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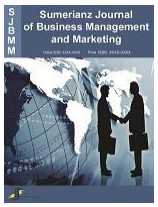

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Gas Flaring Environmental Degradation and Economic Growth in Nigeria

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Abstract

This study examined "Gas flaring, environmental degradation and economic growth in Nigeria". The research was guided by the following objectives: To investigate any relationship between gas flaring and environmental degradation in Nigeria, to evaluate the impact of gas flaring on economic growth in Nigeria, and to examine the impact of gas flaring on sustainable livelihoods in the Niger Delta. The data was obtained mainly from secondary sources including the Central Bank of Nigeria Statistical Bulletin where data on values of output (real GDP) and capital stock (K) measured by gross capital formation will be obtained, the National Bureau of Statistics, where the data on labor stock (L) measured in terms of population and gas production (GP) as well as gas flared (GF) will be obtained from Nigerian National Petroleum Commission technical records. From the research findings, the following were made: Practically in the Nigerian economy, the autonomous component of the model represents other factors that influence economic rate in Nigeria such as population growth, inflation, foreign direct investment (FDI), interest rates, exports as well as private and public investment which are not gas flaring and environmental degradation. The OLS result from this research work (GDP = 91600.77 – 5.635213 – 6.37E-05 X2) showed that the autonomous part of the model (91600.77) related positively with economic growth. The t-statistic value for the co-efficient of autonomous component 91600.77 was statistically significant at 5% level of significance while the two independent variables (-5.635213 α -6.37E-05) were statistically insignificant at 5% level of significance. Time F-Statistic value 158.6975 was significant at 5% level of significance which implied that the overall model is suitable for this research work. In conclusion, Gas flaring and environmental degradation are two concepts that cannot do without each other. Enhancing economic growth and development is the prime responsibility of the state. Also, Gas flaring and environmental degradation crisis has affected various sectors of the Nigerian economy and has left the economy in a bedridden state. the study therefore recommends the following so as to accelerate economic growth in Nigeria: Formation and implementation of policies and programmes that are oil and gas oriented and seeks to improve productivity in the oil and gas sector, provision of adequate social and basic amenities for gas flaring operatives in rural and urban areas to enable them carry out their duties optimally and more resources should be provided to adequately channel flared gas and there should be regular review of gas flaring and environmental degradation activities and operatives.

Keywords: Gas flaring; Environmental degradation; Economic growth and ecological economics.

1. Introduction

Gas flaring in Nigeria started at the end of colonial rule. Shell BP started exploring for oil in the Niger Delta in the 1930's. The first field was found in 1956 and the first export was made in 1958. Flaring of gas mixed up with the crude oil began right at the start, and so did a recognition of its unacceptability. In the long run, up to independence, in 1960, the secretary of state for the colonies , Lord Home was asked to address the flaring as; "there might be wastage of energy and resources going on which one day, those giving advice to the Nigerians (i.e. the British) could be reproached." Edmund (1960) The official response, citing economics and lack of markets was complacent: "until there is the worthwhile market and until there are facilities (e.g. pipelines and storage tanks) to use the gas, it is normal practice to burn off this by product from oil wells."(Nigerian oil and gas industry. File DO 177/33, UK National archives)But the unacceptability of this practice and the massive profits to be made by shell BP under the unsuspecting nose of the Nigerians, were officially recognized by the British.

The extracts from the British Trade Commissioner in Lagos in 1963, illuminate the development of oil resources in west Africa. It reads thus: "Shell/BP's need to continue, probably indefinitely, to flare off a very large proportion of the associated gas they produce will no doubt give rise to certain amount of difficulty with Nigerian politicians

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who probably be among the last people in the world to realize that it is sometimes desirable not to exploit a country's natural resources and who being unable to avoid seeing the many gas flares around the oil fields, will tend to accuse shell/BP of conspicuous waste of Nigeria's wealth. It will be interesting to see the extent to which the oil companies feel it necessary to meet these criticisms by spending more money on uneconomic methods of using gas."

"In the longer run, shell/BP is going to have to consider very carefully how it should explain publicly the large outflows of capital that is likely to take place towards the end of the decade. It will no doubt come as something of a shock to Nigerians when they find that the company is remitting large sums of money to Europe. The company will have to counter the criticisms which will very probably be made to the effect that the company is exploiting Nigeria by stressing the very large contribution it is making to Nigeria's export earnings." (British trade commissioner, UK foreign affairs office, 1963).

The above extracts from official, historical documents show that the British government knows of the practice of gas flaring at the very start of the oil industry in Nigeria. They understood the significant sums of money that Shell and BP would be making by producing and exporting Delta crude. Yet they did nothing to prevent the waste and they were completely obvious to the impact on local communities. If the British colonial government had taken the attitude that they subsequently took in their own country, the people of Niger Delta would not have been exposed to continuous flaring for over four decades.

