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EFFECTS OF PZ CHEMICAL WASTE ON WATER QUALITY AND HOUSEHOLD HEALTH CHALLENGES IN ODOGUNYAN COMMUNITY, IKORODU, LAGOS STATE NIGERIA

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Abstract
Industrial waste constituted a serious threat to the wellbeing of urban dwellers. While researches have focused more on solid waste of various forms that of chemical effluent waste has not been adequately researched in the literature. This study therefore, examined the effects of PZ chemical waste on water quality and household health challenges in Odogunyan community, Ikorodu, Lagos state Nigeria. Using Survey research design, both primary and secondary data were sourced. A purposive multi stage sampling technique was adopted for the study. A buffer zone within the 400metres radius from PZ Cussons Plc. was made. Consequently, a household head in all the houses within the 400metres were picked while 244 residential houses (70%) out of 348 sample frame were randomly selected for questionnaire administration. Variables investigated included socio-economic characteristics, perceived effects of the industry's' chemical waste on water quality. Also, six water samples from six well around PZ Cussons Plc were taken for laboratory test. Both descriptive and inferential statistics were used to analyse the data at p value =0.05. Study revealed that female were 57.4% while frequency of sickness within two weeks ranged from twice 20.7% and trice 24.9 %, while the nature of sickness included diarrhoea (22.8%) dysentery (33.1%) and typhoid (28/7%). Qualitative analysis revealed a non-compliance with WHO water quality standard (E. coli content above 0). It was concluded that well water around PZ Cussons are dangerous for human consumption. Therefore, PZ Cussons Plc. should conduct an adequate chemical waste treatment before its discharge into the public carnal.

Key Words: *Chemical waste, PZ Cussons, Ikorodu, Water consumption*

Introduction

Environmental pollution is the major problem associated with rapid industrialisation, urbanisation, and rise in living standards of people. For developing countries, industrialisation dominated both the formal and informal sector of the economy with the view of contributing to the development of the nation. However, industrialisation can also cause serious problems relating to environmental pollution. Assessment of industrial waste problem greatly varies depending on the nature of the industry, their location, mode of disposal of wastes and nature of waste

generation (The North American Mosaic, 2010).

Industrial facilities generate several tons of toxic chemicals as production-related pollutants and waste. Criteria air contaminants are substances which include nitrogen oxides, carbon monoxides, sulphur oxides, particulate matter and volatile organic compounds, which are associated with environmental effects such as smog, acid rain and regional haze, and health effects such as respiration illness. These pollutants are emitted from a variety of sources, such as residential fuel combustion, motor vehicles and agricultural activities. Industrial sources are also major contributors, such as electric utilities, primary metals smelters and cement kilns (The North American Mosaic, 2010).

Most major industries have treatment facilities for industrial effluents but this is not so in the case with small-scale industries, which cannot afford enormous investments in pollution control equipment as their profit margin is very slender (SDWF, 2013). It has been observed that generally in the developing countries, Nigeria inclusive, a wide majority of industries discharge untreated effluent into rivers and only very few industries have primary treatment plants ranging from oxidation tanks to sedimentation tanks (Dada, 1997). Untreated industrial effluents from industrial processes are of special concern because they produce water poisoning or chronic poisoning in aquatic animals as well as human (Ellis, 1989). Polluted water is always unsuitable for drinking, recreation, agriculture and industry. It diminishes the aesthetic quality of lakes and rivers. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability. Eventually, it is a hazard to human health; nobody can escape the effects of water pollution (SDWF, 2013).

Meanwhile, adequate provision of water and sanitation depends on some qualitative parameters, which must greatly reduce the risk of infection. The task of having the number of people lacking provision of water and sanitation between 1990 and 2015 by the Millennium Development Goal (MDG) is based on adequate provision rather than the improved accessibility (Environment and Urbanisation, 2003).

