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PROCESSING COST AND ECO-EFFICIENCY OF OIL AND GAS PRODUCTIVENESS

AKPAN, ANIEFIOK UDOH (PhD, ACA); *AHAKIRI, FRANCIS IDIEGE; ETIBENSI, JACKSON EDET

DEPARTMENT OF ACCOUNTING, FACULTY OF MANAGEMENT SCIENCES, UNIVERSITY OF CALABAR, P. M. B. 1115, CALABAR, NIGERIA.

*CORRESPONDING AUTHOR

ABSTRACT

This study was undertaken to assess the effect of processing cost on eco-efficiency of oil and gas productiveness in Nigeria for fifteen years. Data were gathered from relevant secondary sources and the data so obtained were subjected to statistical test using the multiple regression analytical technique. It was discovered that processing activities have a positive effect on the level of eco-efficiency measured as the environmental cost per unit of output of oil and gas corporations in Nigeria. It was concluded that costs of gas not utilized, oil produced and gas utilized have a positive relationship with the output of oil and gas produced, and the environmental costs incurred such as cost of mopping up oil spills, corporate social responsibility, fines and penalties paid. Therefore, it was recommended that oil and gas companies should adopt modern techniques and equipment to reduce the effect of their exploration activities on the eco-system and the host communities.

Keywords: Eco-efficiency, Environmental cost, Oil and gas produced, Corporate social responsibility, Exploration activities.

1. INTRODUCTION

Oil and gas exploration and/ or processing activities in Nigeria recently are increasing in a geometric progression due to the crash experienced in the price of crude oil in the global oil market as regulated by the Organization of Petroleum Exporting Countries (OPEC). This is because government, oil and gas industries, petroleum marketers are increasing the volume of oil produced, marketed and exported even at the low price, with the aim of meeting up with increasing government expenditure in their respective countries. This has also exerted pressure on oil companies who increase their search for and production of more crude oil, thus excreting

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negative impact or externalities on both the host communities and the ecosystem in general. Besides, companies are gearing up efforts to ensure continuous maintenance of a higher level of commercial reserves of oil, especially within this period under review, with great expectations that the price of oil would spank up in the near future. The oil and gas sector was and is still the main stay of the Nigeria economy (which is import driven) over the decades, so oil is therefore the major source of income, since it contributes to about 95% of our export, it also plays a vital part in the structuring of the economic, business and political structures of Nigeria (Adati, 2012 & Asuquo, 2012).

Recently, there has been an increase quest for the environmental and sustainable development within international bodies and business fields. There is an increasing requirement for the identification and application of an effective and efficient instrument that could be used to measure and interpret the sustainable level of business' operations especially within the oil and gas industry of the Nigerian economic and social environment and also the need to translate them into specific indices with the aim of protecting the ecosystem, ensuring ecological balance and enhancing socio-geographical progress while carrying out business (oil and gas) operations profitably. (Olujimi, Emmanuel & Sogbon, 2011; Asuquo, Dada & Onyeogaziri, 2018). Consequently, this step gave rise to the concept of eco-efficiency, and its application in the oil and gas sector.

Eco-efficiency is thus a new dimension of environmental management accounting. It considers the environmental consideration and the cost analysis geared at improving products, services and technological innovations used in businesses, institutions and governmental bodies. It is also a tool for sustainability reporting as well as strategic environmental development and sustainability (Asuquo, 2012; Asuquo, Dada & Onyeogaziri, 2018).

1.1 Statement of Problem:

Many environmental issues involving the disturbance of the forest and ground surface from petroleum activities take place; such as clearing of marked sites, construction of roads, tank farms, and other storage facilities, oil platforms, installations of oil pipelines, modification of land and ground surface, and other activities necessary for the exploration of production oil wells and also the building of other production facilities have awakened a major environmental concern amongst oil and gas industries, with the major aim of reducing the impact of negative externalities, environmental cost, while maintaining a higher level of output. Other environmental issues arising from oil and gas production activities include poor discharge of large volume of hazardous waste streams like toxic and oily sludge, gas flaring, oil spillage, free leakages from vandalized pipelines, discharges of oil and gas derived chemical waste, contamination of water sources, increased destruction of soil and aquatic habitats, accidental discharges from abandoned oil wells, oil bunkering, stealing of exploration and production assets, kidnaping of exploration expatriates, high cost of exploration licenses, among other issues. These issues are therefore summed up by companies and included in the production cost as either cost of oil and gas utilized or cost of oil and gas not utilized. Companies are therefore interested in reducing the cost expended to reduce these externalities while carrying out their businesses profitably. Besides these, many firms are still gearing towards the execution of corporate social responsibility (CSR) with the aim of maintaining a sustainable business environment that would respond to the financial need of the organization (Asuquo, 2012).

