Essential Services of Environmental Health in Oil-bearing Communities in Nigeria: Implication for Policy and Practice

Ibanga Ekong[1, *], Edidiong Frank[2]

[1]Department of Community Health, University of Uyo, Uyo, Nigeria
[2]Immanuel General Hospital, Eket, Nigeria

Abstract

Environmental health remains an important, yet poorly regulated, component of public health in Nigeria. Though environmental legislation in Nigeria exists, the need for them to be well designed, as well as efficiently and effectively enforced is paramount. This study aimed to improve environmental services in corporate practices by improving the current knowledge and practice of essential services of environmental health which they should do by regularly assessing environmental and health status to Identify environmental health problems; empower people about environmental health issues; mobilize partnerships to identify and solve environmental health problems; and contribute to developing policies and plans that support individual and environmental health efforts. This was a cross sectional study conducted among health centers in oil-bearing communities in southern Nigeria, multinational companies and tertiary educational and health institutions. There was majorly no formal system to assess environmental health threats (84.2%), and lack of formal systems to acquire input and routinely conduct needs assessment (15.8%). Furthermore, identification of environmental and health status had significant relationships with diagnosis of environmental health problems (r=0.558, p<0.05). There is a need for integrated environmental management system, well regulated by government with support from the private sector, for improved environmental health services in corporate practice.

1. Introduction

Nigeria is the most populous country in sub-Saharan Africa with an estimated population of 193,392,517 as at 2016 [1]. Although urbanization is accelerating, the country is still majorly rural and the main activities on which most of the population depends for employment and income generation are agriculture, fishing, pastoralism and the direct use of fauna and flora. Government, however, relies on exploration of petroleum and solid mineral resources as major revenue earning activities [2]. These activities subject the environment to continuous degradation processes related to the increasing needs of a growing population, coupled with the threat of climate change. Institutions and policies on environmental health exist in various forms and shapes, though with variable efficiencies. Progress in agriculture, industry, transportation and technology is usually the barometer of economic development, leaving in its trail, increase in the quantum of economic output to the detriment of the short- and long-term short-changes of human and material resources arising from the process, thereby wrecking the world, rather than sustaining it for the present and future generations.

* Corresponding author
E-mail address: ibangeky@yahoo.com (I. Ekong)

To control these, environmental legislation must not only be well designed but also efficiently and effectively enforced [3]. Hence for regulators, it is a question of where to allocate resources and which sectors would give the best yield; and how to go about the task of intervening in the affairs of regulated organizations. The legislations, which comprise framework environmental legislation, sectoral legislation and incidental legislation are standards, regulations and administrations adopted to control activities with potential damaging effects on the country's environment is covered by the Nigerian environmental policy. For instance, laws have been formulated to deal with some environmental pollutants, such as toxic chemicals, noise, etc.; control particular activities, such as mining, power generation, etc.; and provide general guidelines for protecting basic natural resources, such as air, land and water [4, 5].

The Nigerian environmental legislation includes the Harmful Wastes (Special Criminal Provisions) Act 1988 Cap 165 LFN 1990; Federal Environmental Protection Agency (FEPA) Act 1988 Cap 131 LFN 1990; Environmental Impact Assessment (EIA) Act 1992 and Nigerian Urban and Regional Planning Act while the Sectoral legislation addresses specific aspects of the environment and human activities and includes Mineral Act 1956, Oil Pipeline Act 1958, Oil in Navigable Waters Act 1968, Petroleum Act 1969 and Factories Act 1987. On the other hand, Incidental legislation which includes Water Works Act 1915, Criminal Code 1916 Cap 77 LFN 1990 and Public Health Act 1917 are not specifically intended to address environmental issues but contain some elements that have an impact on environmental issues [4, 5]. Some Nigerian national laws are adapted from international laws as Nigeria has been signatory to a number of international laws, including Mineral Oil (Safety) Regulations Act 1963, Petroleum Regulations Act 1967, Oil in Navigable Waters Act 1968, Petroleum (Drilling and Production) Regulation Act 1969, Oil Terminal Dues Act 1968, Associate Gas Reinjection Act 1979, Petroleum Amendment Act 1973 and Harmful Wastes (Criminal Provisions) Act No. 42 of 1988 [4, 5], this was between 1963 and 1990. Other pieces of legislation include the Civil Aviation Act 1964, Antiquities Act 1915 (1958), Live Fish (Control of Importation) Act 1965, Explosives Act 1964, Territorial Waters Act 1967, Exclusive Economic Zone Act 1958, Petroleum (Drilling and Production) Regulations Act 1969, Nigerian Atomic Energy Commission Act 1976, Natural Resources Conservation Act 1989, River Basin Development Authorities Act 1987, Sea Fisheries (Licensing) Regulations 1992, Quarries Act 1969, Land Use Act 1972 and National Parks Acts 1991 [4, 5].

