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Health Implications of Industrial Waste in Metropolitan Area of Ibadan, Nigeria

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Abstract:
Industrialisation had afforded man a high standard of living, solved many technological problems and consequently enhanced quality of life. Man's quest for industrialization has brought forth a pollution of the environment in various ways and degrees, depletion of natural resources and impairment of human health. The major objectives of the paper are to examine the profile of industrial waste in the study area, analyse the impact of improper disposal of industrial waste on the residential environments and examine critically psysio-chemical and analysis of well water. Survey research design was adopted. Both primary and secondary data were sourced in, which simple random sampling technique was adopted in selecting 225 residents living within 500m radius to the selected industries. The result shows that there was a significant association between disposal of industrial waste and health implication of the residents around the industrial area (x2=14.69, df=3, P<.001). Further analysis of sampled water revealed that the well water very close to industrial sources have presence of industrial residue and is not suitable for drinking.
The study concludes that all industries operating within industrial environ should as a matter of urgency, develop an effluent treatment mechanism necessary for treatment of industrial waste before discharging it into public drainage. Also, all industries should develop a more friendly relationship between them and the Landlords Association in their host communities towards provision of corporate social responsibility for the community that host them.

Keywords: *Industrialization, Waste-discharges, Health Implication Analysis and Environment*

1. Introduction

Industrialization has afforded man a high standard of living, solved many technological problems and consequently enhanced quality of life, (Omolabi, 2007).The breakthrough and successes have however brought grave costs to life. Man's quest for industrialization has brought forth pollution of the environment in various ways and degrees, depletion of natural resources, impairment of health of humans and other living resources. All these continue unabated as man thirsts for development, (Siyanbade, 2007).
The depletion of the ozone layer caused by the depletion of the atmosphere and the problem posed by disposal of certain toxic wastes by some industries, and the exploitation of natural resourses have suddenly re-awakened man's interest in protecting his environment.
In the 1960s, there were devastating human and ecological disasters in both developed and developing countries due to neglect of the environment and discharge of toxic and hazardous pollutants into the environment. Concern about the dangers of environmental pollution was responsible for the 1972 United Nations Conference on the Human Environment held in Stockholm, Sweden. One of the resolutions of the UN conference was the need for nations to establish institutional framework and measures to control industrial pollution.

Aujogbo (2012) observed that in most industrialized countries of the world today, industries are addressing the problem of environmental control, though this may be attributed to the pressure of public opinion and state compulsion. Notwithstanding, it is important to note that such countries have endeavored to find answers to environmental problems by developing new technologies, production systems, non-pollution processes and recycling techniques. In Nigeria, however, non-challant attitude is given to our environment by both the industries and the public. Industrial production contributes goods, services and jobs, but it is also a major source of pollution and waste (Adegunloye 2011). These pollution and waste can be classified into six categories (Douglas 2004, Iriruaga 2012, Oyebanji 2007): toxic chemicals, air contaminant, greenhouse gases, hazardous waste, non hazardous waste and radioactive wastes. Therefore, wastes seem to be a by-product of growth (Okoanegbete, 2009). Toxic chemicals are substances that are hazardous to human health and environment. In Nigeria, industrial facilities generated several tones of toxic chemicals as production-related pollutants and waste. Air contaminants are substance, which include nitrogen oxides, carbon monoxides, sulfur oxides, particulate matter and volatile organic compounds, are associated with environment effects such as smog, acid rain and regional haze, and health effects such as respiration illness to the residents living around the industries (Olatunbosun 2009,Adekoya 2011, Aujogbo 2012.)

Although, various studies over the year had significantly dwelled into impact of industries on environment, some studies even look at it from socio-economic point of view (Adekoya, 2011) other studies picked certain aspect of industries and measure its impact. Aujogbo (2012), Omolabi (2007), Omole (2010). However, none of these studies critically analyze the impact of series of industries on the environment, people, air and water using both scientific and objectivity parameter as an anchor. It is in view of this that this paper intends to critically examine the locational analysis and health effect of industries on the environment in a metropolitan area of Ibadan, Nigeria.

