An Assessment of the Influence of the Economic Cost of Oil Pipeline Transport Infrastructure Breakages on GDP Contribution of the Oil and Gas Logistics Sector in Nigeria

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*Abstract:-*The study assessed the economic influence of oil pipeline breakages on economy of Nigeria. The major objectives of the research were to determine the effects of economic values of oil and gas resources lost due to incidences of pipeline breakages on the gross Domestic Product (GDP) contribution of the oil and gas sector as well as the influence of the casual factors of pipeline breakages which include pipeline rupture, fire explosion, acts of sabotage and oil theft induced pipeline breakages on the aggregates financial resources (economic value) lost due pipeline breakages. The study also determined the trend of oil pipeline breakages induced economic risks. Time series data was obtained from the pipeline products marketing company (PPMC) and the Nigerian National Petroleum Corporation (NNPC) on the economic values of crude and refined oil and gas resources lost due to pipeline breakages and the GDP contribution of the oil and gas sector. The multiple regression method cum trend analysis were used to analyze the data obtained using the GDP oil and gas and the aggregate economic values of oil and gas resources lost over the years as dependent variables. It was found that the economic cost of pipeline breakages had significant effect on the GDP contribution of the oil and gas sector. The quantitative model expressing the economic effects of pipeline breakages on the GDP contribution of the oil and gas sector is: GDPOG = 3139557.7 − 124.1VRPPL - 2.93VCROL + 283.8REMCOST + e. Similarly, the mathematical model which expresses the relationship between the dependent variable (aggregate economic value of oil resources lost) and the explanatory variables (rupture, oil theft, sabotage and pipeline fire) is:

AGGVOLOS = 10647.29 + 549.4RUPTURE − 6.44OILTHEFT + 124.1SABOTAGE − 67.6FIRE. The trend analysis indicates that there is an increases trend in aggregate pipeline breakages inducing economic risks over the period. Recommendations were given based on the research findings.

Keywords: Oil-pipeline, Breakages, Economic-cost, GDP-oil – and-gas.

I. INTRODUCTION

The Gross Domestic Product (GDP) is an important economic parameter in measuring the output of any national economy or sub-sector output as contributing components of the national economy. It measures to a great extent the total economic values of all outputs of an economy or sub-sector and as such gives an indication of the productive performance of any sector or subsector. Thus any variable, particularly economic variable that significantly affects the GDP contribution of a sector or subsector is usually considered as vital in any attempts to boost the GDP contribution while failure to positively influence such a variable will certainly cause the GDP to shrink and decline. Previous studies such as the work of Nwokedi *etal* (2017) provide satisfactory evidence that support the popular believe that Nigerian economy is about 90% dependent on the oil and gas subsector. The oil and gas subsector reliably depend mostly on the pipeline transport system for crude and refined petroleum products supply to market demand areas. In recent times, the Nigerian oil pipeline transport infrastructures and facilities have witnessed increased breakages and oil and gas leakages occasioned by rupture, fire and explosion and sabotage arising from oil theft and militancy security challenges. Determining the significance of the influence of the economic cost induced by the challenges of pipeline breakages is important in order to appropriately develop pipeline security shield and maintenance strategy for the Nigerian pipeline transportation infrastructural system. To facilitate the distribution of Crude Oil Products from the Oil rich Niger Delta to other parts of Nigeria and for easy access to export jetties, a Network of Pipelines was constructed to inter-link some States at strategic locations (NNPC, 2013). This interlinks crisscross the entire zones of the country; South, West, East and North.

Nigeria has a total Oil Pipeline grid of 5,001 kilometers; this consists of 4,315 kilometers of Petroleum Products Pipelines and 668 kilometers of Crude Oil Pipelines (NNPC Annual Report, 2011). These Pipelines transverses the country forming a Network that inter-connects the 22 Petroleum Storage Depots, the 4 Refineries at Port Harcourt(1&11),

Warri and Kaduna, the off-Shore Terminals at Bonny and Escravos and the Jetties at Atlas Cove, Calabar, Okirika and Warri ((NNPC Annual Report, 2011). The Crude Oil Pipeline is used to transport Crude Oil to refineries in Port Harcourt (1&11), Warri and Kaduna and also to Export Jetties covering a total distance of 668 kilometers. The Multipurpose Pipelines in Nigeria are used to transport Petroleum Products from the Refineries/Import Receiving Jetties to the 22 Petroleum Storage Depots at various places in the country (Adati, 2012).

Nigeria has been going through series of challenges relating to the quality, sustainability and security of her Oil Pipelines which is directly affecting lives negatively. Due to the economic benefits of Crude Oil to the Nigerian State, these challenges relating to the Nation's Oil Pipeline demands urgent attention (Onuoha, 2008).

