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Liquid Waste Management in Nigerian Brewery: A Perception Based Study

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Abstract

Wastes disposal and management has remained a huge challenge for city managers in the face of rapid urbanization as is evident in most African cities. In Nigeria, this has presented serious environmental problems in recent years. The study examined residents' perception on the effects of liquid waste on the environment, whilst gauging these perceptions with the analysis of water samples from the brewery's point of discharge, neighbourhood surface and ground water to determine physicochemical quality using p^H, Bio-chemical Oxygen Demand, and content level parameters. The study revealed that Ibadan brewery possesses an effluent treatment plant for treating liquid wastes being generated. Nonetheless, the physicochemical properties of the water sampled show that surface water was contamination of by brewery effluent. Also, respondents believe liquid waste from the brewery affects the water quality of the community. The study recommended that management of industries adhere strictly to environmental regulations guiding waste management.

Keywords: Perception; Liquid waste; Industrial activity; Effects; Physio-chemical.

1. Introduction

The start of the industrial revolution in 1760s in Europe introduced series of events; one of the most defining and lasting of them was the rise of cities. As migrants began to move from countryside, small towns became large cities. Even though the new industries became sources of wealth for the migrant population, working-class neighbourhoods became bleak, crowded, dirty, and polluted. Initially, no laws to regulate the new industries and the free-market capitalism existed. Later, attempts at regulation – workers' welfare and waste management, began to emanate in earnest in late 19th century, thus, inspiring industrial waste management among others. This narrative is not far-fetched from accounts of industrialization induced rapid urbanization, or in a colloquial sense – suburbanization, in Nigeria. For example, Olusegun, Opeagbe and Amusat (2018) noted that population explosion coupled with series of commercial activities accounts for the myriad of people migrating to Ibadan; the largest city in Western Africa. Urban centers in Nigeria like never before are being compelled to accommodate a teeming population. These urban centers are also witnessing an increase in industrial development which is beneficial for a thriving economy on the one hand and detrimental to the environment through environmental pollution from waste generated on the other hand. Despite the fact that economic contribution of industrial developments to urban areas cannot be overemphasized, their attitude to waste generation and management must not be undermined, for reason ranging from human health to environmental safety.

Even though industrial development, precipitous urbanization, population increase and enhanced living standard of communities have greatly contributed to fast-tracking the rate of municipal waste generation in developing countries such as Nigeria (Jagdeep et. al., 2014; Debnath et al., 2015; Alice et. al., 2016), waste generation from industries has remained a cynosure of attention for municipal waste management agencies, majorly due to the high chemical concentration of their by-product. As industrial production capacity grow, the production and emission of industrial wastes usually in form of solid, liquid, gas or air-borne particulate matter, increases. Regrettably, in countries where industrial waste management regulations are enforced with carrot treatment more often than not, emitted industrial waste find their resting place in the environment through deliberate or accidental emission. Lending credence to this narrative, Ajayi (2011) recognized that the efforts at managing industrial waste and pollution in developing countries are still at its embryonic stages. This viewpoint is in part stimulated by the avowal put forth in Ezeibe and Umenweke (2015) that developing countries see environmental concern as a ploy of the rich countries to prevent the poor nations from industrializing and to keep them as sources of essential supplies for the continual development and prosperity of the industrial countries, as such, a number of developing countries argued that if pollution meant industrialization, they would welcome pollution whole heartedly. This therefore makes it apparent that in developing countries, commitment for economic development through industrial growth remains prominent at the detriment of safe commitment as a result of this; the devotion to waste management remains crude. According to Navarro and Vincenzo (2019) in low-income countries, the widely known method of waste treatment involves open dumping and

burning of waste. For example, in an earlier study, Hammed (2013) lamented on the manner in which liquid waste is being managed in Nigeria.

