ENVIRONMENTAL HAZARD SURVEY; POSITION, PRACTICE AND RELEVANCE IN THE NIGERIAN REFINERIES AND PETROCHEMICAL COMPANIES

[A case study of Kaduna Refining and Petrochemical Company (KRPC) limited]

BY

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THIS PROJECT IS SUBMITTED TO THE DEPARTMENT OF GEOGRAPHY SCHOOL OF SCIENCE AND SCIENCE EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA.

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DECLARATION

I hereby declare that this project work has been conducted by me under the guidance of DR. OKHIMAMHE, A. A. a lecturer of the Department of Geography, federal University of Technology Minna, Niger State.

Award of all credit goes to the writers whose work were consulted and referred to in this project.

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CERTIFICATION

This is to certify that this project is an original work undertaken by MALGWI HARUNA YUSUF registration number PGD/GEO/2003/2004/291 of Geography Department and has been prepared in accordance with the regulation governing the preparation of project work in Federal University of Technology Minna, Niger State.

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DEDICATION

his project is dedicated to my daughter and son, **Sinai** and **Yahhurwa**, who throughout ne period of this programme missed their Daddy's weekend care and to late **Reverend oshua Bature** who had desired to have a word with me but due to the project reparation we could not see, only witness is transition on 11th December, 2004.

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To God be the glory and many thanks to all those who have, in gracious ways, contributed immensely in getting this work ready for presentation.

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I give special thanks to my dear wife Jummai Yusuf, my colleagues in KRPC ltd. and all course mates in PGD programme 2003/2004, Mr. E. C. Nwabufo former Manager, Fire Safety and Environment KRPC Ltd. is worthy of mention, for the support and understanding he gave me.

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ABSTRACT

Environmental Hazard Survey; position, practice and relevance in the Nigerian Refineries and Petrochemical Companies is the topic of this research. Environmental hazards are regarded as the key element responsible for the call to a better Environmental Management taking into account their potential to cause harm to people and the Environment, depending on how their manifestation is encountered.

In this project work, an attempt was made to appraise hazard survey as work tool in Environmental monitoring and control in the oil industries.

The main issues are; knowing where these industries are now, how they are using this tool and the importance they attach to its usage.

The Kaduna Refining and Petrochemical Company (KRPC) was used as a case study. At the conclusion of the work, KRPC was found to have been practicing Environmental Hazard Survey since the inception of the company, but the method and most equipment used are out dated and require urgent adoption of the latest methods and equipment considering the technological advancement in the oil business today. Some general recommendations and suggestions for further research were also proposed.

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GLOSSARY OF TERMS

CONTINGENCY	- An event or situation that might happen in the future
DPR	- Department of Petroleum Resources
EMS	- Environmental Management System
EHS	- Environmental Hazard Survey
ENVIRONMENT	- The physical factors of the surrounding of human beings including the land, soil, water, atmosphere, climate, sound, odors, taste and the biological factors of animals and plants of every description.
FEPA	- Federal Environmental Protection Agency
GIS	- Geographic Information System
HAZARD	- Something that could be dangerous or has the potential to cause harm or damage
KRPC	- Kaduna Refining and Petrochemical Company
NNPC	- Nigerian National Petroleum Corporation
NORM	- Naturally Occurring Radioactive Material
POLLUTION	- The process of making dirty, altering of quality etc of the environment
POLICY	- Set of plans that are used as a basis for making decisions.
RIGHT TO KNOW	- Moral or legal entitlement to knowledge or information
SURVEY	- A detailed investigation of something or close examination of an area
WWT	- Waste Water Treatment

CHAPTER ONE

1.1 INTRODUCTION

There are numerous hazards that exist in the environment; hydrocarbon related hazards have over the years been identified as one that requires frequent monitoring in order to safeguard the environment of their effects.

The definition of the term "environment" means different things to different people. The environment as defined by St. Kitts and Nevis refers to the physical factors of the surroundings of human beings including the land, soil, water, atmosphere, climate, sound, odors, taste, and the biological factors of animals and plants of every description. The term "hazard" is understood as a substance, object or situation with a potential for an accident or damage. Environmental Hazards are regarded as the key element responsible for the call to better environmental management taking into account their potential to cause harm to people and the environment depending on how their manifestation is encountered. The identification of these hazards requires sound knowledge and good work tools. Hazard survey is one of the methods used to identify hazards and a good hazard survey checklist is a dependable work tool. The position, practice and relevance of hazard survey in the Nigerian Refineries and Petrochemical Companies with particular emphasis on Kaduna Refining and Petrochemical Company (KRPC) shall be the focus of this research work. Some of the hydrocarbon related hazard that applies to KRPC includes air, land and water pollution. Nigeria is one of the industrializing countries increasingly becoming aware of the adverse effects of air, land and water pollution on human health, animal and plant life. Various publications highlighted the fact that air pollutants include some of the following namely: Sulfur dioxide, nitrogen dioxide, carbon

monoxide, ozone, ammonia and hydrocarbon. The concentration of these pollutants listed above, are very low in unpolluted air but vary under polluted conditions due to increased industrial activities. Air pollutants also include particulates, smog and smoke. This type of industrial activity determines the type of air pollutants. This is also true for water pollutants in petroleum refining which include ammonia, hydrocarbon, hydrogen sulfide, phenol, cyanide and oil. Air and water pollution problems in one location (country, city, town or village) differ significantly from those of another location, regardless of similarity in source of water and air pollution, due to differences in meteorological conditions. Increase in the concentration of industries and population in one location contributes significantly to increase in the sources of air and water pollutants. The case of land Pollution leads to various degree of land degradation as experienced in the Niger-Delta region of Nigeria where petroleum exploration had taken toll on the land since colonial Nigeria. A careful study of KRPC plant units gave the following as some of the possible pollutants:

(i) Benzene

(ii) Hydrofluoric acid (HF)

(iii) Paraffin solvent (CH_{10})

(iv) Hydrogen sulphide (H_2S)

(v) Sour water

(vi) Spent caustic

(vii) Oil spill

A further analysis of the toxicity and effect on the environment of these pollutants is summarized in the table below:

Table 1.1: POLLUTANTS' TOXICITY AND EFFECTS SUMMARY

Compounds	Threshold Toxicity Limit	Effect on Environment/ Human & vegetation
Benzene	10ppm	Increases Biological Oxygen demand of water system. Toxic to human beings causing dizziness, mental confusion, tightening of leg muscles, and ultimately coma. Affect O_2 carrying capacity of the blood.
HF	3ppm	Upper respiratory poison cannot be tolerated for short periods as it produces ulcers of the upper respiratory tract. Has devastating effect on all body tissues causing hard to heal ulcers.
Paraffin solvent	N/A	None-poisonous, irritating to the eye.
H_2S	10ppm	Highly toxic. Exposure to low concentration produces conjunctivitis, vision problems and digestive disturbances. It kills the cells by paralysis of the respiratory centers. On environment burning produces SO_2 and hence acid rain.
Sour water	N/A	Contains ammonia, H_2S and traces of phenols which are harmful to the water system especially phenols.

A study by the Environmental Planning and Protection Division (EPPD) of the Federal ministry of Works and Housing indicated a moderate concentration of pollutants in the Romi River in the host community of KRPC.

