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Energy Production and Environmental Concerns in Nigeria: The Case of Kaduna Petroleum Refinery on its Host Community

Al-Amin, Mohammed Amin
Department of Geography. Nigerian Defence Academy, Kaduna.
dr.aminu@gmail.com

Abstract

Energy production and environmental pollution has been a topic of interest to diverse groups especially in developing nations where stringent environmental measures are not observed. This work aimed at exploring the various issues associated with a petroleum Refinery in kaduna metropolis of Nigeria. The Refinery was established last 30 years and without the mandatory Environmental Impact Assessment (EIA). This therefore generated environmental stress to the host ecosystem and is causing serious concerns to the host community. The research work has used both Questionnaire survey and laboratory analysis of some selected parameters with the view to finding the factual condition of the ecosystem, so that the opposing claims of both the host community of Rido and that of the petroleum Refinery could be verified to know which one is correct. Samples of Soil, water and air were analyzed amongst others, the results indicated high concentration of heavy metals in both water and soil samples. The air sample also revealed high concentration of both oxides of Nitrogen and Sulfur. These findings and the others were compared to the WHO standards and were found to be above the maximum allowable levels for savanna ecosystem. The result was also corroborated by the findings from the medical and ecological studies which confirmed high degree of pollution related ailments and environmental stress of the surrounding species of flora and fauna. It was therefore recommended that bio-remediation and clean-up of contamination should be implemented together with adequate compensation for the host community of the Rido region.,

Keywords: Energy, Pollution, Ecosystem, Contamination, Refinery, Petroleum

1.0 Introduction

Energy production is always associated with byproducts that can pollute the environment if carelessly handled. This work aimed at a verification of a contamination case on Rido community by the Kaduna Petroleum Refinery; whose 30 years of operations adjacent to the community has generated thousands of tons of waste products that are alleged to have directly or indirectly affected the health and livelihood of the Rido inhabitants. This is to be achieved through the following objectives:

a. undertake a desktop review of the existing reports of Governmental agencies, and independent studies with a view to measuring the strength and weaknesses of assertions contained therein.

b. undertake further studies and analysis of environmental variables within and around the Rido community to verify whatever conclusion reached in the first objective stated above.

c. suggest the necessary measures to be taken to stop the pollution of the host community.

2.0 Study Area and the Petroleum Refinery.

Rido region is located at the south-eastern part of Kaduna metropolis (between latitude 10 and 11 degrees North and longitude 7 and 8 degrees south) in the Chikun local government area of Kaduna state. The region has an annual rainfall of 1295 mm, mean daily temperature range between27 and 33 degrees Celsius. It is within the northern guinea savanna vegetation zone that is developed over ferruginous soils and having a relative humidity of 70% and 40% for wet and dry seasons respectively. Rido region derived its name from the oldest settlement called Unguwar Rido; which is the focused settlement of this research.

This agrarian settlement has been sleeping peacefully until the decision to establish the Nigerian fourth oil Refinery within its vicinity. The choice of this location was made by the then Kaduna Capital Development Board (KCDB) in 1977 and was informed by the south-eastern orientation of Rido to the growing city of Kaduna. This orientation was thought to be parallel to the seasonal wind directions blowing on Kaduna (north-east trade winds of the dry season and the south-west maritime winds of the wet season); which will conveniently disperse away potential emissions of the proposed Refinery off the city of Kaduna and into the wildness of million hectares of farmlands.

The initial proposal for the Kaduna Refinery was that of a simple- Hyde skimming type with only 42,000 Barrel per Stream Day (BPSD). It was however decided that a 100,000 BPSD capacity be constructed. Likewise, another addition was made in March 1988 of a lube plant to process30, 000 metric tons (MT/yr) of Linear Alkyl Benzene.

According to the Refinery construction engineers (Chioda Japan), the complex was designed with environmental safety in mind. It was therefore deliberate to minimize pipe-length to facilitate quick delivery of products from one process section or unit to another; as it is not advisable to transport highly viscous fluid over a long distance of time. To achieve this, intermediate tanks were placed close to various process units; thus using minimum length of pipe, which to a large extent reduces the risks of broken pipes and probable spillage.