In Nigeria, liquid waste management is a major environmental challenge. This is so because poor liquid waste treatments system as posited by Redouane and Mourad (2016) poses great threats to the health of the people as seen in water borne diseases like cholera and diarrhea, and can also result in severe deterioration of environmental quality as seen in streams and river contamination. The negative impacts of poor liquid waste management could cut across local, regional, or global levels, depending on the scale of liquid waste, thereby inflicting harmful effects on both human health and the environment at large. The disposal and management of wastes has remained a huge challenge for city managers in the face of an uncontrolled urbanization as is evident in most African cities. In Nigeria, this has presented serious environmental problems and health concerns in recent years; yet there is little information on waste constituents and waste management in industrial plants, granted, the practice of waste management for rural, small town, urban, and industrial level differs a great deal (Alice et al., 2016).

In light of this It is generally agreed that conscious and meticulous liquid wastes management must be at the core of every industrial activities, nonetheless, very little is known, especially by the public, on the extent at which industries adhere to liquid waste management measures in Nigeria. This is in part due to ignorance on the part of the public on the dangers of uncontrolled industrial waste distribution and restricted access to facilities by the public. Hence, it is important to investigate residents understanding of liquid waste management in area where industries are located as well as conduct chemical test on water samples of the surroundings. Bearing in mind the absence of or in some parts, the moribund state of public water supply system, residents resort to privately dug wells and boreholes for water supply. It is therefore against this background that this study was designed to investigate residents' perception of liquid waste management in the Nigerian Brewery, Ibadan, with the view of assessing the perceived effects of waste management strategies adopted by the industry. As an additional objective, the study analyzed water samples from point of discharge, surface water and ground water to determine its physicochemical quality using the following parameter: p^H, Bio-chemical Oxygen Demand (BOD), content level.

This paper is structured into five sections. The introduction is followed by presentation on theoretical framework on waste management with succinct highlight of industrial waste and regulation as it pertains to Nigeria. Section three captures the methodological approach employed by the study; this is followed by the presentation and interpretation of findings while the fifth section concludes the paper.

2. Theory of Waste Management

The discussion of this paper is hinged on the proposition of the theory of waste management. Theory of Waste Management, as distinguished from waste management practice, denotes a more comprehensive account of the domain and contains conceptual analyses of waste, the activity upon waste, and a holistic view of the functions and goals of waste management (Pongrácz, Phillips and Keiski, 2004). According to Pongrácz et al. (2004), the theory is predicated on the expectation that the control of waste related activities is a necessity to achieve the ultimate aim of resources conservation and protection of human health and the environment. The theory holds that waste management comprises of more than just mere gathering, transporting, treating and disposal of waste, it also entails strategic planning, prescribing options, prevention of the contamination of environment and conservation of resources, minimizing the amount and toxicity of waste creation as well as choosing the best treatment option, taking into consideration legislation, assessing effects and consequences and decision making. The implication of this theory on the study however is reflected in its ability to explicate on what waste management entails holistically thus providing an unbiased assessment of whether the case in point adhere religiously to waste management provisions when the liquid waste generated and disposed from the industry is compared to laid down standards; World Health Organization (WHO), and National Environmental Standards and Regulations Enforcement Agency (NESREA). The theory therefore aid to make inference on waste management practice of the study area.

