Causes and Health Effects of Water Pollution in Domestic Water Sources in Hadeija Metropolis, Nigeria, using Statistical Modeling

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ABSTRACT

In developing countries, water for domestic purposes is initially contaminated or polluted at source and it is a way of transferring waterborne diseases among the local community. The research objectives are to evaluate the causes of water pollution in domestic water sources at Hadeija metropolis, Nigeria, and the impact of use of polluted water for domestic purposes on the health and safety of the immediate community. Secondary information and primary data were used for this study, while simple statistical method (percentages and charts) were used for the analysis of the data. The results showed that about 48% of the community obtained their domestic water from the tap and that 80% of the respondents were aware that the water they use was likely contaminated from the sources. The impact of domestic water pollution on public health of the community indicated that typhoid and cholera are the dominant diseases caused by the use of contaminated water in the study area. There is dire need to formulate a new strategy to reduce contamination of domestic water at source and also to create awareness for boiling domestic water before use.

Keywords: Causes, domestic water, effects, water contamination, Hadeija metropolis

INTRODUCTION

Water is regarded as polluted when there is change in its quality or composition, either directly or indirectly, as a result of both natural and human activities, such that it becomes unsuitable for domestic uses, agricultural, fisheries or any other purposes for which it would otherwise be quite suitable in its normal or uncontaminated state [1]. One of the most important needs of living things is water because of its significance to human and other biological organisms [2]. After air, water is the most vital requirement for sustainance of life. Pollution in a natural way is not very serious with water, as the pollutants get assimilated by water. Water pollutants bring about physical and chemical changes not only in the surface water, but also in the ground water [3]. Water is not suitable for consumption if it has biological organisms like guinea worms, tape worms, cholera and typhoid-creating bacteria and excess chemicals such as fluoride, iron, arsenic and nitrate. The pollutants are usually pathogens, silt and suspended solid particles such as soils, sewage materials, disposed foods, cosmetics, automobile emissions, construction debris and eroded banks of rivers and other waterways [4]. Some of these pollutants are decomposed by the action of micro-organisms through oxidation and other processes [5].

Pollution that affects water comes mainly from industries, farms and sewage systems [6], but in developing nations, water becomes polluted from the sources after pumping. The common sources of water that are available to local communities in Nigeria are fast being severed by a number of anthropogenic factors, of which pollution remained the most dominant problem. There is a closer link between pollution and health damages. Five million people die each year because of polluted drinking water, poor sanitation and domestic unhygienic around the world [7]. In African countries, Nigeria in particular, water related diseases had been interfering with basic human development [8]. There are numerous scientific and economic facts that water shortage or its pollution can cause severe decrease in productivity and death of living species [9]. In Nigeria today research indicated that majority of the common fresh water sources are polluted, resulting in serious outbreak of diseases [10]. The major issues of national and international interest are how these water pollution problems could be fully assessed and mitigated. Proper knowledge and planning are thus essential [11].

In 2005, the National Council on Water Resources (NCWR) recognized the need to urgently establish acceptable Nigerian standard for drinking water quality because it was observed that

the "Nigerian Industrial Standard for Potable Water" developed by Standards Organization of Nigeria and the "National Guidelines and Standards for Water Quality in Nigeria" developed by Federal Ministry of Environment did not receive wide acceptance by all stakeholders in the country. Since water quality issues are health related issues, the Federal Ministry of Health, collaborating with the Standards Organization of Nigeria and working through a technical committee of key stakeholders developed standards for effective protection of public health against water related diseases and standards for protection of water sources from potential sources of contamination [12].

In Hadejia metropolis, concerns had been expressed at the high level of construction of solar and electric motor pumps at political wards which were not connected to water pipeline. Similarly there had been no construction of modern water units.

This research paper therefore aims to examine the sources of domestic water in the study area with emphasis on the various causes of domestic water pollution. The article also examines the health effects due to contamination of domestic water supply.

