

Greenhouse Gas (GHG) Emissions And Oil & Gas Revenue In Nigeria

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Abstract

This paper is an empirical analysis of the impact of greenhouse gas emissions on the oil & gas revenue in Nigeria for the period of 1981-2010. The population of the study is the upstream sector of the Nigerian oil & gas industry. The study adopted multiple regression techniques and data were collected from secondary source from the World Bank database and the central bank of Nigeria statistical bulletin. The findings reveal that gas flaring and gas venting is positively, strongly and significantly influencing the oil & gas revenue in Nigeria. It is recommended among others that, the Nigerian government should utilize revenue derived from the flaring and venting of gas to cater for the environs affected by the unnecessary and deliberate flaring and venting of greenhouse gas. Also, the Nigerian government should increase the amount charged as penalty to control gas emissions hence, reducing the amount expended on control measure.

Keywords: oil & gas revenue, Greenhouse Gas Emissions, Gas flaring, Gas venting, green accounting.

1. Introduction

The Nigerian oil and gas industry accounts for vast revenue from the various sectors within its span, ranging from the upstream, midstream and downstream activities. The upstream activities of the oil and gas industry which deals with the exploration (searching for crude oil either onshore or offshore), development, and production to a large extent midstream (exportation of crude oil) and the downstream sector comprises of refineries, transportation and the marketing of various petroleum products. The key players in these sectors are the Nigerian National Petroleum Corporation (NNPC) and Independent Oil Companies (IOCs). Collectively, the IOCs contribute about 94% of total production in the industry.

The production of oil and oil related products undergoes various processes in the upstream sector of the industry. Such that associated natural gas which is a byproduct of the extractive phase is considered more as a waste product than an economic resource due to the costly nature of converting associated gas into commercial gas. For this reason, In order to enhance cost effectiveness, excess gas from drilling associated with natural gas or oil is burned or flared off, releasing carbon dioxide emission (CO₂), into the atmosphere conversely venting of the gas without burning, releases methane emission (CH₄). Together, and crudely, these gases make up about 80% of greenhouse gases associated with oil & Gas to date.

Over reliance on petroleum has been known to be extremely exigent for countries (e.g. Nigeria) that lack diverse economies, such that vast amounts of resources are capitalized in the production of oil related products. The production of oil related products like fuels, gas result in environmental pollution in terms of greenhouse gases (such as carbon dioxide and methane) that are emitted into the earth's atmosphere as a result of either gas been flared or vented during the production process.

Climate change in the words of Pan African Climate Justice Alliance (PACJA, 2009) is now a serious and long-term threat that has the potential to affect every part of the globe. The impacts of climate change are already being felt in many sectors, and significant harm from it is already occurring. Because of the resultant disruption of economic activities, climate change is no longer just an environmental issue but a developmental issue. It has become a major threat to the sustainable development of developed and developing countries like Nigeria. In a world where technology and environmental threats are changing industries and society so rapidly, the need to evolve with new counter measures becomes ideal, the challenge now is to keep climate change from reversing all the development gains accumulated in the last few decades and with the oil and gas industry been more competitive than ever before, these greenhouse gases that are emitted constitute an economic, social and environmental waste of valuable natural resources which would have otherwise generate more revenue.

Gas flaring and Gas venting which emanates from the production of petroleum products constitute an economical

and financial waste of valuable natural resources and with the persistent increase in the world energy demand for petroleum products, it has further necessitated the rise in greenhouse gas (GHG) emissions which leads to adverse effects to the economy and climate at large. Based on the inadequacy and inconsistency of data judging from the volatile nature of the elements relating to Green Accounting, there are only a couple handful researches in Nigeria and Africa generally.

