

Economic and Environmental Impact of Pipeline Incidents: a case of Delta North Pipeline Network in Niger Delta, Nigeria

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Abstract

This paper focuses on the Pipeline incidences along the Delta North operational corridor from 2008 to 2019. Data was collected from available company records and interviews of eye witnesses. Observations showed that the major nature of pipeline incident recorded was bunkering activities spread across five Right of Way host communities. One of the host communities ranked highest with spill occurrence and a record number of sabotage attacks. The identified high prone area needs to be given special attention to forestall and completely eliminate any form of sabotage. Besides applying good cathodic protection, or anti-corrosive agents to combat corrosion, a more systematic Prevention Risk management approach must be employed to forestall rising wave of oil theft. The security architecture must embrace local community policing, using trained locals to safe guide the pipeline assets. Regular summit involving all stake holders to educate the host communities and all parties on the importance of taking ownership of the safety and security of this vital asset is key.

Keywords: *Oil and Gas Pipeline, Theft and Sabotage, Clamping, host Communities, Niger-delta corridor.*

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I. Introduction

Pipelines are one of the safest forms of Oil and gas transportation across vast networks to reach consumer outlets. They play important roles in our modern society, providing needed fuels for sustaining critical human needs, such as power generation, heating supply, and connecting deport terminals for export etc. The Nigerian economy is heavily reliant on the production and export of this essential commodity called crude oil [Okere, R. 2013]. To effectively meet her budgetary obligations so as to bring about transformational changes for the benefit of her citizenry, her daily OPEC quota by all means must be maintained.

However, there are historic records of frequent and tragic pipeline failures around the world with its association environmental impacts because of the hazardous properties of the products being transmitted. This problem is further heightened by the new wave of organized third party interference and the local regulatory authority's inability to abate its increase in Delta North.

Pipeline integrity managers, are concerned with the risk associated with the business which includes; the safety of people, damage to the environment and loss of income etc. Agbaeze (2000), in his report stated the Sources of pipeline failure to include; Structural problem 40%, Operator error 6%, others 25%, outside force damage 27% and lastly Control problems 2%. He suggested how to improve pipeline Integrity Management, and affirmed that the Pipeline operators can realize many benefits by implementing a data integration approach such that, integrity managers, risk assessment specialists and pigging Engineers can review and analyze generated data within the corporate group structure and infer solutions in line with global best practice. Studies conducted on the causes of pipeline leaks versus pipeline ruptures and the proportion for each shows failures resulting in product loss, leaks constituted 86.8% of failures and ruptures 13.2%. Of which Corrosion is a predominant cause of leaks, Ikporukpo, C. (1998).



Figure 1: Vandalized pipeline (Source: author (2020))

Therefore, the safety of pipeline does not rest only on their design and operation, but also on their maintenance, and management structure. This structure should include a robust security architecture that involves the Pipeline host communities, a maintenance response system and a vision direction for total compliance to the prevailing local regulatory standards.

Continuous incidence along the Delta North operational corridor of Niger Delta of Nigeria, resulting in constant operational downtime and loss of revenue to the asset owners as well as ecological damage to the environment has prompted the asset owners to come up with a better pipeline security outlay and establish an emergency response system to prevent any further oil spill occurrence.

This paper will consider a chronicle of all the incidences on the Delta North Pipeline for the past 11 years with the aim to undertake a desk study to evaluate and document all the incidence points, design a contingency plan for addressing oil pipeline failures. This will also help pipeline managers prioritize their strategies and channel their scarce resource in mitigating the associated impact. This study aims to rank the oil pipeline incident from data collected along the Delta North River pipeline corridor through the following objectives:

- The chronicle all the oil pipeline incidences.
- To enumerate the causes of Pipeline failures.
- To evaluate the number of incidences resulting to Spill.
- To evaluate the nature of incidence and consequences.
- To describe the nature of impact and consequences.

II. Methodology

Data was collected from documented company records and other literatures, as well as eye witnesses during the recorded incidences. The data collected included the following:

- Eye witness account of nature of Pipeline incident.
- Asset Owners documented evidence of the cause of pipeline incident.
- Cost of Pipeline maintenance.
- Carry out data analysis using SPSS and tableau software.