The problems of waste generation in the developing world are similar. Although, there are different types of wastes generated all over the world, but that of chemical waste is more in Odogunyan due the presence of PZ industry. This is why effort will be primarily focused on chemicals waste. Also, more than 80% of the residents depend on the water from the stream abutting this factory where chemicals are discharged indiscriminately into the environment without any form of treatment. The drains are connected together to a large canal that conveys the waste water away from the estate. Significant proportions of the residents rely on water from shallow wells dug within 10 meters of the stream containing the industrial waste, for drinking, washing and ablution. With the continuous discharge of untreated waste water by the factories into the drains and the continuous use of this wastewater for drinking washing, ablution and as irrigation water for vegetables and other crops in the area, the possibility of contamination and eventual health hazard to the inhabitants of the area cannot be overruled. Hence, the importance of this study.

In addition, the existing literatures have concentrated more on other waste with less emphasis on the chemicals waste. For instance, Olatunbosun (2009), looked at the impact of West African Portland Cement (WAPCO) on the Housing environment in Ewekoro; Adekoya (2011) researched on the impact of sawmill industry on the rental value of the adjoining residential property in Ikire; while Awojogbo (2012) worked on the effect of industrial location in metropolitan Ibadan, It is on this premise that this study was carried out on the impact of PZ chemical waste on the water consumption among the Odogunyan community of Lagos state in order to investigate the possible relationship between quality of possibly polluted well water consumed by residents and their perception on the health implications of consuming the water.

Study Area

Lagos state is one of the 36 states of the federation as shown in figure 3.1 and Ikorodu Local Government Area is also one of the 20 local government areas in Lagos State (figure 1). Odogunyan is the largest and fastest growing industrial centre in Ikorodu, Lagos state. It is located in longitude 3° 15′ and 3° 25′ E and on latitudes 6° 35′ N and 6º 40′ N. Industries in the area include those of textile, chemical, steel and footwear. These factories utilize huge volume of chemicals most of which have heavy metals as additive.

The high rate at which the population of Odogunyan is growing coupled with the wide expanse of water has industrial significant implications for availability of land for residential development. Based on the 2006 census, the populations of the study are is 535,619.the resultant effect of the rapid population growth is excessive demand for housing and housing inadequacies.

The community environment is located in an upland area with topography that enhances effective's drainage through which several rivers flow in Lagos lagoon. The area is directly underlain by the beam formation which consists largely of sands/sandstones with lenses of shale's and clay. The formation is thin in Odogunyan and this does not favour it as an important aquifer (Offodile, 2002). In addition, the erinaceous nature of the beam formation makes is susceptible to contamination from anthropogenic sources.

