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Critical Factors of Effectiveness of Environmental Management Plan (EMP) of Oil and Gas Projects in the Niger Delta Region of Nigeria

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Abstract—**Oil and gas production activities have been going on in the Niger Delta region of Nigeria since 1958. The mandatory use of EMP to mitigate the impacts on the environment has not been effective. Researchers have not investigated to a deeper extent the key elements that will increase the effectiveness of EMP's of the oil and gas projects. This makes it difficult to tailor impactful policies and resources to turn things around and achieve environmental sustainability in the context of oil and gas production activities in the Niger Delta region. This study determined critical factors of effectiveness of EMP in the oil and gas projects in the region. The Study involved administration of a semi structured questionnaire on 384 respondents comprising the proponent, regulator and community. The data was analysed using Principal Component Analysis (PCA) to identify the critical factors of effectiveness. The PCA identified a) Collective address of impacts by all stakeholders; b) Commitment; c) Importance of impact data; d) Monitoring and Evaluation and e) Information sharing as critical factors of effectiveness of EMP in the region.**

Index Terms—**Sustainability, Effectiveness, Environment, oil and gas, Environmental Management Plan (EMP), Niger Delta, Mitigation.**

1. Introduction

The Niger Delta region of Nigeria which covers a land mass of over 70,000km^2 with about 800 oil – producing communities (Osuji and Ojinnaka, 2004; Okurebia and Daniel, 2014) is vulnerable to environmental impacts of oil production activities. Researchers have reported the existence of significant impacts of oil production activities in the Niger Delta environment including the works of Odukoya (2006), Ejibunu (2007), Snapps and Aghalino (2010), UNEP (2011), Kadafa (2012), Oshwofasa, Anuta and Aiyedogbon (2012), Iniaghe, Tesi and Iniaghe (2013), Raji and Abejide (2013) and Boris (2015). Raji and Abejide (2013) maintain that Niger Delta is the most oil impacted region of the world. The extent of the degradation in the oil and gas production region in the Niger Delta of Nigeria has been blamed for the persistent violent and social conflict in the region. Oil and gas projects are approved on the condition that Environmental Management Plan (EMP) would be implemented to mitigate the adverse impacts of project and to optimise the positive impacts towards sustainability of the host environment. It has been held that, the implementation of EMPs during project execution supports the achievement of environmental sustainability and enhanced EIA outcome (SPDC 2004; Cashmore, Gwilliam, Morgan, Cobb and Bond, 2004; Noble and Storey, 2005; Harmer, 2005). Other researchers such as Ogunba (2004), Ramjeawon and Beedassy (2004), Paliwal (2006), Kolhoff, Runhaar and Driessen (2009), Cashmore, Richardson, Hilding-Ryedvik and Emmelin (2010) and Shakil and Ananya (2015) have supported that a weak implementation of EMP reduces the ability of EIA to promote environmental sustainability. The global interest in sustainability is to secure the perpetual provisioning of environmental, social and economic needs of the present and future generations. This thinking calls for the address of many global challenges including climate change and has attracted many approaches including the development priorities adopted by the UN member states in September, 2015 as Sustainable Development Goals (SDG). The effectiveness of EIA as an environmental management tool to promote sustainable development and support climate change adaptation in project planning has also received attention (Jiricka, Formayer, Schmidt, Völler, Leitner, Fischer and Wachter, 2016). The effective implementation of EMP is therefore critical in tackling global challenges and to promote the achievement of sustainable Development Goals (SDG). environment. This calls for a review of the EIA process while particularly identifying the specific factors that will improve the effectiveness of EMP for the achievement of sustainability in region. The identification of important practices that would contribute to the effectiveness of

2. Statement of Problem

The reports that oil and gas production continue to negatively impact the producing environment of the Niger Delta directly suggest a failure on the intentions of EIA and indeed EMPs implemented in oil production projects in the Niger Delta to support the sustainability of the environment. This calls for a review of the EIA process while particularly identifying the specific factors that will improve the effectiveness of EMP for the achievement of sustainability in region. The determination of practices capable of contributing to the effectiveness of EMP

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in the oil and gas production projects in the Niger Delta and their subsequent application will set a strategic foundation towards the sustainability of the environment of the region. The identification of key elements to deploy during EMP implementation will lead to the improvement of the current practice of EMP and promote the sustainability of the environment. It will also support to reduce the crises arising from oil and gas production activities that have been linked to environmental degradation. Thus, the study was set to identify important factors of effectiveness of EMP in oil and gas projects in the Niger Delta. . The factors are very important considerations in the implementation of EMP when effectively applied in the EMP process will contribute to the effectiveness of EMP in the sustainability of the oil and gas production environment of the Niger Delta of Nigeria. These factors have been determined through a survey that examined important components that contribute to the effectiveness of EMP through the use of PCA.

