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Knowledge, Perception, and Solution Strategies toward Water Pollution Among Adult Residents of Birnin Kebbi, Nigeria

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ABSTRACT

Background and Objective: The pollution of water is a critical environmental and public health concern in Nigeria, especially in rapidly urbanizing areassuch as Birnin Kebbi. In this study, perceptions and knowledge of adult residents concerning water pollution and recommended measures against it were considered inthe Birnin Kebbi Area. **Materials and Methods:** A descriptive cross-sectional survey design was adopted to assess adult residents' awareness and responses to water pollution. A total of 114 adults (≥18 years) were randomly selected across wards using the Yamane sample size formula (10% margin of error) and surveyed with a validated structured questionnaire using a five-point Likert scale. Data were analyzed using SPSS v20 with descriptive statistics, and ethical approval, informed consent, anonymity, and voluntariness were ensured. **Results:** Results demonstrated that respondents had a good understanding about water pollution (overall mean = 1.91), identifying causes like sewage and waste runoff, industrial and agricultural effluents, and urbanization. Although less than 40% thought that the government is effectively addressing the issue, perceptions of water pollution were relatively high (ovaerall mean = 2.06), with many acknowledging its negative impacts on daily life, biodiversity and public health. Solution strategies were well recognized (total mean = 1.8), including proper waste disposal, water treatment, sanitation improvements, community-based activities, and enforcement of environmental legislation. **Conclusion:** The study reveals that while knowledge and potential solutions are relatively high, perception of water contamination as an immediate concern is moderate. Efforts in attitudinal change, environmental education, and governmental intervention to mitigate the problem are recommended which would help reduce further pollution of water and possible danger imposed on human health, particularly in Birnin Kebbi.

KEYWORDS

Adult residents, Birnin Kebbi, knowledge, perception, solution strategies, water pollution

INTRODUCTION

Water pollution is a major environmental and public health challenge globally, the magnitude of which is heightened in low-and-middle-income countries due to rapid urbanization, industrialization, and inadequate waste management[1]. Contaminated water creates many health hazards, including waterborne

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diseases such as cholera, diarrhea, typhoid, hepatitis, and schistosomiasis, which are significant health burdens among the vulnerable populations of many developing countries[2]. Beyond public health impacts, water pollution also disrupts aquatic ecosystems, impacting biodiversity and ecosystem services on which communities depend for food, livelihoods, and recreation[3].

With the advent of increased urban growth and industrial activities, most freshwater bodies in Nigeria are facing enhanced environmental stress. The poor practices associated with waste disposal, agricultural and livestock farming runoff, and unprocessed industrial effluents have resulted in deteriorated water qualities in a number of rivers, lakes, and wells[4]. In spite of these, community awareness and perception of water pollution are considered vital in shaping the responses of individuals and their collective actions toward its mitigation. Individuals who are more educated and better informed tend to exhibit behaviors that reduce environmental risk and align policy interventions accordingly, according to Kola-Olusanya *et al*.[5] and Zhang *et al*.[6].

Birnin Kebbi is the capital of Kebbi State in Nigeria. It faces challenges related to water quality, given sewage, industrial runoff, and rapid urban growth. In this regard, the design of community-led interventions and the implementation of policy will require an understanding of how residents think about pollution, what people know, and how they would tackle the issue. This research was carried out in a bid to understand how residents of Birnin Kebbi perceive water pollution, what they know about it, and what remedies they might support.

MATERIALS AND METHODS

Study area: The research was carried out between January to August 2025 in Birnin Kebbi, the capital of Kebbi State in Northwestern Nigeria (Latitude 12.45°N, Longitude 4.20°E). The city suffers environmental issues, which means flooding, water scarcity, deforestation, and pollution from poor waste management and urbanization, despite the River Niger providing essential water resources for domestic use, agriculture, and fishing[7].

Research design: The study utilized a descriptive cross-sectional survey in assessing the awareness and methods by which adult residents perceive and address water pollution. This research design fits well in providing insight into the studied variable measured in this research because this type of research captures data at one point in time[8].

Population and sample size: The target population consisted of the adult citizens of Birnin Kebbi above the age of 18 years. The study aimed to investigate 110 participants selected using the Yaro Yamane formula in calculating sample size[7]:

$$n = \frac{N}{(1+N(e^2))}$$

The formula expresses that n is proportional to the population size and inversely proportional to the margin of error.

