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Evaluation of environmental sustainability education provisions for effective management of wastes in oil and gas based industries in Rivers State of Nigeria

Caroline L. Eheazu *

Department of Adult and Non-Formal Education, Faculty of Education, University of Port Harcourt' Box 133 Uniport P.O., Choba, Port Harcourt, Nigeria

Abstract

The purpose of this study was to assess the availability and worth of provisions made by oil and gas industries in Rivers State of Nigeria for the environmental sustainability education of their workers to elicit effective waste management and disposal in the industries. Twenty-five (25) selected oil and gas industries were involved in the study. A questionnaire designed by the researcher was used to obtain requisite data from the twenty-five (25) Environmental Officers and seven hundred and seventy-six (776) base workers in the 25 selected oil and gas industries. Two research questions and two null hypotheses guided the study. Percentages, means and the Chi-square (X^2) were the statistical methods used to analyze obtained data. Following obtained results from the research questions and hypotheses testing, it was established that the oil and gas industries involved in the study had inadequate provisions (with special reference to strategies/programmes and delivery methods/techniques) for the environmental sustainability education of their workers. The implications of the conclusions have been examined, and relevant recommendations made.

Keywords: Environmental Sustainability, Industrial Wastes Management, Workers' Education

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* Corresponding author. *E-mail address:* lc4sure@yahoo.com

1. Introduction

Rivers State of Nigeria is located in the country's popular Niger Delta Region endowed with abundant petroleum (fossil fuel) resources. This endowment has led to extensive oil and gas prospecting and other related industrial activities. Among the Multinational Companies involved in the oil industry are Shell Petroleum Development Corporation (SPDC), Agip Oil Limited, and Total-Fina (Nigeria) Limited. There are also a host of indigenous Petro-Chemical and gas industrial companies.

The industrial activities of these companies, have resulted in the generation of various types of wastes as bye products of the industrial processes. Such wastes may be toxic or non-toxic, solid, liquid or gaseous in nature. In whatever form they are found, they constitute environmental and human hazards, especially if not well managed through appropriate handling and disposal methods and techniques. This may be one reason why Banjo et al. (2011) suggest that waste handlers be periodically subjected to preventive medical processes to obviate possible health problems. Besides, staff of the industrial companies will need to be exposed to appropriate environmental sustainability education programmes that would inculcate in them the necessary knowledge and techniques for safe management and disposal of the hazardous industrial wastes.

The Nigeria Environmental Policy Guidelines (Federal Republic of Nigeria, 1991), requires each of the industrial companies to establish a Health, Safety, Security and Environment (HSSE) unit, currently restructured to Health, Safety and Environment Unit (HSE). The unit oversees the Safety, Health and Environmental Issues of the company in which it is established.

This paper is a report of an evaluative study of the nature, availability and appropriateness of the environmental sustainability education provisions made by the industries to equip their staff for effective management and disposal of wastes generated in the production process with a view to ensure sustainability and safety of the industrial and host community environments.

Throughout the paper, the term *environmental sustainability education* is used to refer to the building of a holistic environmental stewardship through skills development, capacity enhancement and inculcation of relevant knowledge and attitudes among oil and gas workers for their ethical handling of wastes in a manner to promote the health of the workers themselves and that of the host communities, as well as protect the environments of the industries and the adjoining communities against pollutants that may jeopardize future availability and use of biodiversity and developmental resources currently obtainable in the environments.

2. The problem

Nigeria's National Policy on the Environment (Federal Republic of Nigeria, 1999) is geared towards ensuring sustainable development based on proper management of the environment in order to meet the needs of the present and future generations. With particular reference to industrial establishments in the country, the policy specifies among other strategies for achievement of its sustainable development goals (Federal Republic of Nigeria, 1999:17-18):

- Encouraging the use of state-of-the-art equipment and environmentally sound technologies in process operations to enhance in-plant safety and healthy out-plant environments.
- Encouraging existing industries to produce Comprehensive Industrial Master Plans that will show novel and more effective methods of phased pollution abatement and waste management in compliance with set environmental standards.

Prescription of these and other related strategies was induced by observed prevalence of poor waste management and disposal processes in industries in Nigeria, generally (cf. for instance, Ajero and Chigbo, 2012).

In addition to the strategies for achievement of environmental sustainability in industrial processes, the National Policy on Environment further requires that industrial staff also need to periodically acquire the necessary education (information/awareness, skills, knowledge and techniques) that would ensure proper waste management without great risk to the industrial worker. Accordingly, to ascertain the levels of implementation of the necessary strategies and education, and thereby possibly assist in the promotion of safety in the industrial environment and host communities in Rivers State, was the problem of this study with focus on the oil and gas industries.