The hallmarks of the development of the Nigerian oil and gas industry over the last 50years apart from its internationally notorious environmental and human rights record have been:

a. Significant production by oil companies- first of oil and now increasingly of gas- the vast majority of which has been exported to the developed world for billions of dollars.
b. The flattering of a corrupt elite, as the vast majority of Nigerians fail to benefit and the country becomes one of the world's poorest.

It has also deliberately eroded community values and systems which would have allowed communities to challenge company practice. Nigeria has become one of the world's main oil and gas producers- according to the US government, Nigeria is the largest oil producer in Africa and 11th largest in the world, and it is an increasingly major supplier to the US averaging 101 million barrels per day (bbl/d) in 2004, compared with 589,000 bbl/d in 2002. Crude oil production in 2004 was 2.5 million bbl/d. Oil export revenue is estimated at $20.9 billion for 2003 and forecast to be $27 billion for 2004, an increase of over 22%. The country has significant oil, and even more gas reserves. (EIA country analysis brief: Nigeria, April 2005)

Traditionally, oil companies do not like to find gas together with their oil fields, they prefer to find gas without it being mixed up with oil so called non-associated gas (non AG) Finding associated gas(AG) means they have to find ways to dispose of it in order to profit from the oil, the lucrative driver. Whereas finding non AG gives them the freedom to control their gas production without reference to oil production. So flaring of AG has traditionally been much more common generally. But while AG flaring has been increasingly frowned upon in most parts of the world, in Nigeria it has flourished. Understanding the scale of flaring requires an understanding of oil and AG production, as well as of flaring data. Reliable data are difficult to find, in addition, oil production in the Delta is often affected by conflict and a significant amount of oil is stolen (bunkering) by organizer gangs. But it is possible to track a history of increased oil production and thus, without other means of dealings with the gas, more flaring.

For the first 20 years of the industry, almost all the AG was flared: 2.1 billion cubic feet per day (bcf/d) or 92% in 1981, for example. This percentage barely declined during the 1980's standing at about 88% in 1989. It seems to have reached about 2.6 bcf/d in the late 1990's including venting, though by then this was about 75% of all gas production whilst OPEC has suggested that flaring has since dropped below 2 bcf/d and whilst both OPEC and the Nigerian department of petroleum Resources has suggested that gas flared as a percentage of all gas production has dropped below 50%, this is not universally accepted. (World Bank Nigeria: issues and options in energy report, August 1983, World Bank African Gas initiative, main report. (OPEC statistical bulletin, 2003). Gas flaring contributes to climate change which has serious implications for both Nigeria and the rest of the world. The burning of fossil fuel, mainly charcoal, oil and gas, greenhouse gasses- has led to warming up the world and is projected to get much worse during the course of the 21st century according to the intergovernmental panel on climate change (IPCC) this scientific body was set up in 1988 by the UN and the World Meteorological Organization to consider climate change.

2. Statement of the Problem

Gas flaring is said to be as old as oil exploration in Nigeria. Kassim (1986) Gas flaring contaminates the air and constitutes a major source of air pollution in the Niger Delta region of Nigeria. Available evidence suggests that most of the flare stacks/sites are located within human settlement area. Human Rights Watch stated that ‘in most cases gas flares are very close to communities.’ (Human rights watch, 2016) Although Shell Petroleum Development Company claims that this is usually because settlements have grown up around the oil facilities; local communities dispute this claim. In any event, the flares are rarely if ever relocated, or even made safe by providing secure fencing. A visit to some of the communities in the Niger Delta Region did affirm this assertion, as flare sites are located close to Uquo and Ubenekang communities in Esit Eket and Ibeno Local Government Areas respectively. The effects of gas flaring are many but they can broadly be categorized under environmental, health, economic and social implications. Over the past fifty years, gas flaring and venting associated with petroleum exploration and production in the Nigeria’s Niger Delta have continued to generate complex consequences in terms of energy, human health, natural environment, socio–economic environment and sustainable development (Ite and Ibok, 2013). Indeed, widespread gas flaring has inflicted untold hardship and damage to human, plant and animal life. Gas flaring

contributes to climate change resulting in deleterious effects to the environment. The emission of carbon dioxide, burning of fossil fuel, mainly coal, oil and gas have led to global warming with more serious implications for developing countries, especially Africa which is highly vulnerable with limited ability to adapt. In line with the stated problem, this study sets out to find answers to the following research questions:

a. Does any significant relationship exist between gas flaring and environmental degradation in Nigeria?
b. What is, or is there any significant impact of gas flaring on economic growth in Nigeria.
c. Does gas flaring have any significant impact on sustainable Livelihoods in the Niger Delta?

3. Objectives of the Study

The objective of the study is to basically examine the impact of gas flaring on economic growth in Nigeria.

The specific objectives include;

i. To investigate any relationship between gas flaring and environmental degradation in Nigeria.
ii. To evaluate the impact of gas flaring on economic growth in Nigeria.
iii. To examine the impact of gas flaring on sustainable livelihoods in the Niger Delta.