1.1. Methodology

The relevant research design used for this study is the case study research design. Reconnaissance Survey, was carried out. The various industries were visited and questionnaires were administered among 225 residents that are living within 500m radius around the selected industries. Also 25 industrialists were equally interviewed to ascertain their own perception to the effects of industrial location on the health of residents. In order to ascertain further the effect of industries on the health of the people of the adjoining residents Therefore, this paper adopted qualitative (environmental physical, chemical and bacteriological) analysis using Most Probable Number (MPN) for the well. The observed results were used in comparison with the WHO acceptable requirements that serve as the base standard. The sample of well water around the industrial areas were taken to Asejire water works for analysis to ascertain the extent of water pollution and also to know whether the well water located very close to industrial waste effluent is microbiologically and chemically safe for consumption. The physical examination parameters used for this analysis include: appearance, odour, colour, turbidity, pH and total suspended solids. Naturally, water should be clear, colourless and odourless. While odour was measured by threshold odour test through perception study, turbidity indicates presence of dirt and light transmission contents in the sample. This is very important in water treatment for aesthetic reasons. Turbido-meter device was used and values of more than one (1) were obtained for the sampled sources.

The data collected were subjected to qualitative and quantitative analyses. Descriptive statistics namely frequency counts, mean, mode was used to summarized and describe information sought by the study. The main statistical tools that were employed to test the observed differences between some defined variables in the study are non-parametric chi-square test.

1.2. The Study Area

The present day Ibadan, is a product of the Yoruba civil wars of about 1810 to 1893 and was established in 1829 as a refugee and war-camp for dissidents from Oyo and Ife areas of Yorubaland. It is located on the fringe of the forest zone (Mabogunje, 1968). The location of Ibadan was defined by Akinola (1963) as the area extending for about 55 kilometers from Asejire in the East to Agemo in the West and for about 70 kilometers from Iroko in the North to Mamu in the South.

Since 1893 to the present time, the planning of Ibadan is characterized by both planned and unplanned growth. The unplanned sector of the city is mainly its southeastern part, which is predominantly inhabited by the indigenes of the city and constitutes about 40 percent of its spatial coverage. The non-indigenous sector is a mixture of planned and unplanned areas (this makes about 60% of the spatial coverage of Ibadan). The so called planned areas have experienced varied degrees of unplanned growth. Thus, the growth of the city has been by both planned and unplanned accretion. Its land use structure is “jig-saw” affair, which has not been coordinated within the framework of either an overall outline or comprehensive plan (Faniran, 1994).

The total land area of the Ibadan Metropolitan Area is given to be 3,123.30 km2. According to 1991 census figure, Ibadan had a total population of 1,829,187 and more than half of this figure (1,222,570) lived in the Ibadan City. The 1991 Census figure is commonly disputed and it is believed that the population of Ibadan is in excess of three million people (Agbola, 1996).

Ibadan, especially the inner local governments have come under serious pressure of rapid urbanization. 70% of the population crowd themselves up in the 30% of the land area, the whole ibadan metropolitan area had different categories of industries (Small, Medium and Large) spreading across the nooks and crannies of the metropolis. According to the information received from the Corporate Affairs Commission, out of the Eleven (11) Local Government Areas it is Oluyole and Ibadan South West Local Government Areas that had the highest concentration of industries. This may not be unconnected with the sitting of industrial estates in the two Local Government Areas whereas Akinyele Local Government is the Local Government Area with the least number of industries. See Figure 1 shows the spatial distribution of the Local Government Area in Ibadan Metropolitan Areas.