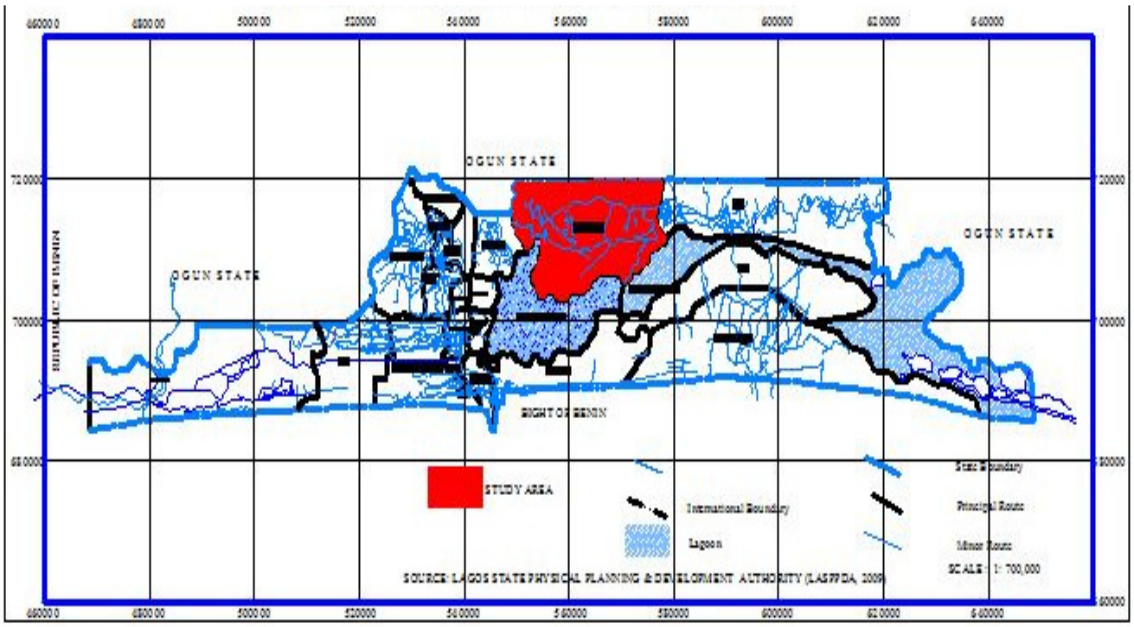

Fig. 1: Map of Lagos State showing the Study Area

Literature Review

Continuous discharge of industrial contaminants into ocean, or injection into deep underground strata, streams and rivers without treatment increases certain components of industrial waste hazardous to human health and the environment. Related concerns include sensitive human populations such as children, the implications of low-level exposures to multiple pollutants, and contamination of ecosystems. As urban population grows in size and wealth, the challenges of industrial waste on residential housing also increases. This places additional pressure on public utilities and infrastructure and the need for public space for the inhabitants of such area. In addition, lack of or inadequate sanitation, fresh water, drainage, roads and waste management characterize many urban areas (Chukuwuemeka *et al.*, 2012).

Domestic, industrial, agricultural processes and other sources produce large quantities of waste products that cause rapid changes to the environment. Exposure to these pollutants at sufficiently high concentration can cause a variety of health problems (Dara, 2002). As nations develop their industrial activities, the production and use of chemicals rises in parallel to the standard of living and consequent increase in the life expectancy (Adepetu and Eziashi, 1998), and environmental deterioration threatens our well-being especially when our air, land (soil) and water for food become contaminated (Eisenbud, 1979).

In line with chemical waste, water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds. As such, water is typically referred to as polluted when it is impaired by anthropogenic contamination which does not support human use (like, serving as drinking water) and/or undergo a marked shift in its ability to support its constituent biotic communities such as fish (Mellanby, 2000). Water pollution could be from unregulated use of fertilizers, pesticides

and herbicides and other industrial activities as well as medical waste generated in the diagnosis, treatment and immunization of human or animals (Okoronkwo, 1998). The importance of good environment in relation to clean water in our daily life cannot be overlooked. Water is needed for different purposes such as drinking, irrigation, swimming, fishing and industrial purpose. Thus, water for different purpose has its own requirement for the composition and purity and each body of water has to be analysed on a regular basis to conform to suitability (Poppe *et al*., 2006).

Some studies have established the effect of untreated water consumption. Awojogbo (2012), conducted a research on the effect of industrial location in metropolitan Ibadan, confirmed that the presence of different industries (medium and heavy) within 400 meter radius generated chemical waste that seep into the underground well water which had implications for the health of the residents.

Johnston *et al*. (2014) also investigated race and poverty in area where oil and gas waste water disposal wells which are used to inject waste water from hydraulic fracturing operations and it was discovered that Waste water injected into disposal wells may, in some circumstances, migrate to the surface or into fresh water aquifers. Toxin can also migrate to ground water through leaks, cracks, or nearby abandoned wells and multiple cases of ground water contamination associated with wastewater disposal have been identified e.g. Texas ground water near oil and gas disposal wells was found to have higher concentrations of chloride and bromide than ground water farther away.