3. Industrial Waste and Nigeria Perspective

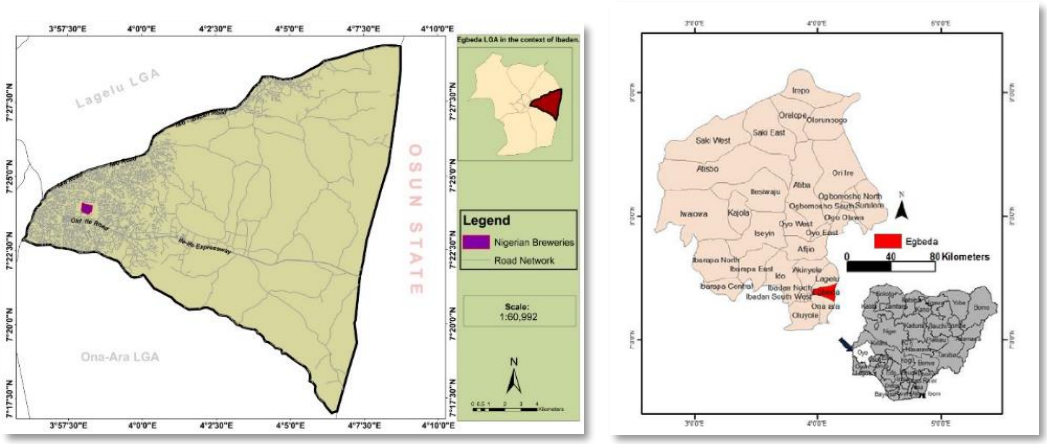
Ngoc and Schnitzer, (2009) described industrial wastes as waste produced as a result of the processing of raw materials for the production of new products. Ngoc and Schnitzer (2009) noted that different types of wastes are produced by industries, some of which are toxic while others are non-toxic depending on type of industry. However, wastewaters from facilities that make food products will not be harmful to humans, but those from other industries may contain a variety of chemical compounds, some of which may be hazardous, as such, constituting potential harm to human health and the environment. According to Amasuomo and Baird (2016), industrial wastewaters which contain hazardous substances must be treated, and the substances removed before the wastewater is discharged to the environment. Stating further, they expressed that presence of hazardous materials is one way in which industrial wastewaters are often different from domestic wastewaters. This implies that chemical compositions in the industrial wastewater are potential causes of health hazard. Oke, Atinsola and Aina (2013) suggested that the poor practices of liquid-waste disposal in Nigeria are perhaps responsible for water-borne diseases

occurring in the city. Generally, in Nigeria, the enforcement of environmental regulations responsible for checkmating the disposal of liquid waste into rivers and water channels by industries rest on the shoulder of the National Environmental Standards and Regulations Enforcement Agency (NESREA), although in urban centers across Nigeria, established agencies saddled with environmental protection and management of wastes, especially, solid waste, also exists. For example, Lagos State Waste Management Agencies (LAWMA) in Lagos, Oyo State Waste Management Authority (OYWMA). However, these agencies, particularly at the state level focus majorly on solid waste and pay less attention to liquid waste management in urban centers across Nigeria. This has thus aroused scholarly and professional lamentations from both environmental and public health commentators. Substantiating on this contention, Hammed (2013) lamented on the laissez-faire manner in which liquid waste is being managed in Nigeria.

4. Materials and Method

The Nigerian Breweries was incorporated in 1946 and currently has nine fully operational breweries with the prominent ones in Lagos, Aba, Kaduna, Ibadan, and Enugu. This study however focuses on the Ibadan brewery which sits on a land area of 70 hectares with a prime location neighbouring the Ibadan airport. The geographical scope of the study has two layers; first is the location of the brewery, then all residential buildings within a kilometer radius from the industry. Figure 1 gives a clear perspective as to layering of the geographical scope. This study employed a descriptive survey research design to facilitate the collection of qualitative data from residents whose dwelling units fell within the radius selected. Within a kilometer radius from the brewery, 4346 buildings were identified and upon ground trothing 46 of these buildings were found to be non-residential buildings (stalls, religious centers, schools etc.) On that basis, a sample size of 215 was derived, using 5% of the residential buildings. Having derived a sample size, a systematic sampling technique was then adopted such that a questionnaire was administered at an interval of twenty (every twentieth house). The study though being a perception based one, collected four water samples using a 25cl tube from different points in the study area like the Alao et al. (2010) and Akpomie et al. (2014). The points are: surface water from the run-off at river Majawe (see Figure 2); Brewery effluent at the industry point of waste discharge; and ground water samples from two 'hand-dug wells' located near the site of the brewery. The distance between the two hand-dug wells was put at 500metres as (Alao et al., 2010 and Akpomie at al., 2014). The samples were obtained and the study conducted in the month of August, 2019. Data acquired was analysed with the use of descriptive statistics such as frequency distribution tables, means and measures of central tendency to mention a few.