Consequently, studies that enclose Green House Gas Emissions as it relates to the petroleum sector restricted their analysis to theoretical frameworks as in Mohammed (2002), Matthew, Anup & Christopher (2009) and Ayoola (2011). While among the few that conducted empirical works are robin, Murray, Cameron, John & Michael (2006), Peter (1990), David (2011) Ochuko (2011), Gbajumo (2011), Asaolu, Agboola, Ayoola and Salawu (2011), Birnur, Robert & Donald (2010), Akabom (2012), Oruba (2005) and Nasiru (2011). In all, empirical studies on Green House Gas Emission as it relates to oil & gas revenue seem to have received little attention in Nigeria. At the moment, only a handful researches are conducted in Nigeria. It therefore goes to show that Dearth of studies in this area clearly indicates a gap and leaves a vacuum within the literature that needs to be filled. This study therefore fills these gaps by extending its analysis to both empirical and also widening the green house gas variables to include carbon dioxide, methane emissions to proxy GHG's as it relates to gas flared and vented in the economy.

Based on the foregoing paragraph, the following questions are raised; does Greenhouse Gas emissions have any effect on the Oil & Gas revenue generated by Nigeria? How much effect, if any does Greenhouse Gas emissions have on the Oil & Gas revenue generated by Nigeria and is it enough to cause a stir? It is in view of the issues surrounding the subject matter; this study is carried out in order to get answers to the above questions and also to fill the gap in literature. The main objective of this study is to examine the impact of Greenhouse Gas Emissions on Oil & Gas revenue in Nigeria. Other specific objectives are:

1. To examine the impact of gas flaring on Oil & Gas revenue in Nigeria.
2. To examine the impact of gas venting on Oil & Gas revenue in Nigeria.

In view of the main objective of the study, the study thereby hypothesizes in null form that:

H₀₁: Gas Flaring has no significant impact on Oil & Gas revenue in Nigeria.

H₀₂: Gas Venting has no significant impact on Oil & Gas revenue in Nigeria.

In other to accomplish the stated objective, this paper is organized into five sections, with this section being the introduction, section two dwells on review of related literature, section three is devoted to the methodology of the study, section four presents and discusses the results of the data analysis, section five concludes the study by highlighting the findings and their recommendations.

2. Literature Review and Theoretical Framework

Petroleum covers both naturally occurring unprocessed crude oil and petroleum products that are made up of refined crude oil. Petroleum is recovered mostly through oil drilling (Guerriero 2012). It is refined and separated, most easily by boiling point, into a large number of consumer products, from gasoline (petrol) and kerosene to asphalt and chemical reagents used to make plastics and pharmaceuticals. Petroleum is used in manufacturing a wide variety of materials, and it is estimated that the world consumes about 90 million barrels each day. The use of fossil fuels such as petroleum has a negative impact on Earth's biosphere as when burned, petroleum releases greenhouse gases into the air which in turn damages ecosystems through events such as oil spills, pollution among others (The Hindu, 2011).

According to Ogbonna & Appah (2012), the major sources of petroleum income are sale of crude oil and gas (oil revenue), Petroleum profits tax and royalties, licensing fees and other incidentals as shown in CBN Statistical Bulletin. The main focus of Petroleum Profits Tax (PPT) is the upstream sector of the Petroleum industry, which deals with oil exploration, prospecting, development and production (EPDP).

In the upstream sector of the Nigerian oil & gas industry, petroleum income from the sale of crude oil and gas (oil revenue) is generated as a result of various agreements in terms of contractual framework within which the NNPC on behalf of the Nigerian government and the IOCs conduct operations in the industry. These include the Joint Operating Agreement (JOA), Production Sharing Contract (PSC) and Service Contract (SC). The revenue generated in these various forms of agreements is shared between the NNPC and the IOC's in a profit sharing formula. The amount accrued to the NNPC (NOC) is that which is reflected in CBN statistical bulletin. That goes to show that this study is restricting its analysis to the revenue generated by the NOC's. Foreign companies operating in joint ventures (JVs) or production sharing contracts (PSCs) with the Nigerian National Petroleum Corporation (NNPC) include ExxonMobil, Chevron, Total, Eni/Agip, Addax Petroleum (recently acquired by Sinopec of China), ConocoPhillips, Petrobras, StatoilHydro and others.