3. Study Area

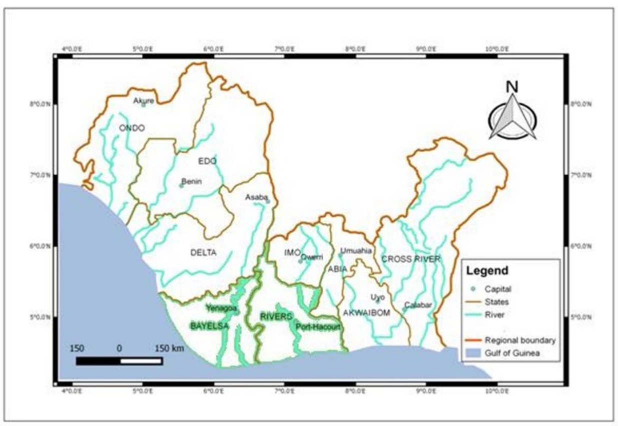

Fig. 1. Niger delta region of Nigeria with map of Niger insert

The Niger Delta refers to the geopolitical area comprising nine states recognised by Nigerian law as oil producing states (NNDC Establishment Act 2000; Iniaghe et al, 2013; Boris, 2015). It is located between Latitudes 4^0 and 8^0 North of the Equator and Longitudes 5^0 and 9^0 East of the Greenwich Meridian see figure 1. The study area's geology is made up of a vast sedimentary basin occurring at the natural delta of the Niger River. The plain is believed to have been formed during the Holocene of the quaternary period by the accumulation of sedimentary deposits. Sedimentary alluvium dominates the geology of this area. The area is generally lowland characterised by tidal flats and coastal beaches, beach ridge barriers and flood plains (Odjugo, 2011). The land surface is generally under 20m above sea level. The floodplain has silt and clay foundation and highly susceptible to perennial inundation by river floods. The study area has much surface water and a high rainfall, of between 2000mm and 4000 mm (Odjugo, 2011). Some areas referred to as 'riverine' come under water at one time of the year or another. The drier upland areas have relief range of 2m to 5m and are the most urbanised areas in the region. The entire topography of the area is characterised by a maze of effluents, rivers, lakes, creeks, lagoons and swamps crisscrossing the low lying plains in varying dimensions (Youdeowei, and Nwankwoala; 2013). The study area experiences Equatorial type of climate -Koppen's Af classification (Odjugo 2011). The mean monthly temperature is between 25^0C to 28^0C. The daily high temperatures are moderated by regular land and sea breezes due to the influence of the Atlantic Ocean. Annual rainfalls are heavy, between 2000mm to 4000mm with less distinct double mean rainfall scheme. Rainfalls are accompanied by lightening, thunder and torrential showers. It has a little dry season between December and February. The vegetation of the study area is composed of four ecological zones. These include: coastal barrier island forests mangrove forests, freshwater swamp forests and lowland rain forests. These different vegetation types are associated with the various zones in the area, and they constitute part of the complex Niger Delta ecosystems. The fresh water swamp forests in the study area constitute the home of biodiversity some considered to be threatened and even endangered (Hemba, 2012 and Hemba, Iortyom and Adelabu, 2017). Some of the Niger Delta plants including *Terminalia ivorensis*, *Piper guineensis, Irvingia gabonensis, Gongronema latifolium*, *Covee eketensis*, *Sagoclotis gabonensis* and *Eulophia* carispholia have been identified by Phil-Eze and Okoro (2009) as important for conservation efforts. The soil type of the study area is majorly made up of fluvial and marine sediments, shallow and poorly drained. The soils are organic in nature and essentially sandy in texture. Some consist of mud mixed with decayed organic matter. The population of Bayelsa state in the 2006 population Census is 1,704,515 while that of Rivers State is 5,185,400 (NPC, 2006). This population comprise Ijaws, Ogonis, Ikwerres, Urhobos and amongst other tribes (Owede, 2005). The Socio-Economic activities in the study area cut across administrational, agricultural, commercial, industrial and educational sectors. The administrative activities are mostly paid employment under the public and private sectors. Public employment is mostly in the Ministries, Departments and Agencies (MDA) of government. In the industrial sector activities involves a range of large, medium and small scale industries. In the agricultural sector, the population is principally involved in subsistence crop farming (Efik 2011). They are characterised by small sized farm holdings. Major crops cultivated are cassava yam and maize. A few other families are involved in livestock like goats which are left to roam about.