Material and Methodology

Study Area

Hadejia is an Hausa town in eastern Jigawa State, northern Nigeria, and is also geographically located between latitude and longitude of 12.4506° N, 10.0404° E. The population was approximately 105,628 in 2006 with 2.94%/year with projected population of 139, 400 in 2016. The town lies to the north of the Hadejia River, and is upstream from the Hadejia-Nguru wetlands, an internationally important ecological and sensitive zone. Hadejia is a center for rice and wheat farming and is strong in poultry, fish and animal farming. The average maximum and minimum temperature and precipitation recorded as 2016 and 2017 was (34.6^0c and 21.5^0c with 177.7mm as 2016) and (35.5^0c and 21.1^0c with 274.1mm as 2017)[13].

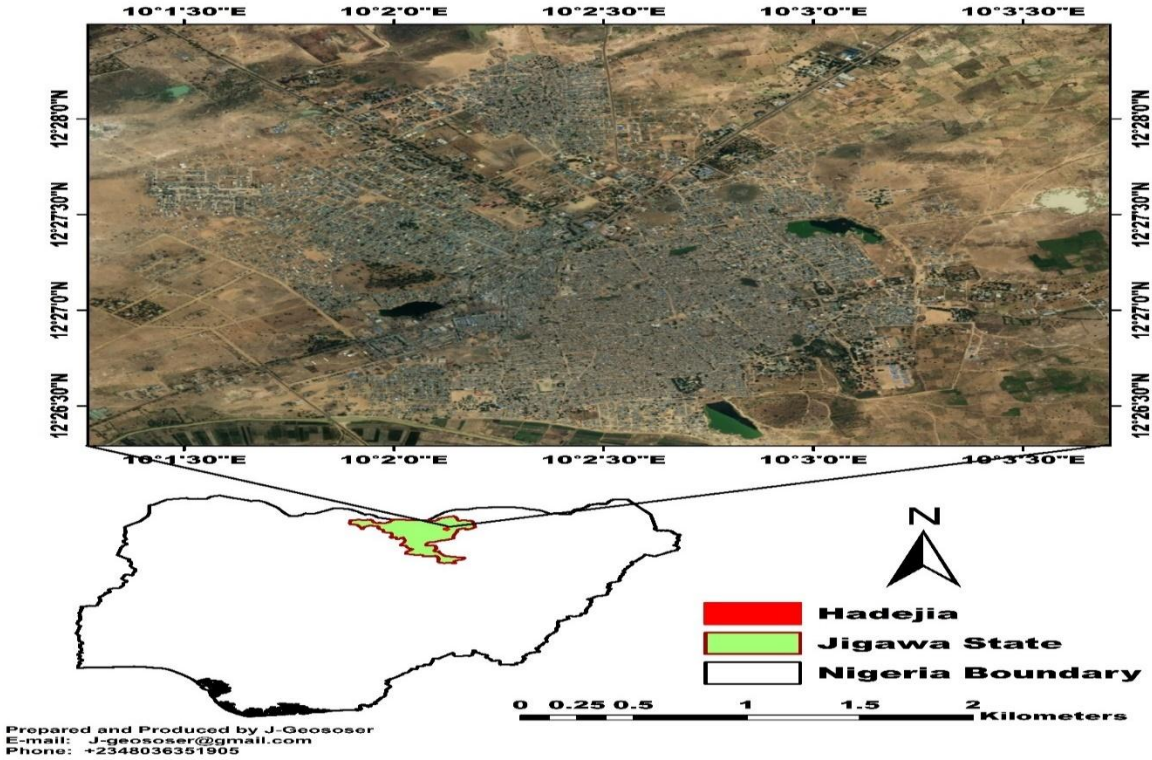

Figure 1: Study Area Map.