Methodology

Survey research design was adopted for the study where both primary and secondary data were sourced. A purposive multi stage sampling technique was adopted for the study. A buffer zone within the 400metres radius from PZ Cussons Plc was made cutting across four localities in the study area. All 384 residential houses within this 400metres were identified from which 244 (70%) were selected for sampling, giving credence to every other house. This was done in order to be able to generate inference. From each house, a household head was interviewed using a copy of structured questionnaire on the socio-economic characteristics of the respondents, perceived impact of industrial chemical waste on the respondents' lives which includes the main source of drinking water, respondents' frequency of fallen sick in the past two weeks and the nature of the ailment illness/sickness. The measurement of sickness was based on the perception of people as argued by scholars (Hambleton *et al*., 2005; Kashdan, 2004) that self-reported health status measurement approach can be used to evaluate health status instead of Hospital records as residents patronize different hospital which makes it difficult to track down their hospital reports. Six hand-dug wells located within less than 7m to the stream into which the factory's chemical waste is dumped and from which residents draw water for drinking and domestic were purposively selected. Water samples were taken from these wells and subjected to laboratory analysis. The parameters which were considered were physiochemical, bacteriological and chemical analysis of water sampled in the study area. This was done in order to

determine the effect of water quality among the residents in the area. Both descriptive and inferential (chi square analysis) statistics were used in analysing quantitative data collected for the study and validated at $p<0.05$.

Table 1: Distribution of samples for the study

S/N	Name of community in Odogunyan LCDA	Housing Stock of 400m radius to PZ cussons	Sample size at 70%
01	Losi Oba	71	50
02	Losi Alara	69	48
03	Agodo Segun	76	53
04	Losi Alara Estate	132	93
	Total	348	244

Result and Discussion

Socio-demographic Characteristics of the Respondents

This section provides the socio-demographic characteristics of the respondents in the study area. Variables discussed under this section included gender, age, marital status, household size, occupation, average income. Others include total number of household per house.

The study revealed that more than half of the respondents 57.4% were females signifying female- headed household in the study area. (Table, 2). Higher incidence of female among the respondents might owe to the period of the days in which the questionnaires were administered (Monday-Friday) which happened to be working days, where many of the male household head would have gone to their respective places of work. Also those who constituted the respondents were mainly the women (wives), self-employed who were domiciled at the home at the time of the survey. With respect to age, more than one third of the respondents 38.4%were above 60 years of ages, connoting that majority of the respondents belonged to the active working age that were capable of providing reliable information.

Marital wise, 73.4% of the respondents were married which could be connected to kind of importance that is attached to marriage in the study area. In addition, the practice of polygamy could also be an added factor. This predominant marital status could also be a significant factor in giving reliable information on the variables under consideration. On education status of the respondents, over three quarter (82.2%) of the respondents had tertiary education (Table 2) while less than ten percent (8.0%) had post primary education qualification. The higher percentage of literacy in the area could be connected to their early exposure of the respondents to western education which assisted the researcher, especially in understanding the issues raised in the questionnaire.

Private Company employee accounted for 27.8%. About 24.0% were civil servant while others in form of trading, farming, self-employed and craftsmanship accounted for 21.6%. Only 18.6% of them had no job while 8.0 % were retiree. The average income of the household revealed that majority (20.7%) of the respondent earned above N80, 000 per month, while 8.0% earned less than N30, 000 per month. Almost half (42.6%) of the respondents had more than five people per household, and 32.5% of them had five.

Table 2: Socio-demographic characteristics of the respondents

Gender	**Frequency**	**Percentage**
Male	101	42.6
Female	136	57.4
Total	237	100
Age		
Less than 30 yrs	11	4.6
31-40	36	15.2
41-50	48	20.3
51-60	51	21.5
Above 60 yrs	91	38.4
Total	237	100
Marital		
Single	38	16.0
Married	174	73.4
Selected	-	-
Divorced	10	4.2
Widow	09	3.8
Widower	06	2.5
Total	237	100
Level of education		
No formal education	07	3.0
Primary/standard/Quranic	16	6.8
Secondary/Technical/Grade II	19	8.0
Post- Secondary Education/Tertiary	121	51.0
Others	74	31.2
Total	237	100
Occupation		
Farming	14	6.0
Craftsmanship	04	1.7
Civil Service	57	24.0
Trading	27	11.4
Self employed	06	2.5
Private company employee	66	27.8
Unemployed	44	18.6
Others	19	8.0
Total	237	100
Household per month		
Less than N30,000	19	8.0
30,001-40,000	16	6.7
40,001-50,000	29	12.2
50,001-60,000	21	8.9
60,001-70,000	21	8.9
70,001-80,000	38	16.0
Above 80,000	49	20.7
Indifference	44	18.6
Total	237	100
Household Size		