Therefore, this paper attempted to examine the challenges faced by oil and gas companies in measuring these environmental costs that impinge on the company's output produced, and how those expenditures incurred during exploration for; evaluation and production of mineral resources affect Eco-efficiency of oil and gas companies. This work attempted to establish the measurable bench mark as a standard of eco-efficiency to be maintained by companies before such companies could be-termed as being eco-efficient. It was discovered that all these attempts mentioned were however rarely or in some cases not adopted by the governments and oil and gas companies over the years. The aim of this research work include the following: examination of the impact of cost of oil and gas production (utilized and unutilized) on eco-efficiency level of oil and gas companies in Nigeria, assess the extent to which the cost of oil and gas production (utilized and unutilized) affects the output of oil and gas companies in Nigeria, and also to examine the impact of the cost of oil and unutilized gas produced on environmental cost.

2. LITERATURE REVIEW AND THORETICAL FRAMEWORK

Environmental management accounting theory is management information systems that make available relevant information which is aimed at helping management in making informed decisions on the environment. Environmental management accounting serves same objective, it gives information on the costs and benefits associated with environmental management, measured in monetary or in physical values. Environmental management accounting (EMA) gives details that would assists in operations and workability of the environmental information management system. It makes available both non-financial and also financial information for making important managerial decisions. Although EMA complements other relevant conventional methods of managerial accounting, but it does not take their place. The key applications of environmental management accounting include:

1. Providing estimates on yearly environmental costs (E.g. costs of waste control, cost of mopping up oil spilled and gas flared including the fines paid)
2. Target settings/ budgeting for improvements in environmental performance
3. Product pricing/pricing system evaluation.

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4. Appraising of investment (e.g., estimating the costs of cleaning up at the termination of a life cycle of a product and evaluation of the cost associated with the environment in a given project)
5. To Identify advantageous circumstance available for saving cost
6. Projecting benefit available in environmental projects.

Eco-efficiency accounting is a new conception in the accounting and environmental field which takes into consideration the economic analysis with the aim of improving products, outputs, while leaving the environment unharmed, it was initiated in 1990 by two researchers (Adati, 2012 & Asuquo. 2012). Thereafter eco-efficiency theory was then developed by a body called World Business Council for Sustainable development in 1991 during which they attempted to define it as a provision of goods and services that are competitively priced but that would meet human needs while eliminating or limiting negative externalities and intensity of the resource throughout the life cycle of the products, services up to a level that it comes in terms with the sustaining capacity of the ecosystem. They further indicated a reduction in intensity of material and energy, releases of toxic materials, enhancement of recycling, maximization of renewable materials, service intensity, and the extension of product durability as the seven elements of eco-efficiency that provide guidance and direction on how businesses around the world can be eco-efficient. Thus a reduction in the negative impact/externalities of production activities on the environment will increase the value of eco-efficiency level of the company (Asuquo, Dada & Onyeogaziri, 2018).

Eco-efficiency theory according to Czaplicka, Burchart-korol & Krawczyk (2010) in their work holds that companies can produce useful products while at the same time reducing negative externalities on the environment, reduce consumption of resource and also the cost. Winfree and Druller (2000) also opined that eco-efficiency focuses on the improvement of ecological and economic performance. It is therefore seen as a strategic tool that is geared at sustainable development, strategic planning, peace keeping; nonviolence environment (Asuquo, Dickson, Emechebe & Ebri, 2016) and resource and cost utilization. Eco-efficiency allows financial and environmental analysts to find the most effective solutions and proffer applicable advice, taking into account the economic aspect and environmental compatibility of products and their impact on the environment. Eco-efficiency measures the level of environmental impact against economic performance. While environmental impact is expected to be as low as possible, economic performance is expected and should be kept as high as possible.

Therefore eco-efficiency is a management tool used in targeting a reduction in the consumption of natural and other resources, reduction in the environmental impact, while increasing the value of product added, economic efficiency in production. Eco-efficiency is also a business and

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accounting tool for sustainability evaluation which indicates the relation in business and economic activities, and also between environmental cost or/and value and other environmental effects. It holds that instead of focusing on the externalities, attention should rather be given to addressing its underlying causes (Asuquo, 2012).

Commenting on the value of business and environmental evaluation tool like eco-efficiency, Bidwell & Verfaillie (2002) in their works were of the view that businesses should set targets and monitor performance with the aim of having indicators as an acceptable managerial tool of evaluating its corporate progress. This therefore supports the fact that eco-efficiency is therefore a management tool for measuring the level of the impact of business activities and environmental cost on the level of output (Asuquo, 2012).