Data collected was entered into and analyzed using Statistical Package for the Social Science (SPSS) version 17.0. The skewed quantitative data was summarized using Median and inter- quartile range while categorical variables using frequencies and percentages. The results were presented in tables and charts. A Likert scale respondent Agreement index was adopted to analyse the perception of the residents in the study area. Also, the physicochemical characteristicsanalysed were pH, temperature, electricalconductivity, total soluble solids (TSS), total dissolved solids, Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), and concentration of magnesium, cadmium, lead and Nickel. The observed values from the water tests were compared against the acceptable (standard) values set by the World Health Organization (WHO) and NESREA. The acceptable values for each parameter are presented in tables 2 and 3.



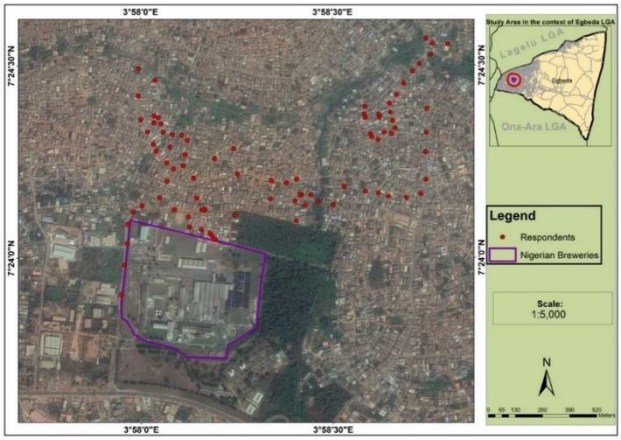


Figure 1: Nigerian Breweries Ibadan and respondents' distribution (ESRIArcGIS 10.4, modified by author).

5. Results and Discussions

Distribution of Respondents and their Perception on the Effects of Liquid Waste on the Environment

The result of the analysis in Table 1 illustrates that 87.8% of the respondents attained minimum of primary education level. As a result, there was little or no barrier in communicating with the respondent when the study was carried out since level of knowledge will influence their capacity to understand contemporary waste management strategies and the effects of liquid waste disposal by the industry. The occupational distribution of respondents also revealed that 33.5% of the respondents were civil servants, 30.7% employed by the private sector (some contract staff at the Nigerian Brewery), 6.5% of the respondents were unemployed, while 22.8% and 6.5% were self-employed and students respectively. Reflective from the occupational characteristics of the respondent is that private entities represent a major source of lively in the study area and the brewery being among them, as such, steady stream of lively remains paramount for the residents of the neighbourhood to cater for their households (ranging from 1 to 9 persons) even if it will be at the detriments of environmental and health safety. Income is in fact a determining factor of neighbourhood choice as it affects the preferred option for neighbourhood, consequently, considering that 47.9% of the respondents earn between ₦19,000 and ₦35,000 (<US$1) monthly, with a Nigerian minimum monthly income of ₦18,000, there is the likelihood that many of the community residents will be more concerned about increasing their earning rather than the adverse effects of liquid waste in their neighbourhood.

Table 1: Distribution of Respondents

Age (yrs)	No of Respondents(N=215)	Percentage (%)
20-24	**25**	**11.6**
25-29	**31**	**14.4**
30-34	**39**	**18.1**
35-39	**19**	**8.8**
40-44	**21**	**9.8**
>44	**80**	**37.2**
Gender	**No of Respondents**	**Percentage**
Male	**101**	**47.0**
Female	**114**	**53.0**
Household Size(person)	**No of Respondents**	**Percentage**
1-3	**44**	**20.5**
4-6	**115**	**53.5**
7-9	**56**	**26.0**
Level of Education	**No of Respondents**	**Percentage**
No formal Education	**26**	**12.1**
Primary Education	**99**	**46.0**
Secondary Education	**59**	**27.4**
Tertiary Education	**31**	**14.4**
Occupation	**No of Respondents**	**Percentage**

Civil Servant	**72**	**33.5**
Privately Employed	**66**	**30.7**
Unemployed	**14**	**6.5**
Self Employed	**49**	**22.8**
Student	**14**	**6.5**
Monthly Income	**No of Respondents**	**Percentage**
<₦18,000	**17**	**7.9**
₦19,000-₦35,000	**103**	**47.9**
₦36,000 - ₦67,000	**72**	**33.5**
>₦68,000	**23**	**10.7**
Total	**215**	**100**