2.1. Objectives

In line with the stated problem, the specific objectives of this study were to:

- Ascertain the nature and variety of environmental sustainability education programmes and approaches (seminars, workshops, regular courses and so on) that the industrial companies had arranged to enable their staff to carry out effective waste management and disposal within their operation areas.
- Establish the adequacy of available strategies for staff acquisition of requisite knowledge and skills.
- Assess the adequacy of the delivery methods/techniques adopted for the training of staff to effectively manage and safely dispose of all types of wastes generated by the industries.

2.2. Research Questions (RQs)

Based on the above objectives, the following research questions (RQs) were raised to guide the study.

RQ_1: What Environmental Education Strategies/Programmes did the industrial companies studied adopt to bring about staff effective waste management and disposal?

RQ_2: What were the delivery methods/techniques employed for the environmental sustainability education programmes?

RQ_3: What were the perceptions of base workers and environmental officers regarding the adequacy of the available programmes and their delivery methods/techniques?

(For clarity, *base workers* are employees with different specialties who provide various types of services at the onshore and offshore bases of an oil/gas industry. *Environmental Officers,* on the other hand, are Health, Safety and Environment (HSE) workers charged with prevention of industrial health hazard, including management and control of industrial wastes).

2.3. Hypotheses (HO_s)

In line with the objectives and research questions, the following null hypotheses (HO_s) were posited for testing:

HO_1: There is no significant difference between the perceptions of industrial base workers and those of environmental officers on the adequacy, type and variety of available environmental sustainability education programmes in the oil and gas industries.

HO_2: There is no significant difference in the perceptions of industrial base workers and environmental officers on the adequacy of the delivery methods/techniques for environmental sustainability education in the industries studied.

3. Area of the study

The area of this study was the Rivers State of Nigeria, which has over one hundred oil and gas industries. Fifty eighty (58) of these industries were identified as viable by the State Ministry of Industries and Natural Resources (Rivers State of Nigeria, 2001). These viable industries are located in five main industrial areas of Rivers State as shown in Table 1.

Table 1. Location of the viable Oil and Gas Industries in Five Main Industrial Areas in Rivers State

Main Industrial Areas	No of viable Oil and Gas Industries
Eleme	3
Etche	2
Obio/Akpor	1
Ogba/Egbeme/Ndoni	4
Port Harcourt City	48
Total	**58**

4. Data and methodology

4.1. Population of the study

The population of the study consists of all the fifty-eight (58) viable oil and gas industries in Table 1. The human population involved in the study comprised all the 58 Environmental Officers and 2,610 base workers in the industries.

4.2. Sample and sampling techniques

The stratified sampling technique was adopted to ensure that industries from all the Main Industrial Areas (Table 1) were involved in the study. Accordingly, one (1) industry each was randomly selected from Eleme, Etche and Obio/Akpor. Two (2) from Ogba/Egbema/Ndoni, and twenty (20) from Port Harcourt City Industrial Area. Altogether, twenty-five (43%) of the 58 viable industries with a population of 1,540 base workers were selected for the study.

A proportionate sampling technique was further used to select 776 (50%) of the 1,540 base workers. Finally, purposive sampling was adopted to select all the 25 Environmental Officers in the 25 sample industries. This brought the total sample used for the study to 801. Table 2 shows the sample of industries and workers used for the study (including the 25 Environmental Officers as noted above).

Table 2. Sample of Industries and Workers used for the Study

Sample of Industries used (as serially identified in the Appendix)	Population of Base Workers in the 25 industries studied (except environmental officers)	Sample of the workers used (50% of base workers plus 1 environmental officer in each industry)	Valid responses (questionnaire) received and used from each industry.
1	64	33	32
2	58	30	28
3	66	34	32
4	65	34	30
5	64	33	33
6	62	32	32
7	64	33	31
8	58	30	29
9	68	35	34
10	58	30	30
11	65	34	32
12	55	29	29
13	59	31	31
14	57	30	30
15	59	31	28
16	65	34	32
17	63	33	32
18	54	28	28
19	69	36	35

20	67	35	35
21	59	31	30
22	54	28	28
23	62	32	32
24	63	33	32
25	62	32	30
Total	**1,540**	**801**	**775 (96.8%)**

4.3. Instrumentation

Data for the study were collected through a questionnaire designed by the researcher for the environmental officers and base workers in the selected oil and gas industries. The questionnaire items were based on the research questions and null hypotheses posited for the study.