- The value of n is calculated using the formula $n \propto 2N/e$.
- The margin of error in this study is 10%. A total of 114 respondents participated in the study.

where, n = Sample size, N = Population size, and e = Margin of error. This approach assumes a 95% confidence level and a 10% margin of error for this study.

Sampling technique: Random sampling techniques were used to draw participants from various wards in Birnin Kebbi; this was a means of giving an equal chance to all demographic groups.

Data collection instrument: The primary data collected through a structured questionnaire have been divided into four sections: (i) Socio-demographic characteristics, (ii) Knowledge about water pollution, (iii) Perception regarding water pollution, and (iv) Solution strategies for water pollution. In order to measure the responses, a five-point Likert scale (1 = Strongly Agree, 5 = Strongly Disagree) was used. The questionnaire was developed based on a literature review and expert consultation to ensure content validity.

Methods of data collection: The trained research assistants used the questionnaires to interview the respondents in person, both in their residences and workplaces. All participation was strictly voluntary, with informed consent received before data collection.

Data analysis: Data were coded and analyzed using SPSS version 20. Descriptive statistics such as frequencies, percentages, and mean scores were computed to summarize respondents' knowledge, perception, and solution strategies toward water pollution. The mean scores were interpreted based on the ranking on the Likert scale: 1-1.49 = Strongly Agree, 1.5-2.49 = Agree, 2.5-3.49 = Neutral, 3.5-4.49 = Disagree, 4.5-5 = Strongly Disagree[9].

Ethical considerations: Ethical approval for the study was obtained from the relevant institutional ethics committee. Respondents' confidentiality and anonymity were ensured, and participation was entirely voluntary, with the right to withdraw at any stage of the study.

RESULTS

Demographic characteristics of respondents: A total of 114 adults participated in the study. The majority of respondents (62.6%) were aged 16-25 years, followed by 31.3% aged 26-35 years. Only 2.6% of people were over 45 and between the ages of 36 and 45. Female respondents constituted 58.3% of the sample, while 37.4% were male, and 3.5% preferred not to disclose their gender. In terms of occupation, most respondents were students (51.3%), followed by employed (19.1%), self-employed (16.5%), and unemployed (11.3%). In terms of education, 1.7% had only completed primary school, 10.4% had completed secondary school, and 87.0% had completed postsecondary education. While some had lived in Birnin Kebbi for less than five to twenty years, the majority (34.8%) said they had been there for more than twenty years (Table 1).

Knowledge of water pollution: The respondents showed good levels of awareness regarding water pollution with a mean of 1.91 (agree). The respondents' views regarding the definition of water pollution are that 58.3% strongly agreed that water pollution is the contamination of water by dangerous substances that make water harmful to human and ecological life. The factors that contribute highly towards water pollution are sewage and dumpsites (43.5% strongly agree), industrial/livestock runoff (42.6% agree), agricultural runoff (46.1% agree), and urbanization (40.9% agree). Moreover, 51.3% of respondents strongly agree that water-borne diseases such as cholera, diarrhoea, dysentery, schistosomiasis, typhoid fever, and hepatitis may constitute a health hazard (Table 2).

Water pollution perception: The overall perception of water pollution among respondents was also positive, with a mean of 2.06 (agree scale). A significant number of respondents (36.5%) felt that water pollution is a serious concern in their locations, and 48.7% believed that water pollution profoundly affects their day-to-day life. Many respondents pointed out the reduction in aquatic biodiversity (44.3-49.6%) and believed that fighting water pollution involves personal responsibilities (43.5%). Only 38.3% believed that

Table 1: Demographic characteristics of the respondents

	Frequency	Percentage (%)
Age group of the respondents		
16-25 years	72	62.6
26-35 years	36	31.3
36-45 years	3	2.6
Above 45 years	3	2.6
Total	114	99.1
Gender of the respondents		
Male	43	37.4
Female	67	58.3
Prefer not to say	4	3.5
Total	114	99.1
Occupation of the respondents		
Student	59	51.3
Employed	22	19.1
Self employed	19	16.5
Unemployed	13	11.3
Total	113	98.3
Highest level of education		
Tertiary education	100	87.0
Secondary education	12	10.4
Primary education	2	1.7
Total	114	99.1
Period of leaving in Birnin Kebbi		
Less than 5 years	20	17.4
5-10 years	20	17.4
11-15 years	13	11.3
16-20 years	19	16.5
More than 20 years	40	34.8
Total	112	97.4