The fuel plant of Refinery consist of a Crude Distillation units 1 and 2, Vacuum Distillation Unit, Naptha Hydrotreating Unit, Catalytic Reforming Unit, Kerosine Hydrotreating Unit, Gas Concentrating/Gas Treatment Unit, Sulfur Recovery Unit, and the Fliud Catalytic Cracking Unit. On the other hand the Lube-Plant consist of Crude Distillation Unit No 2, Vacuum Distillation Unit No 2, Propane De Ashphalt Unit, Furfural Extraction Unit, Hot-Oil System Unit and the Mek De-Waxing Unit.

3.0 Pollution Issues connected to the Refinery.

The above described units of the Refinery Plants are linked to one type of waste product or another. In fact there are units that produce a combination of several wastes as emissions, effluents or sludge. Generally, the wastes fall in to the categories of process solids, effluent treatment solids, and general waste. Waste products from the Refinery are generally consisting of oils, organic and inorganic chemicals, (particularly acids), alkalis, hydrocarbons, sulphide, phenols and other sulfur bearing compounds with suspended solids (Coco et al 1994).

Hazardous air pollutants emitted by the Refinery include organics (*e.g.*, acetaldehyde, benzene, 1,3-butadiene, dioxins, furans, formaldehyde, hexane, phenol, polycyclic organic matter, toluene, and xylene); reduced sulfur compounds (*e.g.*, carbonyl sulfide, carbon disulfide); inorganic (*e.g.*, hydrogen chloride, chlorine, hydrogen cyanide); particulate metals (*e.g.*, antimony, arsenic, beryllium, cadmium, chromium, cobalt, lead, manganese, and nickel), and mercury (Nwajei et al 2000)

While these wastes are treated before discharging into the environment, they still constitute sources of pollution when discharged into the environment at a greater percentage than the natural environment can conveniently absorb. Sources of these waste products from the Refinery are numerous and include the points during shut-down and start-up of equipment; blow-down from cooling towers; boilers; storm water; spent days bottom sediments from separators etc.

Despite the knowledge of the wastes to be generated by the Refinery as contained in the Chioda Engineering manuals, there had not been an Environmental Impact Assessment (EIA) of the Refinery operations prior to the construction of the Refinery in 1979. Similarly, the addition of a Lube Plant in 1988 was also not preceded by any EIA as required by law. The only environmental report traceable by our consultancy firm was an Environmental Audit of the Refinery carried out in 1982 by a British Firm called Oil-Mop Inc.

The audit as expected indicated normalcy in the Refinery operations in regard to its surrounding ecosystem. It showed out that all the parameters it investigated were within the allowable limits of the WHO (1993). A review of the audit by our environmental firm suggested that the timing of the audit was inadequate, as it was done pretty early for the ecosystem to start showing any sign of degradation, as it's proven by science that a minimum of five years is needed to over-stretch the pollution threshold capacity of a host ecosystem of an oil Refinery (Harvath et al 1994).

A World Bank sponsored study of the pollution case of river Kaduna in 1988 was the first empirical evidence which suggested that the Refinery was polluting river romi; which is the medium of "treated" waste water discharge by the Refinery. The result indicated that out of the 37 sampling sites studied the point at which river Romi entered into the Kaduna River is the one having the highest pollution load, which was attributed to the effluents being discharged from the Refinery through the Romi River.

Since then, there had been several academic researches on the pollution incidence of the Refinery on its host

ecosystem. Almost all the researches have indicted the Refinery in one way or the other in polluting it's host ecosystem. A climax of these academic researches was a doctoral study carried out in Ahmadu Bello University between 2001 and 2003. The work studied soil, water, vegetation and human health around the Refinery and compared it with the waste products and operational practices of the Refinery using a scientific tool called Ecological Risk Assessment Method (ERAM) that was developed by American scientists (Cains et al) in 1991. The study indicated that the Diagnostic, Compliance and Warning Indicators were well above the acceptable limit and concluded that the Refinery was impacting negatively on the host ecosystem and communities especially those living adjacent to the Refinery.