The study was carried out between June and July, 2016 in Hadejia Local Government Area. Primary and secondary data were used. Secondary data were collected from journals, newspapers, books and electronic sources. Primary data were collected from the questionnaire survey in the study area. The number of samples was 150 respondents. In the study area there are 11 political wards but 10 wards were selected for the questionnaire distribution and in each ward 15 respondents were selected. Purposive random sampling techniques were used in the study at the time of primary data collection with well-designed interview schedule. Chi-Square ($\chi 2$) test was performed using GraphPad Prism version 6.07, with the test hypothesis below:

- There is no significant relation between polluted domestic water from sources and people affected by polluted domestic water H_0 (Null Hypothesis).
- There is significant relation between polluted domestic water from sources and people affected by polluted domestic water H_1 (Alternative Hypothesis).

Figure 2:Some of the sources of domestic water and poor pipelines network in the study area

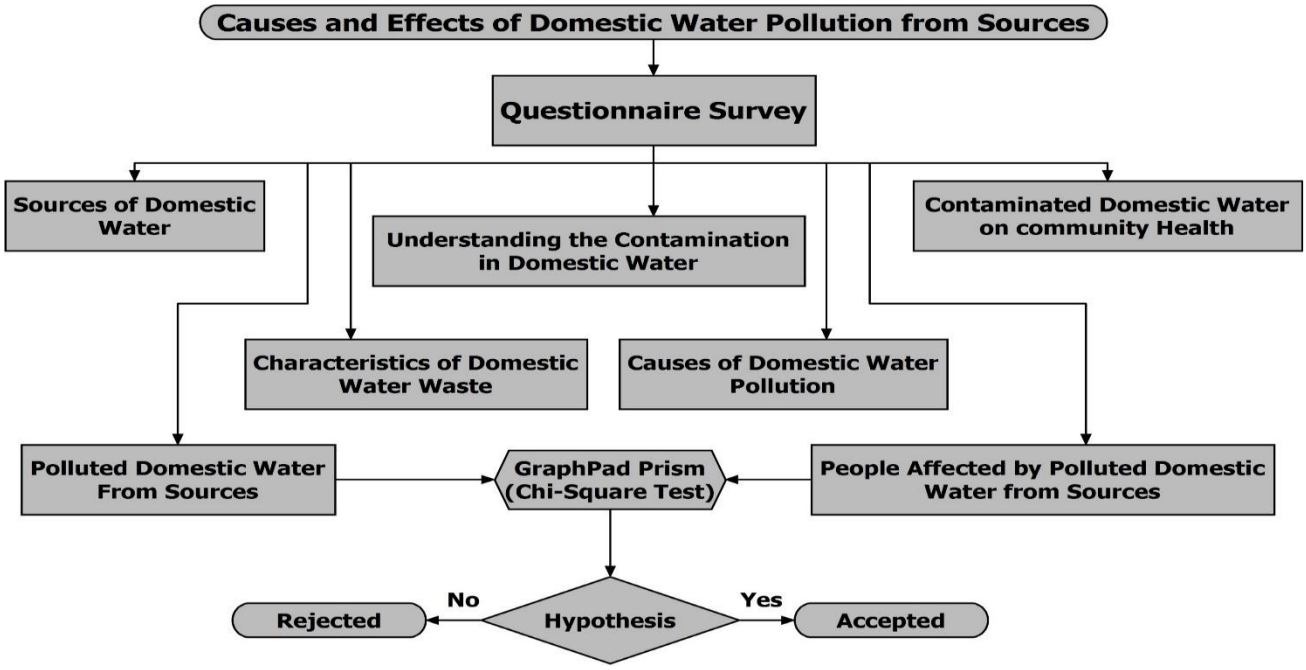

Figure 3**:** Methodological Flowchart

Data analysis

Data was analyzed using simple statistical method (percentages and charts) and Chi-Square test (GraphPad Prism Version 6.07).

RESULTS AND DISCUSSION

Table 1gives the educational status of the respondents. It shows that 46.7 percent of the respondents attained tertiary level of education and only 10 percent of the respondents had primary level of education. From analysis, it is safe to state that the respondents' educational status in the study area was quite satisfactory for understanding the causes of domestic water pollution and health effects on the immediate community.