4. Materials and Methods

The survey method was used to acquire primary data to pursue the objective of this study. Survey involved EMP stakeholders who were identified through review of relevant literature. The use of stakeholders as a valid source of information is popular in this type of study (see also Nieslony, 2004; Okafor, 2011; and Chanchitpricha and Bond, 2013. A stakeholder is defined by De Groot, Stuip, Finlayson and Davidson (2006) as individuals, organisation or a group of individuals who have interest in a concern (e.g. project activities, development programmes) or particular resources. In this study the proponents are the oil and gas multinational companies who initiate oil and gas production projects in the Niger Delta. Others are the regulator and the community. The regulator is departments, ministries and agencies who are in charge of overseeing the implementation and are represented by staff or officials who work in such establishments. The community comprises of academic, project host community, consultants and NGOs, these are used in similar researches by, Isah (2012), Fischer and Nadeem (2013) and Benett et al (2015).

5. Data Acquisition and Sources

A review of various studies on EIA follow-up and EMP was conducted to identify important practices and factors that contribute to achievement of suitability goal of EIA. A set semi-structured questionnaire was constructed comprising of the socio-demographic characteristics of the respondents and questions a set of variables measured on a 5 point likert scale regarding important practices, their effectiveness and adequacy in achieving sustainability in EMP practice in the oil and gas. The questionnaire was administered between July and November 2017 on 384 respondents comprising of the government agencies, oil company officials, academics/consultants, NGOs and members of project communities who formed the respondents.The questionnaire distribution was based on non proportional method across the respondents (Stakeholders). The non proportional distribution of questionnaire is similarly reported by other researchers in studies similar to this and results were consistent with the objectives of the study see for example, Isah (2004). It has been argued that, the non proportional distribution of the questionnaire aid the targeting of respondent sub groups within a population of study that may be considered of high interest or who may not be well covered if not given such prior consideration. (Booth, 1991). Nieslony (2004 p.11) adds that it helps to 'avoid "biased" answers due to the institutional or political background of the respondents'. In that regard, since the sustainability of the environment of the Niger Delta is the focus of this study the community which comprise the various stakeholders described earlier who could be affected directly by the impact of oil production activities were considered of primary interest. It was also to take care of the possibility of biased response by oil companies and government agencies that are directly responsible for implementation and supervision of EMP implementation respectively and who may likely be influenced by their background while responding to the questionnaire (Nieslony 2004). Thus the questionnaire distribution took this into consideration. Hence the questionnaire was distributed accordingly in the percentages as: proponents 20% regulator 10% and community 70% (host community 50%, academic 25% and NGOs 25%). The snow ball method which involves identification of initial respondents within a particular category who then suggest or recommend others within the category for contacting was used to identify individual respondents and the questionnaire was administered on them. Responses where first coded in SPSS and converted to frequencies. The Principal Component Analysis was performed on the data The Data was first coded and The PCA is useful in reducing the dimension of data by determining the correlation between responses especially when dealing with many responses or variables in a given data set (Rea, 2016 and Pasini, 2017). It helps in identifying pattern in data set by analysing its internal dimensions, in the present case, the pattern of responses were analysed in order to reduce the number of responses to generate a small set of underline variables of the original responses (Rea 2016). The Principal Component Analysis is applied in research across many disciplines including geography (Anyadike, 2009; Rea, 2016; Pisini, 20017).