4. Literature Review

The word environment is derived from the French word "Environ" which means "surrounding". Our surrounding includes biotic factors like human beings, Plants, animals, microbes' etc. and abiotic factors such as light, air, water, land, etc. Environment is a complex of many variables, which surrounds man as well as the living organisms. Environment includes water, air and land and the interrelationships which exist among and between water, air and land and human beings and other living creatures such as plants, animals and microorganisms (Kalavathy, 2003). Environmental degradation is the deterioration of the environment through depletion of resources such as air, water and land; the destruction of ecosystems; habitat destruction; the extinction of wildlife; and pollution. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable, (Kumarasamy *et al.*, 2004). The United Nations International Strategy for Disaster Reduction defines environmental degradation as "the reduction of the capacity of the environment to meet social, economic and ecological objectives, and needs". Environmental degradation is of many types. When natural habitats are destroyed or natural resources are depleted, the environment is degraded. Efforts to counteract this problem include environmental protection and environmental resources management.

In a study by Ochuko (2011); this study made use of theories that are related to ecological and neoclassical economics paradigms toward natural resource management and sustainable livelihood approaches. The main focus was on resource regimes and Alternative approach by oil production stakeholders toward environmental sustainability and socio-economic standard of livelihood.

Neoclassical economics tends to support and legitimize a view of progress in society which is limited to the traditional indicators of GNP growth, balance of payments, employment, indices of inflation, etc. But the debate about environmental, transportation, energy or food policy suggests that this conceptual framework was insufficient and that analysis limited to such indicators can be dangerous to society. A number of catchwords was used to suggest a new direction for societal development. Early in the 1970s, ―qualitative growth was suggested to focus on the fact that some growth may be negative and cancerous, while growth of other commodities may be mainly beneficial. Second catchword was eco-development, meaning ecological development which focuses on impacts upon ecosystems and the natural resource base of future generations. Self-reliance was suggested as a strategy leading to improved environmental performance at the local and regional levels (Sachs and Warner, 2001). According to Herman (1996), the economics of sustainable development is a change of vision that involves replacing the economic norms of quantitative expansion (growth) with that of qualitative improvement (development) as a part to future progress. Scholars from the ecological economics also stated that a scientific or technological solution which poison the environment or degrade the social structure and man himself are of no benefit, no matter how brilliantly conceived or how great their superficial attraction, (Schunacher, 1993), unlike the neoclassical economist who traditionally focused upon ―utility as the end of economics. Ecological economy consistence stresses postulate that ecosystems are influenced by economic input (e.g. agriculture, fishery, deforestation) and by economic output such as (pollution from production, distribution, consumption and redistribution). The challenge of ecological economics was to find solutions that use the actual means efficiently and wisely in the service of this ultimate end. One of the most serious problems today, with regard to the goal of sustainability, is that growth is the main organizing principle in economics. Daly argued that, since growth is unsustainable, we need a new ethics to guide the actions within the economy in harmony with the limitation of the natural world. The new ethics is suggested by the terms of sustainability, sufficiency, equity, and efficiency. To capture this cluster of values in one sentence, Daly suggested the following formulation; we should strive for sufficient per capita wealth- efficiently maintained and allocated, and equitably distributed- for the maximum number of people that can be sustained over time under these conditions (Daly, 1991). Sufficiently was meant to illustrate what is necessary, not only to look upon humanly created wellbeing, but also the sustainability of the natural ecosystems. One must maximize the total number of human beings that through the years can live with sufficient wealth. The way one classifies schools of thought in economics is always open to debate. This research referred to two broad categories as stated above, i.e. Ecological economics and neoclassical or mainstream economics. The mainstream was further divided into Keynesians or others who believe in some degree of government intervention as a necessity in a market economy, and those who downplay the role of government and believe firmly in the potential of the market system to solve all kinds of problems, socio-economic and environmental problems included. About 1870, marginal utility theory was developed as a more

fruitful value theory than the previous labor theory of value. Equilibrium theory in terms of supply and demand, and the mathematical approach to economics, became the dominant mode of thinking. Isaac Newton's mechanics were an important source of inspiration and economists hoped to become as scientific as their colleagues in the natural sciences. Objectivity and value neutrality were the goals and it was believed that economics could be purified of all kinds of political elements. Political economics became pure economics, or just economics. Etzioni's Society for the Advancement of Socioeconomics, approaches economics from an interdisciplinary point of view and stresses the need for an analysis of the ethical foundations of economics (Etzioni, 1988). Other groups speak of social economics, humanistic economics and interdisciplinary economics. There are also networks dealing explicitly with environmental issues in relation to economics, such as the New Economics Foundation (Ecological economics) with the Living Economy Network. Prior to the discovery of crude oil in Niger delta, the sea and land was governed by the open access regime where local fishermen and farmers had access to the use of the sea and land in good conditions. Now, government has introduced institutions that have curtailed the rights of the local fishermen and farmers to some part of the sea and land, why other parts are highly contaminated from oil and gas production. North (1990) cited in Vatn (2005) defined institutions ―as the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. This research used ecological economics theories and principles to revised the neoclassical economics assumptions chosen by Marshall to make economics a machine of scientific discovery, has turned economics into a science with a narrow focus through selecting a very limited view on man, focusing on rationale of life and omitting relevant factors due to the choice of methods, but Marshall denied explicit analogies between the law of physics (mechanics) and economics (Marshal, 1920)