Most of Nigeria's policies on environment are fragmented and negate effective and time-saving one-stop implementation strategy thereby leading to disarrayed implementation processes that waste time and promote corruption, for example, the diverse pieces of legislation, which fall within the ambit of environmental protection, including Civil Aviation Act 1964, Antiquities Act 1915 (1958), Live Fish (Control of Importation) Act 1965, Explosives Act 1964, Territorial Waters Act 1967, Exclusive Economic Zone Act 1958, Petroleum (Drilling and Production) Regulations Act 1969, Nigerian Atomic Energy Commission Act 1976, Natural Resources Conservation Act 1989, River Basin Development Authorities Act 1987, Sea Fisheries (Licensing) Regulations 1992, Quarries Act 1969, Land Use Act 1972 and National Parks Acts 1991 [4]. Furthermore, it is doubtful that all relevant stakeholders are involved during policy formulation, nor is there mass environmental education and awareness creation regarding the sustainable environment [6].

The guideline and standards introduced as part of the implementation of Nigeria's environmental policy are (1) effluents limitations (2) water quality for industrial water uses at point of intake (3) industrial emission limitations (4) noise exposure limitations (5) management of solid and hazardous wastes and (6) pollution abatement in industries [4, 5]. To effect these, environmental regulatory agencies have been established. They include the National Environmental Standards and Regulations Enforcement Agency (NESREA), the National Oil Spill Detection and Response Agency (NOSDRA), Forestry Research Institute of Nigeria (FRIN), National Biosafety Management Agency (NBMA), Nigerian Conservation Foundation (NCF), National Emergency Management Agency (NEMA), Nigeria Hydrological Services Agency (NIHSA), River Basin Authority (Federal Ministry of Water Resources) and Federal Environmental Protection Agency.

Environmental regulatory agencies should embody in themselves, first, and then influence organizations to be able to monitor environmental and health status to identify environmental health problems; diagnose and investigate environmental health problems and hazards; inform, educate, and empower people about environmental health issues; mobilize partnerships to identify and solve environmental health problems; contribute to developing policies and plans that support individual and environmental health efforts; assure a competent environmental health workforce; ensure evaluation of effectiveness, accessibility, and quality of environmental health services; and research for new insights and innovation solutions to environmental health problems. The adoption of environmental management systems (EMS) has the advantages of constituting a device that rationalizes and improves management control [7-9], while providing a

tool for signaling the firm's environmental commitment to its external stakeholders [10, 11].

A country's environmental policy should aim at achieving sustainable development in the and securing for quality environment adequate for the health and well-being of her inhabitants; conserve and use the natural environment and resources for the benefit of present and future generations; restore, maintain and enhance ecosystems and ecological processes essential for the functioning of the biosphere and for the preservation of biological diversity and to adopt the principle of optimum sustainable yield in the use of living natural resources and ecosystems; raise public awareness and promote understanding of essential linkages between environment and development and to encourage individual and community participation in environmental improvement efforts; and co-operate in good faith with other countries and international organizations [4, 12]. Hitherto, standards were set without nationally generated baseline data usually lacking in the country, but with adapted guidelines and standards of the World Health Organizations (WHO). In transposing these data between countries, socio-economic and climatic differences are compromised [13].

This study aims to improve environmental services in corporate practices by improving the current knowledge and practice of essential services of environmental health which they should do by regularly assessing environmental and health status to Identify environmental health problems; empower people about environmental health issues; mobilize partnerships to identify and solve environmental health problems; and contribute to developing policies and plans that support individual and environmental health efforts.

2. Methodology

2.1. Study Design

This was a cross-sectional study conducted in 2018 to assess environmental services in corporate practices.

2.2. Study Area

The study was conducted in Akwa Ibom State of Nigeria.

2.3. Study Population/Study Subjects

Tertiary institutions, international companies and health establishments mainly in the oil-producing areas of Akwa Ibom were the subjects.

2.4. Sampling Technique

Sampling was by a simple random technique of purposively listed health facilities.