Table 2: Level of knowledge of the respondents in relation to water pollution

Statement	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Rank
Water pollution is the contamination of water by harmful substances, degrading water quality and rendering it toxic to humans and other organisms	67 (58.3)	40 (34.8)	3 (2.6)	2 (1.7)	1 (0.9)	1.5	1
Runoff from sewage and waste dump sites is a source of water pollution in your community	50 (43.5)	40 (34.8)	15 (13)	6 (5.2)	1 (0.9)	1.82	2
Runoff from industrial and livestock farming sites also contributes to water pollution in your community	33	49	17	13	0	2.09	2
Agricultural runoff contributes to water pollution in your community	27	53	21	8	2	2.14	2
Urbanization causes water pollution in your community	26	47	20	15	3	2.3	2
Cholera, diarrhea, dysentery, schistosomiasis, typhoid, and hepatitis are potential health risks associated with water pollution	59	46	6	2	1	1.6	1
Overall						1.91	2

SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree, Rank: SA = 1, A = 2, N = 3, D = 4 and SD = 5

the government is doing enough in fighting water pollution, although more than half (54.8%) believed that individuals should be held liable for contributing towards water pollution. Together with enhanced water organisms' death rates (50.4%) and the incidence of water-borne illnesses (47.8%), other manifestations of water pollution include alterations in water smell (52.2%), taste (53.9%), and color (53.0%) (Table 3).

Solution strategies for water pollution: With a mean of 1.8 (strongly agree), there was significant support from respondents towards viable methods in combating water pollution. The methods emphasized in this include trash disposal (44.3% agreed), conservation of water (53.9%), support of community efforts (52.2%), and improvement from the government in sanitation services (54.8% strongly agree). Emphasis was also put on support of hygiene instruction (51.3% strongly agree),

Table 3: Level of perception of the respondents on water pollution

Statements	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Rank
The rate of water pollution in your area is very high	15	32	33	26	6	2.79	2
Water pollution is a serious problem in your community	35	42	21	11	2	2.13	2
Water pollution has a significant impact on your daily life	37	56	9	5	3	1.91	1
Addressing water pollution is an individual responsibility in your community	32	50	13	15	3	2.18	1
Water pollution can disrupt the biodiversity of aquatic ecosystems	39	57	12	4	2	1.83	2
Water pollution can disrupt the biodiversity of aquatic ecosystems	44	51	11	4	2	1.83	2
Individuals should be held accountable for their role in water pollution	31	63	13	3	2	1.95	2
Individuals should be held accountable for their role in water pollution	36	52	14	9	2	2.02	2
The government is doing enough to address water pollution	16	44	18	25	19	2.71	3
There is need for proper treatment of water collected directly from the water body before consumption	64	39	8	2	2	1.54	1
Lakes, rivers, and wells are the main sources of drinking water in our community	23	45	23	17	5	2.43	2
Changes in the odor of water indicate that it is polluted	40	60	5	4	2	1.81	2
Changes in the taste of water indicate pollution	32	62	4	14	1	2.03	2
Changes in the color of water are a symptom of pollution	31	61	12	6	2	1.99	2
A high mortality rate of aquatic organisms indicates that a water body is polluted A high mortality rate of aquatic organisms indicates that a water body is polluted	30	58	17	5	1	2	2
Outbreaks of water-related diseases in the community indicate that surrounding water bodies are polluted	40	55	14	3	1	1.85	2
Overall						2.06	2

SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree, Rank: SA = 1, A = 2, N = 3, D = 4 and SD = 5

Table 4: Solution to water pollution problems

Statements	SA (%)	A (%)	N (%)	D (%)	SD (%)	Mean	Rank
Reducing plastic use can help decrease water pollution	28	47	23	9	3	2.2	2
Proper waste disposal can help reduce water pollution	50	51	4	3	3	1.72	1
Water conservation is an effective way to reduce water pollution	35	62	10	4	4	1.85	2
Supporting community-based initiatives can help reduce water pollution	38	60	9	1	3	1.84	2
The government should improve sanitation and hygiene services to enhance water quality.	63	43	3	1	1	1.5	1
Promoting good hygiene through education can help reduce water pollution	59	42	3	5	3	1.67	1
Recycling waste materials can help reduce water pollution in your community	43	54	8	4	3	1.84	2
The government should implement regulations or policies to address water pollution	50	53	2	4	2	1.69	1
Water treatment before release into the environment or water bodies can prevent pollution	55	41	9	6	_	1.69	1
Water quality monitoring is an effective method for controlling water pollution	41	52	10	7	1	1.87	2
Enforcement of pollution control laws is an effective method for managing water pollution	48	51	7	4	_	1.7	1
Investing in wastewater treatment plants is an effective strategy for controlling water pollution	43	55	10	1	3	1.8	1
Minimizing the use of pesticides, herbicides, and fertilizers can help reduce water pollution	36	53	18	4	_	1.91	2
Septic tanks are an effective way to treat sewage by separating solids from liquids	39	59	9	3	2	1.84	2
Agricultural wastewater treatment and erosion contro at construction sites can help prevent water pollution	41	53	11	4	_	1.8	1
Septic tanks are an effective way to treat sewage by separating solids from liquids	39	59	9	3	2	1.84	2
Agricultural wastewater treatment and erosion control at construction sites can help prevent water pollution	41	53	11	4	_	1.8	1
Overall						1.8	1