Another outstanding revelation of the doctoral study was that the Refinery had no solid waste treatment and disposal facility throughout its operational history and is arbitrary dumping the solid waste in an area earmarked (area W) for further expansion of the Refinery. It concluded that such illegal practice is impacting negatively on the health of the staff of the Refinery and the adjacent host community of Rido. The research outcome was widely circulated in Nigeria and abroad and that informed the federal government of Nigeria to award a contract of N2.7 Billion Naira to a British company (Osprey Investment limited) for the clean- up and remediation of the sludge pit and welfare project for the Rido community.

Results of the preliminary studies of the scientific laboratories contracted by Osprey Investments have confirmed some level of contamination in the ground water of Romi community, ironically however denying any contamination around the sludge pit or any area in the Refinery complex, perhaps to avoid staff litigation since none can presumably come from the Rido community.

The illegal toxic solid waste dumping by Refinery in the Rido community in June 2012 was the latest in the string of pollution crimes against the host community of Rido. Our findings revealed that the Refinery is now having problems with the solid waste it produces since the illegal sludge pit of area W was taken over by Osprey Investment for it's clean up and remediation. Hence it resorted through its contractors to such illegality and crime of June 2012 around the Rido community.

The latest in the string of these pollution incidences was on the 6th of June 2012, vehicle loads of solid waste materials from the Refinery were dumped on a roadside in the farms adjoining the Rido community. Consequent upon this the soil and ambient air of the surrounding became contaminated and this resulted in the death of over 800 poultry belonging to a nearby farm called Biams Integrated Farms Ltd. It also resulted in the loss of one life among the Rido community residents.

The incident had elicited several attentions ranging from environmentalists, Academics, CBOs, media etc. After some newspaper captions on the incidence both the Refinery and the government embarked on damage control exercise in which several analyses of the impact of the dumped waste on the community were undertaken.

3.1 Summary of Governments opinion

The government agencies involved in the field investigation on the pollution incidence comprises the Refinery which is a subsidiary of the Nigerian National Petroleum Company (NNPC) that is under the federal ministry of petroleum. Similarly, Federal Ministry of Environment and its subsidiary of the National Environmental Standards and Regulation Enforcement Agency (NESREA) and its state counterpart called Kaduna Environmental Protection Agency (KEPA) were involved in the investigation. The environment committee of the Kaduna State parliament had also undertaken a separate investigation.

The result from these five departments of government showed that there had not been any contamination of the Rido community consequent upon the illegal waste dump in their vicinity. Hence the claims on loss of poultry and a human life were baseless and should be treated as such. Results of laboratory analyses of some parameters were attached to their reports in order to substantiate the conclusions.

3.2 Summary of independent Assessment:

Three independent scientific organizations were involved for an unbiased evaluation of the alleged toxicity of the illegal dump in the Rido community. These were: the Pathology Department of the 44 Nigerian Army Reference Hospital of Kaduna, the Forensic Science Laboratory, Lagos and Analchem Hydro Technologies limited of Lagos.

The result of the analyses and conclusions of these independent bodies out of the samples studied indicated that

there existed substantial evidence to prove the pollution allegation against the Refinery consequent upon the illegal waste dump in the Romi community. The conclusions drawn were based on the strong correlation of parameters analyzed in the sampled waste and bones remains of the affected poultry. The results showed availability of the same toxic elements (Heavy Metals) both in the dumped solid waste and in the avian remains (bones) of the affected poultry in the Rido community. Laboratory results of the parameters analyzed were attached to their independent reports in order to substantiate the conclusions. After a careful study of the reports the following observations could be made:

a, There is no detailed explanation on the sampling procedures (i.e sampling frame and samples handling) as well as the analytical techniques used in the environmental quality investigations carried out. These lead to ambiguities and lack of forensic integrity of the results obtained out of the processes.
b, The parameters monitored or investigated by the governmental agencies were more or less generic/screen and not specific or limited to the issues arising from the June 2012, and therefore cannot be exhaustive enough in determining the pollution allegations being made. On the other hand, the parameters and samples analyzed by the independent laboratories were directly related to the pollution allegations.

With these two disparities mentioned above it will be difficult or rather impossible to make an objective comparison of the two positions and bring out an unbiased conclusion. It is therefore necessary to undertake a standard method of scientific verification using the global best practices on such specific pollution case.