Boxal *et al.* (2004), studied the impact of crude oil and natural gas facilities on rural residential properties value with two variables characterizing hazard and amenity effects. They showed that natural gas wells and flaring platforms cited within 4km of residential properties devalue the price of the property. The report also showed a negative correlation between property values and the number of sour gas wells. These findings reflect the health hazards associated with the negative effect of hydrogen sulfide on property values. Hydrogen sulfide is a constituent of natural gas. The World Health Organization (WHO) prohibits the inhalation of hydrogen sulfide because of its health hazards. World Health Organization (2003), categorized the degrees of negative health hazards associated with exposure to hydrogen sulfide ranging from short, medium and long term. Prolonging exposure to hydrogen sulfide may cause infertility, human poisoning, and death. WHO listed the negative effects of prolong exposure to hydrogen sulfide as ocular disease, respiratory stress, neurological disorder, cardiovascular and metabolic disease and including but not limited to loss of appetite. In their paper that studied the effect of corruption on natural gas flaring, (He *et al.*, 2007).

Fredrickson and Sevesson (2003), showed that higher corruption level in an economy inhibits the effectiveness of environmental regulations. Similar work by Tzeremes *et al.* (2013) studied the effect of government on environmental performance in the NUTS 1 regions of France, Germany, and the UK. Assessments were made on three pollutants CO2, CH4 and NO2 using non-parametric estimators. Findings showed that government quality impact positively on pollution up to a point afterward becomes slightly negative. An indication that high government quality may not translate to increased environmental efficiency. Government efficiency affects environmental quality positively because it enhances the effectiveness of policies implementation (Sanglimsuwan, 2011). Sebastien *et al.* (2011) assessed the link between environmental compliance, corruption and environmental regulations in the forestry sector of 59 developing countries using cross- sectional data and Principal-Agent model. Their work indicated that high judiciary efficiency reduces corruption and environmental non-compliance. Furthermore, Sartzetakis *et al.* (2011) and Sartzetakis *et al.* (2014) used overlapping generation models of two distinct agents of politician and citizen to investigate the effect of corruption on environmental regulations, their finding and conclusion revealed that rent seeking instead of environmental protection, corruption and extensive tax evasion are elements causing the failure of environmental policies. Therefore, the curbing of corruption increases the performance of environmental regulations in natural resources management (Sundstrom, 2013).

Focusing on institutional weakness in the crude oil and natural gas industry in Nigeria, Ayoola (2011)) analyzed data from annual reports of 10 companies involved in natural gas flaring in Nigeria. The paper found that improper disclosure of environmental policies, objectives, and target was common in several companies' annual reports. Most companies report failed to disclose natural gas flaring information or emission quantity despite flaring natural gas, none of the sampled companies had their environmental information verified by a third party and only two companies report scantily acknowledged negative environmental information regarding meeting emission target and objectives.

5. Theoretical Framework

For the purpose of this study, two theories of Ecological economics are reviewed: the stakeholders' theory and the resource curse theory. Ecological economics is a new trans-disciplinary field of study that addresses the relationship between ecosystem and economic system in the broad sense. These relationships are central to many of humanity's current problems and to building a sustainable future (Roberts and Mahoney, 1997). It has a positive approach in its development and understanding of the physical, biological, and social structural and functional relations between economics and natural ecosystems. It is normative in addressing appropriate roles of human economics within natural economics and it is also prescriptive, in proposing institutions and behaviors compatible with sustainability norms (Faber and Bradley, 2008). Ecological economics appeared as absolute new way of thinking and doing business, anti-growth one, unlike the neo-classical economics, focus on growth. It could become in reality, because economic growth without considering the ecosystem is the depletion of the planet's natural

resources, i.e. un-ethical procedure in the flaring of gas. Therefore, it is necessary to include eco-system into economic theory and practice. In light of economics and ecological interrelation, the law of nature gives an indication of the limits of ecosystems. These limit consist of the frame of economic activity, both in relation to input and output factors, (Ingebrigtsen and Jakobsen, 2007). Furthermore, there are theories, principles and the characteristic of ecological economics perspectives on alternative ways of thinking towards the gas flaring and environmental degradation in Nigeria's economy.

In line with the characteristic of ecological economics**,** the earth is like a living, evolving organism, cooperation through decentralized collaborative networks perform better than what is possible through the enormous global power structures. The true economic output is the enjoyment of life (an immaterial flux). We cannot produce better and bigger cars, or planes without producing better and bigger waste control.