Below is the review of research work by different authors who attempted to measure and quantify eco-efficiency, the purpose of this thesis work. This was to assist the researcher derive a verifiable formula thus:

1. WBCSD: "Eco-efficiency = product or service value/environmental influence"
2. ISAR-UNITACD (Sturm, Muller & Upasena, 2002 ; Effiong, S. A. & Asuquo, A. I., 2010): Eco-efficiency = environmental impact/economic value.
3. Steen, Garling, Imrell, and Sanne (2004); Eco-efficiency =1-environmental damage cost/life cycle cost
4. Fredrik (2005): Eco-efficiency = 1- EDC/LCC Where EDC= Environmental damage cost, and LCC= Life cycle costing.

But for the purpose of this work, eco-efficiency is reviewed both in it quantitative and qualitative approach and the author has taken the evaluation of eco-efficiency in the form of cost-per-unit (CPU) of environmental value added (EVD) (Huppes, Hunkler, Rebitzer, & Lichtenvort, 2005). Also in bid to clear the confusion in the inverse ratio as used in the first quantitative definition and also the complexity in the second quantitative definition above, the following quantitative definition is proffered for use in this work.

Eco-efficiency = Total environmental cost (TEC)/total output (TO) = TEC/TO.

The reason for the above quantitative definition is carried out because in quantifying Eco-efficiency, both the denominator and the numerator require their own defined indicator or measurable metric, and the researcher adheres to the requirement of ISO 14042:2000: Environmental management -life cycle assessment - Life cycle impact assessment now revised as: ISO 14040:2006. Under section 6.4 Weighting. As mentioned earlier the eco-efficiency attempts to bring together the two variables, ecology and economy. Therefore, eco-efficiency-index evaluates the performance of companies in relations to it environmental performance as it

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concerns product or operations and also with considerations to its financial performance. It is an index measured as a ratio of environmental variables against their economic variables (i.e. Financial) (Sturm, Muller & Upasena, 2002) this could be represented as:

Environmental influence/ Product and service value (as presented in formula 2 above)

We can therefore see that if we want to increase eco-efficiency, we can accomplish this by giving more values with a reduction in the environmental influence or consumed resources for the analyzed service or product. For example the fuel consumption of a car expressed in kilometers per liters of used petrol, could be used to measure the fuel efficiency of the car. It should how ever be stated that measurement of eco-efficiency is done, it is vital that the program is scientifically proven, accurate, supportive, and even useful. Besides the variables should however be drawn following sets of principles (Bidwell & Verfaillie, 2002; Asuquo, 2013). These principles which are derivable from performance reporting standards include the following:

1. They should be relevant and also very meaningful as it concerns the protection of the eco-system, health of host communities, and the quality of lives.
2. They should assist management to make informed decisions with the aim of improving their performance, like how to modify their methods of production to decrease environmental burden and enhance economic value of the organization.
3. They should recognize all the inherent diversities of businesses ensuring that any indicator used is relevant to the specific business concerned.
4. They should enhance and support benchmarking and monitoring of performance over a given period of time.
5. They should be clearly defined, transparent, measurable, and verifiable both internally and externally.
6. They should be meaningful and understandable to identified stakeholders and decision makers, thus they should not be complex for easy usage.
7. They should be drawn from the overall analysis of a company's products, operations or services, especially they should focus on entire parts that the management has control on directly or which the business can have influence on.
8. They should recognize relevant issues that relates to upstream, and downstream aspect of the oil and gas company's activities.

Generating the data for and computing the result of eco-efficiency may be complicated, because environmental performance covers various and often mix of parameters for different impacts, and the selection of boundaries might be challenging for any organization. Therefore, for the

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purpose of this research work, boundaries recommended for selection based on the need from users, and also the requirement of ISO 14040 is recommended.

3. METHODOLOGY

The researcher adopted the ex-post facto design since this does not provide the researcher the opportunity to control the variables mainly because they have already occurred or cannot be manipulated. The researchers adopted this design since the independent variable which is the exploratory cost to be tested had already been incurred and reported, and as such the researcher can do nothing to manipulate the reported figures. The researcher further adopted a descriptive research design to enable us describe the phenomenon in context of exploratory cost and eco-efficiency and also to establish a functional relationship between the dependent and independent variables within a 15-year span, and also because quantitative analysis of the collected data are involved.

3.1 Model specification

The following econometric models were formulated and stated below:

1. EE= f(PC)

Therefore EE= f (G, S, U.)