4.0 Methodology:
The methodology of this study involved the use of both secondary and primary data. The secondary sources comprised of an elaborate reviews of the engineering manuals of the operations and processes of the Refinery to find out the generation of waste and harmful substances as well as specifications of the operations. The various reports made by government and independent bodies on the various pollution cases of the Refinery were also studied.

Two questionnaires were designed and administered in order to find information on some critical variables of the Refinery ecosystem in terms of health and ecological integrity of the Refinery and it's host community. The health question are was centered on allergic ailments that could be caused by Refinery contamination on the host communities, these included skin allergy, gastronomic-intestinal disorders, cancer related ailments as well as child development disorders which according to Adefemi et al (2007) are attributable to Refinery pollution. Eight hospitals around the Refinery communities were covered by the questionnaire survey and additional two that were far away from the Refinery were covered to serve as control points.

Similarly, environmental parameters of soil, water and air were sampled and analyzed in order to obtain a primary data that can be compared with either a baseline data or with standards that were set by control agencies. Parameters chosen were based on APHA (1998) guidelines and under the meticulous requirement of Data Quality Objectives (DQOs). Instead of using screen parameters as was the case by the governmental agencies mentioned above, the use of contaminant-specific parameters were employed.

The parameters monitored in both the ground and surface waters are therefore as follows: Metallic ions of Copper, Iron, Chromium, Zinc and Manganese. Others include total solids, pH, oil and grease, COD, BOD and Phenols. The parameters analyzed for soil are: Total Hydrocarbons, Oil and Grease, Phenols and Organic Matters. The Parameters for air quality monitored were that of Carbon monoxide, Hydrogen Sulphide, Oxides of Nitrogen and that of Sulfur (Vivan et al 2012).

Air quality parameters were sampled along four transects laid on each side of the Refinery complex; starting from the fence to a length of 10 Kilometers. Samples were obtained at an interval of 2 Kilometers each. This gives a total of 20 samples within a diameter of 20 kilometers. On the other hand two levels of soil samples were taken i.e at surface and at core level these were taken along the transects used for air sampling, thereby giving a total of 40 samples.

Surface Water samples were taken along the Romi River at an interval of 1kilometer starting from the Refinery point of discharge into the river up to 8 kilometers downstream and 4 kilometers upstream at two layers of surface and sub-surface. This gives a total of 24 Samples all together. Water quality parameters of temperature, dissolved oxygen (DO) (using YSI DO/T meter) PH (using corning EEL digital PH meter). Conductivity (Beckman lab. Conductivity meter) using Acidified dichromate method) Biochemical Oxygen Demand (BOD)

(using BOD bottle tech) Ammonia Nitrogen (NH4 +N) Nesslers reagent method. Total Solids (TS) Dissolved Solids (DS) (using gravimetric) and suspended solids (by finding the difference between TS and DS (Swan et al (1979)).

5.0 Results and Discussions

5.1 Ecological Condition

The location and position of the Refinery was assessed in relation to urban growth of Kaduna metropolis and also in regards to the orientation principles that informed the choice of the Rido region for its citing. It was found out that the advice of the KCDB in 1977 was faulty of assuming that the urban growth of Kaduna was one-directional towards the north-eastern side of the city. Conversely, Kaduna was expanding multi-directionally especially after the sectarian crises that engulfed the city in the last 20 years.

Similarly, the orientation principles based on the directions of both the north-east and south-west wind that could prevent atmospheric transportation of the Refinery emissions were also faulty; results from our questionnaire and instrumental calibrations of a mobile wind vane indicated the opposite to the earlier assumption. This therefore results in atmospheric transportation of the Refinery air emission deep down residential areas almost 10 kilometers from the source (i.e. reaching as far as Goni Gora to the west).

The Rido/Refinery ambient ecosystem was also assessed in relation to nutrients/chemical cycles and their pathways and dispersals in the area and how it could affect the biosphere surrounding the ecosystem. It was found out that the volume of organic and inorganic compounds being emitted by the Refinery since its

inception in the last 30 years is in excess to what the natural capacity of the receiving environmental components could absorb and conveniently neutralize.