The challenges confronting the countries Oil Pipelines comes in the forms of Oil theft, Pipeline Ruptures and Sabotage (Onuoha, 2008). The frequency of these challenges has been rather disturbing in the recent times. The integrity of Pipeline Product Marketing Company and law enforcement agencies that have the statutory responsibility to protect the Pipelines is at stake. Despite the 3.5meters right of way (ROW) on each side of the Oil Pipeline and other regulations guiding the laying and operations of Oil Pipelines, recent experience in Nigeria has shown that the integrity and safety of these Oil Pipelines has been incessantly compromised because of primarily Oil theft and Oil Pipeline Sabotage (Ogbeni, 2012).

According to Pipeline Product Marketing Company Annual Report (2015), Oil theft contributes 55.6% of the total Oil Pipeline Breakages in Nigeria while Sabotage contributes 41% within the past twenty years. Statistically, that implies that Oil Pipeline Ruptures and other subtle leakage channels contribute 3.4%.

Oil theft happens when Vandals working on a coordinated Supply Chain Network break up the Oil Pipeline with the criminal intent of obtaining Crude Oil/Petroleum Products for commercial purposes or personal use (Vidal, 2011). It is principally motivated by the criminal intent of Vandals who break into the Oil Pipelines to drill products for pecuniary gains.

The criminal intent notwithstanding, there are other factors which tend to predispose people to indulge in Oil theft. Prominent among these factors are scarcity of Petroleum Products, Wild Spread Poverty, Ignorance among Nigerians, Poor Protection of the Pipelines as well as Shallow Laying and Policing of the Oil Pipelines in Nigeria (Vidal, 2011). The easily accessible Oil Pipelines which often run through Slums and Informal Settlements in mushrooming cities are tempting to desperately poor communities who often don't have electricity and must rely on Oil Lamps for lightening and power. (Anifowose, 2008)

Most times this is just done to sabotage the government by attacking resource base of the country as is currently seen by the activities of various aggressive groups springing up from the Niger Delta Region of the country. These militants indulge in sporadic assault of the Pipeline System in an attempt to sabotage the activities of Oil Companies as well as elicit Government and International attention to the region (Vidal, 2011).

Oil Pipeline Breakages in Nigeria has resulted into untoward consequences ranging from Huge Financial Loss, Environmental Pollutions, Fire Disasters, loss of Farmlands, Death and loss of Substantive Investors with Substantial Investments which are all threats to the economy of the country vis-a-vis National Security of Nigeria.

1.2 Objectives of the Study

The objective of the study is to determine the influence of oil pipeline breakages induced financial cost and/or losses on the Nigerian economy. Other specific objectives include:

1. To evaluate the effects of economic values of oil resources lost as a result of oil pipeline breakages on the gross Domestic Product (GDP) contribution of oil and gas sector.
2. To examine the impacts of incidences of pipeline breakages on the aggregate economic value of oil and gas resources lost over the period covered in the study.
3. To determine the trend of aggregate economic cost of pipeline breakages induced losses.
4. To proffer recommendations on the basis of the research findings.

1.3 Research Questions

1. What is the effect of the economic cost of oil resources lost as a result of pipeline breakages on the GDP contribution of the oil and gas sector?
2. What is the impact of incidences of pipeline breakages on the aggregate economic value of oil and gas resources lost over the period covered in the study?
3. Is there a significantly increasing trend in aggregate economic cost of pipeline breakages induced losses?

1.4 Hypotheses

H_{01}: There is no significant influence of the economic values of oil resources lost as a result of pipeline breakages on the GDP contribution of the oil and gas sector.

H_{02} : There is no significant impact of incidences of pipeline breakages on the aggregate economic value of oil and gas resources lost over the period covered in the study.

H_{03}: The aggregate economic value of pipeline breakages induced losses does not show a significant increasing trend.

II. BRIEF REVIEW OF LITERATURE

2.1 Concept of Pipeline Breakages

Pipelines are defined as modes of transporting for liquid bulk cargo types such as Petroleum Products from Oil Refineries and Import receiving Jetties to Storage Depots. They also serve for cost effective long distance transportation of gas and water resources to market centers demand hubs, industrial cluster and homes. In Nigeria for example, the pipeline transportation system serve for cost effective delivery of three main liquid bulk cargo types namely: petroleum products, gas products and pipe borne water. Petroleum and gas pipelines however prove to have priority attention of the public as the country's economy is almost wholly dependent on the oil and gas sector while water transportation by pipeline is almost gone extinct following decades of neglect and decadence of public infrastructure in Nigeria (Adelana etal, 2011). Petroleum Pipelines transverses the entire countries geo-political zones ranging from subsea swamp, rain forest to the savannah grasslands and are exposed to diverse cultural, political, climates and soil conditions with varying consequences which include vulnerability to vandalism and leaking and seeping of the Petroleum Products with Damaging Implications (Vidal, 2011, Nwokedi etal, 2014).