4.4. Validity and reliability of the instrument

After inputs by colleagues in the area of environmental education to ensure content and face validity of the instrument, a pilot study was conducted by the researcher to ascertain the instrument reliability as a measuring device. Twenty five (25) workers from an oil and gas industry outside the sample used were involved in the pilot study. The questionnaire was administered to the same workers twice within an interval of two weeks. The responses were subjected to a test-retest analysis using the Pearson Product Moment Correlation Statistic. A reliability coefficient (r) of 0.81 was obtained. This was adjudged high enough to consider the instrument reliable (Nkpa, 1997).

4.5. Data Collection

The questionnaire was administered to the subjects (Environmental Officers and base workers) by the researcher with the help of three trained assistants. A total of 801 copies of the questionnaire were administered (25 to the environmental officers and 776 to the workers) in the 25 sample industries.

All the copies of the questionnaire were collected back, giving one hundred percent return. However, twenty six (26nos) of the base workers' returned copies of the questionnaire were found to have lacked some vital pieces of information. These were therefore discarded, leaving 750 (99%) valid responses from the base workers. Accordingly, the total number of validly completed copies of the questionnaire used for the study was 775 (including the 25 from environmental officers)

5. Analysis and results

Percentages, means, critical means and the chi-square (X^2) statistic were used to analyze data for the purpose of eliciting answers to the research questions and for testing the hypotheses. The results are shown below.

5.1. Research Question One (RQ_1)

Responses from the subjects of the study, in relation to RQ_1, are shown in Table 3.

Table 3. Strategies/programmes adopted by the oil and gas industries for the environmental sustainability education of their workers

Strategy/ Programme Identification No.	Strategy/Programme	No of Respondents (N) = 775	
		Strategy/ Programme Adopted	Strategy/ Programme not adopted
1	Compulsory staff attendance of environmental management courses.	65(8.4%)	710(91.6%)
2	Induction exercises for new hires to be familiar with National, State and Company environmental policies.	466 (60.1%)	309 (39.9%)
3	Periodic distribution of fliers handbills and posters to inculcate effective waste management and disposal personal culture.	220(28.4%)	555(71.6%)
4	Regular sponsorship of various categories of staff to attend seminars/workshops on proper ways of industrial environment sanitation, protection and safety.	196(25.3%)	579 (74.7%)
5	Constant updating of staff knowledge and techniques of appropriate industrial environmental safety and waste disposal.	158 (20.4%)	617 (79.6%)

As Table 3 reveals, 8.4% of the 775 subjects for the study indicated that strategy No 1 was being adopted by their company for the environmental sustainability education of their workers for effective management and disposal of their industrial wastes. For strategies/programmes 2, 3, 4 and 5, the percentages of the subjects that had indicated that they were adopted by their industries were 60.1%, 28.4%, 25.3% and 20.4% respectively.

Accordingly, it was only strategy/programme No. 2 (induction exercises for new hires to be familiar with National, State and Company environmental policies) that was adopted by majority of the industries (60.1%). For the remaining 4 (80%) of the strategies/programmes, none was indicated by up to 30% of the subjects as being adopted by their industries for the environmental sustainability education of their workers for effective industrial wastes management and disposal.

5.2. Research Question Two (RQ_2)

Table 4 contains data used to answer RQ_2.

Table 4. Methods/techniques used by oil & gas industries in Rivers State for the environmental education of their workers

Delivery Method/ Technique Identification No	Method/Technique	No of Respondents (N) = 775	
		Method/ Technique used.	Method/ Technique Not used
1	Lectures to promote basic understanding of theories and policies behind proper management and disposal of industrial wastes	313 (40.4%)	462(59.6%)
2	Practical demonstrations within company premises by environmental experts.	253 (32.5%)	522(67.4%)
3	Regular publication and distribution of relevant information newsletters.	150(19.4%)	625(80.6%)
4	Use of films and videotapes for illustrations.	492(63.5%)	283(36.5%)
5	Field trips for direct observations and commentaries.	96(12.4%)	679(87.6%)

As shown in Table 4, majority of the 775 subjects (63.5%) indicated that their industries used films and videotapes as techniques for the environmental sustainability education of their workers for effective management and disposal of industrial wastes.