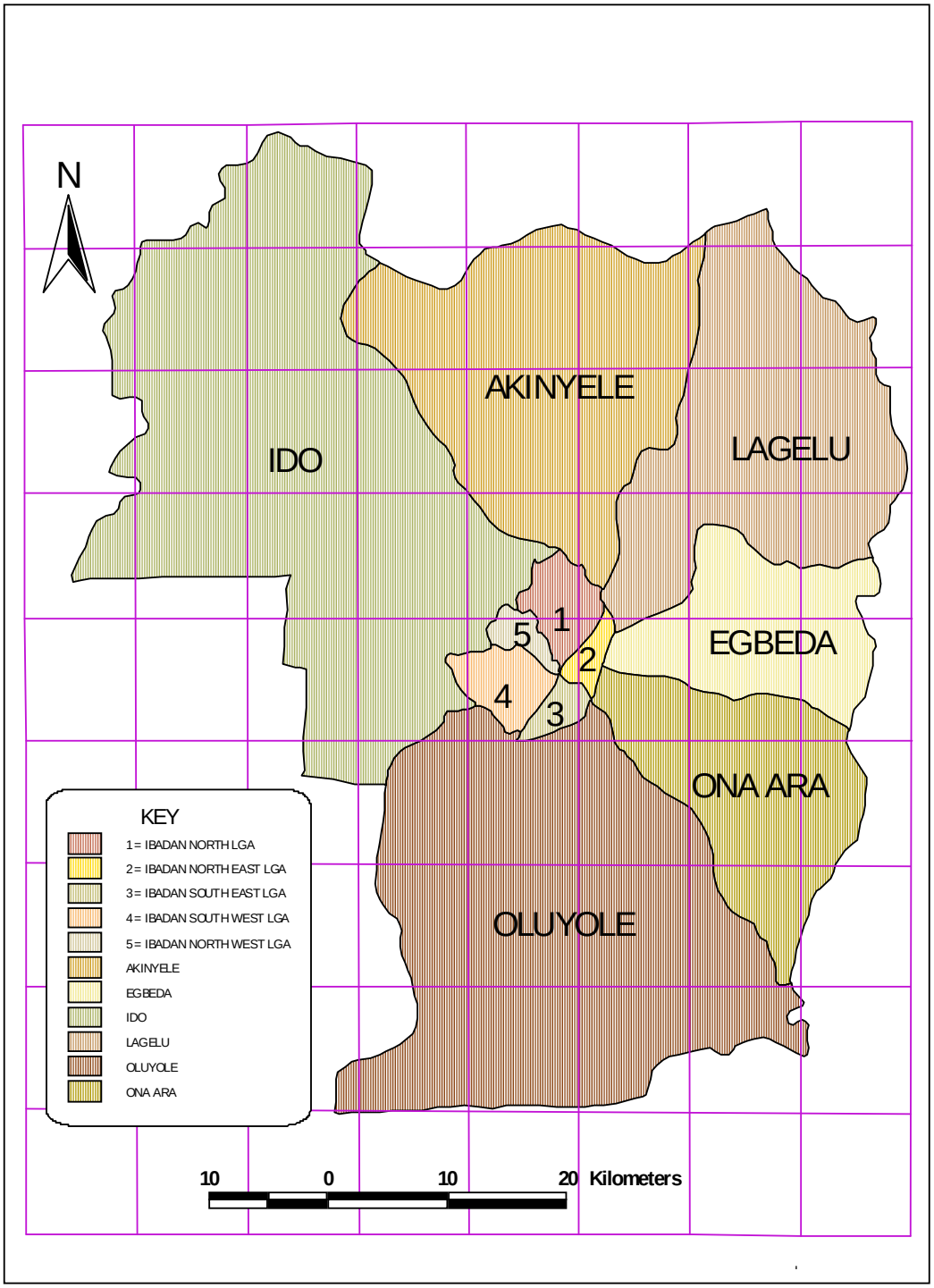

Figure 1: Ibadan Metropolitan Area
Source: Oyo State Ministry of Lands and Housing, 2014

2. Discussion

A glance through Table 1 revealed that more than three quarters of the respondents, 98.5% were of the opinion that they are aware of the presence of Industrial waste around their neighbourhood while 1.5% respondents claimed that they were not aware of the presence of Industrial waste around their environment but they did feel the smell of some of these Industrial waste within their housing environment. This implied that virtually every respondent was directly or indirectly aware of the presence of industrial waste in their environment.

Level of Awareness	No of Respondents	Percentage
Awareness	222	98.5
Non-awareness	03	1.5
Total	225	100

Table 1: Awareness about presence of Industrial waste around one's neighbourhood
Source: Author's Field Work, 2014

Table 2 shows that more than one-quarter of the respondents, 26.7% claimed that the type of waste generated more often in the nearby industrial facility around them was alcohol, disinfectant, which involve different type of chemical especially found in breweries at Alakia, Zartech at Oluyole. Followed by 20% respondents who claimed that the type of industrial waste found around their environment are that of breweries waste, which are disposed in front of the industry or within the premises of the factory.
This is closely followed by sawdust, which accounted for 14.7%,which is also disposed indiscriminately outside or within industrial premises, which affect the wellbeing of the neighbours. Also 9.8% and 7.5% of the respondents claimed that cassava fermented odour, which may take the form of contaminated fluid or the cassava peel itself, which is also not disposed of very properly. While 5.3% and 4.4% of the respondents observed that for Palm kernel shaft and dead animal infected respectively, which are in most case not disposed of properly within and around the industrial facilities, which in turn had effect on the residents of the adjourning neighbourhood.