2.5. Sample Size

A total of 19 establishments were sampled.

2.6. Data Collection

A structured questionnaire was administered and was stratified into the following sections: Monitor Environmental and Health Status to Identify Environmental Health Problems; Diagnose and Investigate Environmental Health Problems and Hazards in the Facility; Inform, Educate, and Empower People About Environmental Health Issues; Mobilize Partnerships to Identify and Solve Environmental Health Problems; Develop Policies and Plans That Support Individual and Environmental Health Efforts; Assure a Competent Environmental Health Workforce; Evaluate Effectiveness, Accessibility, and Quality of Environmental Health Services; and Research for New Insights and Innovation Solutions to Environmental Health Problems.

2.7. Data Analysis

Descriptive analysis was carried out with respect to frequencies and proportions. Other analyses conducted were correlation and multiple regression comparison t and F-test.

2.8. Ethical Considerations

Protocol for this study was approved by the Akwa Ibom State Ministry of Health and written/oral informed consent was obtained from management of the various centers.

3. Result

Table 1. Frequency and Percentages showing responses on the components of environmental services provided by the organizations.

S/N	Questions	Yes n (%)	No n (%)	Unsure n (%)
	Monitoring of Environmental and health status to identify environmental health problems			
1	Formal system to assess environmental health threats	1 (5.3)	16 (84.2)	2 (10.5)
2	Formal system to acquire input	3 (15.8)	16 (84.2)	0 (0.0)
3	Routinely conduct needs assessment	3 (15.8)	16 (84.2)	0 (0.0)
4	Formal system for identifying vulnerable populations	15 (78.9)	4 (21.1)	0 (0.0)
	Diagnose and investigate environmental health problems and hazards			
5	Written protocol to analyze relationship between environmental health hazards and health impacts	15 (78.9)	4 (21.1)	0 (0.0)

S/N	Questions	Yes n (%)	No n (%)	Unsure n (%)
6	Memo of agreement with agents investigating environmental hazards risks	15 (78.9)	2 (10.5)	2 (10.5)
7	Communicable disease surveillance capacity to assess environmental hazards	15 (78.9)	4 (21.1)	0 (0.0)
8	Technical capacity to perform environmental health risk assessments	16 (84.2)	2 (10.5)	1 (5.3)
Inform, educate and empower people about environmental health issues				
9	Presence of environmental health advisory group	13 (68.4)	4 (21.1)	2 (10.5)
10	Provide env. health information to hospital community	15 (78.9)	3 (15.8)	1 (5.3)
11	Capacity to communicate with people of diverse backgrounds	19 (100.0)	0 (0.0)	0 (0.0)
12	Regularly evaluates the effectiveness and appropriateness of communication methods	14 (73.7)	4 (21.1)	1 (5.3)
Mobilize partnerships to identify and solve environmental health problems				
13	Formal system for identifying stakeholders or interested parties	8 (5.3)	11 (57.9)	0 (0.0)
14	Partners with schools of higher learning that are potential sources of future public health workers	6 (31.6)	13 (68.4)	0 (0.0)
15	Up- to – date written directory of potential partners	1 (5.3)	17 (89.5)	1 (5.3)
16	Formal process for developing collaborative or shared efforts on issues of common interest	1 (5.3)	16 (84.2)	2 (10.5)
Contribute to developing policies and plans that support individual and environmental health efforts				
17	Formal process to identify environmental health priorities	2 (10.5)	16 (84.2)	1 (5.3)
18	Ready access to policy makers for briefing, educating or communicating	9 (47.4)	9 (47.4)	1 (5.3)
19	Formal process to be included in the policy in development	17 (89.5)	2 (10.5)	0 (0.0)
20	Formal process to review effectiveness of environmental health policies on a periodic basis	8 (42.1)	10 (52.6)	1 (5.3)
Assure competent environmental health workforce				
21	On- going training plan to improve knowledge, skills and abilities to perform	14 (73.7)	5 (26.3)	0 (0.0)
22	Written standards identifying minimum competencies needed to perform job	18 (94.7)	1 (5.3)	0 (0.0)
23	Routinely conduct personnel assessments	19 (100.0)	0 (0.0)	0 (0.0)
24	Written policy on recruitment training and retention of staff	19 (100.0)	0 (0.0)	0 (0.0)
Evaluate effectiveness, accessibility and quality of environmental health services				
25	Formal process to routinely perform programme evaluation	18 (94.7)	1 (5.3)	0 (0.0)
26	Survey stakeholders to obtain feedback about environmental health services	16 (84.2)	12 (10.5)	1 (5.3)
27	Presence of quality improvement plans	17 (89.5)	2 (10.5)	0 (0.0)
28	Performance standards to measure center's progress	17 (89.5)	2 (10.5)	0 (0.0)
Research for New Insight and innovation solutions to environmental Health problems				
29	Formal process for identifying research needs	16 (84.2)	2 (10.5)	1 (5.3)
30	Formal relationship with research entities	19 (100.0)	0 (0.0)	0 (0.0)
31	Awards programme for innovation by center employees	4 (21.1)	15 (78.9)	0 (0.0)
32	Capacity to seek grants, new funding opportunities or partners for research projects	5 (26.3)	14 (73.7)	0 (0.0)