Oil is the major source of Nigerian revenue and Oil Pipelines remain the most convenient and cost efficient means for transporting Oil Products in the country It is 'primarily' believed that Nigerian National Security is tied to Oil Pipelines. According to Onuoha (2008) any threat to Oil Pipelines in Nigeria is a direct threat to her National Security.

Oil Pipelines crisscross the Niger Delta region of Nigeria extending to other geopolitical zones of the country for refining, storage and distribution (Ogbeni, 2012).Pipeline Products Marketing Company (PPMC, 2015) reports that Oil Pipelines remain the most substantial National Asset of the country. There however exist some obstinate and ugly problems besetting Pipeline transportation of Oil products in Nigeria. These ugly problems involve the Breakages of Oil Pipeline which has numerous consequences (Ogbeni, 2012). Ogbeni (2012) and Onuoha(2008) identifies the casual factors of include Oil Theft, Oil Pipeline Ruptures and Sabotage of Oil Pipelines in Nigeria. What constitutes the interface between the three is that whichever one that happens, the integrity of the Pipeline System is compromised in such a way as to give rise to Spillages of the product transported in large quantities leading to negative consequences (Ogbeni, 2012).

In the case of ruptures, the breakages in the Pipeline are usually unpremeditated as pipeline ruptures depicts pipeline safety systems failure. This might be as a result poor maintenance or sudden failure of component parts. Rupture might as well arise as a result of equipment failure due to its own defective functionality.

2.2 Theoretical Review

Different theories have been developed by scholars over the years in the field of psychology that can be used in explaining a conflicts and disturbing situations relating to Oil Pipeline Breakages in Nigeria. Some of these theories include:

(A) Frustration Aggression Theory

The frustration aggression theory has its roots in the works of Miller and Dollard (1941). They led a research group at the Yale institute of human relations and published a monograph that is useful in explaining human conflict behavior. It is based on the simple and straight forward hypothesis that human frustration may lead to aggressive behavior (Miller and Dollard, 1941).

Since the development of the theory, several scholars have analyzed it. For example, it was observed that frustration ultimately leads to aggression and aggression always implies that frustration has occurred at some previous times (Miller and Dollard 1941). The theory suggests that individuals become aggressive when there are obstacles.

Bushman and Huesman (2010) looks at aggression is a behavior intended to harm another person who does not want to be harmed. Examining the failure modes of oil pipeline infrastructure in Nigeria which constitute majorly of sabotage, vandalism, oil theft induced, etc. as aforementioned; the frustration aggression theory becomes a perfect theory to explain why the youths of the Niger Delta took to arms against the Nigerian state and unleashed unprecedented mayhem on the oil and gas infrastructure and violence in the region. The frustration of the youths, occasioned by the deprivation (by the government and multinational oil companies from benefiting from the natural endowment of Crude Oil and gas resources has led to the aggression and the resultant orgy of violence and incessant breakages of Oil Pipelines in the region. This viewpoint is echoed by many public opinion analysts who opines that the quest for emancipation which lies at the heart of the Niger Delta struggle is not as yet directed towards excision from the Nigerian state but merely a protest against criminal neglect, marginalization, oppression and environmental degradation as well as economic and socio-political hopelessness and in one word, frustration in the Niger Delta. There is a plethora of evidence in the literature that link the aggression and violence in the Niger Delta to the series of unaddressed grievances by the people of the region and the neglects of the region by the government. The literature documented the disappointment and frustration of the people of the region, which led them to take to violence. Several factors have been identified and discussed in the extant literature as the causes of the frustration, thus leading to the militancy in the region. Some of these factors include

I. Environmental Pollution and Despoliation in the Niger Delta:

Several years of Oil Exploration and Production in the Niger Delta by the Shell Petroleum Development Company (SPDC) and other Multinational Oil Companies (MNOCs) have devastated the Oil Communities in the region and led to environmental pollution and despoliation. There is a large body of evidence in the literature that documented the relationship between Oil Exploration and Environment Pollution.

(B) Relative Deprivation Theory

Stouffer (1900 - 1960) is credited with developing relative deprivation theory after world war two. The theory focuses on feelings and action (Thomas, 2015). The theory refers to the idea that the feelings of deprivation and discontent are related to a desired point of reference. Feelings of relative deprivation arise when desire becomes legitimate expectations and those desires are blocked by the society (Thomas, 2015).