Table 1
Socio-Economic characteristics of respondents

What is your occupation					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Civil servant/Public servants	371	96.6	96.6	96.6
	Student/apprentice	13	3.4	3.4	100.0
	Total	**384**	**100.0**	**100.0**	
What is your level of education					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Tertiary school	276	71.9	71.9	71.9
	No formal education	108	28.1	28.1	100.0
	Total	**384**	**100.0**	**100.0**	
How long have you lived in this community					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
	1-5	20	7.3	7.3	7.3
	6-10	26	9.9	9.9	17.2
	11-15	131	48.7	48.7	65.9
	16-20	92	34.1	34.1	100.0
	Total	**269**	**100.0**	**100.0**	
Status in the community					
		Frequency	Percent	Valid Percent	Cumulative Percent
	Union leader	18	6.5	6.5	6.5
	Family head	234	87.0	87.0	93.5
	Immigrant/settler	9	3.4	3.4	96.9
	others	8	3.1	3.1	100
	Total	**269**	**100.0**	**100.0**	

(Source: Field work, 2017)

6. Results

Socio-Economic Characteristics of respondents As shown in Table 1 majority (96.6%) of the respondents are civil/public servants while student and apprentice account for the 3.4%. The table also show a high level of education with majority acquiring tertiary education while only 28% had no formal education. This gives a background of a suitable respondents for the study, it implies that, majority are likely to be informed about what is happening. Tertiary education is also an indication of capacity of critical reasoning over the subject matter. As also indicated in their occupation, majority in the Civil/Public Service explains their background as government staff, consultants, oil company workers and members of the civil society who constitute majority of the stakeholders in the implementation of environmental management plan. The socio-economic characteristics of the respondents give a background of well suited respondents for this study. The familiarity of respondents and their capacity to understand and have critical reasoning on a subject of interest is influenced by their characteristics (Isah, 2012). Further, their familiarity with the Niger Delta environment as indicated by period of residence in the region is a positive indication of their understanding of the issues their suitability as respondents to the study. Majority (48.7%) have lived in the communities between 11-15 years. while 34.1% have lived between 16-20 years, 7.3% have lived between 6-10 years and those who lived between 1- 5 constituted only 9.7% of the respondents. These members of the community as indicated by long duration of resident in the environment, are likely to have adequate experience in the communities to be able to understand what may have been happening in the community with regards to EMP implementation in the oil and gas production activities. Interestingly, EMPs were introduced in the study area in 1996, which is barely 21 years at the time of this survey. This means that majority of the respondents are likely to have witnessed EMP implementation from inception. On their status as members of their community which is very critical in their involvement with issues in the community including participation in the EMP process, in the community it can be deduced as shown in Table 1 that the majority of the respondents (87%) are family heads. Others; Union Leaders (6.5%), immigrant/settlers (3.4%) and 3.1% represent other type of status not considered in the study. The status of the respondents within the community gives them a good standing in terms of access to information within the community. House heads are known as representatives of individual households and a very important source of community information for researchers in the social science, many previous studies in the Niger Delta have relied on them for reliable information (Okafor, 2011; Singh, Kushwah, Singh and Daipuria, opinion leaders and representatives of members of their union. In such regards, they are likely the same persons to be involved with stakeholder's consultation during EIA process and EMP implementation. This makes them suitable respondents for this study since they are very likely to have a fair knowledge of EMP and its implementation.

A. Awareness and Participation in the Implementation of EMP

As shown in Table 2 all the respondents indicated awareness on the need to implement EMP in oil and gas projects in the region. A majority (73.2) also were aware that oil and gas companies are responsible for the implementation of EMP in oil and gas projects. Other (26.8%) which are a minority expect that government should be responsible in the implementation of EMP in oil and gas. Although government is directly involved in the monitoring which supervisorial role, the direct implementation is expected to be carried out by the oil and Gas Company which is the proponent as provided in the guidelines.