Further EE= $a + b_1G + b_2S + b_3U + e$ ……….. Equation (1)

Where

EE = Eco-efficiency

EC = Exploration Cost (further represented by G, S, U.)

U = Cost of gas processed and utilized

G = Cost of gas not utilized.

S = Cost of Oil processed.

e = Error term.

a = Constant

$b_1, b_2, b_3 \geq 0$

$b_{1.} - b_{n.}$ = equation coefficient.

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2. Also in bid to clear the confusion in the inverse ratio as used in the quantitative definition and also the complexity in the quantitative definition by different authors, the following quantitative model is proffered for eco-efficiency for use in this work.

Eco-efficiency

Therefore $\mathrm{EE} = \sum_{n}^{1} \mathrm{EC} \,/\, \sum_{n}^{1} O$

Where EE = Eco-efficiency

EC = Environmental Cost

n = Numbers of years

O = Output.

4. RESULTS / FINDINGS

Data obtained were subjected to appropriate statistical analysis, interpretation and discussed accordingly. The hypotheses that were formulated earlier are also tested at a 0.05 significance level. Discussions resulting from the analysis would be also presented. The raw data from different companies used in the presentations are presented in appendix while the summarized data are presented below.

TABLE A: Extracted regression result on gas unutilized, oil produced, gas utilized and eco-efficiency of oil and gas companies in Nigeria.

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	-12.38430	21.74661	-0.569482	0.5805
GASNT	5.78E-09	1.68E-08	0.343829	0.7375
GASUT	3.02E-09	8.04E-09	0.376036	0.7140
OILPD	4.76E-05	1.35E-05	3.522519	0.0048

R^2	0.617505
Adjusted R^2	0.513188
F-statistic	5.919517
Prob. (F-statistic)	0.011744
Durbin-Watson stat	1.128529

Source: Field survey & researchers' computations

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From Table A, the R^2 is 62 percent. This indicates that up to 62 percent of the variations in the dependent variable, (i.e. eco-efficiency) are being explained by the different independent variables tested, leaving about 38 percent to be reflected in the other variables that are likely to affect eco-efficiency, but which is not captured by the researcher in the model. The adjusted R^2 of 51 percent shows a positive goodness of fit of the parameter estimates. This could be explained to mean that the variables in the regression equation accounted for 51 percent variations in eco-efficiency, thus the variations noticed in cost of gas not utilized, cost of oil produced and gas utilized could jointly be explained as the measure of the effect of production cost variations with regards to the variations in eco-efficiency, while the remaining 49 percent is accounted for by the stochastic error term in the model. The constant term indicates a negative position of all other factors that could impact on eco-efficiency as such it could be said to be insignificant. While other coefficients like the cost of gas unutilized, gas utilized and oil unutilized indicated a positive significance at five percent confidence level. The f-statistic value of 5.91 was positive and greater than the table value of f-statistic of 3.95, indicating the significance of the independent variables, confirming that the high level of the models predictability did not occur by chance, and that the model used fits the data. The t-statistic result indicated that individual independent variables significantly contributed to the variance in the dependent variables, as but that of oil produced had a far more greater than significance as it value of 3.5 +ve was greater than the tabulated t-statistic value of 1.771 with a degree of freedom n-2 (i.e.15-2) = 13 at a one tailed five percent level of significance. The economic implication of the t-statistic is that one percent increase in cost gas unutilized will also lead to about 34% increase in eco-efficiency, and also a percentage increase in gas utilized would lead to about 37 percent increase in eco-efficiency.

The Durbin-Watson (DW) statistic is used to test for the existence of auto correlation in the residual, and the calculated result is compared to the tabulated value. Thus, it is expected that there is no autocorrelation if the calculated DW value is greater than the tabulated DW. From table 4.12, the calculated DW value is 1.128529 while the dL= 0.685 and du = 1.977 (where n=15years and k = 4variables) therefore since 1.128 is greater than dL therefore an indication of non-auto-correlated error in favour of the hypothesis of positive first order autocorrelation.

5. DISCUSSION

Hypothesis I

H_0 Cost of oil and gas production does not have any significant impact on eco-efficiency level of oil and gas companies in Nigeria.

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H_1 Cost of oil and gas production have significant impact on eco-efficiency level of oil and gas companies in Nigeria

The pooled regression result in table 4.12 is used to test the hypothesis using the f-statistic at a five percent degree of freedom, and the following decision line would be drawn.

If the calculated f-statistic value < the f-statistic table value accept H_0.

If the calculated f-statistic values $\geq$ the f-statistic table accept the H_1

The computed f-statistic value from table 4.12 is 5.919517, thus:

V1 = k-1 = 4-1 = 3

V2 = n-k = 15-4 = 11

Therefore at 3, 11 the table f-statistic figure = 3.98.