III. Literature Review

3.1 Theoretical Review

The theoretical framework of this studies can be situated within the context of Max labor theory which views labor as the source of all wealth, that sustains the profit of the capitalist system and the exploitation of the workers (Ritzer,2012). This analogy unfortunately describes the Nigerian state managers who are exploiting the host communities through their proxies, the Oil companies (IOC, NOC) seen as the capitalist, while the workers refers to the exploited host communities living in adverse poverty. Funnily, this position has remained the same despite several years of protest and agitation from the oppressed people of the Niger Delta. Ake, (1983) states that:

“Those who are economically privileged tend to be interested in preserving the existing social order, and those who are disadvantaged by the social order, particularly its distribution of wealth, have a strong interest in changing the social order, particularly its distribution of wealth”

This sustained level of slow activity from the state managers to scale down the poverty of the oil producing region by building basic infrastructure that will trigger socio-economic activities and prevent the environmental degradation of the region as led to a culture of rebellion and restiveness presently witnessed today.

Ake, (1983) further stated that the action of the oppressed is instigated by the lack of their material wellbeing. Clearly, Oil theft and all its associated activities are as a result of the state lack of capacity to bring relief to her people, and the people desperation to survive with little or nothing.

Within the context of our discourse, nothing will abate the rise of pipeline incidence across the Delta North corridor until the state managers and oil company operators sign a pact to deliberately develop the Niger delta region rather than paying lip service and sweeping the underlying issues under the carpet.

3.2 Empirical review (Delta North Pipeline network)

Ekoli, (2013) describes the Niger delta as an oil producing region made up of nine Nine states comprising, Delta, Abia, Cross-river, Edo, Akwa-Ibom, Ondo, Bayelsa and Rivers state. The population of this region is well above thirty-one million people, with multi diverse ethnic nations. Ikei, 2009 state that 95 percent of Government revenue is derived from this region alone, which makes the Nigerian state a mono economic export nation.

Delta state is one of the major oils producing states in the South-south region of Nigeria with about 122 kilometers of coastline bounded by the bight of Benin in the Atlantic Ocean. The state is made up of Twenty-five local Government areas, blessed with abundance of hydrocarbon reserves along with other solid minerals. (<https://www.deltastate.gov.ng/>, 2020).

The Delta North corridor covers about three Local government areas in Delta state made up of Ndokwa west, Ndokwa East and Ukwuani Local government Areas playing host to several oil companies.

One of the Pipeline asset operators along the corridor responsible for the evacuation of already processed crude, and currently servicing a cluster of marginal field Operators with a 48km evacuation line tied in to Nigerian Agip Oil Company (NAOC), bounded by nine Right Of Way host communities on the stretch of pipeline.

Despite the wealth of natural resources within these communities, there still abound massive level of poverty and lack of basic infrastructure largely due to leadership failure from the State managers. It is therefore not surprising to see the frequent attacks made on very import asset meant to bring wealth to both the owners and host communities.

IV. Data Description

Table 1: Number of Pipeline incidents within the Delta North Host communities

Location	Date	Nature of damage	WORK DONE	Activity	Consequence
KM 11	2015	Attempted Bunkering	Encasement and concrete works	Valve and flowline installed	No Spill
KM 21	2019	Attempted Bunkering	Encasement and concrete works	Valve and flowline installed	No Spill
KM 26	2016	Attempted Bunkering	Clamping	Drilled hole on pipeline	No Spill
KM 27	2008	Attempted Bunkering	Encasement and concrete works	Valve installed	No Spill
KM 31	2009	Attempted Bunkering	Nil	un-successful attempt	No Spill
KM 34	2010	SABOTAGE	sectional replacement	pipe line was blown with dynamite	Oil Spill
KM 35	2013	SABOTAGE	sectional replacement	pipe line was blown with	Oil Spill

				dynamite	
KM36/37	2016	SABOTAGE	Clamping	Pipe was cut using hacksaw	Oil Spill
KM 38/39	2017	SABOTAGE	Clamping	Pipe line cut using hacksaw	No Spill
KM 40	2018	FLOOD/Natural disaster	sectional replacement	A section of the pipe was damage	Oil Spill
KM 45	2014	Attempted Bunkering	Encasement and concrete works	Valve and flowline installed	No Spill

V. Results And Analysis

Pipelines are constantly the targets of Oil thieves especially in the Niger Delta region of Nigeria. International Oil companies like Shell have been dealing with ‘hot tapping’ (drilling into a pressurized pipeline) and ‘bunkering’ (illegally obtaining fuel from pipelines) for more than 40 years. Figure 2 indicates the pipeline kilometers and the chronicle of attempts made by oil thieves.

The consequences of these attacks range from damages to the integrity of the pipeline to environmental degradation from Oil Spills and increased cost of carrying out sectional replacement of damaged pipe sections.