The result presented in Table 1 above reveals that in most of the centers visited, there was no formal system to assess environmental health threats (84.2%). Presence of formal systems to acquire input and routinely conduct needs assessment was reported as 15.8%, respectively. As for whether there was a formal system for identifying vulnerable populations, 78.9% of the centers indicated they had this system in place. The majority of them indicated that they had: written protocol to analyze relationship between environmental health hazard and health impact (78.9%); written memo of agreement with agents investigating environmental hazards or risk (78.9%); communicable disease surveillance capacity to assess environmental hazards (78.9%); and technical capacity to perform environmental health risk assessments (84.2%). More than half of the centers reported a presence of environmental health advisory group (68.4%); 78.9% of the centers reported the will to provide environmental health information to the hospital community, while all centers demonstrated capacity to communicate with people of diverse background (100%). Centers that regularly evaluate the effectiveness and appropriateness of communication methods were in the majority (73.7%).

Result also reveals that only very few centers had a formal system for identifying stakeholders or interested parties (5.3%); partnered with schools of higher learning that were potential sources of public health workers (31.6%); had up-to-date written directory of potential partners (5.3%); and had a formal process for developing collaborative or shared efforts on issues of common interest (5.3%). Most of the centers as presented in Table 1 did not have any formal process to identify environmental health priorities (84.2%) neither did they have ready access to policy makers for briefing, educating or communicating about environmental health issues (47.4%). Result also reveals less than half of the centers had a formal process to review effectiveness of environmental health policies on a periodic basic (42.1%), as for whether they had a formal process to be included in policy development, more than half of the centers were in the affirmative (89.5%).

With regards to the competency of their environmental health workforce, most of the centers reported that there was an on-going training plan to improve knowledge, skills and abilities to perform (73.7%); written standards, identifying minimum competencies needed to perform their jobs (94.7%), routinely conduct personnel assessments (100%); and also had written

policy on recruitment, training and retention of staff (100%). More than half of the centers indicated that they had a formal process to routinely perform programme evaluation (94.7%); and surveyed stakeholders to obtain feedback about environmental health services (84.2%). A higher percentage also indicated that they had quality improvement plans (89.5%) and performance standards to measure centers' progress (89.5%). Most of the centers also indicated that they had a formal process of identifying research needs (84.3%) and had formal relationship with research entities (100.0%), but only 21.1% had award programmes for innovative solutions by center employees. Disappointingly, most of the centers lacked the capacity to seek grant, new funding opportunities or partners for research projects (73.7%).

Table 2. Correlation among the components of environmental variables.

		1	2	3	4	5	6	7	8
1	V1	1							
2	V2	0.558*	1						
3	V3	0.307	0.924*	1					
4	V4	0.553	0.090	-0.057	1				
5	V5	0.739**	0.595**	0.530*	0.251	1			
6	V6	0.122	0.742**	0.703*	-0.163	0.091	1		
7	V7	0.427	0.604**	0.381	0.101	0.301	0.370	1	
8	V8	0.350	-0.175	-0.301	0.381	0.373	-0.575*	-0.045	1

*significant at 5% ($p < 0.05$), **significant at 1% ($p < 0.01$).

Result in Table 2 shows that identification of environmental and health status had significant relationships with diagnosis of environmental health problems (r=0.558, p<0.05), and with development of policies and plans that support individual and environmental health efforts (r=0.739, p<0.01). Result also reveals that diagnosis was significantly related to the centers' ability to inform, educate and empower people about environmental health issues (r=0.924, p<0.05), contribute to developing policies (r=0.595, p<0.01), competency of environmental health workforce (r=0.742, p<0.01) and the effectiveness of their evaluation (r=0.604, p<0.01). The level of their ability to inform, educate people on environmental health issues was found to be significantly related to the competency of their environmental health workforce (r=0.703, p<0.01).