Thus since the calculated value which is 5.9 is greater than the figure from the f-statistic table which is 3.9, therefore the null hypothesis is rejected and the alternative adopted and put to further use thus:

The production costs have significant impact on eco-efficiency level of oil and gas companies in Nigeria.

TABLE B: Extracted regression result on gas unutilized, oil produced, gas utilized and output of oil and gas companies in Nigeria.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.95E+08	98873660	2.979722	0.0125
OILPD	20.45818	61.43244	0.333019	0.7454
GASUT	0.137796	0.036533	3.771825	0.0031
GASNT	0.446280	0.076384	5.842599	0.0001

R^2 - 0.829635

Adjusted R^2 - 0.783171

F-statistic - 17.85570

Prob (F-statistic) - 0.000155

Durbin-Watson stat - 1.980386

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SOURCE: Field survey & researchers' computations

In analyzing Table B, the R^2 of 83 percent indicates that variations in cost of oil produced, cost of gas utilized and gas unutilized accounts for about 83 percent of the variation in the output of the companies under study, while the remaining 17 percent is accounted for by the stochastic error term built into the model. The value of 83 percent showed a good or strong relationship between the dependent variable and the independent variables The adjusted R^2 of 78 percent indicates goodness of fit of the parameter estimates, meaning the regression line accounted for more than 78 percent of the aggregate variations in output which is as a result of variation in the explained variables shown in the equation with lesser than 22 percent accounted for by the error-term or other unused variables that may positively affect output. In carrying out a test for the overall significance of the model, f-statistic is used at a statistical significant level of five percent. With the F statistic table value of 3.59 (using V_1 = k-1, = 4-1, = 3, and V2 = n-k, = 15-4, = 11). Thus the calculated f-statistic value of 17.85570 is greater than the tabulated value of 3.59, showing that they were significant.

The t-statistic result indicated that individual independent variables significantly contributed to the variance in the dependent variables, as but that of oil produced and gas not utilized had a far more greater than significance as their value of 3.77 +ve and 5.84 +ve respectively were all greater than the tabulated t-statistic value of 1.771 with a degree of freedom n-2 (i.e.15-2) = 13 at a one tailed five percent level of significance. The economic implication of the t-statistic used also indicated that one percent increase in oil spilled will lead to about 33 percent increase in output.

In the test for autocorrelation, the Durbin- Watson statistic indicated that DW value 1.980 was greater than the tabulated dL value of 0.685 as well as the dU of 1.977. This result revealed that there was no auto correlation, since the Durbin-Watson statistic results or values ranged from zero to four, therefore the value near 2 shows non-autocorrelation; and value towards zero (0) shows positive autocorrelation, while the value towards 4 shows negative auto-correlation.

Hypothesis II

H_0: Cost of oil and gas production does not significantly affect the output of oil and gas industries in Nigeria.

H_1: Cost of oil and gas production significantly affects the output of oil and gas industries in Nigeria.

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With reference to table 4.13 and still using the f-statistic to test the significant of coefficient; the calculated f-statistic is 17.85 and the value of the f-distribution table is 3.59, given that

V1 = 4-1 = 3

V2 = 15-4 = 11

At 5 percent degree of freedom, 3:11 = 3.59

Thus since the f-distribution table is lesser than the calculated value of the f-statistic, then we therefore reject the null hypothesis and accept the alternative hypothesis and put it to use thus:

Production costs have significant impact on the output of oil and gas industries in Nigeria.

TABLE C: Extracted regression result on gas unutilized, oil produced and environmental cost of companies in Nigeria.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	30797.31	5635.172	5.465193	0.0001
GASNT	-5.17E-05	9.01E-06	-5.738673	0.0001
OILPD	0.081356	0.013243	6.143252	0.0000

R-squared	-	0.797924
Adjusted R-squared	-	0.764245
F-statistic	-	23.69180
Prob. (F-statistic)	-	0.000068
Durbin-Watson stat	-	2.059463

SOURCE: Field survey & researchers' computations

From Table C the R^2 and adjusted R^2 were 79 percent and 76 percent respectively. This indicated that 79 percent of variations in environmental costs incurred by oil and gas companies were jointly explained by the variations in cost of gas unutilized and oil unutilized, while remaining 21 percent was explained by other variables not captured in the model. The adjusted R^2 of 76 percent indicated the goodness of fit of the parameters of estimate, implying that 76 percent of the variation in environmental cost was actually explained by the variations in cost of gas not utilized and oil produced, the remaining 24 percent was explained by the stochastic error term in