Type of Industrial Waste	No of Respondents	Percentage
Saw dust	33	14.7
Breweries waste	45	20
Cassava fermented odour	22	9.8
Alcohol, disinfectant	60	26.7
Dead animal infected	10	4.4
Palm kernel shaft	12	5.3
Bedding, shavings, paper, faecal matter	05	2.2
Gauze, pads, garments, cellulose	10	4.4
Sharps	17	7.5
Fluids	06	2.7
Residuals	02	0.9
Total	225	100

Table 2: Type of Industrial waste
Source: Author's Field Work, 2014

2.1. Sources of Industrial Wastes
Table 3 shows that three quarters of the respondents 75.6% claimed that the sources of Industrial waste that disturbed their environment are from within factory premises, which may include back of side of industry, front of industry, etc. that are within certain radius to their housing environment while 7.6% respondents claimed that their source of industrial waste is from laboratories and research centres. Other sources of industrial waste include distribution and transportation sections 6.7%, and outside factory premises 5.7%. This shows that most of the industrial wastes affecting the people of the study area are predominantly from industrial premises.

Places of Generation	No of Respondents	Percentage
Within Industrial premises	170	75.6
Laboratories and research centre	17	7.6
Production centres	10	4.4
Distribution and transportation section	15	6.7
Outside industry premises	13	5.7
Total	225	100

Table 3: Places where the Industrial waste that affect one's environment are generated
Source: Author's Field Work, 2014

2.2. Effect of Disposal of Industrial Waste on the Resident Environment
Table 4 it can be observed that more than three quarters of the respondents 82.2% maintained that Industrial waste had effect on their residential environment while 11.1% claimed that they could say whether it had effect or not while 6.6% were of the opinion that Disposal of Industrial waste do not have any effect on their residential environment. An indication that shows that improper disposal of industrial waste does have different type of impact on the residential environment of the adjoining neighbourhood.

Effect of Disposal of Industrial Waste	No of Respondents	Percentage
Has effect	185	82.2
Has no effect	15	6.6
Cannot say	25	11.1
Total	225	100

Table 4: The Impact of Disposal of Industrial Waste on the Residents Environment
Source: Author's Field Work, 2012

2.3. Impact of Improper Disposal of Industrial Waste on Residential Environment

A glance through Table 4.5 shows that more than one third of the respondents in the study area 35.1% claimed that improper Industrial waste management causes pollution contamination of water and soil through percolation and leaching of waste to the ground water in the surrounding neighbourhood, especially the well water. Closely followed by respondents who observed that improper industrial waste management causes irritation, while 27.0% of the respondents claimed that improper Industrial waste management led to the pollution of air through smell of obnoxious gases, disinfectant, stinking gases and fumes. Whereas other effect accounted for 5.4% those in this categories of others are; (psychological effects, undue anxiety from machine operation, generator noise among others). An indication that shows that improper Industrial waste management inflicts different nature of effect on the environment where such Industrial facility is located.

Effect of Improper Industrial Waste Management on the Environment	No of Respondents	Percentage
Pollution of air	50	27.0
Pollution of water and soil	65	35.1
Irritation	60	32.4
Others	10	5.4
Indifferent	25	11.1
Total	225	100

Table 5: Impact of Poor Industrial Waste Management
Source: Author's Field Work, 2014

2.4. Hypothesis Testing

There is no significant relationship between effect of disposal of industrial waste and health of the residents around industrial area.

Table 6 shows that 22.2% of the residents around the industry who indicated that industrial waste disposal had effect and claimed air pollution as one of the health risk, while 2.7% indicated that it had no effect. Also, 28.9% of the residents who indicated that industrial waste disposal had effect claimed that water and soil pollution was one of the health risk, while 2.7% indicated that it had no effect. Additionally, 26.7% of the residents who indicated that Industrial waste disposal had effect claimed that irritation was one of the health risk, while 3.1% indicated that it had no effect. Finally, 4.4% of the residents who indicated that industrial waste disposal had effect, while 9.3% residents indicated that it had no effect. The chi-square test indicated a significant association between effect of disposal of industrial waste and health of the residents around industry ($X^2 = 61.54$, df=3, p<.001).