SA = Strongly agree, A = Agree, N = Neutral, D = Disagree, SD = Strongly disagree, Rank: SA = 1, A = 2, N = 3, D = 4 and SD = 5

recycling (47.0% agreed), enforcement of laws in controlling pollution (44.3% agreed), and support in the provision of wastewater treatment infrastructure (47.8% agreed). Other approaches emphasized by the respondents include treatment of water before disposal or release into the environment, surveillance over water quality status, no use of agro-chemicals, and use of methods in eradicating wastage in agriculture (Table 4).

DISCUSSION

The research examined the level of knowledge, perception, and possible solutions regarding the water contamination issue among the residents of Birnin Kebbi in Nigeria. The data reveal that the respondents possess generally high levels of awareness and understanding regarding water contamination.

Based on the demographic information, most respondents were females aged 16-25 years with a high level of post-secondary education. Since increased awareness of environmental matters has been linked with age and educational levels, this may be a contributing factor to the relatively high levels of environmental knowledge exhibited by the respondents[5,9]. The dominance of students in this level of awareness indicates that environmental awareness campaigns in educational institutions may be key in changing the attitude of the environmental concern exhibited in the community.

The respondents demonstrated accurate awareness regarding the primary causes of water pollution from sewage, industries, animal husbandry, agriculture, and urbanization. The above-mentioned research outcomes support other research conducted in other communities across the regions of Nigeria, in that human sources were viewed as the most significant cause of freshwater pollution[3,4,10]. In addition, the identification of waterborne ailments, such as cholera, diarrhea, and typhoid, illustrates that participants were aware of the health issues generated through freshwater.

The concern about water pollution as a serious issue affecting people's daily lives was also manifested. Participants recognized the concern of individual responsibility as well as the impact of water pollution on water ecosystems. But less than half agreed that the government was doing enough on the issue of water pollution. Similar conclusions were drawn in other parts of Nigeria, where people regarded the government's effort as inadequate[6,11].

Several measures were cited by participants as necessary if water pollutants were to be controlled, such as waste disposal, water conservation, encouraging communally driven projects, improvements in governmental sanitation, education on hygiene, recycling, compliance with legislation that bans water pollution, and investment in waste treatment. Such measures align well with the global best practices frameworks for the sustainable use of water as well as the control of pollutants[1,12,13]. This two-part focus seems ripe with communally driven projects.

CONCLUSION

Studied individuals demonstrate sound knowledge levels of the sources of water pollution. Participants exhibited positive views on water pollution, recognizing its significance as well as its effects, together with acknowledging their responsibilities. Moreover, this study identified that the public is aware of the solutions associated with waste management, water conservation, community-based projects, compliance with environmental laws, and the treatment of wastewater before discharge. The report recommends increasing public education on water pollution, improving governmental enforcement of policies related to sanitation and water pollution control, as well as greater public involvement through cleanup programs. Again, focus is placed on improvements such as infrastructure development for wastewater treatment facilities, agricultural practices, as well as periodic testing, complemented by further studies on the effects of water pollution. By this, better management of the environment, as well as public health, would be achieved. Again, this will also address the environmental issue in the city of Birnin Kebbi.

SIGNIFICANCE STATEMENT

This study provides empirical evidence on adult awareness, perceptions, and mitigation preferences regarding water pollution in Birnin Kebbi, Nigeria. The findings inform policymakers, environmental agencies, and public health practitioners about existing knowledge gaps, governance weaknesses, and community priorities. By linking perception with practical solutions, the study supports targeted environmental education, improved sanitation planning, and strengthened regulatory enforcement to reduce water contamination and associated health risks in rapidly urbanizing settings nationally.

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