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the model. The constant term of 30797.31 indicated significance of other variables not covered by the test. Going by the individual test of the independent variables against the dependent variables it was revealed that cost of oil produced have a great effect or impact on the environmental cost at a five percent significant level with a t-statistic result of 6.14 indicating a result higher than the tabulated t-statistic value of 1.771 at degree of freedom n-2 which is 13. This meant that one percent increase or decrease in cost of oil produced will lead to about 61 percent increase and decrease in environmental cost respectively, however cost of gas not utilized reflected on the model with a negative result. The NOVA on the f-statistic is 23.69 as computed while the tabulated f-statistic is 3.88 (where V_1 = k-1 = 3-1 =2; and V_2 = n-k = 15-3 = 12). Thus the calculated f-statistic is greater than the tabulated value; and indication of statistical relevance of the variables.

Testing the auto correlation, the calculated DW = 2.06, dL = 0.814 and dU= 1.75, k= 3 and n=15 years with 5 percent significance point of dL and dU, this revealed that the model used was free from auto-correlations since the calculated DW Value was greater than both the dL and dU tabulated values.

Hypothesis III

H_0: Cost of oil and unutilized gas produced has no significant relationship with the environmental cost incurred by oil and gas companies in Nigeria.

H_1: Cost of oil and unutilized gas produced has significant relationship with environmental cost incurred by oil and gas companies in Nigeria.

The pooled regression result in table C is used to test the hypothesis using the f-statistic at a five percent degree of freedom, and the following decision line would be drawn exactly as stated above

If the calculated f-statistic value < the f-statistic table value accept H_0.

If the calculated f-statistic values $\geq$ the f-statistic table accept the H_1

The computed f-statistic value from table 4.14 is 17.85570, thus:

V1 = k-1 = 3-1 = 2

V2 = n-k = 15-3 = 12

Therefore at 2, 12 the table f-distribution figure = 3.59.

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Thus since the calculated value which is 17.86 is greater than the figure from the f-statistic table which is 3.59, therefore the null hypothesis is rejected and the alternative adopted and put to further use thus:

Cost of oil and unutilized gas produced has significant relationship with environmental cost incurred by oil and gas companies in Nigeria.

The model used in the cause of this work has a broad spectrum.

6. IMPLICATIONS TO RESEARCH AND PRACTICE

This study provides enough reason for company directors to adopt appropriate accounting measures to report eco-efficiency and exploration/production cost both in their environmental report and even the annual financial reports. The main thrust of this study was to investigate and assess the effect of production cost on eco-efficiency of the oil and gas industry in Nigeria. The study was aimed at determining functional relationships that exist between the major variables: cost of oil produced and gas produced and unutilized or utilized on the company's environmental cost and output over the years.

The fall in the global oil prices rate and the increase demand for oil and gas have led to increase in production activities which have been found to have negative impact on the Niger-Delta region of Nigeria. Also, the fear of shortage have called for the maintenance of commercial oil reserves in Nigeria as well as other countries, apart from holding them with speculative intentions this two have been found to contribute to the problems

After doing justice to this subject of this study on effect of exploration cost on eco-efficiency of oil and gas industry of Nigeria, the following recommendations were proffered by the researchers:

1. Companies should endeavor to adopt IFRS 6 and other relevant international accounting standards like IAS 36, IAS 37, and IAS 38 in reporting exploration activities.
2. Existing environmental legislations which are presently outdated should be reviewed to accommodate eco-efficiency need of companies.
3. Oil and gas companies should carry out investigation to find out methods, machines and processes that would eliminate if not reduce the negative impact of their exploration and production activities on the
4. Environment (externalities) and use them effectively.

7. CONCLUSION

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After an in depth study, it was concluded that exploration and / or production activities influenced the level of eco-efficiency in the oil and gas industry of Nigeria; and these activities involved heavy sunk cost in addition to cost involvement associated with keeping peace in the environment which ensures conducive work place for productive activities to thrive (Asuquo, Dickson, Emechebe, & Ebri, 2016). The need of establishing a model for the measurement of eco-efficiency levels of different companies in order to assess their contribution to environmental sustainability is imperative, as this study has revealed that eco-efficiency model that was proffered in this study could be used by anybody (public or private) to place a benchmark on companies who stand to face reputational risk if the fall below the benchmark. It was therefore concluded that the oil and gas production have a positive relationship with the environmental cost and output of oil and gas companies.