₦420 = US$1 (as at April, 2020)

The responses were examined by comparing the mean (x) with the weighted value (X). Responses are categorized into five levels of agreement in order to calculate Respondents Agreement Index (RAI). The greater the respondents' satisfactory index compared to the mean, the greater the level of agreement. Table 2 presents the level of agreement of respondents. Scientifically, the quality of water is not ascertained via subjective queries or perceptions. Tables 3 and 4 illustrates that surface water was contaminated by brewery effluent, however, the groundwater was non-toxic and therefore safe for domestic purposes. Respondents level of agreement on that the effect of liquid waste discharge can affect water quality in the environment thereby making water less potable (4.09) was considered very important and strong since the weighted mean is greater than mean value (x = 3.70). Also observed from the study was that respondents understand that industrial effluents are obnoxious to the environment (3.42). The calculated RAI variance is (0.22) with a standard deviation of (0.47) against a coefficient of variation (36.15). From the results gathered therefore, a number of challenges are faced by residents in the neighbourhood adjoining the brewery. They include among others, the discharge affecting the water quality, air pollution from the industrial activity with adverse effects on the residents' health.

Table 2: Perceptions on Liquid Waste Management

Level of Agreement	**Respondents Opinion**					**NR**	**SWV (a)**	**RAI a/215**	**x-x**	**$(x-x)^2$**
	5	**4**	**3**	**2**	**1**					
The Industry generates effluents that is obnoxious to the environment	**255**	**272**	**126**	**56**	**26**	**215**	**735**	**3.42**	**-0.28**	**0.08**
Liquid waste such as chemicals and toxic water are being discharged into the environment.	**365**	**332**	**126**	**14**	**10**	**215**	**847**	**3.94**	**0.24**	**0.06**
The Industrial pollution is minimal and so tolerable	**50**	**176**	**159**	**126**	**45**	**215**	**601**	**2.80**	**-0.9**	**0.81**
The waste has some effect on people's livelihood	**350**	**348**	**123**	**14**	**10**	**215**	**845**	**3.93**	**0.23**	**0.05**
The effect of the liquid waste discharge can affect water quality in the environment thereby making water less potable.	**425**	**312**	**129**	**10**	**4**	**215**	**880**	**4.09**	**0.39**	**0.15**
The air pollution caused by the industrial activity has its own health implication.	**410**	**312**	**129**	**14**	**5**	**215**	**870**	**4.05**	**0.35**	**0.12**
Total								**22**		**1.3**

5- Strongly Agree; 4 - Agree; 3 - Undecided; 2- Disagree; 1- Strongly Disagree.
RAI = Respondents Agreement Index
SWV = Sum of Weighted Value
NR = Number of Respondents
N = Total Number of Variables

$$\frac{\sum (SWV)}{NR} = RAI$$

$$x = \frac{\sum (SWV)}{N} = \frac{22.23}{6} = 3.7$$

$$\text{Variance } (S^2) = \frac{\sum (x - \text{mean})^2}{} = \frac{1.3}{} = 0.22$$

N6
Standard Deviation (S.D) = √Variance = √0.22 = 0.47
Co-efficient of variation = S.D X 100% = 0.47 X 100 = 36.15
Mean 1.3

Physio-chemical Characteristics of Water Samples

After examining the respondents' sources of drinking water, the study revealed that 49.6% of the respondents source their drinking water from wells (with varying depths). The preponderance in the collection of drinking water from wells is partly attributable to an ineffective public water supply and distribution system in the neighbourhood as is the case with many urban centers in Nigeria. Also, as a function of income level, 29.4% of the respondents source their drinking water from boreholes. Drilling a borehole is expensive and requires more than the usual geo-technical inventory a hand-dug well would typically require. An additional 21.1% of the respondents rely on sachet/bottled water as source for their drinking water. Majority of the research population ($9.6%) rely on underground water as source for their drinking water. The implication of this observation lies in the fact that percolation of chemical laden and noxious effluents could contaminate the ground water sources relied upon by the vast majority of the research population. It is based on this deduction as well as the need to validate or invalidate the perception of the residents on their perceived environmental impact and health effect of the liquid waste discharged from the industry that the study examined the water parameters to describe the water quality in the study area.