Social satisfaction is the opposite of relative deprivation. Relative deprivation is generally considered to be the central variable in the explanations of social movement and is used to explain the quest for social change that inspires social movement. Social movement emerges from collective feelings of relative deprivation (Thomas, 2015). Relative deprivation theory is applied to socio-political, economic and organizational problems.

The deprivation of the people of the Niger Delta from controlling their Oil proceeds and Oil Wells have given rise to a lot of social movement in the past which have metamorphosed into aggressive groups that have been engaging in Oil Pipeline Sabotage and vandalism in the country. The resultant deprivation of the people of the region from the benefit of their God given resources has led the youths and women in the area to begin to clamor for resource control and self-determination. It is believed that the deprivation of the people of the region in sharing equitably from their resources and the inaction of laws that further prevent them from equitably sharing from their resources have led to social movements which have given birth to various militants groups destroying oil installations and engaging in oil theft activities..

The youths of the Niger Delta region who are deprived from their God given resources began an armed campaigns and demand for greater control of the Oil resources from their lands. The resource deprivation of the people of the region had increased the struggle. Based on the foregoing, one may infer that the casual factors of oil pipeline breakages in Nigeria are more of security challenges than safety and maintenance challenges**.**

2.3 Empirical Review

The local laws of Nigeria however mandate Multi-National Oil Companies to pay compensations for any damage resultant from rupture of the Pipelines to the individual and communities affected (Badejo etal 2004). Section 11(5) of the National Oil spill Detection and Response Agency Act creates an obligation on a licensee to compensate anyone who suffers damage as a result of the operation of the license issued under the Act. This section had over the years raised acrimony on the fact that the Act does not provide clear basis for measuring the value of compensation and compels claimant to go to court where they would have to prove that the damage is not the act of a third party and/or prove that the damage was due to negligence of the licensee (Uyigue etal, 2007). The most devastating Oil Pipeline Rupture in Nigeria leading to explosion occurred in Jesse community of Ethiope West Local Government Area of Delta State on 18th of October 1998 killing at least 1000 people (Uyigue etal, 2008)

It was noted that vandalism, rupture ,Oil theft and sabotage in Nigeria is another represent modal split of pipeline breakages and failures leading to leakages in Oil revenue These apart from rupture involves the deliberate act of Vandalism of Oil Pipelines for criminal purposes (Onuoha, 2008). Vandalism is a premeditated, deliberate interference with a Pipeline System calculated to obstruct, truncate and sabotage the transportation of a product for socio-economic or political reasons. It is thus an indication of failure of pipeline security system involving the willful destruction of public or government property in keeping with criminal intent or by Sabotage. In Nigeria, Oil theft has been perpetrated principally by criminal syndicates who are motivated by the desire to loot Oil products for material aggrandizement. This organize crime is often aided and ablated by the state agents which gives it a semblance of a franchise (Vidal, 2011).

Oil theft is also known in Nigeria as Oil Bunkering which is the act of drilling into the Pipeline with the intent to steal products (Micheal etal., 2015). Vandalism can be on Crude Oil Pipelines or Petroleum Product Pipelines. Whichever, heavy cost is attached. According to PPMC Annual Reports (2015), the Nigerian Oil Pipeline Infrastructures have been subjected to incessant attacks by vandals over the years. The frequency of such attacks has been rather disturbing in the recent times. For instance, in 1999 alone, there were over 477 recorded cases of Pipeline Vandalism, in 2010, there were 5518 cases, in 2011, there were over 4468 cases of Pipeline vandalism and a total of 4037 cases in 2015 (PPMC Annual Report 2015). PPMC (2015) further identified fire and explosion as another major failure mode of oil pipeline infrastructure in Nigeria. Though in recent, the percentage of oil pipeline failure and destruction caused by fire and explosion has shown significant decline.

Several studies have identified major pipeline failure modes in Nigeria as aforementioned to include rupture, fire explosion, vandalism and sabotage and oil theft induced. It is however important to observe that most of the failure modes equally have casual factors inducing them. Prominent among these factors are scarcity of Petroleum Products, widespread

poverty and ignorance among Nigerians, poor protection of the Pipelines as well as shallow lying of the Pipelines, poor maintenance and safety culture and corruption in the sector (Vidal, 2011). Some of these factors have been alluded to in the following citation: The vandalism mostly take place in poor countries because international Oil and Gas Companies often fail to bury or protect their Pipelines as they would have to do in rich countries. The easily accessible Pipes which often run through slums and informal settlements in burgeoning cities are tempting to desperately poor communities who often have no electricity and must rely on Oil lamps for lightening and power (Vidal, 2011).