8. FUTURE RESEARCH

It is important to note that the evaluation of the concept of eco-efficiency, which is liking to optimal capital structuring estimation or model of standard magnitude variance ratio analysis (Asuquo, 2011), carried out by the researchers was still in the early growth phase given the period of it conception, and also the method / index adopted for this work have not been fully adopted by some companies in the oil and gas industry of Nigeria to a great extent, therefore executing further studies in this area and applying same to other companies like the chemicals, drugs, cement, etc. should be of greater importance to researchers who choose to explore this area of interest. Also the model of standard magnitude variance ratio analysis (Asuquo, 2011) could be adapted for the evaluation.

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REFERENCES

Adati, A, K (2012). *Oil Exploration and spillage in Niger Delta of Nigeria* Civil and Environmental Research Papers, (3)

Achudume, A. (2009). *The effect of Petrochemical Effluent on Water Quality of Ubeji Creek in Niger Delta of Nigeria"* Bulletin of Environmental Contamination and Toxicology, 83 (3) 410-415

ISSN: 2455-8834

Volume: 04, Issue: 12 "December 2019"

Asuquo, A. I. (2012). Environmental friendly policies and their financial effects on corporate performance of selected oil and gas companies in Niger

Delta Region of Nigeria. *American International Journal of Contemporary Research (AIJCR)*: USA: *Centre for Promoting Ideas,* 2(*1*), 168-173, IS (print): 2162-139x.

Asuquo, A. I., Dada, E. T. & Onyeogaziri, U. R. (2018). The effect sustainability reporting on corporate performance of selected quoted brewery firms in Nigeria. International Journal of Business & Law Research, 6(*3*) 1-10 July-September www.seahipaj.org ISSN: 2360-8986.

Asuquo, A. I., Dickson, E. D., Emechebe, C. B. & Ebri, O. U. (2016). Accounting implications of cost involvement in peace-keeping on the economic growth of Nigeria: The case of Niger Delta. *International Journal of Economics, Finance and Management Sciences.* 4(*5*) 275-283 doi:10.11648/jijefm.2016045.17 www.sciencepublishinggroup.com, ISSN 2326-9553 (print), ISSN : 226-9561 (online).

Asuquo, A. I. (2013). Analysis of financial accounting standards and their effects on financial reporting and practices of modern business organizations in Nigeria. *European Journal of Business and Management.* 5(*4*), 60-68, www.iiste.org ISSN: 2222-1905 (paper) ISSN: 2222-2839 (online).

Asuquo, A. I. (2011). The application of standard magnitude variance in optimal capital structuring/working capital management in business organizations. *Multi-Disciplinary Journal of Academic Excellence.*5(*1*), 109-120, www.globalacademicgroup.comISSN: 2141-3212.

Bebbington, J & Gray, R. (2001). *Accounting for the Environment,* Second Edition, London; Sage Publications.

Bidwell, R. & Verfaillie, H. (2002). Measuring Eco-efficiency a Guide to Reporting Company Performance, *World Business Council for Sustainable Development,* Geneva.

Czaplicka, K. Burchart-korol, D. & Krawczyk, P. (2010). Eco-efficiency conception: *Journal of Achievement in Materials and Manufacturing Engineering,* 43(1).

Effiong, S. A. & Asuquo, A. I. (2010). Environmental accounting and environmental cost reporting: Implications and prospects for business survival. *African Journal of Management and Administration,* 3 (*4*) 144 -147, ISSN: 2141 – 0143.

ISSN: 2455-8834

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Fredrik, L. (2005). Measuring Eco-efficiency by LCC/LCA Ratio: An Evaluation of its applicability. Chalmers University of Technology.

ISO (2006). *ISO 14000: Environmental Management*. ISO Central Secretariat, Vernier, Geneva, Switzerland.

Huppes G, Hunkler D., Rebitzer, G. Lichtenvort, K. (2005). what is LCC? *In working draft from SETAC WG on Life Cycle Costing*

Olujimi, J, Emmanuel, A. & Sogbon O. (2011) Environmental implications of oil exploration and exploitation in the coastal region of Ondo State, Nigeria: A regional planning appraisal. *Journal of Geography and Regional Planning 4(3),* 110-121

Sturm, A., Muller, K. & Upasena, S. (2002). Eco-efficiency in the NOGEPA Covenant: *Setting Weights on Environmental Effects.* Leiden-Netherlands. Llk-ol

Steen, B., Garling, A., Imrell, A. & Sanne, K. (2004). Development of Interpretation Keys for environmental product declaration(EPD Draft),Chalmers, ABB, Akzo Nobel, Sweden.

Winfree H. F, & Druller, S. P. (2000) *Environmental Accounting and Management initiatives,* NY, London: Oak Tree Press.