Table 2
Respondent's awareness and participation in the implementation of EMP

Awareness that EMP should be implemented on oil and gas projects					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Yes	349	90.9	100.0	100.0
	No	35	9.1		
	Total	384	100.0		
Responsible person for the implementation of EMP in oil and gas projects in the Niger Delta					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Oil companies	281	73.2	73.2	73.2
	The government	103	26.8	26.8	100.0
	Total	**384**	**100.0**	**100.0**	
Duration associated with EMP implementation in oil and gas projects					
		Frequency	**Percent**	**Valid Percent**	**Cumulative %**
Valid	Below 2 years	38	9.9	9.9	9.9
	2-4 years	58	15.1	15.1	25.0
	4-6 years	68	17.7	17.7	42.7
	6-8 years	108	28.1	28.1	70.8
	above 8 years	112	29.2	29.2	100
	Total	**384**	**100.0**	**100.0**	
Level of participation in EMP implementation					
		Frequency	**Percent**	**Valid Percent**	**Cumulative %**
Valid	NGO representative	67	17.4	17.4	17.4
	Governmentrepresentative (DPR, NESREA and FME)	38	9.9	9.9	27.3
	Oil company (Proponent)	77	20.1	20.1	47.4
	EIA researcher/consultant	67	17.4	17.4	64.8
	Community representative	135	35.2	35.2	100.0
	Total	**384**	**100.0**	**100.0**	

(Source: Field work, 2017)

This standard practice is similar with is obtainable in other EIA jurisdictions. Based on this response, it could be concluded reasonably that the respondents are fairly aware of the implementation of EMP of the projects in oil and gas in the region and that they are suitable respondents for the study. The association of the respondents in EMP implementation showed that majority of the respondents (57.3%) have been involved with EMP implementation for above 6 years duration. Others (17.7%) have been involved with EMP implementation between 4-6 years and a few others (15.1%) have been involved with EMP implementation between 2-4 years. The remaining small minority of 9.9% have been involved with EMP implementation for less than 2 years. The duration of their involvement with EMP is very crucial in their understanding of the issues and their identification of very important factors that could be deployed in the effectiveness of EMP. On the levels of participation in the EMP implementation process, findings showed various levels of participation by the respondents. As indicated (35%) participate as community representatives 20.1% as oil and gas company officials, 17.4%. as researchers/consultants while 17.4% participate as NGOs or civil society groups and 9.9% participate as officials of government who are staff in the various departments and ministries who represent the regulators in the the EMP practice. These group represent the various stakeholders in the EMP process as discussed earlier; the community the common term comprising of the researchers/consultants, the NGOs and representatives of the project communities whose participation are considered to represent the interest of the ordinary people who could be affected by the activities of a project in very critical areas bothering on their survival and comfort. The regulator is represented by the government officials while the proponent is represented by the oil company officials. The respondents representing the major stakeholders of EMP suggests that they have adequate grasp of the issues and are suitable for this study.

B. *Results of PCA*

Table 3
PCA Variable codes

Variables of EMP Implementation Activities	**Code**
Consideration of Monitoring in EMP	CME
Consideration of Indirect impacts in EMP	CIE
Consideration Cumulative Impacts in EMP	CCI
Evaluation and Management of Impacts in EMP	EMI
Communication on Implementation	COI
Data Collection (Timing and Use)	TUD
Address of Mitigation Measures	AMM
Address of Long-Term Impacts Issues	ATI
Address of Cumulative Impacts Issue	ACI
Address of Monitoring Issues	AMI
Transparency in Decision Making process	TDM
Training of Community Members	TCM
Funds for Implementation	FFI
Commitment to the Goals and Objectives	CGO
Transparency in Implementation Process	TIP
Link EMP to EMS	LEE
Stakeholders involvement	STI

(Source: Field work, 2017)

The PCA involved extraction of 17 variables from responses in the questionnaire on important activities, their effectiveness and adequacy in the sustainability of the environment in the context of EMP in oil and gas as shown in Table 3. Correlation analysis was performed in order to determine the relationship between the variables so as to examine the underline pattern in the responses. The result showed strong positive and negative correlation between the variables as indicated in Table 4 which is the correlation Matrix of the important implementation activities of EMP. Given the observed strong positive and negative correlation coefficients between the variables in the correlation matrix, the autocorrelation made it difficult to clearly explain how the variables relate and contribute to the effectiveness of EMP in the sustainability of the environment. To address this challenge, the raw data of the variables was subjected to PCA. This study proceeded by using the principal axis method to extract the components and was followed by a varimax (orthogonal) rotation. After the rotation, only the components with the Eigen values greater than one (1) were retained. Consequently, 5 components were retained and accounted for a cumulative percentage variance of 81.017%. Table 5, shows the variables and their corresponding