Table 1: Educational status of the respondents

RESPONDENT	FREQUENCY	PERCENTAGE
Primary	15	10%
Secondary	45	30%
Tertiary	76	46.7%
Other	20	13.3%
Total	150	100%

The educational status is a variable for analysis of causes of pollution of domestic water sources. It is also through which the effects on health of water contamination on domestic water use could be understood [5]. This will help to get satisfactory information that would reduce bias in the study.

Majority of the respondents (80%) stated that there was pollution in the domestic water sources due to penetration of sewage water into the water pipelines and it was further observed that only 20% of the respondents thought that the water was unpolluted.

Figure 4 indicated that 48% of the respondents got their domestic water from the tap and 9.00 % from the river. This was because they were living in the northern part of the study area which had border with River Hadejia. Nonetheless, 23 % acquired their domestic water from borehole and 20% of the respondents indicated'others'as their sources of domestic water.

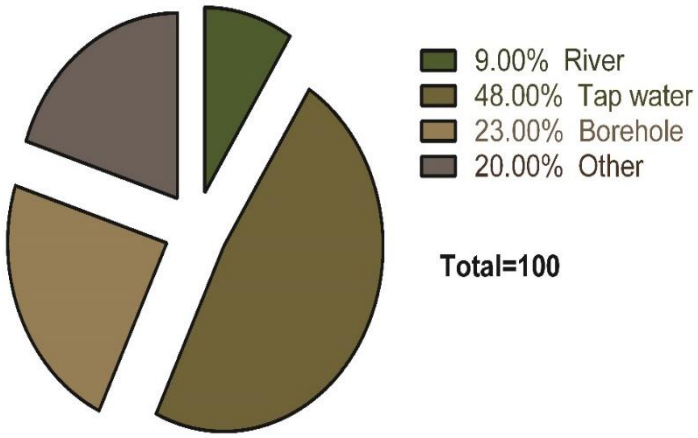

Figure 4: Sources of domestic water in Hadeija metropolis

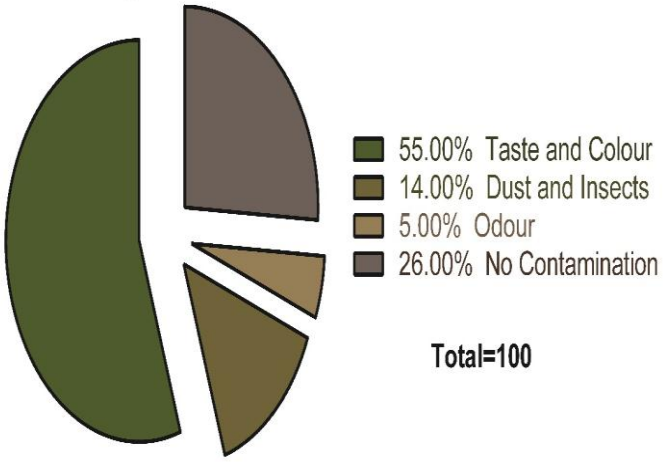

Figure 5: Understanding the contamination

Understandingwater contamination based on colour

Water colour was taken as a variable for analysis, through which contamination of the domestic water can be ascribed. From Figure 5, it is known that almost 18% of the respondents stated that their water colour was yellow, 14% of the respondents realised their domestic water was brown colour, and 21.3% of the respondents had found their water in black colour; 46.7% of the respondents said that their domestic water acquired from source was colourless.