5.1. Stakeholder's Theory

The traditional definition of a stakeholder is "any group or individual who can affect or is affected by the achievement of the organization's objectives" (Freeman, 1984). The general idea of the Stakeholder concept is a redefinition of the organization. In general the concept is about what the organization should be and how it should be conceptualized. Friedman and Miles (2006), states that the organization itself should be thought of as grouping of stakeholders and the purpose of the organization should be to manage their interests, needs and viewpoints. This stakeholder management is thought to be fulfilled by the managers of a firm. The managers should on the one hand manage the corporation for the benefit of its stakeholders in order to ensure their rights and their participation in decision making and on the other hand the management must act as the stockholder's agent to ensure the survival of the firm to safeguard the long term stakes of each group.

The definition of a stakeholder, the purpose and the character of the Organization and the role of managers are very unclear and contested in literature and has changed over the years. Even the "father of the stakeholder concept" changed his definition over the time. In one of his latest definitions (Freeman, 2004) defines stakeholders as "those groups who are vital to the survival and success of the corporation". In one of his latest publications (Freeman, 2004) adds a new principle, which reflects a new trend in stakeholder theory. In this principle in his opinion the consideration of the perspective of the stakeholders themselves and their activities is also very important to be taken into the management of companies. He states "The principle of stakeholder recourse. Stakeholders may bring an action against the directors for failure to perform the required duty of care" (Freeman, 2004). All the mentioned thoughts and principles of the stakeholder concept are known as normative stakeholder theory in literature. Normative Stakeholder theory contains theories of how managers or stakeholders should act and should view the purpose of organization, based on some ethical principle (Friedman and Miles, 2006). Another approach to the stakeholder concept is the so called descriptive stakeholder theory. This theory is concerned with how managers and stakeholders actually behave and how they view their actions and roles. The instrumental stakeholder theory deals with how managers should act if they want to flavor and work for their own interests. In some literature the own interest is conceived as the interests of the organization, which is usually to maximize profit or to maximize shareholder value.

5.2. Resource Curse Theory

The resource curse or excess availability of natural resources presents a particularly interesting analysis when it comes to economics and often underpins many of the policies and theories which can be looked at in relation to how the government can organize its own economic behavior, so as to achieve long-term economic growth (Acemoglu, 1996). The purpose of this section of the literature review is to look at factors associated with the resource curse. In particular, the explanations of the resource curse and the way in which they may potentially be dealt will be examined, before putting the resource curse into context and then discussing measurement techniques and policy approaches and looking specifically at how these may be used in relation to the resource curse in Libya. Crucially, it is noted that there is empirical data to suggest that countries with a higher level of natural resources were also seen to be displaying trends of low economic growth (Alexeev and Conrad, 2009). This seemingly presents a potentially interesting point of analysis for those involved in developing policies that will enable a country with a high level of natural resource to achieve a better level of economic growth as a result (Alexeev and Conrad, 2009).

The concept that natural resources may become what was seen to be an economic curse emerged during the 1980s, with the actual terminology "resource curse" first being used in 1993 (Sachs and Warner, 1995). These theories essentially created an analysis of a counterintuitive situation whereby it was shown that countries with a high level of natural resource were not developing economic growth at the expected rate. A wide variety of studies, notably those by Sachs and Warner (1995) aimed to show the link between natural resources and economic growth, which then led to a wide variety of studies on precisely why this negative relationship appeared to exist (Mauro, 1950).

One of the leading explanations to be presented in relation to the resource curse theory is that of the "Dutch Disease" theory established by Matsuyama (1992), which argues that when an organization or country specializes in a particular type of resource production, the combination of the specialization as well as the appreciation of the exchange rate will then result in a decline and will become more conducive to other industries which are not going to lead to the same economic growth (Lutz, 1994).

Fundamentally, it is argued that this type of resource curse can lead to other factors such as the industrial sector generally lagging behind as they are not the main driving force within the economy (Fosu, 1996). The underlying notion of this theory is that the level of expansion experienced as a result of the use of natural resources is not going

to be large enough to offset the negative effect of failure to industrialize other sectors in order to support central economic growth within the relevant industrial sector. Furthermore, this type of reliance on natural resources can impact on the way in which exports are treated within countries with a high level of natural resources which will be looking towards exporting these natural resources and may even do so in preference to other exports, which could ultimately improve economic growth Papyrakis and Geriagh (2007).

The empirical example which was used during the development of the Dutch Disease concept was used by The Economist, in 1977, when it looked towards explaining why there had been such a dramatic decline in the manufacturing sector across the Netherlands, since natural oil fields had been found eighteen years earlier. Research in the area of the Dutch Disease concept has focused on a situation whereby there has been a natural resource discovery, although it is noted that this could potentially be used as the same concept when there is any large inflow of foreign currency. For example, it could be due to substantial foreign investment or a large amount of assistance from abroad (Manzano and Rigobon, 2006).