Table 4
Correlation of EMP implementation activities

	CME	**CIE**	**CCI**	**EMI**	**COI**	**TUD**	**AMM**	**ATI**	**ACI**	**AMI**	**TDM**	**TCM**	**FFI**	**CGO**	**TIP**	**LEE**	**ST I**
CME	1																
CIE	.111	1															
CCI	.108	.563	1														
EMI	.138	.019	-.107	1													
COI	.144	.096	.128	.154	1												
TUD	. 233	.467	.402	.283	.234	1											
AMM	.144	-.212	-.106	.374	.044	-.189	1										
ATI	.009	-.210	-.047	.224	.047	-.134	.887*	1									
ACI	-.144	.076	-.095	.355	.104	.075	.605*	.654*	1								
AMI	-.021	-.177	-.002	.285	-.124	-.182	.923*	.877*	.598	1							
TDM	.025	-.200	-.187	.434	.083	-.039	.825*	.782*	.634*	.770*	1						
TCM	.322	-.063*	-.020	.466	.176	-.601*	.841*	.821*	.493	.792*	.827*	1					
FFI	.247	-.269	-.241	.306	.010	-.309	-802*	.712*	.563	.799*	.616*	.654*	1				
CGO	.086	-.305	-.250	.282	.112	-.288	.514	.519	.456	.532	.502	.530	.664*	1			
TIP	.182	-.178	-.140	.215	.116	-.050	.509	.474	.370	.484	.466	.526	.471	.741*	1		
LEE	.308	.099	.013	.052	.170	-.142	.568	.611*	.460	.523	.548	.644*	.545	.638*	.648*	1	
STI	-.011	-.177	-046	.068	.101	-.329	.613*	.625*	.294	.586	.453	.596	.564	.624*	.472	.719*	1

*Significant co-efficient @ 95% confidence level, (Source: Field Work, 2017)

Table 5
Rotated component matrix

Rotated Component Matrix[a]						
Variables of EMP Implementation Activities	Code	Components				
		1	2	3	4	5
Consideration of monitoring in EMP	CME	-.043	.163	.042	*.913	-.207
Consideration of indirect impacts in EMP	CIE	-.143	-.022	*.852	.115	.010
Consideration cumulative impacts in EMP	CCI	-.020	-.010	*.855	-.192	.007
Evaluation and management of impacts in EMP	EMI	.444	-.101	-.034	*.627	.317
Communication on implementation	COI	-.008	.173	.093	-.069	*.913
Data collection (timing and use)	TUD	-.021	-.254	*.614	.400	.377
Address of mitigation measures	AMM	*.913	.282	-.098	-.004	-.028
Address long term impacts issues	ATI	*.898	.289	-.040	-.157	.009
Address of cumulative impacts issue	ACI	*.729	.100	-.044	.070	.227
Address of monitoring issues	AMI	*.900	.278	-.023	-.020	-.206
Transparency in decision making process	TDM	*.799	.385	.070	.213	.074
Training of community members	TCM	*.722	.390	-.267	.030	-.074
Funds for implementation	FFI	.358	*.755	-.316	.162	.083
Commitment to the goals and objectives	CGO	.274	*.777	-.116	.294	.112
Transparency in implementation process	TIP	.413	*.797	.145	-.107	.062
Link EMP to EMS	LEE	.470	*.672	.002	-.282	-.003
Stakeholders involvement	STI	.829	.206	-.117	.300	.031
Eigen value		**5.642**	**2.986**	**2.084**	**1.812**	**1.249**
% of explained variance		**33.188**	**17.564**	**12.259**	**10.660**	**7.346**
Cumulative %		**33.188**	**50.752**	**63.011**	**73.671**	**81.017**

*Significant loadings +/- 0.60, Source Field work (2017)

Table 6
The relative strength of underline dimensions of EMP implementation activities

Component Identification	Index of Component Activity	Component Defining Variable	Relative Contribution	Cumulative Contribution of components
I	Collective address of impacts by all stakeholders	Address of mitigation measures (0.913)	33.188%	33.188%
II	Commitment	Transparency in the EMP implementation (0.797)	17.564%	50.752%
III	Importance of impact data	Consideration cumulative impacts EMP (0.855)	12.259%	63.011%
IV	Monitoring and Evaluation,	Monitoring in EMP (0.913)	10.660%	73.671%
V	Information sharing	Communication on implementation process (0.829)	7.346%	81.017%