In tandem with the above, the following can be identified as causative and predisposing factors of Oil Pipeline vandalism and ruptures in Nigeria:

- Inordinate Ambition to Accumulate wealth.
- Culture of Criminal Impunity and Corruption in Nigeria.
- Poor Policing and Protection of the Pipelines.
- Political sabotage as in the case of Niger Delta Militancy.
- Widespread poverty of the rural and urban-slum dwellers.
- Scarcity of Petroleum Products.
- Flourishing of Oil Black Market in Nigeria.
- Regional Neglect.
- Poor Management of the Pipelines
- Construction of the route with sub-standard materials.
- Poor Regulation Enforcement.

The effects of these incessant pipeline incidences in Nigeria are identified to Oil to include loss of petroleum resources and revenue. Pipeline Breakages have led to reduction on the quantity of Crude Oil produced in the country. Statistics indicate that between 1998 and 2015 alone, Nigeria lost 1,909,629,029.29 barrels of Crude Oil and 24,183,460 metric tons of Petroleum Products to pipeline breakages (NNPC, 2015).

The Financial losses associated with Oil Pipeline Breakages are enormous and may be arrived at by quantifying the monetary value of lost products, cost of recovering part of the products, cost of repair of the vandalized and ruptured Pipelines, the cost of environmental sanitation and the cost of compensation in some cases (NNPC Annual report, 2011). This has amounted to huge sum of money over the years. A report by PPMC (2015) indicates that Nigeria lost a whooping sum of 10.9 billion US dollars to Oil theft and vandalism between 2009 and 2011 alone. These translate to huge economic losses with far reaching implications for Nigerians economic growth and development and by extension; National Security.

The menace of environmental degradation and pollution constitute another serious challenge posed by pipeline breakages. Oil Pipeline Breakages has led to high incidence of Oil spillage in Nigeria over the years. The Draft Annual Statistical Bulletin of the NNPC (2011) shows that Oil spill are significantly on the rise in Nigeria. Associated with the incidence of Oil spills is the attendant environmental degradation which jeopardizes the land, vegetation and habitation of the affected areas (Adelana etal ,2011). This has been exemplified in desolation of farmlands, loss of aquatic and wild lives, as well as water and air pollution. These conditions have implications for public health and safety of the people (Adelana etal, 2011).

III. RESEARCH METHODOLOGY

The research adopted historical survey approach in which the historical of oil pipeline breakages were covering a period of 18years from 1998 to 2015 were obtained from the NNPC and the PPMC. The time series data provided evidence of the economic cost of pipelines breakages including the remediation cost as well the casual factors of the incidences of pipeline breakages which include rupture, sabotage, fire explosion and oil theft induced breakages. The historical data of the contribution of the oil and gas sector to the economy represented by the oil and gas sector GDP was used as the dependent variable while the economic values of crude oil resources lost, refined petroleum products lost and remediation cost were used as independent variables to measure economic the influence of oil pipeline breakages on the GDP of the oil and gas sector using the statistical tool of multiple regression analysis. Similarly the influences of the casual factors of pipeline breakages were also determined. Trend analysis using the Ordinary least square regression method was used to measure the trend of aggregate economic loss induced by pipeline breakages.

3.1 Multiple Regression Analysis

This is a statistical technique for estimating the parameters of an economic model and testing for statistical significance of the estimated economic variables. It uses data of economic variables to determine the mathematical relation that best describe the relationship between the economic variables. It involves both the estimation of parameters values and testing for statistical significance. If the mathematical relation between the dependent and independent variables is determined, decision can then be taken. The multiple regression method is used here because one dependent variable Y (GDPOILG) called regressal and three independent variables VRPPL, VCOL and REMCOST, called regressors are involved. Using the technique explained above, the research data will be analyzed in the first instance. Secondly, multiple regression method will further be used to estimate the influence of incidences of pipeline breakages on the aggregate economic cost of oil resources lost in order to achieve the

second objective. Thus the dependent variable in the second objective is the AGGVOLOS, while the independent variables are RUPTURE, OILTHEFT, SABOTAGE and FIRE incidences.

The third objective will be achieved using trend analysis using the ordinary least square method of regression where the dependent variable 'Y' is the aggregate economic value of oil resources lost and the independent 'X' variable is time in year from 1998 to 2015.

Where:

AGGVOLOS = Aggregate economic cost of pipeline breakages induced losses'

VRPPL = Economic value of refined petroleum products lost due to pipeline breakages,

VCOL = Economic value of crude oil resources lost due to pipeline breakages,

REMCOST = Financial cost of remediation

GDPOILG =GDP contribution of the oil and gas sector

Rupture = incidences of pipeline breakages caused by rupture,

Oil theft = incidences of pipeline breakages caused by oil theft activities,

Sabotage = incidences of pipeline breakages caused by sabotage'

Fire = incidences of pipeline breakages caused by fire outbreak.