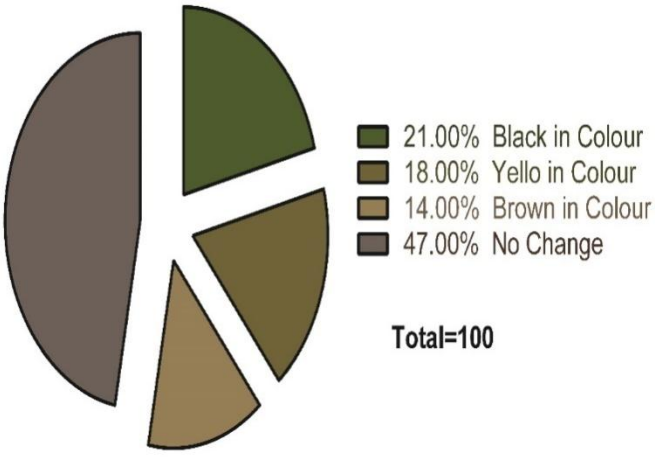

Figure 5: Understanding water contamination based on colour

In Table 2, 81.3% of the respondents stated that their domestic water was already contaminated from source. In Figure 6, 55% of the respondents reported that their water source was contaminated through taste and colour; 14% of the respondents said that there was contamination

with dust and insects, while 5% of the respondents understood water contamination through odour; and 26% of the respondents said that their water was not contaminated.

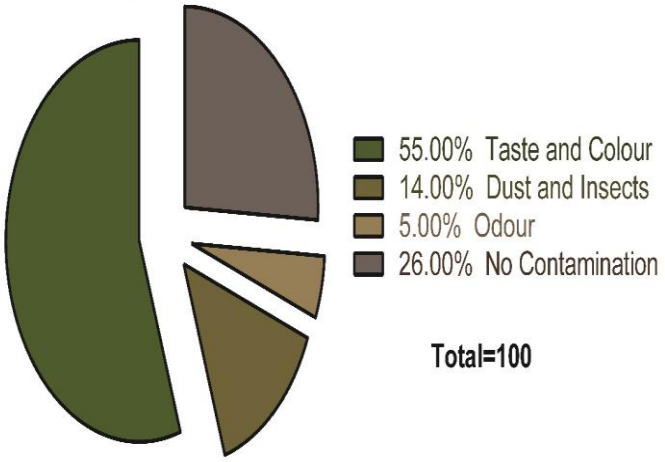

Figure 6: Understanding the contamination

Table 2: Problem at the Source of Domestic Water site that makes it polluted

RESPONDENT	FREQUENCY	PERCENTAGE
Yes	122	81.3%
No	28	18.7%
Total	150	100%

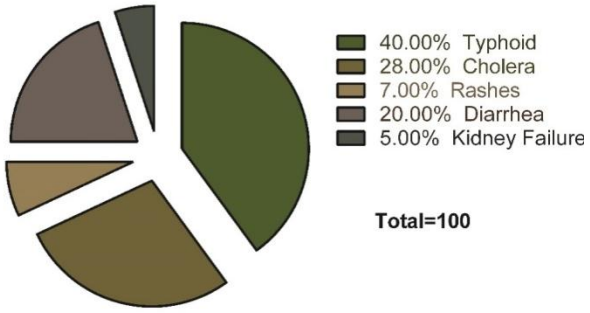

Figure 7: Contaminated Water Impact on Community health

People affected by diseases were considered as a variable for this study, through which the types of diseases caused by contamination in the domestic water sources were recognized. This helps to acquire satisfactory information that would reduce bias because pollution in water acts as causative agent in spreading water born disease [3]. From Figure 7, it was noted that 40% of the respondents said that their family members were affected with typhoid fever through

contamination in the domestic water. About 28% of the respondents said that their family members were affected with cholera; 20% of the respondents said that diarrhoea was the most common disease caused through contamination in the domestic water, while 7% of the respondents said that rashes was one of symbols that affected their family after use of polluted water, and the remaining 5% of the respondents said problems of kidney failure was because of use of contaminated water in the study area.