Similarly, the air, soil, water and organisms' ecology were considered in relation to their functional integrity consequent upon their proximity to the Refinery and the outcome was that there is a sustained and chronic metabolic distress in the functional ability of most living organisms in the immediate vicinity of the Refinery. The Public health Experts covered by the questionnaire were further emboldened on their position when they compared medical records from the clinics being patronized by the Rido inhabitants.

5.2 Environmental Condition

Tree independent laboratories were used for the analysis of the sales parameters. The results obtained in these laboratories were the statistically handled to obtain the average of each result. The values obtained are therefore presented on table 5.1

It can be seen from the results that there existed contamination of water, soil and air in and around the Rido community. However, the results have indicated that the contamination level is not capable of causing an outright harmful effect on the biotic and abiotic resources of the community when isolated but if extrapolated over time it is certainly very dangerous.

The result of the surface water samples indicated an average acidity (in pH) of 5.7 all through the samples obtained. This has disputed the results provided by both KEPA and the quality control department of the Refinery. the implication of this is that the parameter is far below the WHO (1993) standard for drinking water quality which the UN body recommended a range between 7.0 - 8.5 as the desirable limit.

Similarly, the values obtained for total solids are given at 1800 m/ ltr which is far above the WHO recommended desirable value of less than 500 m/ ltr. Infect the value obtained has even surpassed the maximum permissible limit of 1500 as put forward by the WHO (1993).

Table 5.3: Average Observed Values of Parameters Monitored on Surface Water.

Element	Mean Observed at point of Discharge	Desirable	permissible
Copper	1.2	<0.0005	<1.0
Iron	1.6	<0.01	<1.0
Chromium	0.18	<0.05	<0.1
Zink	5.6	<0.5	<5.0
Manganese	0.8	<0,01	<0.5
Total solids	1800	<500	<1500
pH	5.7	7.0-8.5	<9.2

As mentioned in the sampling frame, some specific heavy metals were also monitored in the surface water. The results obtained were also not within the allowable limit; even though it does not constitute an immediate harm when viewed from the value alone, but not when viewed from the long time of exposure. The metals of copper and iron are actually far above the WHO desirable and even permissible standards. The average value obtained for copper is 1.2, as against the WHO (1993) recommended value of 0.005 in the desirable limit or the permissible limit of 1.0.

This is also the same story with iron of which the value obtained from our verification exercise is averagely at 1.6 which over 700% above the WHO (1993) is recommended desirable value of 0.1. In fact, the value 60% above the "red zone" limit of 1.0 as set aside by WHO (1993) for drinking water quality. As is well known that the surface water of river Romi is being used by the neighboring communities for drinking and other domestic purposes. The other heavy metals analyzed in the surface water samples is that of Chromium and Manganese both of which are far above the WHO (1993) desirable and permissible limits. The average values of Chromium in the surface water are 0.18, while the maximum desirable and permissible by the WHO (1993) are pegged at 0.05 and 0.1 respectively. On the other hand while the WHO (1993) permissible limit of manganese is 0.5 the observed value in the samples analyzed were 0.8, this increase is very high.

As stated earlier, the air quality was monitored from the four directions of the Refinery at an interval of 2 kilometers on transecting of 10 kilometers. The average results obtained are shown on table on 5.3. It could clearly be seen that there exist contamination of the air, even though the atmospheric characteristics at the time of the sampling was unstable as the wind speed constantly disperses the emissions from stacks. Likewise the capacity utilization of the Refinery plants at the time of the investigation was only 20%! Despite that these level of pollutants were recorded. It therefore follows that if the actual air emission is to be determined then the current value must be multiplied by eight to get the 100% emission at the Refinery full capacity.

5.3 Health Condition.

In order to make findings on medical history of the Rido community and the health impact of the Refinery operations on its immediate communities, eight medical centres were studied, 3among the centres were located within 2 kilometers from the Refinery complex (1 centre in Rido village, one in Maraba and the other at Kafam). The other three were located from 3 kilometers to 10 kilometrs away from the Refinery. A range of survey activities were conducted in each of the centres. These included examination of medical records, questionnaire administration to medical personnel, patients and patients relations.