Health Risk	Effect of Industrial Waste Disposal		Total	X^2	df	Sig
	Had effect	Had no effect				
Air pollution	50 (22.2%)	6 (2.7%)	56 (2.7%)			
Water and soil pollution	65 (28.9%)	6 (2.7%)	71 (31.6%)			
Irritation	60 (26.7%)	7 (3.1%)	67 (29.8%)	61.54	3	<.001
Others	10 (4.4%)	21 (9.3%)	31 (13.8%)			
Total	185 (82.2%)	40 (17.8%)	225(100%)			

Table 6: Chi-square Test Showing the Effects of Industrial Waste on Residents

Table 7 shows that 28.9% of the residents who indicated that industrial waste disposal had effect on their health claimed that injury was one of the health implication, while 4.4% residents indicated that it had no effect. Also, 9.3% of respondents of the industrial area who indicated that industrial waste disposal had effect claimed that infection was one of the health implication, while 4.0% of them indicated that it had no effect. Additionally, 27.1% of the residents who indicated that industrial waste disposal had effect claimed that pollution was one of the health implication, while 4.9% indicated that it had no effect. Finally, 16.9% of the participants who indicated that industrial waste disposal had effect, other health implication, while 4.4% residents indicated that it had no effect. The chi-square test indicated a significant association between effect of disposal of industrial waste and health implication of the residents around industrial area ($X^2 = 14.69$, df=3, p<.001). Based on these results, the null hypothesis is rejected while the alternative hypothesis is confirmed.

Health Implication	Effect of Industrial Waste Disposal		Total	X^2	df	Sig
	Had effect	Had no effect				
Injuries	65 (28.9%)	10 (4.4%)	75 (33.3%)			
Infection	21 (9.3%)	9 (4.0%)	30 (13.3%)			
Pollution	61 (27.1%)	11 (4.9%)	72 (32.0%)	14.69	3	<.001
Others	38 (16.9%)	10 (4.4%)	48 (21.3%)			
Total	185 (82.2%)	40 (17.8%)	225(100%)			

Table 7: Chi-square showing Effects of Industrial Waste on Residents Health

2.5. Physicochemical Analysis of Well Water where the Industries are Located

The pH scale expresses acidity and alkalinity in water source. On the scale, the number 7 represents a condition of neutrality (pure water). In the study, all the sampled well sources are more acidic, (see table 4.35). Jericho well has 4.59, Oluyole area well has 4.10, Breweries area well is 5.13 and Apata well has 6.04 (the lower the pH reading on the scale, the higher the acidity and the higher the reading (above 7), the higher the alkalinity). Total Suspended Solid (TSS) refers to residue of water at 103^0C (Oyo State Water Corporation, 2014). All the sampled well sources have a value of 1 and 0.5, which means that there are traces of suspended solid substance. Based on the WHO acceptable TSS value of 580mgII, the well water are not suitable for consumption.

2.6. Bacteriological Analysis of Well Water Closer to Effluent Discharge of Industrial Waste

Bacteriological examination is particularly important because it offers the most logical test for the detection of fecal and potentially dangerous pollutant (Oyo State Water Corporation, 2014). It is therefore necessary to assess water purity and safety of drinking water. The presence of such fecal indicator organisms in a sample of drinking water denotes that intestinal pathogens could be present, and that the supply is therefore potential dangerous to health. The higher the numbers of pathogen count in the bacteriological analysis the more risky such water source for drinking.

Similarly, industrial water, wasted fluid from industries, may contain the causative organisms (pathogen) of many communicable diseases such as typhoid, dysentery, cholera etc Aujogbo (2012). An examination of cases of water borne diseases in the study area could be linked with presence of coli forms in the water sources (not as a causative factor, but as an associative factor). The various measurements above zero indicate the presence of industrial residue, sewage, feaces, fumes discharge from machines that had polluted the water.

2.7. Chemical Analysis of Well Water in the Study Area

Chemical test is needful for hygienic assessment in terms of presence of toxic matters, alkalinity, total hardness, presence of calcium carbonate and chloride contents of all the well water sources were examined through titration technique. Alkalinity of water is the capacity of that water to accept proton. Total alkalinity titration was carried out to determine the amount of chemical dosages required in the treatment of the well water source. The alkanity values obtained for the six well water samples show a higher pH values, which makes them more acidic unlike what is obtainable in Oyo State Water Corporation Asejire water work source.