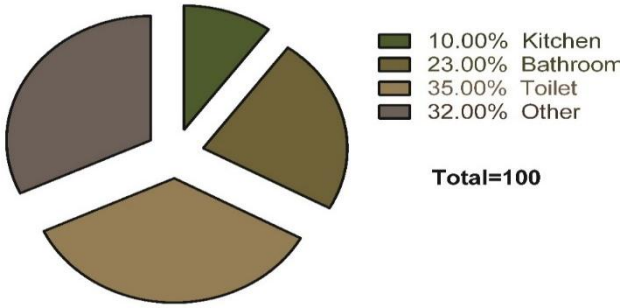

Figure 8: Characteristics of sources of domestic water contamination

Figure 8 indicated that 35% of the respondents stated that toilet water waste product was the major characteristic of domestic water waste in the study area; 10% of the respondents stated that kitchen waste water contributed towards contamination of domestic water; 23% stated that water from bathroom contaminated domestic water source. Nevertheless, 32% of the respondents indicated 'Others' as characteristics of domestic water waste.

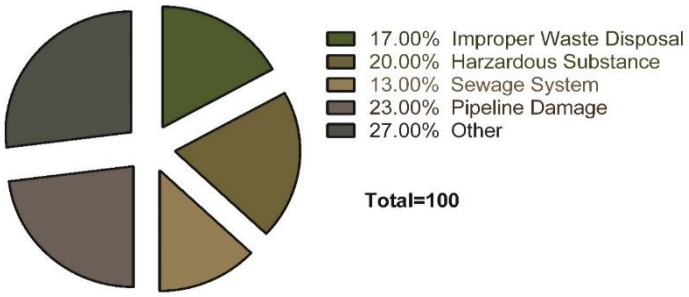

Figure 9: Causes of domestic water pollution in study area

Figure 9 shows that 20% agreed that the main cause of water pollution in the area are hazardous substances, 13.3% are sewage system, 23% are pipeline damage and 27% indicated other causes of domestic water pollution.

Table 3: Domestic water pollution protection programme

RESPONDENT	FREQUENCY	PERCENTAGE
Yes	139	92.7%
No	11	7.3%
Total	150	100%

In Table 3, Majority of the respondents (92.7%) of the respondents noted that there was no domestic water pollution programme in the study area either by Government or any civil society organization.

Table 4: Domestic water treatment before used in study area.

RESPONDENT	FREQUENCY	PERCENTAGE
Yes	65	43.3%
No	85	56.7%
Total	150	100

While Table 4, indicated that 43.3% of the respondents treated the water before domestic use. However, 56.7% used the water directly without any form of treatment.

Table 5: Test Statistics

	Polluted domestic water from sources		
Category 1	Observed	Expected	Residual
Yes	108	75	33
No	42	75	-33
	People Affected by Polluted Domestic Water		
Category 2	Observed	Expected	Residual
Yes	120	75	45
No	30	75	-45
		Category 1	Category 2
Statistical Analysis	Chi-Square	15.26	29.67
	d.f	1	1
	p.v	0.0001	0.0001
	z	3.906	5.444
	s.s	yes	yes

Note: d.f means degree of freedom, p.v means P value, z means Z value, and s.s means Statistical significant.

From Table 5, the minimum expected value frequency is 75. The Chi-square analysis outcome of this study described high significant relations between the contamination of domestic water from sources and people affected by the use of polluted water and it is statistically significant at 99% level of confidence. Therefore, alternative hypothesis is accepted and null hypothesis (Ho) is rejected.

CONCLUSION

The results of this study conducted based on the questionnaire survey and Chi-square test indicated strong relations between the contamination of domestic water from sources and people affected by the use of polluted water. The research findings show that almost 81.3% of the respondents expressed that their domestic water was polluted either from the main source (Water Pump center) or from domestic water source units (Political wards), and also that the water affected community health and safety. It was observed that water pipelines are running through drainage and that water units for domestic purposes were constructed close to drainage. To reduce contamination of domestic water from sources, it is recommended that construction of domestic water supply pump units within quarters should be avoided. It is better to connect it with water link pipeline as a booster. However, construction of proper designed domestic water supply units and regular sanitary practices in and around the sources must be maintained. Health is very important for increasing the standard of living. Hence, the optimal solution to overcome the issue is to have separate water pipeline in one side and in another side the drainage and other amenities can be established. The study also suggested that filtering and boiling domestic water (especially for drinking purposes) before use, is significant and will reduce waterborne diseases.

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