The production of oil and oil related products undergoes various processes in the upstream sector of the industry. Such that associated natural gas which is a byproduct of the extractive phase is considered more as a waste product than an economic resource due to the costly nature of converting associated gas into commercial gas. For this reason, in order to enhance cost effectiveness, excess gas from drilling associated with natural gas or oil is deliberately burned off, releasing carbon dioxide emission (CO_2), into the atmosphere conversely venting of the gas without burning, releases methane emission (CH_4). Together, and crudely, these gases make up about 80% of greenhouse gases associated with oil & Gas to date. A Greenhouse Gas (sometimes abbreviated GHG) is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect (IPCC 2008). The most abundant greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Gas flaring is a process in which excess gas from drilling associated with natural gas or oil is deliberately burned off, releasing carbon dioxide into the atmosphere. Because many of Nigeria's oil fields lack the infrastructure to produce and market associated natural gas, it is often flared. The CO_2 emissions can be split into two sources: emissions that originate from the combustion of fossil fuels which include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring and emissions that originate from the decomposition of limestone (not included in the analysis).

Subsequently, gas venting is the deliberate release of associated gas as gas, rather than burning. This usually occurs from leaks in pipeline either due to vandalization or during the production phase. Associated gas is the raw natural gas that emanates from oil wells and it's commonly a mixture of methane and other hydrocarbons. In view of the fact that methane is a major component of associated gas, the direct venting of associated gas gives rise to methane and volatile organic compound emissions. Shindell and Drew (2005) argue that the contribution to climate change from methane is at least double previous estimates as a result of this effect. Other sources of greenhouse gas emission such as oil spillage, blow outs, among others which could occur accidentally during the production process are not included in the analysis of this study.

Studies that reflected on Greenhouse Gas Emissions as it relates to the petroleum sector include among others the works of Mohammed (2002), researched for a theoretical framework for Environmental Accounting application on the Egyptian petroleum Sector in which different concepts and terminology associated with Environmental Accounting were discussed and clarification as to why Environmental Accounting was besieged paramount was highlighted. The research introduced a system for Environmental Accounting at various levels within the Egyptian petroleum sector that evaluated environmental issues such as petroleum reserve, emission trading among others. The limitation to this study relies on the fact that it studied the petroleum sector of Egypt, though an African country but it can't be compared to the petroleum sector in Nigeria.

Ayoola (2011) examines the theoretical framework for gas flaring and its implication for environmental accounting in the Nigerian Petroleum Industry. Data were sourced from the annual reports of companies involved in gas flaring in the oil and gas industry and the result revealed that the issue plaguing environmental accounting disclosures relate to lack of a standardized requirement for disclosure, political will for legislation, enforcement and the allocation of environmental costs. The limitation to this study relies on the fact that it studied the petroleum sector of Nigerian but from a theoretical methodology.

Furthermore, Nasiru (2011) conducted an empirical research on the impact of gas flaring on Nigeria crude oil revenue and tax abatement measures by the Nigerian government. By the use of multiple regression analysis, the study revealed that gas flaring has a negative impact on Nigerian crude oil revenue and tax abatement measures reduced gas flaring but not significantly. The limitation to this study was the time frame adopted. For a time series data study which should be a minimum of 30 years, the study only adopted 10 years.

David (2011) examined the Capping of Carbon and Methane Emissions in Nigeria. The study suggested how to cap two of the emissions that are prone to Nigeria as a nation. According to the study, Carbon emissions are released from burning fossil fuels that are used to power vehicles, generators while Methane gas is also produced from decomposed waste products of ruminant animals. The study revealed that safety systems such as liners, covers, gas and liquid extraction and monitoring wells to detect contamination can aid in capping Carbon and Methane Emissions in Nigeria. Also, the planting of Fast Growing Malaysian tree (*Albizia falcata*), Candelnut, will help assimilate CO_2 to make their own food when combined with light and water. Since their growth is rapid, they are able to absorb CO_2 during growth and at maturity thereby reducing Carbon and Methane Emissions in Nigeria. The limitation to this study was the domain adopted in the study. The study viewed emissions from the agricultural sector of the Nigerian economy.