In the cases of the other four methods/techniques, 40.4% of the subjects (313) responded that their industries used lectures to promote basic understanding of theories and policies behind proper management and disposal of industrial wastes. The extent of use of the remaining methods/techniques (2, 3 and 5) was represented by the relevant percentages of respondents that were positive in their answers (32.5%, 19.4% and 12.4%) respectively.

In effect, the method/technique most patronized by the industries in the environmental sustainability education of their workers was the use of films and videotapes (with 63.3% respondents); while the least adopted of these methods/techniques was field trips (with only 12.4% of the respondents being positive about them).

5.3. Hypothesis One (HO_1)

Table 5 presents the data used to test HO_1. The data were obtained from the subjects' responses to the questionnaire items shown in the table.

Table 5 presents the observed and expected frequencies of the responses of the 25 Environmental Officers and 750 base workers in the oil and gas industries regarding adequacy of the type and variety of environmental sustainability education programmes adopted by their companies. In the observed

frequencies, 10 (40%) of the 25 (3.3%) of the other base workers said so. The expected frequencies (e) are put within brackets beside the observed frequencies (o).

Table 5. Chi-Square (X^2) calculation of the difference between the perceptions of environmental officers and those of base workers regarding adequacy of the variety of environmental sustainability education programmes adopted by the oil and gas industries

Questionnaire item:	Respondents	Responses (N = 775) Adequate	Not adequate	X^2 Cal.	X^2 tab.	Decision
Environmental sustainability education programmes in my industry are adequate/not adequate in type and variety for effective staff management and disposal of our industrial wastes	Environmental Officers	10(1.13)	15(23.87)	72.80	3.84	Reject $H0_1$
	Base workers	25(33.87)	725(716.13)			

Using the below formula the calculated X^2 (X^2 cal.) = 72.80. This was found to be greater than the table X^2 (X^2 tab.) which is 3.84; df = 1; p = 0.05

$$X^2 = \frac{\Sigma (fo - fe)^2}{fe},$$

The null hypotheses $H0_1$ is thus rejected. Accordingly, the alternative hypothesis that there is a significant difference between the perceptions of the environmental officers and those of other base workers is accepted at the 0.05% probability level. More analysis on this result is done in the discussion section below.

5.4. Hypothesis 2 ($H0_2$)

Table 6 shows the data used to test the hypothesis.

The observed and expected frequencies of the responses of the environmental officers and base workers in the oil and gas industries under study to the questionnaire item statement in column 1 of Table 6 are as presented in the table with the expected frequencies enclosed in brackets beside the observed frequencies.

The observed frequencies show that while 7(28%) of the 25 environmental officers said that the environmental sustainability education methods/techniques adopted by the industries were adequate, 30(4%) of the 750 base workers said so.

Table 6. Chi-square calculation of the difference between the perceptions of environmental officers and those of the base workers regarding adequacy of delivery methods/techniques adopted by oil and gas industries for the environmental sustainability education of their workers

Questionnaire item Statement	Respondents	Responses(N = 775) Adequate	Not adequate	X^2 Cal.	X^2 tab.	Decision
The delivery methods/ techniques for environmental sustainability education in my company are adequate/not adequate for achieving effective staff management and disposal of our industrial wastes.	Environmental Officers	7(1.19)	18(23.81)	4.65	3.84	Reject $H0_2$
	Base workers	30(35.81)	720(714.19)			

Using the below formula the calculated $X^2 = 62.65$. This was found to be greater than the table value (3.84). df = 1; p = 0.05.

$$X^2 = \frac{\Sigma (fo - fe)^2}{fe},$$

The null hypothesis $H0_2$ is therefore rejected and the alternative hypothesis, which is that there is significant difference between the perceptions of the environmental officers and those of the other base workers regarding statement in Table 6, is acceptable. More analysis of this result is in the discussion section.

6. Discussion of findings

The discussion of findings is made in relation to the research questions and the hypotheses posed for the study. Answers obtained from RQ_1 made it clear that the strategy/programme most adopted by the industries was the induction exercise for new hires to be familiar with National, State and Company environmental policies. The other four environmental sustainability education strategies/programmes (table 3) were very poorly patronized. This could be explained by the fact that induction exercises are compulsory for new hires. Usually, this is done by the company training personnel in collaboration with the environmental officers. The situation was however unfortunate because the other four poorly adopted environmental sustainability education strategies/programmes are equally important for effective management and disposal of industrial wastes. Besides, their neglect runs counter to the United Nations emphasis on education as an important aspect for combating environmental hazards (Alvanak and Cruz, 1997).