Table 3. Relationship between scores.

Dependent variable		B	Standard error	t –calc.	P-value	R^2	F-calc.	Remarks
V3	Intercept	1.333	2.785	0.48	0.638	0.094	1.769	NS
	V1	0.528	0.397	1.33	0.201			
V4	Intercept	7.047	0.765	9.207	0.000	0.008	0.140	NS
	V2	0.054	0.145	0.374	0.713			
V5	Intercept	3.888	0.828	4.70	0.000	0.354	9.32*	S
	V3	0.480	0.157	3.05	0.007			

NS=Not Significant, S=Significant at 5% ($p < 0.05$).

Result in Table 3 reveals that 9.4% of the variation in the ability of the center to inform, educate and empower people about environmental health issues was accounted for by their identification of environmental health problem. Result also reveals that there was no significant relationship between identification of environmental health issue and their ability to inform, educate people about environmental health issues. Result also shows that only 8% of the variation in the ability to solve environmental health problems was explained for by their ability to diagnose and investigate environmental health issues ($R^2=0.008=8.0\%$) noting that diagnoses and investigation of environmental health issues did not significantly predict ability to solve environmental health problems (F-calc.=1.769, p>0.05). The ability to contribute to developing policies and plan had significant relationship with the ability of these centers to diagnose and investigate environmental problems and hazards ($R^2=0.354$, F=9.32, p<0.05).

4. Discussion

In the centers studied, 84.2% had no system to assess environmental health threats while only 15.8% had formal systems to acquire input and routinely conduct needs assessment. This practice ought to be completely overhauled because employees use their own procedures when not being directed or when not being supervised. The results of a suitable and sufficient risk assessment would help users to choose which good preventive/corrective practice measures are most appropriate [14]. With regards to having a formal system for identifying vulnerable populations, 78.9% of the centers responded in the affirmative. Though details were not sought on how this was conducted, it is important to know that this could be achieved by analyzing the levels and socio-

demographic predictors of four concepts related directly to social determinants of health: socio-economic security, social inclusion, social cohesion and social empowerment [15]. Notably, the World Health Organization (WHO) has urged governments around the world to focus public health policy, practice and research on the social determinants of health in order to improve the health of the most vulnerable and marginalized groups [16-18]. Various populations have been identified as more vulnerable to environmental hazards; individual and experiential factors can lead to different vulnerability across populations. These factors include those whose biophysical characteristics make them more vulnerable such as the developing fetus, infants, children and older adults. People with acquired biophysical factors such as chronic illness, those with differences in functioning due to trauma, and those with altered immunity also become more vulnerable to poor health outcomes. Additionally, those born with congenital anomalies and with variations in cognitive and physical abilities may be at more risk from specific toxic exposures [19].

Written protocol to analyze relationships between environmental health hazard and health impact was reportedly in the affirmative for 78.9% of the centers, the proportion of which was same for those having written memoranda of agreement with agents investigating environmental hazards or risk, and those with communicable disease surveillance capacity to assess environmental hazards; but was similar for those with technical capacity to perform environmental health risk assessments (84.2%). Some studies posit that differences in environmental health risk assessments approach fail to meet the needs of policy makers [20-23] – citing the differences in scientific perspective, inconsistencies in concept and somewhat lax use of terminology as being implicated. Uncertainties in exposure assessment may thus feed through into even larger uncertainties in terms of impact [24]. There is a need for an integrated approach to health risk assessments within and between industries. By integrated approach is meant the means of assessing health-related problems deriving from the environment, and health-related impacts of policies and other interventions that affect the environment, in ways that take account of the complexities, interdependencies and uncertainties of the real world [24].

In the majority, the centers reported a presence of environmental health advisory group (68.4%), with 78.9% affirming the will to provide environmental health information to the hospital community while all centers demonstrated capacity to communicate with people of diverse background, and a majority (73.7%) regularly evaluating the effectiveness and appropriateness of communication methods. This practice promises success as

demonstrated by the United Kingdom national agencies and local health boards which have revisited housekeeping policies to reflect the new awareness of the importance of basic hospital hygiene, along with formal monitoring, feedback to cleaners, and surveillance of key environmental pathogens [25, 26].