Finally, Birnur, Robert & Donald (2010) analyzed gas flaring and venting: extents, impacts and remedies as it

relates to various countries. Based on their study, it was discovered that in Nigeria although flared volumes have decreased, the majority of the decrease is mainly due to decrease in oil production caused by civil unrest. Both regulatory enforcements and financial incentives are proving insufficient in Nigeria. Also, the methodologies used in estimating gas flaring and venting have to be updated, improved and made consistent worldwide. The limitation to this study was the fact that the study was conducted for a vast range of countries which could not necessarily compared to a case study.

There are various theories in the field of environmental accounting that could be adopted for the study. These include; Political cost theory which explains how groups external to the firm might be able to impose political cost on the firm as a result of political actions such as pollution, emissions and carbon footprints disclosure made by a firm in relation to their positive or negative impacts on their physical environment (Watts & Zimmerman 1978). Also, positive accounting theory which predicts that all people are driven by self-interest. As such, particular social and environmental activities and their related disclosures would only occur if they have positive wealth implications for the management involved (Watts & Zimmerman, 1986). Another theory is the legitimacy theory, Mathews (1993) provides a good definition of legitimacy as Organisations seek to establish congruence between the social values associated with or implied by their activities and the norms of acceptable behaviour in the larger social system in which they are a part. In so far as these two value systems are congruent we can speak of organizational legitimacy. When an actual or potential disparity exists between the two value systems there will be a threat to organizational legitimacy. This study adopted the legitimacy and political cost theory to underpin the work on the impact of greenhouse gas on oil & gas revenue in Nigeria.

3. Research Methodology and Model Specification

The study adopted the causal comparative/ex post facto research design. The choice of this research design is informed by the main objective of the study. In this context, the design will be used to determine the impact of Greenhouse Gas Emissions on Oil & Gas revenue of Nigeria. The study is centered on the Nigerian oil and gas upstream Sector. The study used Secondary data, mainly unbalanced time series data from the World Bank database and Central Bank of Nigeria (CBN) statistical bulletin. The data will be restricted to Oil revenue generated from records in the CBN statistical bulletin and Greenhouse gas emissions in Nigeria from records in the World Bank database for each year covered by the study. The study will cover a period of thirty (30) years from 1981 – 2010 and adopted multiple regressions as a technique for analysis.

3.1 Model Specification and Variable Measurement

The study adopted the regression analysis model. The model tends to examine the impact of GHG emissions on Nigeria's Oil & Gas revenue, where Oil & Gas revenue which is proxied as the total petroleum revenue generated by the NNPC (NOC) in Nigeria is the dependent variable and GHG emissions which are proxied as gas flaring (CO₂) and gas venting (CH₄) are the independent variables. For the purpose of proper analysis, Carbon Dioxide emissions (CO₂) and Methane (CH₄) emissions are the proxies that will be used as gas flaring and gas venting respectively. The model was however formulated to test the hypothesis that GHG emissions have no significant impact on Nigeria's Oil & Gas revenue.

In general, the regression model is described as
 $Y_1 = F(a + b_1x_1) + e_1$ Therefore:
 $PREV_1 = F(a + b_1GHG) + e_1$ eqn. 1
 $PREV_1 = F(a + b_1CO_2 + b_2CH_4) + e$ eqn 2.
 Where:
 PREV = Oil & Gas revenue
 a = Constant
 b = Co-efficient of independent variable
 CO₂ = Carbon monoxide Emissions
 CH₄ = Methane Emissions
 e₁ = Term Error

Variables	Specifications	Measurements
Oil & Gas revenue	(NOC's petroleum revenue) PREV	\$ (US dollars)
Gas flaring	(Carbon monoxide emissions) CO ₂	Qty * price of CO ₂
Gas venting	(Methane emissions) CH ₄	Qty * price of CO ₂

4. Result and Discussions

This section presents the result of data analysis and tests of hypotheses formulated earlier in the paper. The summary of the Regression Result are presented and analyzed, and then policy implications and Recommendation will be drawn and made from the findings of the study.