1.2 STATEMENT OF RESEARCH PROBLEM

The host communities of the oil industries in Nigeria have cried out in the print and electronic mass media of environmental pollution, the oil workers have presented at various forums the health hazard they are exposed to and seek for urgent attention from the Government. The nation's refineries and petrochemical companies are identified

among the source of environmental hazard that requires a comprehensive hazard survey format and practice. The establishment of these companies in Warri, Port Harcourt and Kaduna under the umbrella of Nigerian Nation Petroleum Corporation (NNPC) has a very significant role in the national polity. However, **effective monitoring tools are needed to ensure that acceptable practice is strictly followed.** The study area is wide, and each project has a peculiar impact on the host community. However, a case study of Kaduna Refining and Perochemical Company is to be presented as an effort to open up avenues for further studies in the other areas.

1.3 AIM AND OBJECTIVE OF THE STUDY

The aim of the study is to contribute to the effort of the Federal Environmental Protection Agency (FEPA) now Federal Ministry of Environment, in the control of Environmental hazards by assessing the usage of environmental hazard survey as a tool for monitoring such hazards especially in the hydrocarbon industries. The aim shall be achieved through the following objectives:

(a) Checking and assessing the work tools for Environmental Hazard Survey in such industries in meeting the required purposes and make recommendations.

(b) Checking the strategies put in place for the effective monitoring of Environmentally hazardous discharges by such industries and suggest improvement

(c) Identifying possible areas requiring further studies and document them for further research.

(d) Recommending other method(s) of ensuring compliance to regulatory laws and conducting environmental hazard surveys.

1.4 HYPOTHESIS

Inline with the objectives of the study, the following assumptions have been made prior to the study:

1. That environmental hazard survey as a tool for effective monitoring of environmental hazard is not well understood or not effectively used by the operators of these industries.
2. That there is no direct control by the Federal ministry of environment over the activities of these industries and thus the management can freely violate environmental laws and go free.
3. That the host communities are not aware of their right to know those things that constitute hazard in the operations of these industries to their environment
4. That the study will exhume other areas of research for interested scholars for further research.
5. That our level of technological development is lingering behind giving room to unnecessary bending of quality standards.

1.5 JUSTIFICATION

On 30th day of December 1998, His Excellency General I.B. Babangida, President, Commander-in-Chief of the Armed Forces, Federal Republic of Nigeria Signed the Decree establishing the Federal Environmental Protection Agency (FEPA) with the following functions among others: -

(a) Responsibility for monitoring and helping to enforce environmental protection measures;

(b) Co-operation with Federal and State ministries, Local Government Councils,

statutory bodies, and research agencies on matters and facilities relating to environmental protection.

The course of study being Post Graduate Diploma Environmental Management in a Federal University of Technology, and the study topic being: Environmental Hazard Survey Position, Practice and Relevance in the Nigerian Refineries and petrochemical Industries, falls within matters relating to environmental protection and the required research agencies stated in the decree.

A *compendium of Environmental laws of African Countries volume - I of 1996 refers to the framework laws and Environmental Impact Assessment (EIA) regulations. Egypt is one of the Countries that have benefited from Environmental survey works that became part of a National law (Egypt official journal of Environment – Issue No. 5 of 3 February, 1994)*

The objective of the study as out lined if achieved, will also contribute to Nigeria's position in enhancing the frame work of Environmental laws of the Country in line with the United Nations Environmental Protection (UNEP) and United Nation Development Project (UNDP)'s joint project on Environmental law and institutions in Africa to which Nigeria was a participant along with twenty-three other Countries including Egypt.

1.6 SCOPE AND LIMITATIONS OF STUDY

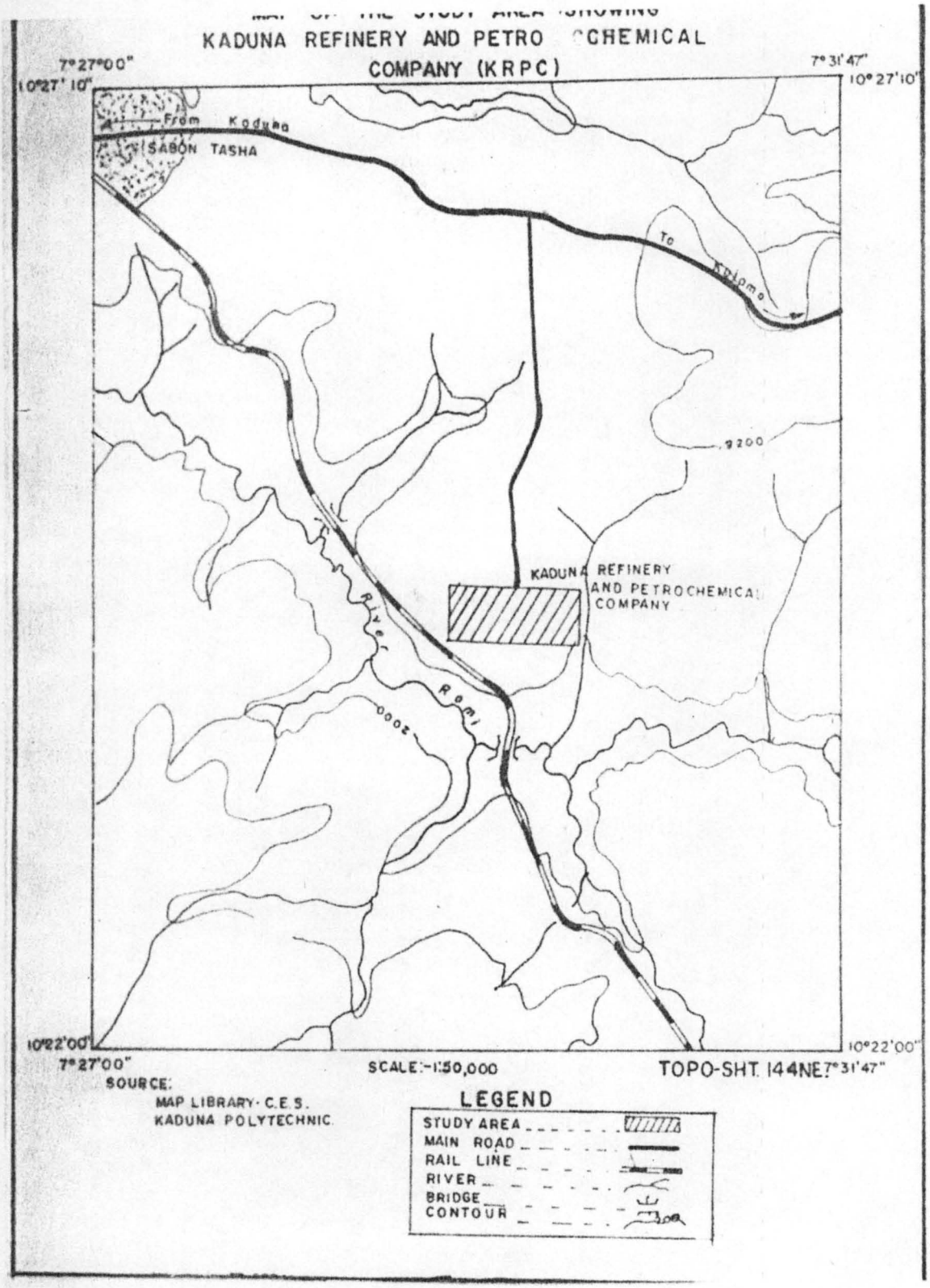
The study will be limited to the Kaduna Refining and Petrochemical Company (KRPC) and the host community at Fadaman-Jaki Chukun Local Government Area, Kaduna State, Nigeria. Time, funds, technological prowess and required manpower to cover the nation's refineries and petrochemical companies are the main limitation to this study.