Finally, there is also a body of research which suggests that the resource curse can be attributed to the lack of attention and investment placed on other sectors (Cotet and Tsui, 2010). More specifically, when the region is producing such a large income stream, naturally, it can be tempting to ignore other areas, and in certain developing countries, the government in question will often rely heavily on the income being derived from natural resources, without planning for the future by developing the infrastructure in such a way that other factors can also evolve alongside the natural resource boom. This has resulted tp the lack of sufficient diversification / lack of development of further resources in Nigeria and other resource-rich African countries.

6. Methodology

The main aim of the study is to analyze the impact gas flaring and environmental degradation has on economic growth in Nigeria for the period 2000 to 2018. Secondary data obtained from the central bank of Nigeria (CBN) and National Bureau of Statistics (NBS) were used for this research. Annual time series data with the aid of quantitative econometrics tools and statistical tests were adopted to evaluate the effect gas flaring and environmental degradation on economic growth in Nigeria.. The econometrics software (E—views 10), involving ordinary least square technique of analysis was used for data analysis

The multiple regression model is specified as;

GDP = F (GASFLR, OILSPL)…… (1)

Where;

GDP= Gross Domestic Product

GASFLR= Gas flaring

OILSPL= Oil spillage

$GDP= \beta_0 - \beta_1 GASFLR - \beta_2 OILSPL$…….. (2)

Where;

GDP = Gross Domestic Product in Nigeria

β_0 =autonomous contribution to domestic product

β_1 =co-efficient of gas flaring in Nigeria

GASFLR= Gas Flaring in Nigeria

β_2= Co-efficient of environmental degradation

EDR = Environmental degradation

U_1 = Error term

6.1. The Apriori Expectation of the Model

The apriori expectation is that gas flaring and environmental degradation have negative effect on economic growth. This means that increase in gas flaring and environmental degradation is expected to decrease economic growth in Nigeria and a decrease in gas flaring and environmental degradation is expected to increase economic growth in Nigeria. Therefore, $\beta_1, \beta_2 < 0$.

6.2. Data Analysis and Interpretation of Results

Table-1. Regression Result Using Ols Technique

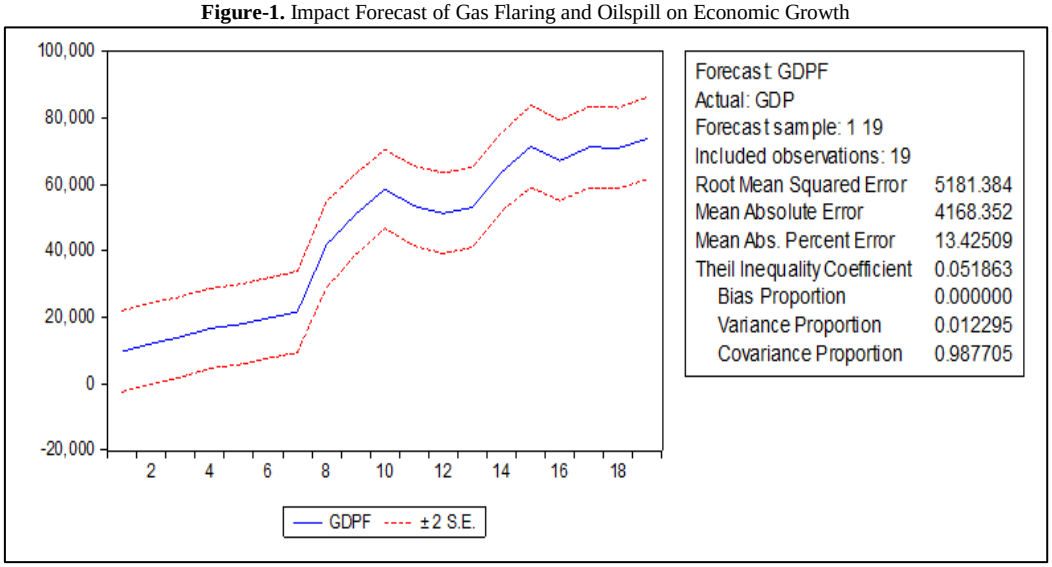
Dependent Variable: GDP				
Method: Least Squares				
Date: 08/22/19 Time: 23:32				
Sample: 1 19				
Included observations: 19				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	91600.77	4610.917	19.86606	0.0000
OILSPL	-5.635213	1.439392	-3.914996	0.0012
GASFLR	-6.37E-05	9.69E-06	-6.578975	0.0000
R-squared	0.952009	Mean dependent var		44150.51
Adjusted R-squared	0.946010	S.D. dependent var		24299.97
S.E. of regression	5646.282	Akaike info criterion		20.25932
Sum squared resid	5.10E+08	Schwarz criterion		20.40844