Total hardness, Calcium hardness and Calcium ion tests were carried out to obtain a value for the formation of foams and lather when using the water for washing, out of the six well water samples, only Apata well shows a level of higher hardness content. The WHO allowable hardness value is 0-120 while it has 130 (see table 4.8). For this type of temporary hardness, proper boiling would do the purification. An advanced treatment would be to add Calcium Hydroxide [$Ca(0H_2)$].

Chloride content gives the level of natural chlorine level in the water source,, which then helps to determine the requirement magnitude/volume for the chlorination treatment. From the analysis, it is observed that the six well have allowable chorine content. For examples, while the WHO acceptable chlorine content is 200 – 600, the well water source have 60 (Jericho), 18 (Breweries), 52 (Oluyole) and 91 (Apata) chlorine values (see table 4.8).

From the qualitative analysis as evidence in Table 4.8, it could be deduced that physical and chemical characteristics of the six wells are manageable within the WHO allowable concentration. Except for a slight difference for total hardness of Apata water as explained above. This may not be unconnected with the seepage of petroleum products that percolate in to the ground water table, which causes pollution.

Parameters (mg/u)	Well Water Source						WHO Standards Maximum Allowable Concentration	Oyo State Water Corporation
Physical	**Jericho**	**Breweries**	**Oluyole**	**Apata**	**Olubadan**	**Idiayunre**		**Asejire**
Appearance	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Odour	Unobjectionable	Objectionable	Objectionable	Objectionable	Unobjectionable	Fishy	Objectionable	Fishy
Colour	0	0	0	0	0	0.5	5-50 units	1.24
Turbidity	0	0	0	0	0	4.66	5-25 units	5.0
TSS	1	0.5	0.5	1	1	0.15	580-1500	0
pH	4.59	5.13	4.70	6.04	4.59	6.8	70-85	7.2
Chemical								
Alkanity	20	50	50	65	20	58	0.5-1.0	38
Total Hardness	115	60	45	130	115	84	0-120	64
Calcium ion	16	20	6	40	16	25.6	50-150	44
Calcium Hardness	40	50	15	100	40	64	75-200	64
Chloride	60	18	32	91	60	30	200-600	17.6
Hardness								
Calcium ion	16	20	6	40	16	25.6	50-150	44
Calcium Hardness	40	50	15	100	40	64	75-200	64
Chloride	60	18	32	91	60	30	200-600	17.6
Bacteriological								
Total Coliforms/100ml	0	170	330	490	0	0	0	0

Table 8: Qualitative Analysis Result of Well Water in Ibadan Metropolitan Area of Oyo State

2.8. Recommendations and Conclusion

a. All industries operating within residential environ should as a matter of urgency develop effluent treatment centre in their premises for the treatment of industrial waste before discharging it outside to public drainage/canal or lagoon.
b. All industries should develop a more friendly relationship with their company and Landlord /tenant in the environment where they do operate concerning the issue of joint management of liquid waste and other effluent within the environment so as to promote sustainable urban development.
c. The production period should be limited to day time 6.am-9pm so as to combat the rate of inconvenience that the residents would have faced if it were to be done throughout the night when the residents might have been asleep or resting.
d. The Oyo state Government should enforce the policy of polluters pays into industries that operate very close to residential environment so that their menace to the environment may be reduced.
e. The Oyo State Government through the Ministry of Environment in collaboration with National Environmental Standards Regulation and Enforcement Agencies should embark on the issue of Environmental Impact Auditing to determine the progress impact on the environment of the activities of various industries within the community.
f. The Oyo State Government and through its planning and development control agencies should commence a proper Environmental Impact Assessment (EIA) before an industry could be located in any area so as to see to desirability using environmental effects as parameters
g. The Oyo State Government should endeavour to relocate some industries to a newly established industrial estate to be constructed by the government or in an already existing industrial estate because industrial and residential development are not compatible.
h. The Oyo State Ministry of Physical Planning and Oyo State Urban and Regional Planning Board should enforce development control measure to guide against proximity of residential to industrial location.
i. Approving residential development project within an industrial location by town planning agencies should be discontinued so as to people from being exposed to health hazards from the industries.
j. Industrial waste treatment centre should be constructed and located in each of the local government areas that have industries for the sustainability of the community.

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