1.7 DESCRIPTION OF STUDY AREA

The Kaduna Refining and Petrochemical Company (KRPC) Limited is one of the subsidiaries of The Nigerian National Petroleum Company (NNPC). It is located at Fadaman –Jaki about 16km from Kaduna City center, off Kachia road in Chukun Local Government Area of Kaduna State, Nigeria. His Excellency Alhaji Aliyu Shagari commissioned the refinery plant in 1980 while His Excellency General Ibrahim Babangida commissioned the Petrochemical plant in 1988.The Plant was located away from the residential area at the project stage as could be seen on the study area map but presently with the urbanization and population explosion, residential quarters are springing up fast closing the gap that once existed. Additional petroleum related industries have also sprung up. The refinery is located in the tropical northern midlands of Nigeria, site co-ordinates 07°25'E, 10° 28'N. The site is located approximately 600 metres above sea level, and well above the maximum flood level of the Kaduna River, which passes at a distance of about 10km away. Kaduna is located in a Zone 0 area (Modified Mercalli V and below) with respect to seismic exposure as per Munich Re's World Map of Natural Hazards. At Kaduna, the risk from this exposure is expected to be low. Temperature is high but not extreme, with maximal in the order of 35°C to 40°C. Rainfall is seasonal, total 377mm annually, with defined wet and dry seasons of about six months each. During the dry season, the northeast " Harmmatan" wind, from the Sahara dominates, and during the "Rainy" season, there is more humid southwest airflow from the sea. The region is prone to electrical storms during the wet season, but not generally liable to significant windstorm activity. Historical weather patterns have however been unreliable in predicting the seasonal changes in recent years, and loses due to more

extreme metrological conditions cannot be precluded. This region of Nigeria is highly subject to thunderstorms, typically about 140 days per annum, but not generally liable to significant windstorm activity. About 400Km to the East of Kaduna is a known area of volcanic activity that stretches in a southwest to northeast line from offshore Gulf of Guinea to on-shore Cameroon that is also a Zone 1 (MM VI) region. This exposure is not expected to be significant.

Fig 1.1 **MAP OF THE STUDY AREA**



CHAPTER TWO

2.0 LITERATURE REVIEW

Environmental Hazard Survey in the oil industry is one of the proactive practices gaining special attention in recent times. Yang (1992) in his work "The study of environmental hazards in Shaanxi China" asserted that survey of environmental hazards is very important in today's world, considering the various natural evolution and events of variations which is happening on the surface of the earth and bring disaster to human society. Early detection and essential information for the study of distribution of environmental hazards is made possible by efficient surveys that serve a proactive function and a tool in making decision. The complex operations in both the upstream and down stream sector of the oil industry in Nigeria require such efficient surveys in order have sufficient information that will give management the required knowledge for appropriate actions. Hussein (2000) also advanced an integrated approach to environmental hazard survey "the use of remote sensing technique and GIS" referencing the many types of parameters and variables which are dependent on each other in environmental hazard survey. Environmental hazard survey in the oil industry have many types of parameters and variables which are dependent on each other giving credence to the work of Hussein and others as advanced. The traditional environmental audit used can now be enhanced by the new techniques giving added advantage for information exchange, data retrieval and analysis. The position of remote sensing as a tool for environmental hazard survey was clearly presented in an unpublished lecture notes on remote sensing Applications by Okhimamhe, A. A. (1999). *Land, water, atmosphere management, conserving Biodiversity, Agriculture and general vegetation management*

are made possible from the remotely sensed data which provides useful information for the effective management of these resources. The use of remote sensing as a tool in environmental hazard survey makes possible a wider coverage of areas that hitherto cannot even be accessible. The British safety Council's position on major hazard audit and analysis as documented in Tolley's Health and safety at work Handbook (1994) refers; the potential for major hazard situation arising must be considered by manufacturing management. Management should be asking itself the following questions:

a) What is the worst possible event or situation that could arise in this location?

For instance, a major rapidly escalating fire, a sudden release of large quantities of toxic gases, a pressure vessel explosion, collapses of a major structure, or a nuclear radiation incident?

b) What procedures have been established in the event of such an incident-taking place?

The major hazards audit should assist management, safety and Environment specialists in the necessary assessment and decisions.

Environmental hazard survey meets part of the guidelines for Hazard Evaluation Procedures as packaged by the American Institute of chemical Engineers. A detailed guideline on how best to utilize hazard survey data to achieve safe process that will save the environment from degradation and pollution was also documented.

2.1.1 REMOTE SENSING APPLICATION

Data collection in the field, especially the remote and difficult to access terrain where oil industries in Nigeria operate could be very costly and near impossible at the desired time. The benefit of any survey can be said to be appropriate only if it can assist in the solution of an information need, at a cost appropriate to the user, be it an individual, an institution, a country or an international organisation.

Extract from the report of the third United Nations conference on the exploration and peaceful uses of outer space (UNISPACE 111) convened at the United Nations office at Vienna from 19 to 30 July 1999 referred to such matters as are relevant to remote sensing application to environmental hazard survey as follows:

Remote sensing technology confers many direct and indirect benefits on society among which are:

(i) Cost and time savings which are produced through achievement of greater efficiency and effectiveness in a wide range of planning and monitoring activities, compared to alternative sources of comparable information, such as aerial photographic surveys;

(ii) Greater saving in human live through better supply of information useful in disaster management;

(iii) Better quality of life through better security and enhanced management of the environment and natural resources;

(iv) Greater reduction of uncertainty in general decision making.

Among the major information needs of many developing countries (Nigeria inclusive) are those required to support decision making in general important sectors? (These sectors

include the oil sector). With the wide range of sources of remotely sensed image data, at varying wavelengths and spatial resolutions, the application of earth observation systems for natural resources management are varied, as indicated by the following list:

(a) Agriculture, e.g. disease detection, water needs assessment;

(b) Fire and hazard detection and tracking;

(c) Disaster monitoring and relief;

(d) Environmental monitoring, particularly oil spills and pollution;

(e) Coastal resources management engineering;

(f) Land information, and other urban and regional planning products;

(g) Navigation safety

(h) Topographic mapping at large scale;

(i) Hydrologic monitoring of urban and other catchments area;

(j) Placement of facilities, e.g. roads, pipes, power lines and other infrastructure;

(k) Census, tax and property evaluation;

(l) Tourism and recreation;

(m) Business and marketing, including market research and demographics;

(n) Law enforcement, peacekeeping and treaty monitoring.

2.1.2 ENVIRONMENTAL HAZARD SURVEY USING SATELLITE REMOTE SENSING

Satellite remote sensing offers several unique advantages over alternative means of data collection, such as airborne and ground surveys, which makes an ideal tool for fulfilling certain information needs. The advantages generally relate to:

(i) The lower cost of imagery acquisition;

(ii) The speed and relative ease with which space-borne imagery could be obtained;

(iii) The high frequency of data collection, resulting in current up to date, information;

(iv) The homogeneity of data collection by the use of a single Instrument to capture data over large areas;

(v) Improved data coverage, particularly in remote areas and for large portions;

(vi) The spatial continuity of observations.

The Internet resources today usher users to valuable source of consistent information that permit retrospective (time series) studies, such as determine the origin of marine pollution or rate of depletion of a specific resource. Examples of relevant worldwide web sites include the following:

Center for earth observation (www.ceo.org).

Committeeon earth observation satellites (ceos.esrin.esa.it/dossier/);

Satellite active archive (www.saa.noaa.gov)

European Space Research Institute (http://shark 1.esa.it/informations.html).

Operational remote sensing has today evolve to the stage where an end-user could, with comparative ease and at short notice, obtain new or archived imagery of any desired geographical area, within a relatively short period ranging from a few hours to a few weeks. On the other hand, aerial survey of comparable areas may require several months for implementation.