1	03	1.3
2	07	3.0
3	11	4.6
4	38	16.0
5	77	32.5
More than 5	101	42.6
Total	237	100

Table 4: Respondents' frequency of fallen sick in the past two weeks

Frequency of fall sick in the past two weeks	Frequency	Percentage
Once	31	13.0
Twice	49	20.7
Thrice	59	24.9
More than three time	30	12.7
Not fallen sick at all in the past two weeks	68	28.7
Total	237	100

Nature of the ailment /illness/sickness

Results of investigation on the types of sickness experienced by respondents revealed that 7.6%had cholera. The proportion of respondents who experienced dysentery and diarrhoea accounted for 13.1%, 27.8%, and 22.8% respectively. More than one quarter (28.7%) of the respondents claimed to have typhoid (table 5). It could be observed that water borne diseases were common ailments in the study area.

Table 5: Nature of the ailment illness/sickness of the respondents

Nature of the ailment illness/sickness	Frequency	Percentage
Malaria	66	27.8
Dysentery	31	13.1
Cholera	18	7.6
Diarrhoea	54	22.8
Typhoid	68	28.7
Total	237	100

Laboratory test in the quality of water from the sampled wells in the study area

To enhance the study's credibility, samples from the six wells were subjected to laboratory analysis. All the parameters that were considered in physicochemical, bacteriological and chemical analysis of sampled water taken from the six wells in the study area revealed the following.

Analysis of water in terms of colour revealed that apart from well number 3 and 6, all other wells (well 1, 2, 4 and 5) were colourless (table 6). Analysis of the Total Suspended Solid (TSS) revealed that well 1 to 6 had 434, 450, 441, 439, 490, and 433 reading respectively, indicating some traces of suspended solid substance against the WHO acceptable TSS value of 500-1,500 mg/l. This implied that all sampled well water were not suitable for consumption. With respect to pH level, all the sampled well were more Alkaline with a pH reading of 9.67 for well; 1, 9.82 for well; 2, (9.71) for well 3; 9.70 for well 4; 9.69 for well 5 and 9.6 for well 6 (see table 6).The lower the pH reading on the scale, the higher the acidity. Also, the higher the pH reading (above 7), the higher the alkalinity. Acidity in the body could cause gastric problems like ulcer while inadequate alkalinity in the body may cause respiratory problem.

In order to assess the bacterial purity and safety of drinking water, bacteriological examination of water is

very germane due to its ability to detect faecal and potentially dangerous pollutants. The presence of such faecal indicator organisms from the sampled water denoted the presence of intestinal pathogens (the supply which is therefore potentially dangerous to health). The WHO requires clean water to have coli form value of zero. The higher the numbers of pathogen count in the bacteriological analysis the more risky such water source for drinking. A laboratory analysis of sampled water from the six wells indicate no presence of *E. coli*, implying the absence of faecal contamination in the industrial wastes injected into water channels in the study area.

From the six sampled well water, the analysis revealed that the total plate count (TPC) value of 45 FU/ml for well 1, 30FU/ml for well 2, 42 FU/ml for well 3, 43 FU/ml for well 4, 20FU/ml for well 5 and 44 FU/ml for well 6 were revealed. These TPC value are rather outrageous, far higher than WHO expected maximum value of between 0 and10FU/ml. The effect of high value of TCP in water used for washing, bathing and of drinking is very dangerous to the health of the users. This result demonstrates the incident caused by intrusion of industrial chemical waste through underground channels into the drinking water supply from the well. In terms of Chlorine, well 1to 6 had a reading of 20, 24, 80, 75, 80 and 27 respectively. Chloride content gives the level of natural chlorine level in the water source. The analysis revealed a deficiency in content for all the wells covered by the study with values of 8 20,24,80,75, 80 and 27, far below WHO acceptable standard of 200 – 600 in quantity. This implied that it is not suitable for consumption. Although, chlorine is used to combat microbial contamination, they can however, react with organic matter in the water and form dangerous carcinogenic trihalomethenes which according to Joseph Price, cited in Moseby medical dictionary (2017) is the greatest crippler and killer of modern times. It is an insidious poison.