World Business Council for Sustainable Development, (2000) *Eco-efficiency: creating more value with less impact,* Geneva.

World Business Council for Sustainable Development, *Eco-efficiency: Creating more value with less Impact.* Geneva 2000

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APPENDIX

APPX 1

15-Year Calculation Of Eco-efficiency Data (N'000,000)

YEAR	ENV. COST (a)	OUTPUT (b)	ECOEFFICENCY (a/b)	APPOX
1	3,270,470,000.00	698,055,109.00	4.685117203	4.6851
2	2,029,460,000.00	701,775,632.00	2.891892946	2.8919
3	700,860,000.00	776,758,946.00	0.902287645	0.9023
4	1,434,000,000.00	830,590,601.00	1.726482335	1.7265
5	2,671,410,000.00	870,593,985.00	3.068491221	3.0685
6	8,195,000,000.00	759,377,947.00	10.79172767	10.7917
7	13,878,000,000.00	753,232,333.00	18.4245941	18.4246
8	6,333,000,000.00	804,343,507.00	7.873501738	7.8735
9	21,885,000,000.00	849,139,618.00	25.77314677	25.7731
10	30,445,000,000.00	893,462,226.00	34.0753074	34.0753
11	10,913,000,000.00	892,936,747.00	12.22147037	12.2214
12	9,123,000,000.00	857,746,495.00	10.63600965	10.6360
13	5,559,000,000.00	773,634,398.00	7.185564673	7.1856

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14	2,940,950,000.00	867,293,933.00	3.390949582	3.3909
15	8,987,300,000.00	808,896,452.00	11.11056919	11.1106

1	3.3909	924,923,457	973,194,083	211,080
2	7.1856	984,625,340	814,202,904	308,240
3	10.636	1,099,764,454	884,410,682	363,130
4	12.2214	1,300,860,876	893,118,358	396,880
5	34.0753	1,403,304,167	819,906,056	661,810
6	25.7731	1,493,832,692	808,816,359	535,620
7	7.8735	1,554,559,926	673,583,023	242,230
8	18.4246	1,719,342,078	620,035,660	191,620
9	10.7917	1,392,823,023	523,444,448	110,380
10	3.0685	1,897,233,640	586,485,320	194,420
11	1.7265	1,817,011,147	619,094,346	181,670
12	0.9023	2,186,441,282	423,624,344	181,670
13	2.8919	1,858,357,530	328,577,822	327,480
14	4.6851	2,094,511,627	257,889,718	191,620

Source: Extracts from NNPC statistical bulletin and Authors' Computation

APPX 3

Output, cost of oil and gas utilized, cost of gas unuitilized, Cost of oil produced

Year	Output	Gas utilized	Gas unutilized	Oil produced
1	808,896,452	765,600,787	917,846,242	397,600
2	867,293,933	924,923,457	973,194,083	211,080

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3	773,634,398	984,625,340	814,202,904	308,240
4	857,746,495	1,099,764,454	884,410,682	363,130
5	892,936,747	1,300,860,876	893,118,358	396,880
6	893,462,226	1,403,304,167	819,906,056	661,810
7	849,139,618	1,493,832,692	808,816,359	535,620
8	804,343,507	1,554,559,926	673,583,023	242,230
9	753,232,333	1,719,342,078	620,035,660	191,620
10	759,377,947	1,392,823,023	523,444,448	110,380
11	870,593,985	1,897,233,640	586,485,320	194,420
12	830,590,601	1,817,011,147	619,094,346	181,670
13	776,758,946	2,186,441,282	423,624,344	181,670
14	701,775,632	1,858,357,530	328,577,822	327,480
15	698,055,109	2,094,511,627	257,889,718	191,620

Source: Extracts from NNPC statistical bulletin and Authors' Computation

APPX 4

Environmental cost gas unutilized, and oil produced

Year	environmental cost n 'millions	gas unutilized	oil produced
1	10,123.30	917,846,242	397,600
2	10,123.30	973,194,083	211,080
3	7,661.06	814,202,904	308,240
4	12,990.00	884,410,682	363,130
5	19,660.00	893,118,358	396,880
6	41,615.00	819,906,056	661,810

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7	36,646.00	808,816,359	535,620
8	17,240.00	673,583,023	242,230
9	14,594.00	620,035,660	191,620
10	8,195.00	523,444,448	110,380
11	6,848.11	586,485,320	194,420
12	12,526.00	619,094,346	181,670
13	21,484.00	423,624,344	181,670
14	38,881.33	328,577,822	327,480
15	44,749.96	257,889,718	191,620

Source: Extracts from NNPC statistical bulletin and Authors' Computation