IV. DATA ANALYSIS, RESULT AND DISCUSSION OF RESULT

Table 4.1: Modelling the Impacts of Economic Costs (Values) of Oil Resources Lost Due to Pipeline Breakages on the GDP Oil and Gas

variable	mean	std deviation	N			
GDP OILG	8122619.72	6193638.464	18			
VRPPL	27855.76	32199.417	18			
VCROL	5675.00	19268.797	18			
REMCOST	29800.00	20468.050	18			
	constant	Vrppl	vcl	Remcost	Multiple r	r square
standardized coefficients	3139557.791	549.404	-6.436	124.142	.893	.798

Source: Authors calculation.

The analysis of table 4.3.1 by multiple regression analysis using the GDP contribution of the Oil and Gas subsector as the dependent variable and value of values of crude oil lost, refined petroleum products lost and remediation cost as explanatory variables indicates an average of 8122619.72 million naira as the GDP contribution of the oil and Gas sector over the period. The average financial values of crude oil lost, refined petroleum products lost and remediation cost over the 18 years covered in the study amounts to 5675.00million naira, 27855.76million naira, and 29800.00million naira with standard deviations of 19268.79, 32199.42, and 20468.00 respectively.

The multiple R which measures the degree of association of the estimated variables is 0.893 which indicates the existence of 89.3% association GDP contribution of the oil and Gas sector, values of crude oil resources lost, value of refined petroleum products lost and remediation cost. The R square as a measure as a measure of the explanatory power of the model is 0.798, indicating that approximately 80% total variation in the GDP contribution of the oil and Gas sector is explained by pipeline breakages induced financial losses causes directly by loss of crude oil resources, loss of refined petroleum products and financial cost of remediation.

The quantitative model expressing the economic effects of pipeline breakages on the GDP contribution of the oil and gas sector is: *GDPOG = 3139557.7 – 124.1VRPPL - 2.93VCROL + 283.8REMCOST + e*

Table 4..2 : table of indicators of the significance of the effects of the values of crude oil resources lost, refined petroleum products resources lost and remediation as a result of pipeline breakages on GDP oil and gas

Variable	t-score	t-table	P-value	Sig.(P < 0.005)	Decision
VRPPL	-4.635	1.74	0.00	No	Accept
VCROL	-0.69	1.74	0.96	No	Accept
REMCOST	7.022	1.74	0.00	Yes	Reject

Source: Authors calculation

As indicated in the table above, the result shows a t-score of -4.63, -0.69 and 7.022 for values of Refined petroleum Products lost (VRPPL), values Crude Oil Resources lost (VCROL) and Remediation cost (REMCOST) respectively. The corresponding T-tabulated values of 1.74 for each and P-values of 0.00, 0.96 and 0.00 for VRPPL, VCROL, and REMCOST respectively shows that while the financial cost of pipeline breakages induced oil spill remediation had significant effect on the GDP contribution of the oil and gas sector, the economic values of pipeline breakages induced crude oil resources lost and refined petroleum products lost had no significant effect on the GDP of the oil and gas sector. Further examination however shows that the economic value of refined petroleum products lost over the period has a higher level of economic effect on the GDP oil and gas than the values of crude resources lost within the same period.

The policy implication is that pipeline management, surveillance and protection policy and systems is needed for both crude oil and refined petroleum products conveying pipelines, stricter and more serious pipeline shield and protection system should be developed for the refined petroleum products pipelines which has over the years had a more significant loss effect on the GDP oil and gas. This will equally impact on remediation costs such that limiting oil pipeline breakages coupled with development of cost effective remediation strategies will lead to optimal remediation cost and the optimal effect on GDP oil and gas in particular and the Nigeria economy at large.

Table 4.3: Modeling the Effects of Incidences of Pipeline Breakages on the Aggregate Financial (Economic) Value of Oil and Gas Resources Lost

Variable	Mean	Std Deviation	N				
AGGVOLOS	51217.658	42731.257	18				
RUPTURE	61.667	43.03	18				
OILTHEFT	1402.778	1121.32	18				
SABOTAGE	595.2889	571.191	18				
FIRE	450.889	778.115	18				
COEFFICIENTS							
	CONSTANT	RUPTURE	OILTHEFT	SABOTAGE	FIRE	MULTIPLE R	R SQUARE
Standardized Coefficients	10647.295	549.404	-6.436	124.142	-67.625	.869	.755

Source: Authors calculation.

The table above indicates that the average aggregate financial value of oil resources lost due to pipeline breakages in Nigeria over the 18 years covered in the study is 51217.658million naira with standard deviation of 42731.26. The average oil resource loss inducing incidences as a result of pipeline rupture, oil theft activities, sabotage and fire outbreak amounts to 61.67, 1402.78, 595.28 and 450.89 respectively.