(Source: Field work, 2017)

component loadings. In order to interpret the pattern, a loading of 0.60 was used to indicate the significance of a variable that was loaded on a component. As such, a variable was said to load significantly when the factor loading is +/- 0.60 or above. On the bases of the significant loadings, Component I had seven (7) variables, Component II had 4 variables, 3 variables loaded significantly on Component III, 2 variables loaded on Component IV, while Component V is with one variable. Component I has an Eigen value of 5.642% and a percentage and cumulative percentage variance of 33.188%. The component load significantly and positively on seven variables. They are address of mitigation measures in current EMP practice in projects within Niger Delta (0.913); address of long term impacts issue in current EMP practice in projects within Niger Delta (0.898); address of cumulative impacts issue in current EMP practice in projects within Niger Delta (0.729); address of monitoring issue in current EMP practice in projects within the Niger Delta (0.900); transparency in decision making process in current EMP practice in projects within Niger Delta (0.799). The loadings were also significant and positive on training of community members on issues of environmental sustainability in current EMP practice in projects within Niger Delta (0.722) and public stakeholder's involvement in current EMP practice in projects within Niger Delta (0.829). The components, their eigen values and variance explained are shown in rotated component matrix in Table 5.

Looking at the significant variables, they denote *collective address of impacts* by all stakeholders

in EMP. The Component Defining Variable (CDV) is Address of mitigation measures with th highest loading of 0.913 on this component. Component II recorded an Eigen value of 2.986 and a percentage of explained variance of 17.564% making a total cumulative percentage variance of 50.752% with component I. It has significant loadings on adequacy of funds for implementing EMP (0.755); commitment of the stakeholders to the goals and objectives of EMP (0.777); transparency in the EMP implementation process (0.797) and provisions that link EMP to EMS (0.672). This component denotes *Commitment to the actualization of EMP*. The CDV for this is Transparency in the implementation process with the highest loading of 0.797. Component III with an Eigen value of 2.084 explained a percentage variance of 12.259% and together with component I and II explained a total cumulative percentage variance of 63.011%. This component loaded significantly and positively on three variables namely Consideration of indirect impacts of EMP (0.852); Consideration of cumulative impacts to sustainability within the context of EMP (0.855) and Consideration of the importance of timing and use of data collected in relation to the EMP to sustainability within the context of EMP (0.614). This component denotes *importance of impact data* on the effective implementation and sustainability of EMP. The CDV is Consideration of Cumulative impacts in EMP with the highest loading of 0.855 on this component. Component IV has an Eigen value of 1.812 and a percentage variance of 10.660%. Together with components I, II and III they explain a cumulative percentage variance of 73.671% in the whole data matrix. It loads significantly on two variables namely Consideration of monitoring to sustainability within the context of EMP (0.913) and Evaluation and management of impacts to sustainability within the context of EMP (0.627). This component is an index of *Monitoring and evaluation* which is very vital for effective implementation of EMP. The CDV is Consideration of monitoring in EMP (0.913). Component V with an Eigen Value of 1.249 accounts for a percentage variance of 7.346%. The component in addition to those before it recorded a cumulative percentage variance of 81.017%. It loaded significantly on one component which is Communication on the implementation process to sustainability within the context of EMP. This component is an index of *information sharing* to all stakeholders and has a high positive loading of 0.913. The four identified uncorrelated combination of components together explains 81.017% of the total variance in the EMP implementation activities raw data matrix leaving only 18.983% unexplained. Table 6 shows the relative strength of the underlying dimensions of the EMP implementation activities as reflected by the component defining variables.