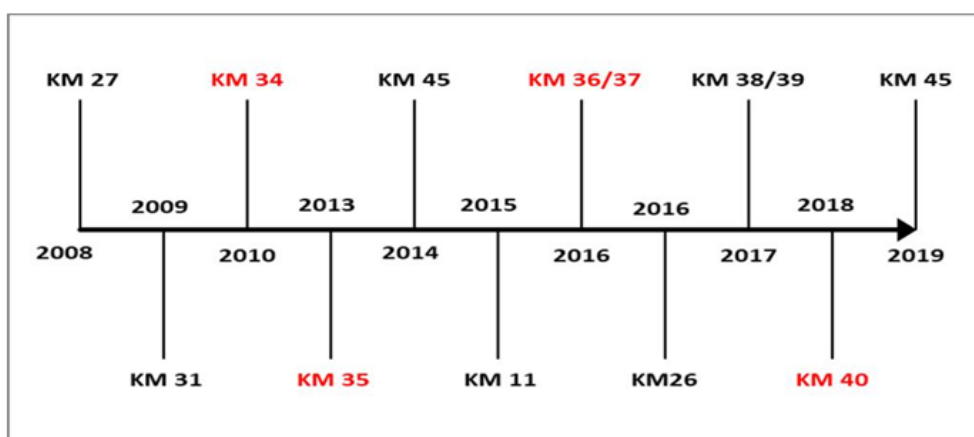


Figure 2: Pipeline Locations attacked by Oil thieves (Source: author (2020))

Figure 3 shows oil spill incidences from the activities of oil thieves from 2008 to 2019. Only four oil spill cases were recorded with the period under review, testimonies from eye witnesses shows that oil spill remediation were immediately carried out by the asset owners with minimal damage to the environment.

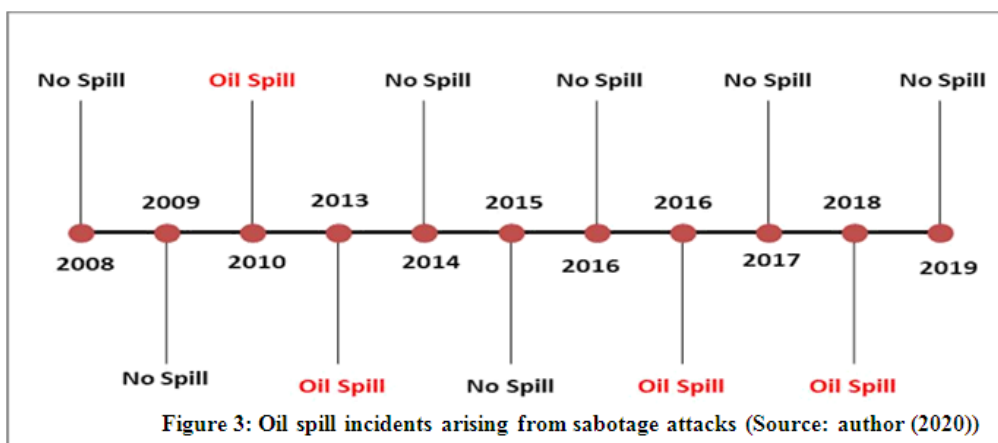


Figure 3: Oil spill incidents arising from sabotage attacks (Source: author (2020))

54.5% of failure was due to illegal bunkering activity as recorded in table 2 while sabotage attacks was 36.4% of total pipeline incidence.

Table 2. Nature of the type of pipeline attempts

	Frequency	Percent	Valid Percent	Cumulative Percent
Bunkering	6	54.5	54.5	54.5
Flood	1	9.1	9.1	63.6
sabotage	4	36.4	36.4	100.0
Total	11	100.0	100.0	

(Source: author (2020))

Due to the higher frequency of bunkering attempt, more concrete works was carried out to seal off hot tapped zones with 3'' valve installation by oil thieves representing 36.4% of total incidence. Interestingly, three sectional replacements were carried out from sabotage attacks increasing the overhead cost of pipeline maintenance. Kilometer 11 to 31 is prone to bunkering activities, the host communities around those right of way needs to be more sensitized to take ownership of securing the pipe asset. Host communities with high rate of sabotage from our eye witness indicate high rate of youth restiveness occasioned by many years of deprivation from the international oil companies and the state managers.

Table 3. Maintenance frequency on the pipeline

	Frequency	Percent	Valid Percent	Cumulative Percent
Clamping	3	27.3	27.3	27.3
Encasement and concrete works	4	36.4	36.4	63.6
Nil	1	9.1	9.1	72.7
sectional replacement	3	27.3	27.3	100.0
Total	11	100.0	100.0	

(Source: author (2020))

Figure 5 and 6 shows that over 70 million was spent on carrying out pipeline maintenance and oil spill remediation along the Delta North corridor by the asset owner. Marginal cost spent covered encasement and concrete works even though it had the highest frequency of occurrence.