In terms of effective partnerships, only very few centers had a formal system for identifying stakeholders or interested parties (5.3%); partnered with schools of higher learning that were potential sources of public health workers (31.6%); had up-to-date written directory of potential partners (5.3%); and had a formal process for developing collaborative or shared efforts on issues of common interest (5.3%). However, studies have elucidated the benefits of partnerships as being 'scaling up' of the organization's activities [27]. Additionally, it has been posited that through partnerships, parties can gain insight in the views of the others and learn from each other, so that knowledge is accumulated [28], creativity is stimulated, and a wider range of solutions can be generated [29]. The link between intersectoral partnerships and sustainable development was formalized when partnerships were declared an important tool for implementing sustainable development at the 2002 World Summit on Sustainable Development (WSSD) in Johannesburg [30-32]. On the other hand, some demerits have been identified as partnering bringing about a lack of clarity on which actor is responsible for what, thereby leading to avoidance of responsibilities [33].

Identification of environmental health priorities was a weakness among 84.2% of the centers studied and a similar majority of 89.5% had no formal process to be included in policy development. A comparative study in Birmingham Alabama in the United States has concluded that benefits of identification of environmental health priorities included the prioritization of tangible, known risks in everyday life instead of rare, disaster- related events which can help inform future efforts to study, understand and effectively address environmental issues, and would be particularly relevant to developing effective community-based strategies in vulnerable populations [34]. Another study in the Philippines established a novel approach to establishing environmental health priorities based on the concept of principal environmental exposure pathways (PEEPs). It posited that principal environmental exposure pathways extended the concept of a causal pathway backward from health outcome to exposure, then to the industrial, transportation, commercial, or living conditions that gave rise to the pollution of interest; identifying five PEEPs, namely: an urban air-pollution pathway; a community water-supply pathway; an urban solid waste pathway; a rural "point-source" pathway; and a pathway whereby

fertilizers and pesticides affect food, worker health, and rural water supplies [35]. By so doing, the populations at risk were characterized to estimate the burden of morbidity and mortality related to each PEEP, as well as identifying the health outcomes that were experienced by those exposed along each pathway or that they would be expected to experience; determining where adequate health outcome information was available or absent; where exposure sources were or were not adequately identified; where there were significant gaps in agency responsibilities; where new data flows were needed; and where things could have been improved by improving inter-agency cooperation [35]. This could prove to be a compact method of identifying and analyzing environmental health priorities. Though most of the centers also indicated that they had a formal process of identifying research needs and all the centers indicated they had formal relationships with research entities only one-fifth of them had award programmes for innovative solutions by center employees. Disappointingly, this is reflected by the lack of capacity to seek grant, new funding opportunities or partners for research projects by about three quarters of the centers, a situation which does not foster development and sustainability [36].

Competency of environmental health workforce seemed to be given necessary boost with most of the centers reporting an on-going training plan to improve knowledge, skills and abilities to perform (73.7%); having written standards and identifying minimum competencies needed to perform their jobs (94.7%); and all centers routinely conducting personnel assessments and having in place, written policy on recruitment, training and retention of staff. These are commendable practices as alluded to by the United States' Center for Disease Control [37].

The significant relationship observed between the identification of environmental and health status and significant relationships with diagnosis of environmental health problems ($r=0.558$, $p<0.05$), and with the development of policies and plans that support individual and environmental health efforts ($r=0.739$, $p<0.01$), reflect the need for timely environmental risk assessments within any system [38]. Similarly, diagnosis of environmental health problems was significantly related to the centers' ability to inform, educate and empower people about environmental health issues ($r=0.924$, $p<0.05$), contribute to developing policies ($r=0.595$, $p<0.01$), competency of environmental health workforce ($r=0.742$, $p<0.01$) as well as to the effectiveness of their evaluation ($r=0.604$, $p<0.01$). This is in tandem with findings from a Brazilian study which encourages participatory environmental diagnosis as a leverage for improved systems [39], the competency of the workforce significantly accounting for the level of the centers'

ability to inform, educate people on environmental health issues.

Regression analysis showed, as in other studies [40], that the ability to contribute to developing policies and plans had significant relationship with the ability of these centers to diagnose and investigate environmental problems and hazards ($R^2=0.354$, $F=9.32$, $p<0.05$).