The issues of interest bordered on medical conditions suggested by Holland et al (1979), particularly those of skin, respiration, Gastro-intestinal and neuron-related disorders. The numbers of patients diagnosed with the ailments in the medical centres were compared with 2 other medical centres that were picked to serve as control locations and are located some 40 kilometers away from the Refinery communities. The following results were obtained:

Table: 5.4: Skin Related Diseases Around KRPC

S/NO	Type of problem	Clinic 1	Clinic 2	Clinic 3	Clinic 4	Clinic 5	Clinic 6	Control 1	Control 2
1.	Number of Patients diagnosed with skin diseases.	2/10	4/10	5/10	1/10	0/10	1/10	0/10	1/10
2.	Patients diagnosed with skin itching	2/10	3/10	4/10	2/10	1/10	0/10	1/10	0/10
3.	Patients diagnosed with skin Bumps	3/10	4/10	3/10	2/10	1/10	0/10	1/10	1/10
4	Patients diagnosed with skin Psoriasis	4/10	2/10	3/10	5/10	2/10	2/10	0/10	0/10

Table: 5.5: Respiratory Related Diseases Around KRPC

S/NO	Disorder	Clinic 1	Clinic 2	Clinic 3	Clinic 4	Clinic 5	Clinic 6	Clincal7	Clinical 8
1.	Patients diagnosed with emphysema, bronchitis, asthmas e.t.c.	4/10	0/10	3/10	6/10	1/10	0/10	1/10	0/10
2.	Patients diagnosed with sarcoidosis, alveolar damage, pleural effusion e.t.c	2/10	5/10	4/10	2/10	1/10	0/10	1/10	0/10
3.	Patients diagnosed with pulmonary edema, embolism, hypertension e.tc.	3/10	4/10	3/10	6/10	1/10	1/10	1/10	1/10
4	Patients diagnosed with pneumonia, asbestosis cough e.tc	4/10	3/10	3/10	5/10	2/10	2/10	0/10	0/10

Table: 5.6: Gastro-Intestinal Disorders Around KRPC

S/NO	Disorder	Clinic 1	Clinic 2	Clinic 3	Clinic 4	Clinic 5	Clinic 6	Clinical 7	Clinical 8
1.	Patients diagnosed with irritable bowel.	4/10	3/10	1/10	3/10	2/10	5/10	0/10	1/10
2.	Patients diagnosed with gastro esophageal	4/10	3/10	4/10	2/10	1/10	0/10	0/10	0/10
3.	Patients diagnosed with crohns disorders	3/10	3/10	3/10	2/10	1/10	0/10	1/10	0/10
4	Patients diagnosed with imflametory bowel stress.	4/10	4/10	3/10	5/10	1/10	2/10	1/10	0/10

Table: 5.7: Nue2ro-Related Diseases Around KRPC

S/NO	Disorder	Clinic 1	Clinic 2	Clinic 3	Clinic 4	Clinic 5	Clinic 6	Clinical 7	Clinical 82
1.	Patients diagnosed with muscle weaknesses	6/10	3/10	5/10	2/10	0/10	0/10	0/10	0/10
2.	Patients diagnosed with poor coordination	5/10	3/10	3/10	1/10	1/10	0/10	0/10	0/10
3.	Patients diagnosed with loss of sensation	6/10	3/10	3/10	2/10	2/10	0/10	0/10	0/10
4	Patients diagnosed with altered level of consciousness	5/10	3/10	2/10	4/10	2/10	2/10	0/10	0/10

It should also be noted that discharges of pollutants from the oil Refinery are found to be associated with a variety of adverse health effects including cancer and a number of other chronic health disorders like *apalastic anemia*, *pancytopemia*, *pernicinus anemia*, *pulmonary* (lung) structural changes and a number of other acute health disorders like dyspnea (difficulty in breathing), upper respiratory track irritation with cough, conjunctivitis, neurotoxin effects (like visual blurring, tremors, delirium, unconsciousness, coma, convulsions etc. Some specific Refinery pollutants associated with specific health disorders are given as below:

Benzene according to (Guodeman et al 2005)are classified as human carcinogens, and long exposure to it can cause an increase risk of cancer in humans (such as leukemia, lymphoma, myeloma etc) as well as a plastic anemia, *pancytopenia*, chromosomal beakened bone marrow. Exposure to n-hexane can cause *polynueropathy* (muscle weakness and numbness).