Table 1: Regression Results: Oil & Gas Revenue and Greenhouse Gas Emissions

Variables	Coefficient	t – statistics	P-Values
CONSTANT	-4.33e +08	-3.35	0.002
CO ₂	268.0868	4.64	0.000
CH ₄	122.5038	3.57	0.001
R ²			0.6449
ADJ. R ²			0.6186
F – STAT			24.52
F SIG.			0.0000

Source: Stata Output

The cumulative R₂ (0.6449) which is the multiple coefficient of determination gives the proportion or percentage of the total variation in the dependent variable explained by the explanatory variables jointly. Hence, it signifies 64% of the total variation in oil and gas revenue in Nigeria is caused by greenhouse gas emissions (Gas Flaring and Gas Venting). This indicates that the Model is fit and the explanatory variable are properly selected and used. The F-statistic value of 24.52 shows that the model of the study is well fitted; this is further substantiated by the significant value of 1%.

4.1 Gas Flaring and Oil & Gas Revenue

From table 1 above, gas flaring which was proxied by CO₂ has a t-value of 4.64 and a beta value of 268.0868 which is significant at 1%. This signifies that gas flaring is positively, strongly and significantly impacting on oil & gas revenue generated in Nigeria. Hence, the more the revenue generated, the more gas flared. It therefore implies that for every one dollar (\$1) increase in gas flared, the oil & gas revenue will increase by two hundred and sixty eight dollars (\$268). This may be as a result of the fact that IOC'S in Nigeria find it cost effective to flare gas rather than utilize it into the production of commercial gas. This provides an evidence of rejecting null hypothesis one of the study which states that gas flaring has no significant impact on oil & gas revenue in Nigeria. Finally, this finding is in line with the study of Birnur, Robert & Donald (2010) and contrary to the study conducted by Nasiru (2011), Oruba (2005).

4.2 Gas venting and Oil & Gas Revenue

From table 1 above, gas venting which was proxied by CH₄ has a t-value of 3.57 and a beta value of 122.5038 which is significant at 1%. This signifies that gas venting is positively, strongly and significantly impacting on oil & gas revenue generated in Nigeria. Hence, the more the revenue generated, the more gas vented into the atmosphere which leads not only to environmental hazards but also waste of valuable resources. It therefore implies that for every one dollar (\$1) increase in gas vented, the oil & gas revenue will increase by one hundred and twenty two dollars (\$122). This may be as a result of the fact that IOC'S in Nigeria finds it cost effective to vent gas than to utilize it into the production of commercial gas. Also, with the persistent increase in pipeline leakage through pipeline vandalization in the country which remains the single most significant source of gas venting in the country. This provides an evidence of rejecting null hypothesis two of the study which states that gas venting has no significant impact on oil & gas revenue in Nigeria. Finally, this finding is in line with the study of Birnur, Robert & Donald (2010).

5. Conclusion and Recommendation

The paper investigates the impact of greenhouse gas emissions on oil & gas revenue in Nigeria. Gas flaring and gas venting constitute the determinants factors, while the oil & gas revenue represent the dependent variable of the study. It was found that gas flaring and gas venting has a positive and significant influence on oil & gas revenue generated in Nigeria at 1% level of significance. Therefore the result implies that IOC's in Nigeria find it cost effective to flare and vent gas not minding the environmental and financial cost implication on the government of Nigeria. It is recommended that

the Nigerian government should utilize revenue derived from the flaring and venting of gas to cater for the environs affected by the unnecessary and deliberate flaring and venting of greenhouse gas. Also, the Nigerian government should increase the amount charged as penalty to control gas emissions hence, reducing the amount expended on control measures of unnecessary and deliberate flaring and venting of gas.