Regarding the delivery methods/techniques adopted by the oil and gas industries for the environmental sustainability education of the workers for effective industrial waste management and disposal, only one (use of films and video tapes) was indicated by majority (63.5%) of the respondents as being used by the

industries. The remaining four delivery methods/techniques were indicated as poorly adopted (table 4) by the respondents.

With regard to findings based on the two null hypotheses of the study, it must be observed that although the X^2 analysis of data in Tables 5 and 6 found no significant differences in the perceptions of the workers about (a) the adequacy on variety of the education programmes and (b) delivery methods and techniques adopted by the industries for environmental sustainability education of their staff, nevertheless, figures in Tables 5 and 6 show that majority of the two sets of respondents indicated the immense inadequacies in the adoption of both the programmes and the delivery methods.

7. Conclusions

Based on the above discussion of findings, the following conclusions have been drawn by the researcher:

- Apart from the induction courses for new hires, the oil and gas industries studied did not adequately adopt compulsory staff attendants of prescribed courses; periodic distribution of fliers; regular sponsorship of staff to attend seminars/workshops, and constant updating of staff knowledge and techniques as environmental sustainability education strategies/programmes for effective staff management and disposal of their industrial wastes.
- Again, besides the use of films and video tapes for illustrations, majority of the industries made inadequate provisions for such other relevant delivery methods/techniques as lectures, practical demonstrations, regular publication and distribution of information newsletters and field trips which definitely would have improved the potential of their environmental sustainability education programmes for effective staff management and disposal of industrial wastes.
- Both the environmental officers and base workers in the industries studied shared in the perception of the overall inadequacy of the environmental sustainability education programmes and delivery methods in the various oil and gas industries.

7.1. Implication of the conclusions

The above conclusions have an obvious implication; namely, that unless there is improvement in the provision made by the companies for effective environmental sustainability education of their staff, the companies as well as their host communities face the hazard of pollution arising from ineffective staff management and disposal of industrial wastes.

7.2. Recommendations

In view of the above conclusions and their implication, the following recommendations have been made:

- The oil and gas industries should adopt more positive programmes and delivery methods for the environmental sustainability education of their staff for effective management of their industrial wastes.

- The Federal Ministry of Environment, in collaboration with the national Industrial Training Fund (ITF), should:
    1) Insist on certain levels of environmental sustainability education and training for workers in the oil and gas industries.
    2) Place surveillance on the oil and gas industries with a view to sanction those that would not comply with statutory guidelines on industrial training and on proper industrial waste management by the staff.

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Appendix 1. Sample industries used for the study

Identification Number	Name of Industry	Industrial Area
1.	Daewoo Nigeria Ltd. Ebubu	Eleme
2.	SPDC Odagwa	Etche
3.	Agip Gas Plant Idu	Ogba/Egbema/Ndoni
4.	Total-Fina Elf Nigeria Limited, Obagi	-do-
5.	Willbros Nigeria Limited Choba	Obio/Akpor
6.	Anadrill Nigerian Limited Trans Amadi PHC	Port Harcourt City
7.	Arco Petro Chemical Engineering Company Port Harcourt	-do-
8.	Baroid Sperry Sun Petroleum Nigeria Limited Trans Amadi	-do-

9.	Boskel Nigeria Limited Rumuibekwe Port Harcourt	-do-
10.	Central Oil Engineering Company, Oroigwe Port Harcourt	-do-
11.	EJF Global Services Limited Aba Road Port Harcourt	-do-
12.	Geomarine Systems Ltd, Port Harcourt	-do-
13.	Global Energy and Refining Limited, Trans Amadi Port Harcourt	-do-
14.	HS Petroleum Limited, Port Harcourt	-do-
15.	Intel Services Port Harcourt	-do-
16.	International Energy Services, Rumuomasi Port Harcourt	-do-
17.	Mobil Oil Nigeria Plc, PHC	-do-
18.	Multi-tech Oil Field Limited, Port Harcourt	-do-
19.	Network Oil and Gas Limited, Port Harcourt	-do-
20.	Nigerian Logging & Support Services, Trans Amadi Port Harcourt.	-do
21.	Oil and Industrial Services Limited, Trans Amadi Port Harcourt	-do-
22.	Pan African Oil Services Limited, Trans Amadi Port Harcourt	-do-
23.	Petrofield & Services Limited, Port Harcourt	-do-
24.	Saipem Contracting Nigerian Limited, G.R.A. Phase II PHC	-do-
25.	West African Oilfield Services, Trans Amadi Port Harcourt	-do-