Figure 2: River Majawe, Ibadan (August 10, 2019).

Figure 3: A Drainage Channel at Majewe, Ibadan.

In table 3, among the parameter examined is pH, the study revealed that the well water has average pH value of 5.62mgl. The surface stream water sample revealed 7.13pH value while brewery effluent had 7.37pH value. The findings revealed that the well water is slightly acidic while the surface water and waste water is tending towards alkaline. However, the values were within the permissible limits of NESREA and WHO's, 6 – 9 and 6.6 – 8.5 respectively. Hence, the pH of the ground water (GW1 and 2) poses no life threat to people using the water for domestic purposes as well as and the aquatic habitants. Result from the temperature analysis uncovered that the well water had an average value of 25.5^{oC} surface water has 25.4^{oC} while the brewery effluent revealed 26.7^{oC}. However, this falls within the NESREA permissible limit of less than 40^{oC}, however, the whole samples were higher than WHO limit which can affect the water quality.

The Biological Oxygen Demand (BOD) of surface water is the most widely used parameter in evaluating its organic pollution. The study reveals that the well water had an average amount of 1.63mgl with a standard deviation of 0.02, the surface water with a mean value of 1.12mgl with a standard deviation of 0.01, while brewery effluents has a mean value of 1.05mgl with a standard deviation of 0.03. The values of BOD of the samples recorded were

satisfactory when compare against the WHO and NESREA standards, thus, they were adjudged to be within the permissible limit. Furthermore, the result also confirmed that the electrical conductivity of the well water had about 259µ, surface water - 931µ and that of the brewery effluent - 1318µ; which represented the highest value. Revelations from these values were that that surface water and brewery effluent are above the permissible standard of WHO.

The results of the TSS for samples were not in conferment with the NESREA standard. The well water had an average value of 43.5mgl with a standard deviation of 0.05, the surface water had 87mgl with the standard deviation of 0.011 and the brewery effluent had the highest value, 90mgl, with a standard deviation of 0.11. A possible suggestion for the high values recorded can be as a result of the effluent being deposited into the river by the brewery. However, TSS is used to evaluate surface water quality. The well water samples were within 30mg/l permissible limit set by FMENV but above the permissible limit of NESREA. This can be explained by the fact that as the waste water permeates the ground the solid materials will be filtered out. Whereas the surface water and brewery effluenthave much higher values (87 and 90) as revealed in Table 1 than the FMENV permissible limit and that of NESREA. If this waste water is applied directly to agricultural lands or discharged into rivers and stream, this could result into a situation where the land are unsuitable for habitation either for aquatic life or plants.

From table 4, in almost all the water samples, Well Water (0.001), Surface water (0.003) and Brewery Effluent (0.004) concentration of cadmium was recorded above the permissible limit except for hand dug well 1 which was not detected in the water sample. Concentration of lead in all the collected water samples ranged between 0.00 to 0.15mg/l. This implies that the water from most of the sites is not suitable for human consumption. This is so because the maximum permissible limit for Nickel (Ni) in water is 0.02 mg/l and the result obtained showed that the concentration of nickel in Well Water was 0.036, Surface Water was 0.043 while Brewery Effluent was 0.065, all noted to be above the permissible limit. Furthermore, the concentration of magnesium in water samples ranged between 2.1 to 5.2mg/l, with the Well Water, Surface water and Brewery Effluent having 2.21mg/l, 2.20 mg/l and 5.23mg/l respectively denoted value permissible when juxtaposed with the limit according to WHO, though above the standard laid out by NESREA (0.02mg/l). A possible suggestion for this extremity in values might be due to the addition of civic wastes and brewery effluents as the sewage of the neighbourhood is directly discharged into the river along with the industry which are also discharging their effluents directly into the river. This position is corroborated by earlier studies such as; Alao et al. (2010) and Akpomie et al. (2014), who noted that the level of heavy metals increases in the rivers due to discharge of industrial effluents and civic pollution of various kinds. This is in turn deteriorates water quality, hence, making water unsuitable for domestic use and aquatic habitation.