Exposure to naphthalene is linked to cataracts and anemia in human infants. Metals emitted from refineries can cause effects such as mucus membrane irritation (e.g bronchitis, decreased lurk capacity), gastro intestinal effects, nervous systems disorders, and skin irritation, reproductive and developmental disorders.

Carbonyl sulfide may cause coughing, hoarseness, inflammation and ulceration of the respiratory track, chest pain, and pulmonary edema in humans (Asaolu 1995). Ozone is responsible for the reduction of lung function, respiratory systems (e.g. cough, chest pain, throat and nose irritation).

6.0 Conclusion and Recommendation.

The outcome of the study indicates a negative ecological relationship between the Refinery and its adjacent environmental parameters and the human health of the host community. This is consequent upon the negative operational practices of the refinery. The environmental guidelines as specified by EGASPIN are not being adhered to and internal corruption in the system is not helping matters as well. It is also observed that there is lack of corporate social responsibility of the refinery management on its host community of Rido settlement.

It is therefore recommended that a total overhaul of environmental and safety procedures of the refinery be embarked upon. There should also be a clean-up and remediation of the Rido ecosystem, plus a welfare/rehabilitation project of the host community.

References

Adefemi OS Asolu. Olade O (2007). Assessment of the physicochemical Status of water samples from major Dams in Ekiti State. Nigeria. Pak. Nut. 6(6) 657-659.
APHA (1998) Standard Methods of the Examination of Water and Wastewater. 20th edn. Washington. D.C
Asaolu SS (1998.) Chemical Pollution Studies of Ondo State. Ph.D Thesis. Fed. Univ. Technology Akure. (Unpublished).
Cains et al 1991; Ecological Risk Assesment Model, Journal of Research in Environmental Science and

Toxicology. Vol 1 (3) pp 41-46
Cocu. M.. Lupeanu. M.I.. Nicorici.M.. Lonescu L. & Sandu. S. (1994). The Dangerous wastes and Health Risks in Romania: National Report, Central European Journal of Public Health, 2(supply), pp. 41-43
Gaudeman. W.J. Avol, E. Gilliland. F. Vora H. Thomas. D. Berhance, K. McConnell. R. Kuenzil N. Murmann. F. Rappaport E. Margolis H. Bales D. & Peters. J. (2005). The Effects of Water Pollution on the child Development from 10 to 18 Years of Age. New England Journal of Medicine, 352(12), pp. 1276
Goodall. B. (1995). Environmental Auditing. A Tool for Assessing the Environmental Performance of Tourism Firms. The Geographical Journal. 161(1). Pp. 29-37.
Harvath. A & Hegedus. E. (1994). Hazadous Wastes in Hungary-National Report. Central European Journal of Public Health, 2(suppl), pp. 30-33.
Holland. W.W. Bennett. A.E Cameron. I.R. Florey. CV Leeder. S.R Shilling R.S.F..
Swan. A.V & Waller. R.E (1979). Health Effects of Particulate Pollution: Reappraising the Evidence. Am Journal Epidemiol. 110(5) . pp 525-659.
Nwajei GE. Gagophien PO (2000). Distribution of heavy metals in the sediments of Lagos Lagoon. Pak.J.S.c Ind Res. 43:338-340
Vivan EL. Adamu CI & Ayuba KN (2012) Effects of effluent discharge of Kaduna refinery on the water quality of river Romi. Journal of Research in Environmental Science and Toxicology. Vol 1 (3) pp 41-46
WHO (1993) Guideline for drinking water quality 2nd Ed. Recommendation. World Health Organization Geneva Switzerland

Mohammed A. Al-Amin is an Associate Professor with the Nigerian Defence Academy. His research interest is centred on Energy and Environmental Management. Al-Amin is a member of several environmental organizations, including the Nature Trust International; where he served as two times Chairman of the organisation. He is also an Environmental Blogger (greennotice@blogspot.com). Currently, Al-Amin leads an environmental rights group called Green Assembly and is making a huge impact in checking the excesses against the natural resources of Africa