From the qualitative analysis as evidenced in table 6, it could generally be deduced that physical and chemical characteristics of the well are not manageably acceptable within the WHO allowable standard. This may not be unconnected with the seepage of industrial/waste product that leaks into the underground water this corroborating the earlier findings by Awojogbo (2012). Based on the premise that the water sample failed in most of the analysis, it could therefore be said that the water samples did not conform to the drinking water standard and are therefore dangerous to health.

Table 6: Analysis on the parameters used for the quality of water in the study area

Parameters (mg/u) Physical	Sampled well Water						WHO Standards Maximum Allowable Concentration	Remark
	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6		
Colour	C	C	CL	C	C	CL	Colourless	NS
TSS	434	450	441	439	490	433	500-1500	NS
pH	9.67	9.82	9.71	9.70	9.69	9.66	6.0 - 9.5	NS
Alkalinity	9.67	9.45	9.55	9.60	9.53	9.67	01-5.8	NS
Total plate count TPC	45	30	42	43	20	44	0-10	NS
Total Coliform/100ml	N.P	N.P	N.P	N.P	N.P	N.P	0	S
Chlorine	20	24	80	75	80	27	200-600	NS

Note C=coloured, CL=colourless, Not present=NP, NS=Not suitable for consumptions S=Suitable for drinking

Hypothesis testing

To further investigate whether there was a significant difference in the quality of water taken by the people in the study area, a hypothesis which says there is a significant difference in the distribution of parameters used as quality of water taken from the sampled wells in Odogunyan community of Ikorodu Lagos was formulated. Observed variables were measured in terms of the parameters tested such as Total Suspended Solids (TSS), pH, alkalinity and total plate count (TPC) for all the six sampled well in the study area. The results of chi-square showed that there was no significant difference in the distribution of parameters across the sampled well water (chi-square = 1.069, p=0.957 sig level of 0.05) (Table 7 and 8). It can therefore be concluded that, water quality based on the parameters measured do not differed significantly from each other, and also not different from the earlier result that compromise the expected WHO standard of drinking water. The results therefore, have serious implication for the health of the people in the study area.

Table 7: Analysis on the parameters used for the quality of water in the study area

Parameters (mg/u) Physical	Sampled well Water						WHO Standards Maximum Allowable Concentration
	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	
TSS	434	450	441	439	490	433	500-1500
pH	9.67	9.82	9.71	9.70	9.69	9.66	6.0 - 9.5
Alkalinity	9.67	9.45	9.55	9.60	9.53	9.67	01-5.8
Total plate count TPC	45	30	42	43	20	44	0-10
Chlorine	20	24	80	75	80	27	200-600

Table 8: Hypothesis Test Summary

	Mean Rank	Null Hypothesis	Test Statistics		Decision
VAR00001	3.30	The distribution of parameters are the same across the sampled well water	N	5	Retain the null hypothesis
VAR00002	3.20		Chi-square	1.069	
VAR00003	4.10		Df	5	
VAR00004	3.80		Asymp. Sig.	0.957	
VAR00005	3.50				
VAR00006	3.10				

Conclusion and Recommendations

Base on the result of the investigation contained in the study, it is concluded that well water taken by people who are residents around PZ Cussons factory are dangerous to the health of the respondents in the study area. Therefore, PZ Cussons Plc. should carry out an adequate chemical waste treatment before it is been discharged into the public canal. Relocating industrial estate away from residential environment can help in ameliorating the problem of chemical waste contaminating water consumed by residents in the vicinity of environmental polluting industries. Ministries of Physical Planning should enforce the acceptable development control measure for the location of residential development in an industrial zone among others.

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