Table 3: Physicochemical characteristics of the Samples

Parameters	Acceptable Values		Observed Values		
	WHO	**NESREA**	**WW**	**MR**	**BE**
pH (mgl/$^{-1}$)	**6.5-8.5**	**6-9**	**5.62**	**7.13**	**7.37**
Temperature(C°)	**12-25**	**<40.0**	**25.5**	**25.4**	**26.7**
Conductivity (µ)	**400**	**NS**	**259**	**931**	**1318**
BOD(mgl)	**40**	**30**	**1.63±0.02**	**1.12 ± 0.01**	**1.05±0.03**
TSS (mgl)	**NS**	**25**	**44± 0.05**	**87± 0.011**	**90± 0.11**
DO (mgl-1)	**7.5**	**7.5**	**3.25± 0.014**	**2.50± 0.011**	**2.0± 0.12**
Cadium (mgl-1)	**0.01**	**<1**	**0.001**	**0.003**	**0.004**
Lead (mgl-1)	**0.01**	**0.5**	**0.035**	**0.00**	**0.15**
Nickel (mgl-1)	**0.02**	**0.5**	**0.036**	**0.043**	**0.065**
Magnesium (mgl-1)	**200**	**0.02**	**2.21**	**2.20**	**5.23**

Note: WW (Ground/Well water)**; MR** (Surface water)**; BE** (Brewery Effluent)

Table 4. Heavy metal concentration (mg/kg) in samples

Parameter(mgl)	**Acceptable Values**		**Observed Values**		
	WHO	**NESREA**	**WW**	**MR**	**BE**
Cadmium	0.01	<1	0.001	0.003	0.004
Lead	0.01-0.05	0.5	0.035	0.00	0.15
Nickel	0.02	0.5	0.036	0.043	0.065
Magnesium	200	0.02	2.21	2.20	5.23

Note: WW (Ground/Well water)**; MR** (Surface water)**; BE** (Brewery Effluent)

A holistic view of the findings from the physico-chemical analysis revealed that there is contamination of surface water by brewery effluent, but the ground water within the neighbourhood adjoining the industry are non-toxic and safe for domestic purpose, particularly, drinking.

6. Conclusions

From the data gathered, Nigerian Brewery in Ibadan possesses an effluent treatment plant (the capacity and efficiency though undisclosed) which is functional and useful in mitigating hazards of wastes (liquid) being generated. Nonetheless, respondents' perception on the effects of liquid waste management from the population sampled averred that the discharge of the brewery effluents affects the water quality and air quality in the neighbourhood which has adverse effects on the health of the residents. An attempt to validate or invalidate their perceptions necessitated the physicochemical properties water and liquid waste sample test. The result of the test however revealed that there is contamination of surface water by brewery effluent, though groundwater was non-toxic and therefore safe for domestic purposes. To mitigate liquid waste from having a negative impact on the environment and the residents is to propose better ways of reducing the effect. This study agrees that industries will always produce waste no matter what but the strategies adopted by the industries to keep waste from having negative impact on the environment and its people is of paramount importance. Therefore, industries should adopt efficient preventive measures, choose the best treatment option, take into consideration legislation and also strictly adhere to standards and guidelines mapped out by various health and environment regulatory bodies. This is with a view to greatly reduce the pollution of water bodies by discontinuing the introduction of harmful chemical element or component into them. Furthermore, to complement the efforts of industries in liquid waste management, regulatory bodies like NESREA must carry out routine inspection and monitoring of industry's waste management plans and plan implementation. While it will be out of the scope of this research to recommend that municipalities restructure dilapidated public water system across Nigerian cities, It is not out of place if state governments and concerned institutions consider providing pipe-borne water as a source of drinking water for people in Ibadan and throughout the country. The concerned authorities can go a step further to put effective measures in place to remove sources of contamination in water bodies that supply locals with water for household use. Finally, the study also recommends that further studies to examine the air quality of the neighbourhoods surrounding the brewery be carried out.

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