The mathematical model which expresses the relationship between the dependent variable (aggregate economic value of oil resources lost) and the explanatory variables (rupture, oil theft, sabotage and pipeline fire) is:

AGGVOLOS = 10647.29 + 549.4RUPTURE – 6.44OILTHEFT + 124.1SABOTAGE – 67.6FIRE

The multiple R indicating the level of association between the aggregate financial value of pipeline incidence induced loss of petroleum resources and the explanatory variables (rupture, oil theft, sabotage, and pipeline fire incidences) is 0.87. This indicates an 87% level of association. The value of the R-square is 0.755. This shows that about 76% of variation in aggregate financial value of pipeline breakages induced oil losses is explained by incidences of pipeline rupture, oil theft activities, and sabotage and fire outbreaks.

The table below gives further details of` the levels of significance of the effects of incidences of pipeline rupture, oil theft, sabotage and fire on the aggregate value of pipeline breakages induced financial/revenue losses.

Table 4.3.1: Levels of Significance of Incidences of Pipeline Breakages of Aggregate Revenue Losses.

Variable	t-score	t-tabulated	Decision
Rupture	0.538	1.740	Non-significant
Oil theft	1.183	1.740	Significant
Sabotage	1.856	1.740	Significant
Fire	-1.555	1.740	Non-significant

Source: Authors Calculation

The table indicates t-scores of 0.538, 1.183, 1.848 and -1.555 for rupture, oil theft, sabotage and fire pipeline incidences respectively with corresponding t-tables of 1.740 each. This implies that while pipeline breakages occasioned by incidences of sabotage and oil theft shows a significant impact on the aggregate value of pipeline breakages induced revenue losses; pipeline breakages occasioned by incidences of rupture, and fire out break have no significant effects on aggregate pipeline breakages induced revenue losses.

The policy implication is that while general combative effort must be geared towards limiting loss inducing incidences of pipeline breakages occasioned by all casual factors (rupture, oil theft, sabotage, fire) and the attendant economic effects; greater combative effort must by focused on sabotage activities which shows a higher significant effect on the economy than other casual factors.

4.4: Modeling the Trend of aggregate Economic Costs Induced By Incidences of Pipeline Breakages.

Model	Coefficients		t-Score	t-table	
	B	Std. Error			
Constant	35051.57	20091.160	1.745	1.740	
X - Year	2184.07	1856.107	1.877	1.740	

Source: Authors Calculation

The third objective of the research seeks to ascertain the trend of aggregate financial cost of pipeline breakages induced losses of petroleum products over the 18 years period covered in the study. The trend analysis indicates a mean aggregate financial loss per annum of 51217.6583million naira over the period. The trend equation is :

$Y = 35051.570 + 2184.1X + e.$

The positive coefficient of the X variable (+21884.4) is an indication that there is an increases trend in aggregate pipeline breakages inducing economic risks over the period.

4.1: Test of Hypotheses

TEST OF HYPOTHESIS H_{o1}

Hypothesis	F-Score	F-Table	P-value	Sig.($P < 0.005$)	Decision
H_{01}	18.392	5.56	0.00	Yes	Reject H_{01}

Source: Authors calculation.

The test of hypothesis H_{01} which states that there is no significant economic effect of oil pipeline breakages on the GDP contribution of the oil and gas sector; shows an F-score of 18.39 and F-tabulated of 5.56 with P-value of 0.00 at 0.05 level of significance and n-1 degrees of freedom. Thus, we reject the null hypothesis and accept the alternate hypothesis that there is a significant effect of oil pipeline breakages on the GDP contribution of the oil and gas sector.

Test of hypothesis h_{02} by ANOVA: effect of incidences of pipeline breakages on economic value of pipeline incidence induced oil and gas resources lost.

HYPOTHESIS	F-SCORE	F-TAB	P-VALUE	DECISION
H_{O2}	10.03	5.56	0.001	Reject H_{02}

Source: Authors calculation.

The test of Hypothesis H_{02} using the ANOVA method shows an F-score of 10.03, F-table of 5.56 and p-value of 0.001 at 17 degrees of freedom and 0.05 level of significance. Thus we reject null hypothesis H_{02} and accept the alternate hypothesis to conclude that there is a significant impact of incidences of pipeline breakages on the aggregate economic value oil resources lost and the cost of remediation cost within the 18 years covered in the study.

Table 4.1.2.: Test of Hypothesis H_{03}

HYPOTHESIS	t-Score	t-tab	DECISION
H_{O3}	1.877	1.740	Reject H_{03}

Source: Authors calculation.