5. Conclusion

From the foregoing, essential environmental health services in corporate practice has been demonstrated to be deficient in terms of formal systems to assess environmental health threats, acquire input and routinely conduct needs assessment. Additionally, ability to attract grants and conduct operations research was very poor, with partnership among the centers for improved services being almost non-existent. However, it has been demonstrated that identification of "environmental and health status" had significant relationships with diagnosis of "environmental health problems"; this was similar to "development of policies and plans that support individual and environmental health efforts". Diagnosis of environmental health problems was significantly related to the centers' ability to inform, educate and empower people about environmental health issues. Hence, there is a need for integrated environmental management systems, well regulated by government with support from the private sector, for improved environmental health services in corporate practice.

Competing Interests

The authors declare that they have no competing interests.

Data Availability

The data used to support the findings of this study is available on request to the corresponding author.

Acknowledgements

References

[1]   Demographic Statistics Bulletin - National Bureau of Statistics (2017).   Accessed   online   at: https://nigerianstat.gov.ng/download/775 in June 2019.

[2]   Aigbedion I and Iyayi SE. Diversifying Nigeria's petroleum industry. International Journal of Physical Sciences Vol. 2 (10), pp. 263-270, October, 2007.

[3]   Mushal R. 'Reflections upon American Environmental Enforcement Experience as it may relate to Post ^Hampton Developments in England and Wales' (2007) 19 JEL 201; C Abbot, 'The Regulatory Enforcement of Pollution Control Laws: The Australian Experience' 2005, 17 JEL161.

[4]   Eneh, OC. Managing Nigeria's environment: The unresolved issues. J. Environ. Sci. Technol. 2011, 4: 250-263.

[5]   Anukam LC. Case Study IV-Nigeria. In: Water Pollution Control: A Guide to the Use of Water Quality Management Principles, Helmer, R. and I. Hespanhol, (Eds.). Taylor and Francis, Washington DC: WHO/UNEP, 1997.ISBN-13: 9780419229100.

[6]   Nwafor JC. Environmental Impact Assessment for Sustainable Development: The Nigerian Perspective. Environment and Development Policy Centre for Africa, Enugu, 2006.

[7]   Frondel M, Horbach J, Rennings K. End-of-Pipe or Cleaner Production? An Empirical Comparison of Environnemental Innovation Decisions accross OECD Countries, Business Strategy and the Environment, 2007, 16 (8), 571-584.

[8]   Wagner M. Empirical Influence of Environmental Management on Innovation: Evidence from Europe, Ecological Economics, 2008, 66 (2-3), 392-402.

[9]   Wagner M, Llerena P. Eco-Innovation through Integration, Regulation and Cooperation: Comparative Insights from Case Studies in Three Manufacturing Sectors, Industry and Innovation, 2011, 18 (8), 747-764.

[10] Johnstone N, Labonne J. Why Do Manufacturing Facilities Introduce Environmental Management Systems? Improving and/or Signaling Performance, Ecological Economics, 2009, 68 (3), 719-730.

[11] Laperche B, Picard F. Environmental Constraints, Product-Service Systems Development and Impacts on Innovation Management: Learning from Manufacturing Firms in the French Context, Journal of Cleaner Production, 2013, 53, 118-128.

[12] Anukam LC. Case Study IV-Nigeria. In: Water Pollution Control: A Guide to the Use of Water Quality Management Principles, Helmer, R. and I. Hespanhol, (Eds.). Taylor and Francis, Washington DC: WHO/UNEP, 1997, ISBN-13: 9780419229100.

[13] World Bank, 1990. Towards the Development of an Environmental Action Plan for Nigeria. World Bank, Washington DC.

[14] Lele DV. Risk assessment: A neglected tool for health, safety, and environment management. Indian J Occup Environ Med. 2012 May-Aug; 16 (2): 57–58.

[15] Ward PR, Mamerow L, Meyer SB. Identifying Vulnerable Populations Using a Social Determinants of Health Framework: Analysis of National Survey Data across Six Asia-Pacific Countries. PLoS One. 2013; 8 (12): e83000.

[16] Commission on Social Determinants of Health (2008) Closing the gap in a generation: Health equity through action on the social determinants of health. Final report of the CSDH. Geneva: World Health Organization.

[17] Gilson L, Doherty J, Loewenson R, Francis V (2007) Challenging Inequity Through Health Systems. WHO Commission on Social Determinants of Health.

[18] Pittman PM (2006) Beyond the sound of one hand clapping: experiences in six countries using health equity research in policy. J Health Polit Policy Law 31: 33-49. doi: 10.1215/03616878-31-1-33. PubMed: 16484667.