2.2.1 ENVIRONMENTAL HAZARD SURVEY AND GEOGRAPHIC INFORMATION SYSTEM (GIS).

Some work by Atenucci et al (1991) "Introduction", "Evolution of the Technology," and "Application" in Geographic Information System: A guide to the Technology, New York van Nostrand Reinhold refers: "In the context of the use of remote sensing as an effective tool for hazard tackling and warning, geographic information system serves as an important database. GIS usually computer based with an emphasis on preserving and utilizing the inherent characteristics of spatial data, by handling both components of spatial data, the physical location in space and the location. GIS tend to handle the two elements of spatial feature separately, the spatial relationships being represented by graphical displays and the attribute information being stored within a database." Today's world of Information Technology values database information and that makes GIS a class of its own where combined with remotely sensed environmental data in the task of hazard survey in any oil industry.

2.2.2 HAZARD SURVEY DATA MANAGEMENT

The use of remotely sensed data with a corresponding GIS database, offers a very compatible tool for monitoring, warning, and taking decision in managing Environmental hazards. Lewis M. C. (1993) in his paper "Natural Occurring Radioactive Material (NORM) in the oil field: Monitoring and handling techniques" presented at a workshop on radiation safety in the Nigerian Petroleum Industry gave a model to be considered in today's GIS world. At the time of Lewis's presentation, Chevron Nigeria Limited was developing a program to continue their naturally occurring radioactive

surveys in new fields and when significant changes occur in existing fields. Because NORM builds up slowly, they envision routine surveys will be conducted after a few years of operations in new fields. Survey was to be planned for changes in operations such as adding new producing formations in existing fields, developing water flood or stream flood projects or other enhanced recovery work. As existing fields mature and more water were to be produced, those fields were eventually to be re-surveyed. Cook advanced a NORM decision flowchart for oil production facilities that could easily be stored, accessed and produced if need be and if it were inputted as a GIS, both the spatial characteristics and attribute information required for making decisions at any time would be readily available for all the oil wells. The application of remotely sensed data input in a GIS, makes storing, analysis and output to follow a standardized format that makes decision on environmental hazards simple. It also gave room for data exchange since the integrity of such data cannot be doubted.

2.3 CONCLUSION OF LITERATURE REVIEW

Literature on environment hazard survey in the oil industry and general Environmental Hazard Survey work by various authors was reviewed. Remote sensing and GIS being the latest tools to be used in environmental hazard survey was advanced. The environment hazards considered by the various authors and the methods of monitoring, acquiring data, storing, analysis and output of such data are all applicable to the oil industry and could make decisions for action simplified if imbibed. The traditional environmental audit practiced in Nigerian oil industry could be enhanced using the new techniques advanced. From the foregoing, the need to know the position of this tool "Environmental Hazard Survey" in the oil industry in Nigeria became necessary so that appropriate

recommendations could be made for all stockholders to imbibe the use, this is the focus of this study.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 TYPE OF DATA

Four categories of data were collected on the one questionnaire administered, they are:

(i) To determine the extent of employee's knowledge of environmental hazard survey in KRPC.

(ii) To ascertaining the position of environmental hazard survey in KRPC.

(iii) To establish the relevance of environmental hazard survey in monitoring the operational activities of KRPC.

(iv) To determine employee's general knowledge of 'EHS' practice in the oil industries in Nigeria.

In addition to the questionnaire data, an interactive study was also carried out at the Environmental pollution control unit of KRPC, to point out the strategies in place for the management of environmental hazards in the company.

3.2.0 METHODOLOGY

Since this research work is on a specialized tool of work, the environment pollution control unit of the Fire, Safety and Environment department of KRPC was the reference unit for interactive study. For general employee knowledge of 'EHS' practice in the oil industries in Nigeria, a random sampling of two hundred (200) employee of KRPC was carried out using questionnaire administration. The host community was visited and verbal interview was conducted with the community leaders at Rido, Romi, Mahuta and Marraba Rido.

3.2.1 QUESTIONNAIRE DESIGN

Copies of questionnaire were produced to collect information from employees. The questionnaire contained general information and four (4) sections of five statements each as outlined below:

(i) Employee's knowledge of environmental hazard survey in KRPC- A_{1-5}.

(ii) Position of environment hazard survey in KRPC-. B_{1-5}

(iii) Relevance of 'EHS' in monitoring KRPC operational activities- C_{1-5}.

(iv) General knowledge of 'EHS' practice in the oil industries in Nigeria- D_{1-5}.

A total of twenty statements for the employees to express their opinion on a scale of 0-5 as defined below:

Table 3.1: EMPLOYEES' SCALE OF OPINION

0	I don't know	I do not have sufficient information to evaluate the statement.
1	I strongly disagree	I believe the statement to be completely wrong.
2	I disagree	I believe the statement to be incorrect.
3	I am neutral	I am in different to the statement.
4	I agree	I believe the statement to be correct.
5	I strongly agree	I believe the statement to be absolutely true.

3.3 INTERACTIVE STUDY.

The study was carried out involving review of pollution control work procedures, monitoring logbooks, environmental control handbook, and discussions with

environmental pollution control personnel of KRPC. The study is aimed at pointing out the current strategies employed by the management of KRPC in handling Environmental hazards that could be of concern to both employees and the host community and also either correct or upheld the initial assumptions documented prior the study in chapter one.

3.3.1 KRPC ENVIRONMENT POLICY.

KRPC environment policy was x-rayed and summarised below.

KRPC Management is fully committed to the protection of the environment and it has in keeping with NNPC corporate management policy on environment established an environmental pollution control unit under fire, safety and environment department.

The unit monitors the impact of the company's activities on the environment and advice the management to take remedial actions where necessary to protect the environment from any foreseeable hazards emanating from the company's operations.

3.3.2. OIL SPILL CONTINGENCY PLAN.

In KRPC facilities, crude oil, intermediate products, the refined petroleum and petrochemical products are stored in tanks. These products are transferred from one point to another through pipelines by pumps. The oil spill risks in KRPC have been identified in the following areas:

(i) Tank farm/tank age area.

(ii) Process units.

(iii) Shipping area.

(iv) Waste water treatment plant.

A spill is the uncontrolled release into the environment of a pollutant, including oil or

other hazardous materials. KRPC oil spill classification is based on department of petroleum resources oil spill classification. This is based on the location of the spill and the quantity of oil spilled (See table below).

Table 3.2: OIL SPILL CLASSIFICATION TABLE

SPILL CLASSIFICATION	SPILL LOCATION LAND	INLAND WATER	COASTER/OFF SHORE
MINOR	Any spill less than 250 bbls	Any spill less than 25 bbls	Any spill less than 250 bbls
MEDIUM	Any spill between 250-2500 bbls	Any spill between 25-250 bbls	Any spill between 250-2500 bbls
MAJOR	Any spill more than 2500 bbls	Any spill more than 250 bbls	Any spill more than 2500 bbls

- Bbls-barrels.

KRPC's oil spill contingency plan has organisation and responsibility for key officers Viz: Manager director, executive director operations and manager fire, safety and environment. All emerging oil spill in the company are treated with dispatch following the alerting procedures as contained in the oil spill contingency plan.

3.3.3 SOLID WASTE MANAGEMENT.

The following process is employed to deal with solid waste in KRPC.

(a) Identification of sources of waste generation.