7. Discussion of Findings

As shown in the analysis, PCA has successfully reduced 17 original variables (EMP implementation activities) to 5 orthogonal components that clearly identified mitigation measures, commitment to actualization of EMP, importance of impact data, monitoring and evaluation and information sharing as critical factors that can guarantee at least 81% effective implementation of EMP for sustainable development in the oil and gas production region of theNiger delta. As indicated by the component defining variable, effective address of mitigation issues is essential in achieving effectiveness in EMP implementation in oil and gas in the Niger Delta. Mitigation is the core of EMP implementation because it leads the way to sustainable environment post consent. It refers to specific actions that are taken to avoid or minimize the impact of development on the environment. There is a consensus amongst researchers that economic needs which bring about development is many times satisfied at the expense of certain unavoidable environmental concerns (Finer et al. 2008; Benchimol and Peres 2015; Winemiller et al. 2016; Sahleya, Vildosob, Casarettob, Taborgab, Ledesmaa, Linares-Palominoa, Mamanic, Dallmeierd andAlonsod, 2017). The assessment process leads to the identification of such concerns and the EMP is set to address them through mitigation. Implementation of mitigation measures is clearly presented in the EMP and tries to link every specific action to a particular impact. Usually mitigation is implemented based on the principle of avoidance which may include modification of project design or implementation processes that are adjusted in time and space to avoid the occurrence of specific impacts; minimization refers to actions that will reduce intensity or duration, and compensation which is the introduction of a balance by way of substitute to make available in another form or place what has been lost through the development process. These are applied in hierarchy; where avoidance is possible, it is adopted and where it is impossible, minimization is adopted and may proceed in that hierarchy to compensation where certain measures are taken to compensate for unavoidable environmental impact. This mitigation hierarchy has been recognized by Sahleya et al, (2017) to support biodiversity management in oil and gas projects. These actions support the protection of the environment and to ensure its continuous existence and performance which has been recognized as fundamental to environmental sustainability. Without effectively addressing mitigation issues, the EMP will not achieve its purpose and will not be effective in the sustainability of the region. This will have significant implication on human and natural environment since the environmental impact of oil production activities will not be controlled.

The consideration of transparency in the implementation process ensures that all parties are committed and carried along and the environmental issues are addressed in such a manner that is acceptable to all described as democratic (Wachi, 2016). Transparency also provides opportunity for all perspectives to be explored and considered so that every detail is addressed during implementation. It is significant in addressing social impact as much as the environmental impact. Without transparency in the implementation process, critical stakeholders will not be committed and able to offer important contributions to the success of the implementation. This will result to the failure of the EMP to achieve effectiveness.

Data collection is thus very essential component of monitoring, gathering data helps to determine the occurrence and extent of impact. Monitoring itself is simply defined as repetitive collection of data to establish a pattern (Mak'Oniare, 2012; Ahamed 2007). As emphasized by Chang, Wenqi, Jing, Sun and Rong (2018) in China, monitoring is essential for the success of EMP. The environment is a complex system such that it cannot be completely predicted. Yet, EMP which carries on with the application of mitigation measures relies on the accuracy of the predications during the assessment. According Georgeades (2015) mitigation measures themselves are capable of triggering changes within the environment. Sometimes, the impacts of one project may trigger change in the environment. In this regard, it is very necessary that the environment is monitored during the EMP implementation to determine the performance of the environment as it responds to the change chain. Mak'Oniare (2012) has identified 3 types of monitoring that happens during EMP implementation. They include; compliance monitoring; impact monitoring and baseline monitoring. Impact monitoring is critical to check for such cumulative and indirect impacts that may occur during the implementation of the project. The indication of this variable as the component defining variable emphasizes the importance of monitoring for effectiveness of EMP in the oil and gas production landscape of the Niger Delta.

Arts et al (2001) emphasize the importance of communication in the implementation of EMP. Communication is the tool used to inform stakeholders about the performance of the environment during implementation of EMP (Bennett et al, 2015). In a study in Uk on the perception of Stakeholders on the use of EMP as an environmental management tool, Bennett et al (2015), reported a lack of knowledge about the effectiveness of EMP amongst stakeholder due lack of communication. Wachi (2016) collaborates that communication is very necessary in the attainment of effectiveness in stakeholder engagement in the design and implementation of EMP. Effective stakeholder engagement in itself is crucial to the effectiveness of EMP, communication as such must be effective for this to be achieved.

8. Conclusion

The Niger Delta region of Nigeria is vulnerable to the impacts of oil and gas production activities which have been going on since 1958. There has been reports of a plethora of social and environmental impacts including youth restiveness that have been linked to the impacts of oil and gas production activities despite the mandatory requirement for the use of EMP to mitigate these impacts. Researchers have not investigated to a deeper extent the key elements that will increase the effectiveness of EMP's of oil and gas projects in the Niger Delta region. As result is not clear which specific EMP activities are significant in the achievement of sustainability in the context of EMP of oil and gas projects in the Niger Delta region of Nigeria? These findings have determined critical factors that if deployed wil support the improvement of the EMP process and to achieve sustainability of the Niger Delta environment. Future EMP implementation must therefore take these activities into consideration for the achievement of sustainability in the region.

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