Log likelihood	-189.4636	Hannan-Quinn criter.		20.28456
F-statistic	158.6975	Durbin-Watson stat		1.461099
Prob(F-statistic)	0.000000			

Table-2. Autoregressive Conditional Heteroskedasticity Result (Garch and Arch)

Dependent Variable: GDP				
Method: ML - ARCH (Marquardt) - Normal distribution				
Date: 08/22/19 Time: 23:35				
Sample: 1 19				
Included observations: 19				
Convergence achieved after 8 iterations				
Presample variance: backcast (parameter = 0.7)				
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	91600.77	5677.317	16.13452	0.0000
OILSPL	-5.668068	1.689902	-3.354080	0.0008
GASFLR	-6.45E-05	1.03E-05	-6.236147	0.0000
	Variance Equation			
C	17450378	8322488.	2.096774	0.0360
RESID(-1)^2	-0.498179	0.251632	-1.979795	0.0477
GARCH(-1)	0.868302	0.184266	4.712235	0.0000
R-squared	0.951379	Mean dependent var		44150.51
Adjusted R-squared	0.945301	S.D. dependent var		24299.97
S.E. of regression	5683.210	Akaike info criterion		20.24257
Sum squared resid	5.17E+08	Schwarz criterion		20.54082
Log likelihood	-186.3045	Hannan-Quinn criter.		20.29305
Durbin-Watson stat	1.458784			

Figure-1. Impact Forecast of Gas Flaring and Oilspill on Economic Growth



The estimates can thus be presented in a regression form as follows
GDP = 91600.77 – 5.635213 + 6.37E-05
SEE = (4610.917) (1.439392) (9.69E-06)
T^* =[19.86606] [-3.914996] [-6.578975]

R^2 = 0.952009
AR^2 = 0.946010
F = 158.6975
DW = 1.461099

From the regression result above, the estimated model is GDP = 91600.77 – 5.635213 ×1 6.37E-05 ×2 the negative sign in the model indicates that gas flaring has a negative effect on economic growth in Nigeria. This implies that when gas flaring decreases by 23.55006, economic growth rate will decrease by 1%. Positive sing in the model indicates that environmental degradation provided by oil spillage has a positive relationship with economic growth that if oil spillage increases by -6.37E-05 economic growth increases by 1%

6.3. Standard Error Test Result Interpretation

6.3.1. Parameter β_0 (co Efficient of Autonomous Component)

$$(S\ \beta_0) = 4610.917$$

$$½\ \beta_0 = \frac{91600.77}{2} = 45800.385$$

Since $(S\ \beta_0) > (1/2\ \beta_1) = 4610.917 > 45800.385$ accept H_0 and reject H_i which implies that parameter β_1 (co efficient of autonomous component is statistically insignificant at 5% level of significance)

6.3.2. Parameter β_1 (co-Efficient of Gas flaring)

$$S(\beta_1) = 1.439392$$

$$(1/2\ \beta_1) = \frac{5.635213}{2} = 2.8176065$$

Since $(S\beta_1) > (1/2\ \beta_1) = 1.439392 > 2.8176065$ accept H_0 and reject H_i which implies that parameter β_1 co-efficient of gas flaring is statistically insignificant at 5% level of significance.

3. Parameter β_2 (co-efficient of environmental degradation)

$S(\beta_2) = 9.69E\text{-}06$

$$(1/2\ \beta_2) = \frac{5.635213}{2} = 2.8176065$$

Since $S\ \beta_2 > (½\ \beta_2) = 9.69E\text{-}06 > 2.8176065$ accept H_0 and reject H_i which implies that parameter β_2 co-efficient of environmental degradation is statistically insignificant at 5% level of significance

6.3.3. Student T-Test Result and Interpretation

Degree of freedom = (n-k) = (10-3) = 7 testing at 5% level of significance where;

n = number of observation

k = number of parameters

t-tab = t 0.025 = 2.365

Below are student t-test results for parameter β_0 (co-efficient of autonomous component)

t cal = 19.86606, t-tab = 2.365

since t* > t-tab, reject H_0 and accept H_i which implies that the parameter β_0 (autonomous component) is statistically at 5% level of significance

For parameter β_1 co-efficient of gas flaring t* = -3.914996 t-tab = 2.365

Since t* < t-tab, accept H_0 and reject H_i which implies that the parameter β_1 co-efficient of gas flaring is statistically insignificant at 5% level of significance.

For parameter β_2 co-efficient of environmental degradation t*= -6.578975 t-tab = 2.365

Since t* < t-tab, accept H_0 and reject H_i which implies that the parameter β_2 co-efficient of environmental degradation is statistically insignificant at 5% level of significance.