(b) Determination of type of waste (advice on reduction)

(c) Provision of solid waste disposal vans

(d) Removal of waste to collection point (Area w)

(e) Segregation of waste

(f) Recycle waste (where applicable)

(g) Transfer to asset disposal committee (where applicable)

(h) Incinerate waste (where applicable)

(i) Disposal waste at designated area (land filling)

(j) Adequate record of quantity kept.

3.3.4 AIR POLLUTION CONTROL

The following are KRPC sources of emission of particulate matter, hydrocarbon and odour. Fluid catalytic cracking (FCC) Regeneration fuel gas, dust from catalyst loading and offloading, products of incomplete combusting from flare, incinerators, heaters and boilers, vents, drains, flanges on equipment columns and lines, sampling point by the tanks and lines. Pressure safety valves and (API& CPI) separators at the waste water treatment plant and also from chemical reaction in process and neutralization basins. A constant monitoring of these sources of emission is done with abatement equipment and techniques including the following:

Conventional cycles, electrostatic precipitators, steam or air injection in process and vessels, video monitoring of flare and the use of combustion techniques, flare gas recirculation, use of high stalk flare and the burning of improved fuel ensures reduction of gaseous pollutants, hydrocarbon emission control is achieved by strict process control, choice of storage tank types, cooling systems, vapour recovery lines, N_2 blanketing, proper seals in values, flanges and pumps/ compressors. In addition to all the provisions made for the air pollution control, routine air quality monitoring is carried out in the plant and its environs to ensure compliance with regulatory standards.

3.3.5 WATER POLLUTION CONTROL.

From the design stage of the KRPC plants, it was known that wastewater from the plants will be contaminated and will therefore be an environment hazard if discharged without treatment. As a result of this, wastewater treatment (WWT) units have been constructed in the refinery and petrochemical plants. Various factors were considered for selection of wastewater treatment facilities in the plants. These factors include quantities and quality of various types of wastewater discharged, as well as the wastewater regulations imposed on the refined and Petrochemical plants. Considerations were given to the plants, precipitation (i.e. rainfall), temperature and the nature of effluent Receiving River.

Wastewater in KRPC plants undergoes primary, intermediate, secondary and tertiary treatments. Before the effluents are discharged, it is sampled for analysis in the laboratory to ensure that it confirms to regulatory standards. The parameters analysed are as shown below:

(i) P^{H}

(ii) Temperature

(iii) Electrical conductivity

(iv) Salinity

(v) Oil and grease (oily water)

(vi) Total suspended solids (TSS)

(vii) Total Dissolved Solids (TDS)

(viii) Chemical Oxygen Demand (COD)

(ix) Dissolved Oxygen (DO)

(x) Phenol

(xi) Cyanide

(xii) Sulphide (as H_2S)

(xiii) Ammonia (asNH_4^+)

(xiv) Surfactants

(xv) Sulphur (as $SO4^-$)

(xvi) Total Coliform bacteria

(xvii) Heavy metals (Ni, Cr^+, Pb, Cu, Zn, V, Fe^{3+}, Ti, Cd, Hg)

The frequency of the sampling is daily for the effluent while the recipient rivers - Ròmi and Rido is monthly. Bioassay of the effluent is also conducted by allowing the final effluent to pass a medium containing certain species of fish. (*This has long been in a state of disrepair*)

3.3.6 KRPC RELATIONSHIP WITH HOST COMMUNITY ON ENVIRONMENTAL MATTERS

The interactive study have not established any documented evidence of "the right to know" of the host community. Few cases of farmlands affected by oil spills were however recorded, the gas flaring impact and oil seepage has been documented but that could be a good area of study by any interested researcher. The flare design is to disperse product of combustion into the atmosphere over 50 km radius; this covers a lot of settlements around the study area.

3.3.7 KRPC RELATIONSHIP WITH ENVIRONMENTAL REGULATORY BODIES.

The record available during the interactive study revealed that regulatory bodies like the Department of Petroleum Resources (DPR) have an office in the company premises. KRPC do send mandatory statutory reports to them while others do have a seldom visit to the company.

CHAPTER FOUR

4.0 DATA ANALYSIS AND DISCUSSION OF RESULTS

The KRPC employees returned a total of one hundred and sixty (160) questionnaires out of two hundred (200) administered, this represented 80% response presented for analysis. The respondents' opinion on the statements was grouped into three so that evaluation of the varied opinions will be easier and the study objective will be easily brought into perspective as indicated on the table below:

Table 4.1: OPINION GUIDE TABLE

STATEMENT GROUPING	EVALUATION GUIDE	STUDY GUIDE
0&3	None-contributory responses	**Very poor awareness on subject matter**
1&2	Negative position on subject matter	**Appraise study objective by respondents' position**
4&5	Positive position on subject matter	**Appraise study objective by respondents' position**

The variables upon which information were collected for the studies are:

1. (A_{1-5}) Employee's knowledge of Environmental Hazard Survey (EHS) in KRPC.
2. (B_{1-5}) The position of EHS in KRPC.
3. (C_{1-5}) The relevance of EHS in monitoring KRPC Operational activities.
4. (D_{1-5}) Employees' general knowledge of EHS practice in the oil industries in Nigeria.
5. A bench mark interactive study at the environmental control unit of KRPC.

Table 4.2: QUESTIONNAIRE RESPONSE TABLE

S/N0.	STATEMENTS AS CLASSIFIED	RESPONSES AS 0&3	RESPONSES AS 1&2	RESPONSES AS 4&5	TOTAL RESPONSES
1	A_1	31	29	100	160
2	A_2	61	24	75	160
3	A_3	35	69	56	160
4	A_4	54	33	73	160
5	A_5	51	20	89	160
6	B_1	34	11	115	160
7	B_2	60	30	70	160
8	B_3	56	14	90	160
9	B_4	64	24	62	160
10	B_5	39	73	48	160
11	C_1	23	11	126	160
12	C_2	14	11	133	160
13	C_3	28	12	120	160
14	C_4	14	13	133	160
15	C_5	12	118	30	160
16	D_1	28	17	115	160
17	D_2	14	11	135	160
18	D_3	9	8	143	160
19	D_4	20	12	128	160
20	D_5	13	7	140	160

Respondents' opinion were gathered and grouped on table-2 while an evaluation guide was given for the purpose of enhancing analysis on table-1.

A simple interrelation of variables and % proportion of the data will be the basis of the results. It could be recalled that the purpose of this research is to examine Environmental Hazard Survey as a tool for the control of hazards in the oil industries in Nigeria, its position, practice and relevance. It is therefore necessary to implore the indicators on Table 2 for the appraisal of the various scores captured for each variable.

The assumptions made prior the study will also be considered along the discussion in order to meet the objective of the study.