The t-score of 1.877 and t-table of 1.740 at 0.05 level of significance shows that the trend of aggregate loss is significantly increasing. Thus to limit the economic cost and impacts of oil pipeline breakages, there is need to strengthen pipeline protection and management policies to achieve decreasing trend of economic cost and incidences of pipeline breakages.

V. SUMMARY OF MAJOR FINDINGS

The average aggregate economic value of crude oil and refined petroleum products lost due pipeline breakages within the period covered in the study amounts to 51217.658 million naira per annum while the average annual GDP contribution of the oil and gas sector is 8122619.72 million naira. The study found that the economic loss of resources due to oil breakages show a significant impact on the GDP contribution of the oil and gas sector. Also while the values of crude oil and refined petroleum products which stood at 5675.00 million naira and 27855.76 million naira respectively shows no significant effects on the GDP contribution of the sector, the cost of remedy (recovery and clean-up, repair costs) which is an annual average of 29800.00 million naira shows a significant effects of the economy of the oil and gas sector. The annual average total incidences of oil pipeline breakages is 2510 incidences with total annual casual factors of 62 ruptures, 1402 oil theft induced pipeline incidences, 595 sabotage induced incidences and 451 fire incidences. While sabotage and oil theft induced pipeline breakages shows significant effects of aggregate economic cost of pipeline breakages, rupture and fire shows no statistical significance on the aggregate economic cost of pipeline breakages. The trend of aggregate economic losses is found to be significantly increasing within the period covered in the study.

VI. CONCLUSION

From the foregoing, the researcher concludes that oil pipeline breakages has led to loss of crude oil and refined petroleum products and remediation cost whose economic values has significant impact on the GDP contribution of the oil and gas sector. Also, sabotage and oil theft activities over the led to the greatest number oil pipeline incidences which have shown significant impacts on the aggregate economic value of resources lost due to pipeline breakages. Thus pipeline security shield should be developing with priority and greater on sabotage, in order that pipeline breakages occasioned by sabotage might reduce.

VII. RECOMMENDATION

In view of the adverse economic significant influence of pipeline breakages the national output as evidenced by result of the study, I proffer the following and employ the government to put them into consideration:

1. More Pipeline protection and Management Attention for the Refined product Pipelines.

Based on the findings of the study that the economic value of refined petroleum products lost due to pipeline breakages shows more significant effect on the economy, it is therefore recommended that greater surveillance attention and protection strategy be focused on the pipelines transporting refined petroleum products in order to limit product losses necessitating economic wastages. This will help to limit pipeline induced losses of refined products and consequently, the economic cost.

2. Development of Shield and protection for Coastal Pipelines against Sabotage and Oil Theft.

Since only Sabotage and Oil theft are casual factors of incidences of pipeline breakages leading to significant economic losses, it is important that while the oil majors focus on implementing safety policies against fire and rupture which are maintenance and safety challenges facing oil pipeline management; sabotage and oil theft are security challenges arising from militancy in the Niger Delta. Government should therefore adopt a negotiation strategy in handling this while equally working to provide gainful job opportunities in the region to engage the youth meaningful employments to take their interest off sabotage of oil installations and oil theft. To this end, one may suggest 100% resource control and the practice of true Federalism and Natural Law which is based on equity in which the Federating Units express their right to primarily control the natural resources within their borders and make a rational/reasonably agreed contribution towards the maintenance of common services of the government at the center; for the collective benefits of the nation.

3. Total Reformation of Nigeria National Petroleum Cooperation

There should be total reformation of the NNPC Senior Management Structure in order to overhaul the "Supply Chain Network" to eliminate links between Vandals and corrupt NNPC officials. This link between the two group continue to lubricate the information chain of the vandal thus keeping them in the business of oil theft and sabotage.

4. A Synergy between the various Law Enforcement Agencies

There should be adequate synergy between law enforcement agencies having the statutory responsibility to watch Pipelines and arrest Vandals. The Police Force, State Security Service, Nigeria Security and Civil Defense Corps, the Inspector General of Police Special Task Force on Anti-Pipeline Vandalism, and Local Vigilant Group for adequate monitoring and sending of information to the right channels to deter Vandals and make responds to Oil Pipeline Breakage urgently without discrepancy of information.

5. Introduction of Leak Detection System.

The Federal Government of Nigeria needs to introduce some major Leak Detection System as used in the Western World to ensure Operational Safety. There are some major technologies for monitoring Pipelines-from physically walking the lines to Satellite Surveillance.

I recommend Computational Pipeline Monitoring or CPM. This technology takes information from the field related to pressure, flows, and temperature to estimate the behavior of the product being transported. Ones the estimation is completed, the result are compared to other field reference to detect the presence of an anomaly or unexpected situation which may be related to a leak. This very technology will tackle the issues of Oil Pipeline ruptures in the country.

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