[19] Leffers J, Smith CM, Huffling K, McDermott-Levy R, Sattler B. Harmful Environmental Exposures and Vulnerable Populations. Environmental Health in Nursing. [Mount Rainier, MD]: Alliance of Nurses for Healthy Environments, [2016].

[20] Commission of the European Communities: The European Environment and Health Action Plan 2004–1010. Brussels 9.6.2004.   Com   (2004)   416   final. [http://ec.europa.eu/environment/health/pdf/com2004416.pdf].

[21] Bridges J. Human health and environmental risk assessment: the need for a more harmonised and integrated approach. Chemosphere. 2003, 52: 1347-1351. 10.1016/S0045-6535 (03)00469-7.

[22] McMichael AJ. Integrated assessment of potential health impact of global environmental change: prospects and limitations. Environ Monitoring Assess. 1997, 2: 129-137. 10.1023/A: 1019061311283.

[23] Machenbach JP. Global environmental change and human health: a public health research agenda. J Epidemiol Community Health. 2007, 61: 92-94. 10.1136/jech.2005.045211.

[24] Briggs DJ. A framework for integrated environmental health impact assessment of systemic risks. Environmental Health 20087: 61.

[25] National Patient Safety Agency. 2007. The national specifications for cleanliness in the NHS: a framework for setting and measuring performance outcomes. NPSA, London, United Kingdom.

[26] Healthcare Commission. 2008. Inspections of cleanliness and infection control: how well are acute trusts following the hygiene   code.   http://www.official-documents.gov.uk/document/hc0809/hc07/0718/0718.pdf. Accessed June 2019.

[27] Cowe R. "Business NGO partnerships: What's the payback?" In Ethical Corporation 2004. Edited by: Embelton, D.

[28] Poncelet EC. Personal transformation in multistakeholder environmental partnerships. 2001; Policy Sci, 34: 273–301.

[29] Davis TS. Reflecting on voluntary environmental partnerships: lessons for the next century. 1999; Corporate Environ Strat, 6 (1): 55–59.

[30] Hens L, Nath B. The Johannesburg Conference. 2003; Environ Dev Sustain, 5: 7–39.

[31] Norris C. "Partnerships for sustainable development. The role of type II agreements". In Global challenges: Furthering the multilateral process for sustainable development, 2005. Edited by: Kallhauge, A C, Sjöstedt, G and Corell, E. 210–230. Sheffield, UK: Greenleaf Publishing.

[32] Eweje G. Strategic partnerships between MNEs and civil society: the post-WSSD perspectives. 2007; Sustain Dev, 15 (1): 15–27.

[33] Giguere S. Local governance and partnerships: A summary of the findings of the OECD study on local partnerships, Paris: Co-operative Action Programme on Local Economic and Employment Development (LEED); 2001.

[34] Bernharda MC, Evans MB, Kenta ST, Johnson E, Threadgill SL, Tyson S, Becker SM and Gohlke JM. Identifying environmental health priorities in underserved populations: a study of rural versus urban communities. Public Health. 2013 November; 127 (11): 994–1004. doi: 10.1016/j.puhe.2013.08.005.

[35] Hertzman C, Torres E, Subida R & Martins J. Identifying Environmental Health Priorities for a Whole Nation: The Use of Principal Environmental Exposure Pathways in the Philippines. International Journal of Occupational and Environmental Health Volume 4, 1998 - Issue 2.

[36] Lansang MA, Dennis R. Building Capacity in Health Research in the Developing World. Bulletin of the World Health Organization; October 2004, 82 (10).

[37] Environmental Public Health Performance Standards (Version 2.0). National Center for Environmental Health Division of Emergency and Environmental Health Services, 2014.

[38] Nadel S, Galuano D, Orozco L. Adoption of Environmental Management Systems and Organizational Changes: The Case of the French Industrial Firms. Journal of Innovation Economics & Management, 2016, 3 (21); 109-132.

[39] Moniz MA, Sabóia VM, Nascimento do Carmo C, Hacon S. Participatory environmental diagnosis and of health risks from the surrounding communities the Petrochemical Complex of Rio de Janeiro, Brazil. Ciênc. saúde coletiva vol. 22 no. 11 Rio de Janeiro Nov. 2017.

[40] Delmas M, Pekovic S. Environmental Standards and Labor Productivity: Understanding the Mechanisms that Sustain Sustainability. Journal of Organizational Behavior, 2013; 34 (2), 230-252.