References

- Akabom I. A. (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* Vol. 2 No. 1; Jan 168
- Asaolu T. O., Agboola A. A., Ayoola T. J. and Salawu M. K.(2011) Sustainability Reporting in the Nigerian Oil and Gas Sector. Proceedings of the Environmental Management Conference, Federal University of Agriculture, Abeokuta, Nigeria, 2011. <http://www.unaab.edu.ng>
- Ayoola T. J. (2011), "Gas Flaring and its Implication for Environmental Accounting in Nigeria" *Journal of Sustainable Development*, Vol. 4, No.5; October 2011,
- Birmur B. G, Robert H. & Donald H. (2010) gas flaring and venting; extents, impacts and remedies.
- David S. (2011) Capping Carbon and Methane Emissions In Nigeria. <http://www.digitaljournal.com/blog/10385>
- Gbajumo-S. M.A (2011) Impact of Niger-Delta Crisis On Human Resource Practices In Oil Companies. University Of Lagos.
- Guerriero V. (2012). "A permeability model for naturally fractured carbonate reservoirs". *Marine and Petroleum Geology* (Elsevier) 40: 115–134. doi:10.1016/j.marpetgeo.2012.11.002.
- IPCC (2008) "IPCC AR4 SYR Appendix Glossary" (PDF).
- Mathews, M. R. (1993) *Socially Responsible Accounting*, UK, Chapman & Hall.
- Mohamed A .R.(2002), "Theoretical Framework for Environmental Accounting- Application on the Egyptian Petroleum Sector" The Egyptian Forum on Environment & Sustainable Development (EFESD) Cairo, Egypt. Ninth Annual Conference of the Economic Research Forum (ERF) 26-28 October.
- Nasiru Y. (2011), "Gas Flaring and Crude Oil Revenue: Evidence from Nigeria. *Nigerian Journal of Accounting Research*. Vol.7 number 2. Page 130.
- Ochuko T. O.(2011) "Gas Flaring/Power plants in Nigeria: Socio-economic and Environmental Impact on the People of Niger Delta". Master's Thesis in Environmental Management. Universitetet i Nordland, Bodø Graduate School of Business
- Ogbonna, G.N. & Appah E. (2012) Petroleum Income And Nigerian Economy: Empirical Evidence; *Arabian Journal Of Business And Management Review (Oman Chapter)* Vol. 1, No.9; April 2012.
- Oruba C.O (2005), a quantitative if gas utilization and flare reduction policies in the Nigerian petroleum industry, petroleum training journal. 2 (1), pp. 63.
- Pan African Climate Justice Alliance. PACJA (2009): The Economic Cost of Climate Change in Africa.
- Peter C. R. (1990) Economic and Financial Determinants of Oil and Gas Exploration Activity. Asymmetric Information, Corporate Finance, and Investment. University of Chicago Press, 1990. (p. 181 - 206) <http://www.nber.org/books/glen90-1>
- Robin S., Murray H., Cameron H., John W., Michael G. (2006), " The impact of CO2 emissions trading on firm profits and market prices" . *Climate Policy* 6,pp. 29–46 www.climatepolicy.com;
- Shindell, & Drew T. (2005). "An emissions-based view of climate forcing by methane and tropospheric ozone". *Geophysical Research Letters* 32 (4): L04803 Bibcode:2005GeoRL..3204803S. doi:10.1029/2004GL021900.
- The Hindu Chennai, India (2011)."Libyan tremors threaten to rattle the oil world".
- Watts, R.L. & Zimmerman, J.L (1978), towards a positive theory of the determination of accounting standards. *The accounting review* pp. 112 -134
- Watts, R. L. and Zimimerman, K. L. (1986). *Positive accounting theory*. London; Prentice-Hall.

Appendix

. reg prev co2 ch4

Source	SS	df	MS			
Model	1.9847e+18	2	9.9235e+17	Number of obs =	30	
Residual	1.0927e+18	27	4.0470e+16	F(2, 27) =	24.52	
Total	3.0774e+18	29	1.0612e+17	Prob > F =	0.0000	
				R-squared =	0.6449	
				Adj R-squared =	0.6186	
				Root MSE =	2.0e+08	

prev	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
co2	268.0868	57.83233	4.64	0.000	149.4246	386.7489
ch4	122.5038	34.27008	3.57	0.001	52.18741	192.8202
_cons	-4.33e+08	1.29e+08	-3.35	0.002	-6.98e+08	-1.68e+08