4.1.1 EMPLOYEES' KNOWLEDGE OF ENVIRONMENTAL HAZARD SURVEY IN KRPC

Statements A_{1-5} of the questionnaire were aimed at revealing the position of employees' knowledge of Environmental Hazard Survey in KRPC. Of the 160 responses to each of on the questionnaire and the opinion guide referred to these responses as none contributory to the scope of this study, accounting for 19.3 - 31.8 % that could be said to have very poor awareness of the subject matter. Also a minimum of 20 and maximum of 69 respondents marked 1 or 2, representing 12.5 – 43.1% that is referred to as negative position on subject matter. Finally a minimum of 56 and maximum of 100 respondents marked 4 or 5, representing 35 – 62.5% that is referred to as positive position on each subject matter. The negative and positive responses suggest that the subject matter is viewed on individual's exposure to environmental matters in KRPC but the overall sample suggest that the employees have good knowledge of EHS. (See figure 4.1)

Figure 4.1: EMPLOYEE'S KNOWLEDGE OF "EHS" IN KRPC

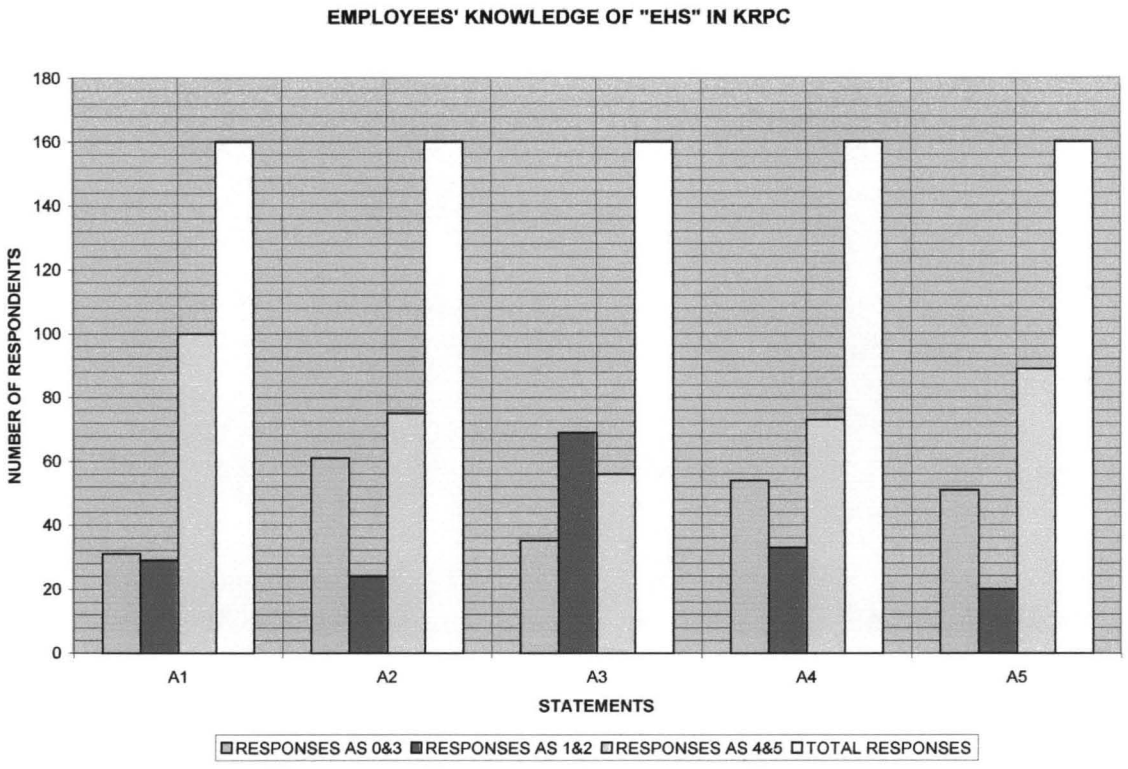


Figure 4.2: POSITION OF "EHS" IN KRPC

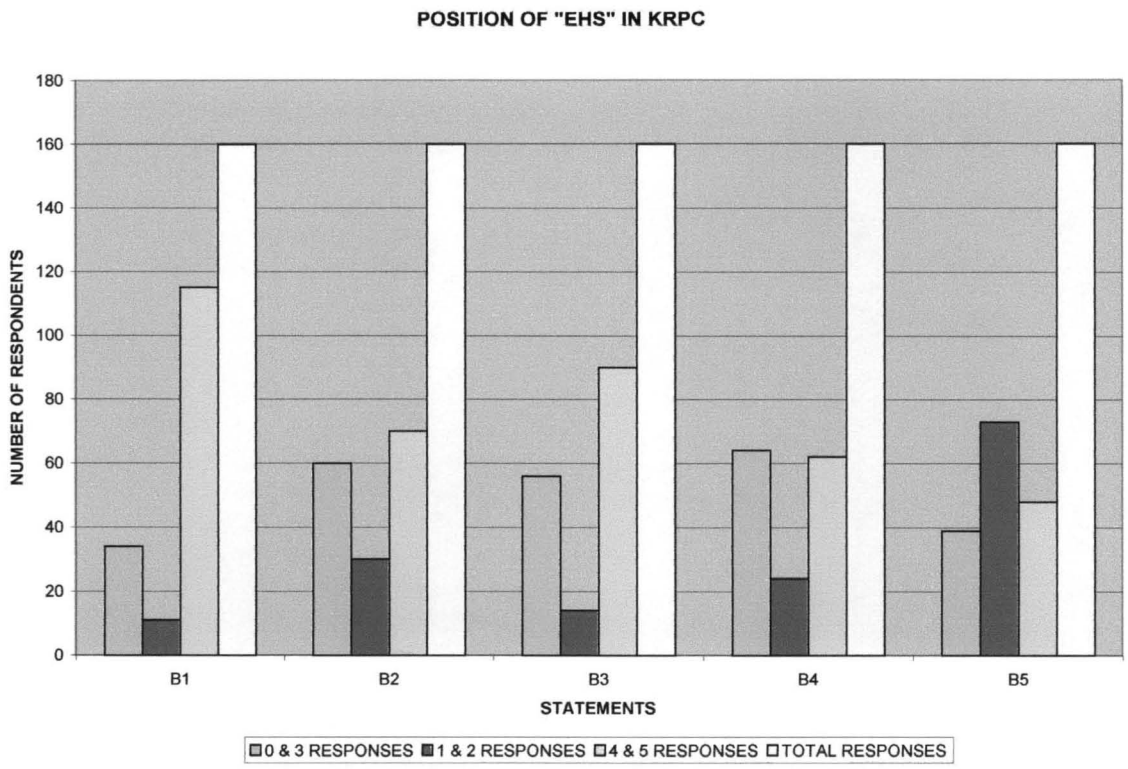


Figure 4.3: RELEVANCE OF "EHS" IN MONITORING KRPC OPERATIONAL ACTIVITIES

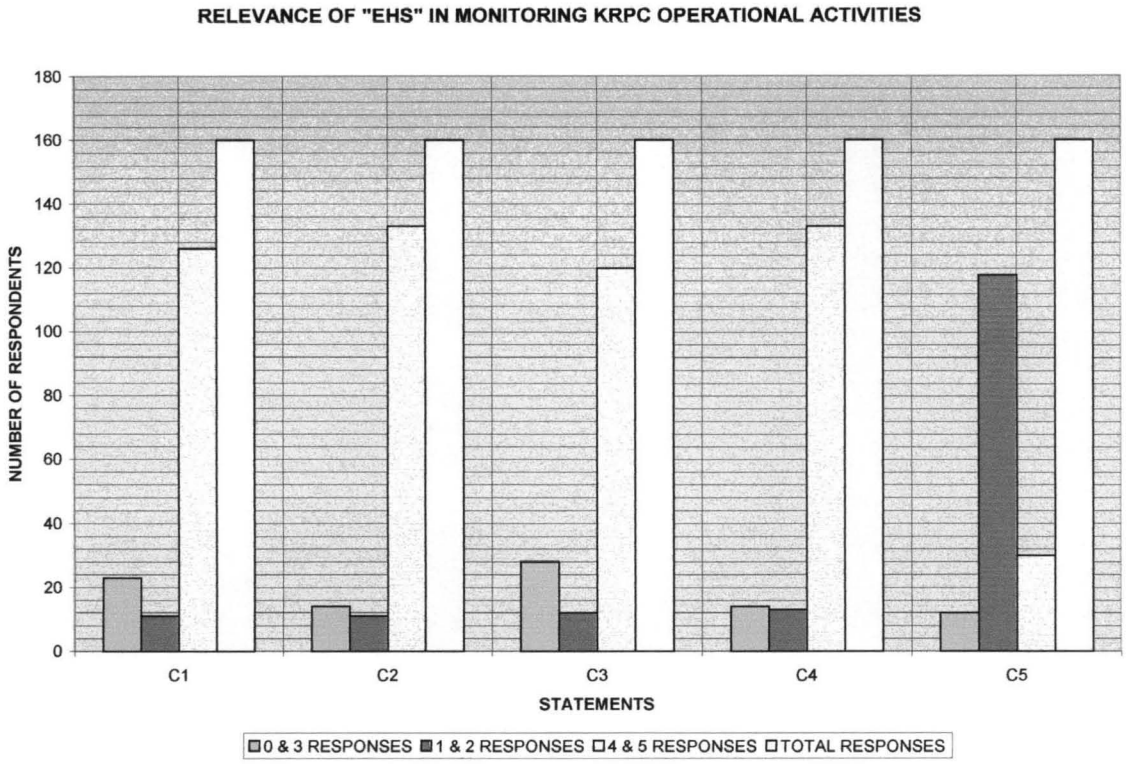
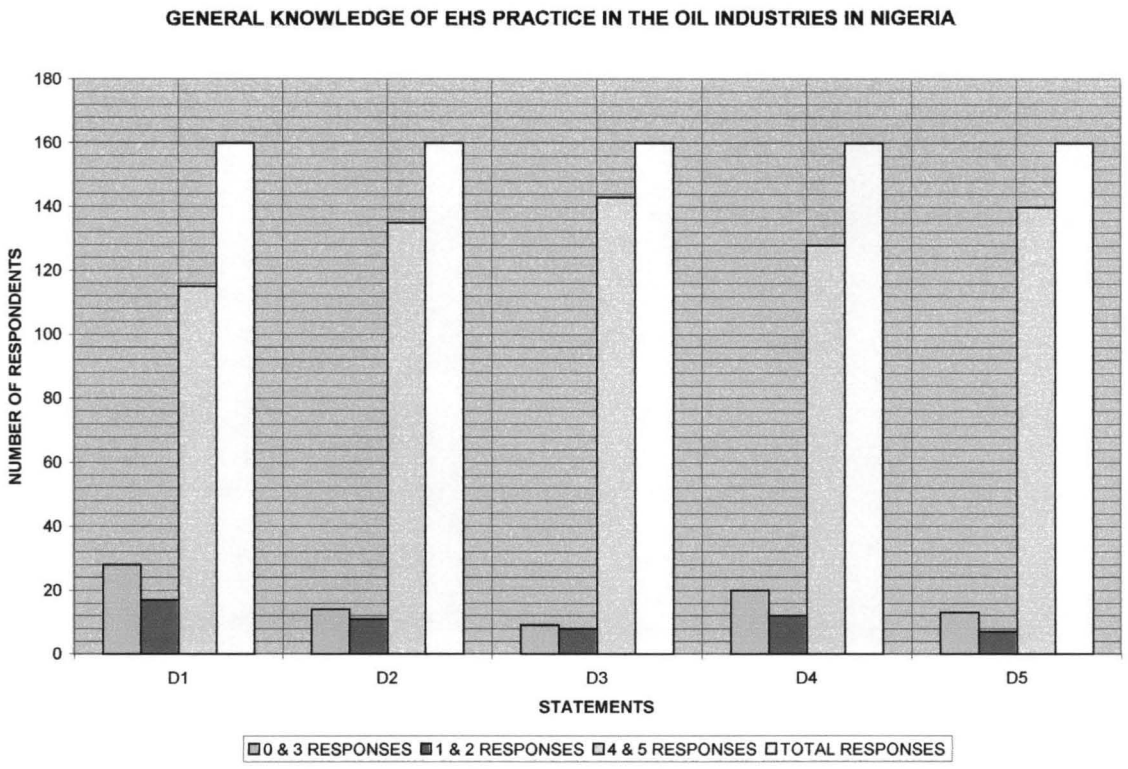


Figure 4.4: GENERAL KNOWLEDGE OF "EHS" PRACTICE IN THE OIL INDUSTRIES IN NIGERIA



4.1.2 POSITION OF ENVIRONMENTAL HAZARD SURVEY (EHS) IN KRPC

Statements B1-5 of the questionnaire were aimed at establishing the position of EHS in KRPC if in practice. From Table 1, a total of 160 respondents to each of the five questions were recorded. 34-64 respondents gave a none-contributory response representing 21.2% - 40%. 11-73 respondents gave a negative position on each statement; accounting for 6.8% -45.6% 38- 115 respondents gave a positive position on each statement representing 23.7% - 71.8%.

The positive responses to the variables as indicated above are in line with the interactive study carried out as indicated in 3.3.1.

Environmental Hazard Survey (EHS) is used as a very important tool for monitoring and collecting data either daily or monthly in KRPC. The result of this finding thus dismisses the assumption number one under 1.4 as far as KRPC is concerned. (See chart-2)

4.1.3 RELEVANCE OF EHS IN MONITORING KRPC OPERATIONALACTIVITIES

Statement C1-5 of the questionnaire was aimed at revealing the relevance of EHS in monitoring KRPC operational activities.

From Table 1, a total of 160 respondents to each of the five statements on the questionnaire were recorded and their opinions grouped as follows:

12-28 respondents gave a non-contributory opinion to each statement representing 7.5% -17.5%.

11-118 respondents had negative position on each statement accounting for 6.8% - 73.7%.

30 – 135 respondents had positive position on each statement representing 18.7% -71.8%.

The result of the interactive study as indicated in 3.3.2, 3.3.3, 3.3.4, and 3.3.5 are in

agreement with the respondents' opinions above. The assumption number five which asserts that our level of technological development is lingering behind giving room to unnecessary bending of quality standards is thus upheld.

The result of 3.3.6 and 3.3.7 also upheld the assumption number, two and three which asserts that there is no direct control by the Federal Ministry of Environment over the activities of these industries. The host communities also are not aware of their "right to know" those things that constitute hazard in the operations of these industries to their environment. (See chart-3)

4.1.4 GENERAL KNOWLEDGE OF 'EHS' PRACTICE IN THE OIL INDUSTRIES IN NIGERIA

Statements D1-5 of the questionnaire were aimed at sampling the general knowledge of EHS practice in the oil industries in Nigeria.

From Table 1, of the 160 respondents to each of the five statements, the following grouping opinion was made.

9-28 respondents had a none-contributory position for analysis, this represent 5.9% -17.5%.

6 – 17 respondents had a negative position on each statement, representing 3.7% - 10.6%.

115 – 143 respondents had a positive opinion on each statement representing 71.8% - 89.3%. From the responses, it is clear that majority of those sampled are knowledgeable about EHS practice in the oil industry. (See chart-4)

4.2 IMPLICATION OF RESULTS

From table 1, the results of A_{2-5} indicated an obsolete approach to EHS by KRPC; this is further confirmed by the result of B_1. However, the latest approach of EHS can easily be integrated since there is a very high awareness amongst the employees as indicated by the result in 4.1.4. The results of D_{1-5} indicated that the assumption number four is upheld meaning that other areas of research for interested scholars abound in the context of the study of Environmental Hazard Survey in the Nigerian Oil industries.

The results of C_1 indicated the need by KRPC management to quickly define its position on issues of EMS.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 SUMMARY OF FINDINGS

This study was conducted by questionnaire administration and interactive study at the Kaduna Refining & Petrochemical Company (KRPC) Ltd. in Kaduna, Nigeria.