6.3.4. Distribution Test Result and Interpretation

Degree of freedom = (n-k) /k-1 = 10-3/ 3-1

Testing at 5% level of significance for a one-tailed test. Where;

n = Number of observations

k = Number of the parameters

t-tab = F. 0.05 = 2.365

Since t* (158.6975) > t-tab, reject H_0 and accept H_i which implies that the overall multiple regression model is statistically significant at 5% level of significance

6.3.5. Durbin Watson Test Result Interpretation

D* = 1.461099, Since 0< D* < 2, reject H_0 and accept H_i which implies that there exist the presence of positive autocorrelation in the successive error term of the regression model.

6.3.6. Co-Efficient of Multiple Determination Result and Interpretation

From the regression analysis of the model above the value 0.952009 implies that 95% variation in economic growth is due to the variation in gas flared and environmental degradation and the remaining 5% of the variation is due to the disturbed error term U implying that the regression …. Obtained from the result using OLS

7. Discussion Finding

The OLS result from this research work (GDP = 91600.77 – 5.635213 – 6.37E-05 X2) showed that the autonomous part of the model (91600.77) related positively with economic growth. This implies that if gas flaring and environmental degradation provided by oil spillage is zero economic growth will be progressive i.e. all things being equal, if gas flaring and environmental degradation is zero, other factors that influence economic growth will contribute 91600.77 to economic growth rate in Nigeria. Practically in the Nigerian economy, the autonomous component of the model represents other factors that influence economic rate in Nigeria such as population growth, inflation, foreign direct investment (FDI), interest rates, exports as well as private and public investment which are

not gas flaring and environmental degradation. The co-efficient of the independent variable (– 5.635213) part of the model showed that gas flaring had a negative relationship with the economic growth rate in Nigeria i.e. ceteris paribus Oil spillage decrease by – 6.37E-05, economic growth will be increased by 1%. This finding is in line with the apriori expectation.

The t-statistic value for the co-efficient of autonomous component 91600.77 was statistically significant at 5% level of significance while the two independent variables (-5.635213 α -6.37E-05) were statistically insignificant at 5% level of significance. Time F-Statistic value 158.6975 was significant at 5% level of significance which implied that the overall model is suitable for this research work. The co-efficient of S.E.E for autonomous component (4610.917) was statistically insignificant at 5% level of significance while the independent variables (1.439392 α 9.69E-06) was also statistically insignificant at 5% level of significance.

The co-efficient of multiple determination value (0.952009) showed that 95% of the variation in economic growth rate was due to the variation in gas flaring and environmental degradation. It also indicated that the regression line of the model has a good fut. The Durbin Watson value (1.461099) indicated that there exist a positive auto correlation in the successive error term of the model.

8. Recommendations

Having seen the problems facing the growth of the Nigerian economy, the study therefore recommends the following so as to accelerate economic growth in Nigeria:

- **i.** Formation and implementation of policies and programmes that are oil and gas oriented and seeks to improve productivity in the oil and gas sector.
- **ii.** Provision of adequate social and basic amenities for gas flaring operatives in rural and urban areas to enable them carry out their duties optimally.
- **iii.** More resources should be provided to adequately channel flared gas. There should be regular review of gas flaring and environmental degradation activities and operatives.

9. Conclusion

Gas flaring and environmental degradation are two variables that are mutually dependent. Enhancing economic growth and development is the prime responsibility of the government.. Gas flaring and environmental degradation crisis has affected various sectors of the Nigerian economy and has left the economy with inestimable costs with slowed growth. However, some government policies on gas flaring and environmental degradation have been identified to be a viable measure that can lead to increase in economic growth.

This study therefore examined how gas flaring and environmental degradation can be minimized to accelerate economic growth. The empirical findings revealed that gas flaring and environmental degradation have negative effects on economic growth and this relationship is significant at the 5 percent level. Hence, economic growth as a national issue would be enhanced if gas flaring and oil spillage can be reduced. In conclusion, the economic growth rate of Nigeria can be greatly improved if the government will fund adequately and provide means to minimize gas flaring and oil spillage in Nigeria, therefore a need to introduce new technologies, direct more resources and attention to the oil and gas sector.

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Appendices

Gas Flaring, Environmental Degradation and Economic Growth Variables

year	gdp	Oil spillage	Gas flaring
2000	11267.8	3609.2	964738682
2001	11371.3	3555.9	932621570
2002	11538.6	3497.3	907764328
2003	11645.4	3493.8	867940112
2004	12127.6	3487.5	850063954
2005	20448.5	3479.7	819558276
2006	32936.7	3546.4	784407938
2007	42922.41	242.23	759688726
2008	46,012.52	191.62	619398854
2009	49856.1	110.38	509351905
2010	54612.26	194.42	581568354
2011	57511.04	157.81	619032858
2012	59929.89	181.67	588666724
2013	63218.72	327.48	409311430
2014	67152.79	355.69	285761600

2015	69023.93	482.81	341372264
2016	67931.24	87.93	312448053
2017	66774.36	186.7	308693004
2018	82578.45	174.5	264582176

Source: CBN 2016 Annual Statistical Bulletin & NNPC 2016, 2018 Annual Statistical Bulletin

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