developing countries, where meeting daily needs is the primary concern for people (Gulagi *et al.,* 2020). The study also found a direct relationship between the level of education and awareness of nuclear energy. Those with higher secondary or higher educational qualifications were more likely to be aware of nuclear power generation. On the other hand, awareness of this issue is minimal among those with only primary or lower secondary education. The finding suggests that educational background is important in science and technology-based projects. Similarly, higher-income families are generally more aware of the risks of this technology and are relatively more informed about emergency planning. However, it has been found from multiple sources that although many are in favor of nuclear power generation, they object to its construction in Rooppur—a classic 'Not In My Backyard' (NIMBY) response. They accept nuclear power as a potential means of national development, but do not want to take risks in their area. This observation is considered an important psychological barrier in any public attitude research related to development projects. Behind this are health risks, environmental impacts, concerns about possible accidents, and a lack of trust in the government. The study found that many individuals are unaware of emergency planning and awareness activities, particularly among those with lower educational attainment and lower incomes. The lack of knowledge is noticeable, and the finding is particularly worrying, as public awareness and preparedness are crucial safety nets regarding the risks associated with nuclear power projects. The study reveals that most people plan to leave the area in the event of an emergency. It suggests that panic is high among the general public, and there is a lack of realistic risk analysis. The study finds a moderate level of confidence in the government among the inhabitants regarding the regulation of the

RNPP. Almost half gave a neutral opinion on this issue, meaning they are unsure whether the government can safely manage the project. A significant portion of the respondents expressed distrust in the government regarding this issue. Transparent information sharing and awareness building through regular communication with the inhabitants can resolve the trust issue. Data analysis revealed that individuals who voted against the project had a relatively higher level of education and were more aware of the project's risks. On the other hand, less educated people gave relatively more support, which may also indicate limited access to information and the one-sided effect of government propaganda. The study also reveals that female respondents participated at a higher rate than men, which is a positive indication of the active involvement of women in rural society. Although there was no significant difference in knowledge about nuclear energy between men and women, women had higher risk perception and health-related concerns. Survey participants preferred solar energy the most as an alternative energy source, reflecting the public's positive attitude towards modern renewable energy. Young and middle-aged people are more supportive of solar energy, which could be an important indicator for future sustainable energy policies. Additionally, nuclear energy is the least popular due to safety concerns among inhabitants and a lack of comprehensive information. The results of the study are also consistent with previous international studies, such as in China, Korea, and several European countries, where almost identical trends in NIMBY attitudes, risk awareness, and trust in the government were observed (Yuan *et al*., 2015; Horst, 2007). This study has some important messages for the government. First, implementing nuclear power projects is not enough; instead, continuous campaigning, transparency of information, and provision of urgent training are necessary to increase public awareness. Second, direct communication and exchange programs should be initiated with the local people so they can be informed about the project activities and make informed decisions, rather than being influenced by fear or rumors. Third, the knowledge-based analysis observed among the educated and high-income groups needs to be incorporated into project-related policymaking. The study's limitations include a small sample size, a focus on a specific area, and a relatively short observation period. Future studies may encompass a broader scope, involve a larger sample size, and incorporate qualitative research to yield more in-depth and comprehensive results. Finally, although the RNPP is a significant step towards energy security and economic development in Bangladesh, the perspectives, risk perceptions, and trust of the local people involved are critical considerations. In light of this study, the government and relevant agencies should make the safety system user-friendly, increase public awareness, and ensure transparency in information about the project. Only then will the people genuinely enjoy the benefits of this high-tech development project, and national development will become more dynamic.

Conclusions

This study focuses on the RNPP in the country's Pabna district. The findings indicate that the local people's understanding of the project remains limited, particularly among less educated and lower-income groups. While some people consider nuclear power to be one of the future's energy solutions, most residents view the project with skepticism, especially given its current status. The "Not in My Backyard" (NIMBY) attitude is particularly noticeable here, where people acknowledge the role of nuclear power in national development and power generation, but are

reluctant to see it in their area. This view is consistent with global reality and highlights the importance of gaining social acceptance from local people before implementing any large-scale project. The data from this study indicate that most people prioritize three key aspects of the electricity supply system: uninterrupted supply, low prices, and environmental protection. Long-term issues, such as climate change, have not yet gained priority in the public consciousness, which can be a crucial guideline for policymakers. Solar energy is the most prevalent alternative source of electricity generation among respondents aged 18 to 49. This trend could play a helpful role in shaping future sustainable energy policies. Many people still fear and are uncertain about nuclear energy, mainly due to the lack of sufficient information, limited government propaganda, and the impact of past nuclear accidents. There is a lack of clear understanding among the public about what to do in the event of an emergency. Research has shown that in the event of a potential accident or leak, most people will prepare to leave the area, which is a direct result of panic and lack of information. This reality sends a clear message to the government that raising awareness among the people and training them in emergency preparedness is essential. Public trust in the government is limited. Almost half of the respondents expressed a neutral attitude, and a significant portion distrusted the government. The study has shown that educated and high-income people are relatively aware and can analyze risks rationally. Less educated people often form opinions based solely on propaganda or rumors. Therefore, targeted awareness campaigns among people of different social strata are necessary to implement nuclear projects successfully. The government's decisions, international agreements, and the perspectives, beliefs, and social acceptance of people are key to the sustainability of such development projects. In high-risk projects, such as nuclear power projects, it is dangerous to ignore the local people, as they are not just spectators but are also directly exposed to the risks. Their inclusion should be ensured at every stage of policy formulation, planning, and implementation. The RNPP is a revolutionary initiative and will play a significant role in Bangladesh's energy security. However, the local people's trust, knowledge, and preparedness are equally important. The government and relevant agencies should utilize the findings of this study to manage the project in a participatory, transparent, and humane manner. The project will be successful in the real sense only if the ordinary people's questions, concerns, and uncertainties can be removed. Above all, the study results indicate that any technological development project can become sustainable through infrastructural development, social acceptance, accountability, and gaining people's trust. This lesson applies not only to Rooppur but to all development projects in Bangladesh and should be considered a crucial step towards sustainable development.

Declaration of Interest

The authors have no competing interests to declare.

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