The objective of the study is to assess work tool (EHS) for Environmental Hazard Control in the Refineries and Petrochemical Industries in Nigeria.

In line with the objective of the study some assumptions were made prior the commencement of the study.

The data was collected on four variables on one questionnaire administered.

A total of 160 questionnaires were returned out of the 200 copies administered representing 80% responses were presented for analysis and discussion.

After the data analysis and discussion, one out of the five assumptions was dismissed for lack of merit while four were upheld.

Problems encountered on the field were chiefly follow-up of respondents who were on shift duties and the time limitation for the submission of this work.

5.2 CONCLUSION

5.2.1 GENERAL

In this study, five variables were used to analyze the position, practice and relevance of Environmental Hazard Survey (EHS) in the Nigerian Refineries and Petrochemical companies, taking Kaduna Refining and Petrochemical Company (KRPC) as a case study, and of the five variables, four are on single questionnaires while the fifth is a study as outlined below.

1. Employees' knowledge of EHS in KRPC
2. Position of EHS in KRPC
3. Relevance of EHS in monitoring KRPC operational activities.
4. General knowledge of EHS practice in the oil industries in Nigeria.
5. Interactive study at the Environmental Pollution Control of KRPC.

There were five statements, which made up each of the four variables on the questionnaire.

The interactive study covered hazards related to water, air, land and how they are managed in KRPC.

5.2.2 POSITION OF EHS IN KRPC

The study is currently done by methods that are due for review. The management of KRPC are yet to imbibe any of the latest EMS for standardization and world wide acceptance.

5.2.3 PRACTICE OF EHS IN KRPC

The practice has been from inception of the plant as an integral part of equipment and processes.

5.2.4 RELEVANCE OF EHS IN MONITORING OPERATIONAL ACTIVITIES.

The study revealed that the relevance of EHS in monitoring operational activities of the oil industries cannot be over emphasized. The regulatory bodies should make their presence potent giving latest methods for EHS in the oil industries.

5.3.1 RECOMMENDATION

The result of this study indicated that EHS is a vital tool for monitoring the operational activities of the oil industries. It also revealed that going along could optimize its position, practice and relevance with changes in technology. It is based on these facts that the following recommendations become necessary:

1. All Environmental Regulatory Bodies should be current in operational activities of the oil industries, so as to understudy the best EHS techniques that will match the changes being experienced technologically.
2. Oil industries management should define their position on standardization so that they can benefit with the current worldwide ISO Certification of Processes and Management.
3. The host communities of the oil industries should have a right to know what can constitute hazard to their environment and guard against it.
4. The stakeholders should apply the latest technology of Remote Sensing and GIS in the oil business so as to have a wider coverage and exchange data that will be of common use.
5. Regulatory bodies should publish results of hazard surveys conducted on the oil industry plants and operational activity areas. Since most of them have not even developed a right to know document for their host communities.

5.3.2 SUGGESTIONS FOR FURTHER RESEARCH

This research cannot be said to have covered everything that is concerned about Environmental Hazard Survey in the study area. However, efforts is made in this work to open up more questions that require further studies which among others, the following could be considered:

1. The relational indices for EHS and hazard impact on the host communities of the oil industries.
2. National EHS database a dream or reality.
3. EHS checklist for Refining and Petrochemical Plants.
4. Environmental Audit and the consequential benefit on EHS reports.
5. When EHS becomes obsolete, how can it be turned around to meet challenges of the time? This question should be addressed.

Further more, longer period of research into the position, practice and relevance of EHS should be encouraged so that a closer look of the activities of the oil industries will be undertaken.

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Appendix I

QUESTIONNAIRE

GENERAL

1. *JOB TITLE*.....

2. *GRADE LEVEL* JS1 - 4 ☐ SS4 – 7 ☐ SS3 – 1 ☐ M6 – M2 ☐

3. *PRESENT HIGHEST LEVEL OF EDUCATION*:

HIGHER DEGREE ☐ DEGREE ☐ HIGHER DIPLOMA ☐

ORDINARY/NATIONAL DIPLOMA ☐ GCE/ WASC/SSCE & OTHERS ☐

4. *YEARS OF SERVICE IN KRPC*

Below 5yrs ☐ 5 – 10yrs ☐ 11- 15yrs ☐ 16 – 20yrs ☐ 21yrs & above ☐

SECTION ONE

EMPLOYEE'S KNOWLEDGE OF ENVIRONMENTAL HAZARD SURVEY (EHS) IN KRPC						
'EHS' has been known to you as an effective tool for Environmental monitoring for long in KRPC	I don't know 0	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
The implementation of ISO-14001 (Environmental Management System EMS) can be enhanced by the practice of Environmental Hazard Survey (EHS). KRPC is yet to define its position on these issues.	0	1	2	3	4	5
There is no standard Environmental monitoring System in KRPC to match ' EHS'.	I don't know 0	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
KRPC has adequately trained some personnel that are now specialists in the use of 'EHS' as a tool for Environmental Monitoring in KRPC.	I don't know 0	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
'EHS' requires some specialized equipment, which are not readily available in KRPC.	0	1	2	3	4	5

SECTION TWO

POSITION OF ENVIRONMENTAL HAZARD SURVEY (EHS) IN KRPC						
	Environmental Hazard Survey (EHS) as practiced in KRPC, is overdue for review to reflect the latest methods and equipment for sustainable development.	I don't know 0	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
	'EHS' is practiced as an audit exercise but has no consciously established data- base.	0	1	2	3	4	5
	'EHS' data forms a major source for environment related decision/policy formulation or execution in KRPC.	0	1	2	3	4	5
	No exchange of experiences with other oil companies on the latest methods of acquiring 'EHS' data	0	1	2	3	4	5
	Environmental hazard survey is a new term that has not been in use in KRPC.	0	1	2	3	4	5

SECTION THREE

RELEVANCE OF 'EHS' IN MONITORING KRPC OPERATIONAL ACTIVITIES						
'EHS' is relevant for the monitoring of KRPC operations considering the possible environmental impact on the host community.	I don't know 0	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
A continuous monitoring of the environment by a well established "EHS" system would position KRPC in a better position to relate with facts to the host community.	0	1	2	3	4	5
'EHS' data as a tool for Environmental monitoring can be used to compare notes with other sister companies practicing it and thus hasten decisions on matters of similarity.	0	1	2	3	4	5
With 'EHS' in place, a warning signal could be sent out to the host community in good time when imminent danger is envisaged.	0	1	2	3	4	5
The Oil Industries do not generate hazards that justify the need for 'EHS'.	0	1	2	3	4	5

SECTION FOUR

GENERAL KNOWLEDGE OF 'EHS' PRACTICE IN THE OIL INDUSTRIES IN NIGERIA						
Environmental Hazard Survey with latest equipment like Nigeria Sate-1 could be of immense contribution in resolving the environmental needs of the Niger Delta	I don't know 0	Strongly disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
Environmental hazards could easily be managed using data from EHS so the oil industries in Nigeria should be encouraged to imbibe the practice.	0	1	2	3	4	5
The Federal Ministry of Environment should insist on the practice of 'EHS' by the major players in the oil industry.	0	1	2	3	4	5
The application of Geographic Information System (GIS) in the Oil industries Should be pursued by captains of Industries for 'EHS' data to be meaningful for data exchange.	0	1	2	3	4	5
The Oil Industries should play a big role in financing training and research work that will document 'EHS' data in the country for storage into a National data- base.	0	1	2	3	4	5