PIPELINE REPAIR COST ANALYSIS

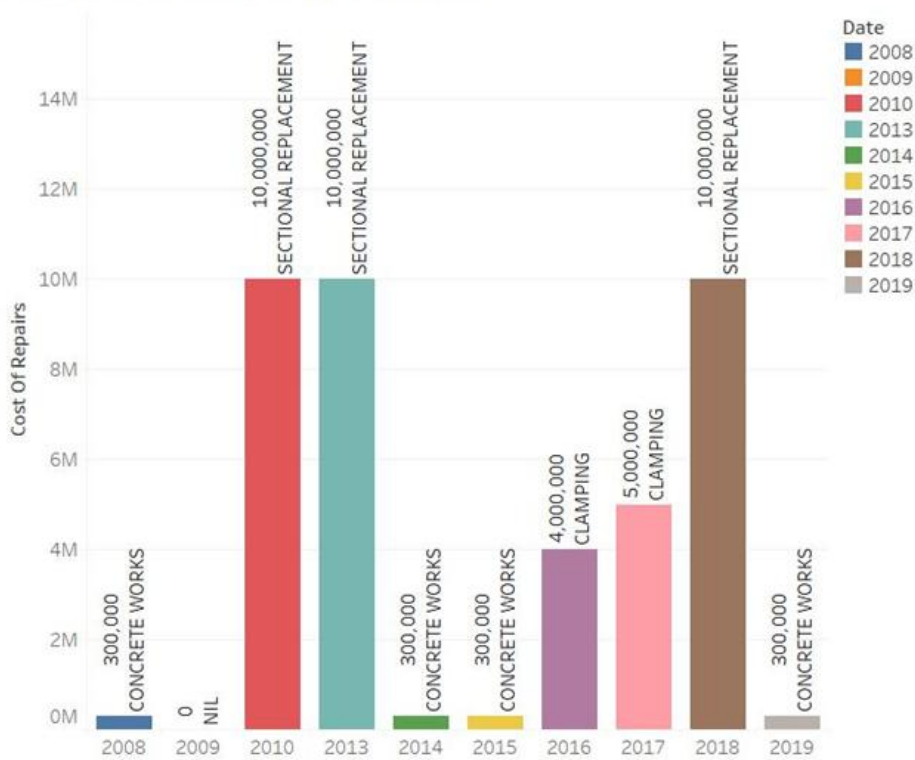


Figure 4: Oil pipe Repair cost (Source: author (2020))

Major cost of maintenance incurred was from the sectional replacement of the two sabotaged pipeline incidence and the third from pipeline rupture occasioned by 2018 natural disaster. As discussed, these are loss of revenue from the activities of criminally minded individuals within the host communities venting their grouse against the failure of leadership.

OIL SPILL & REPAIR COST ANALYSIS

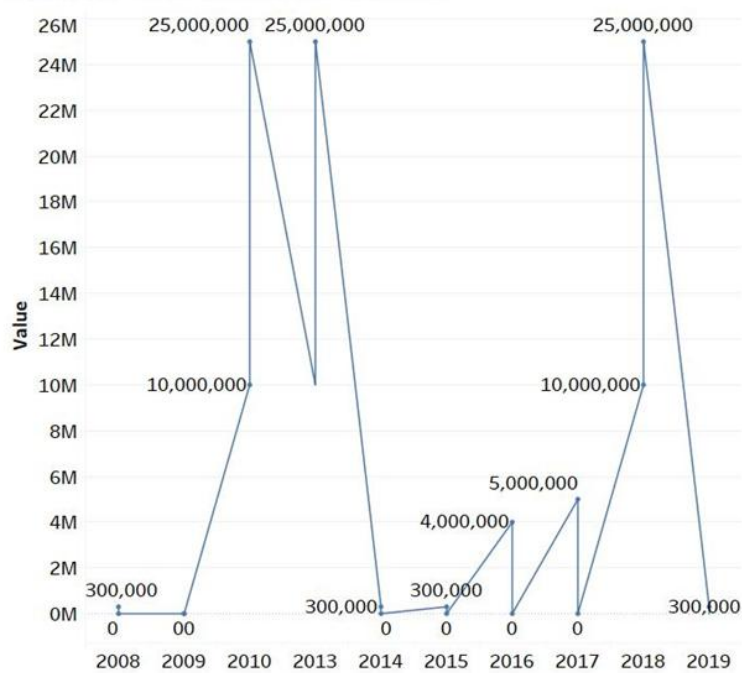


Figure 5: Oil spill cost analysis (Source: author (2020))

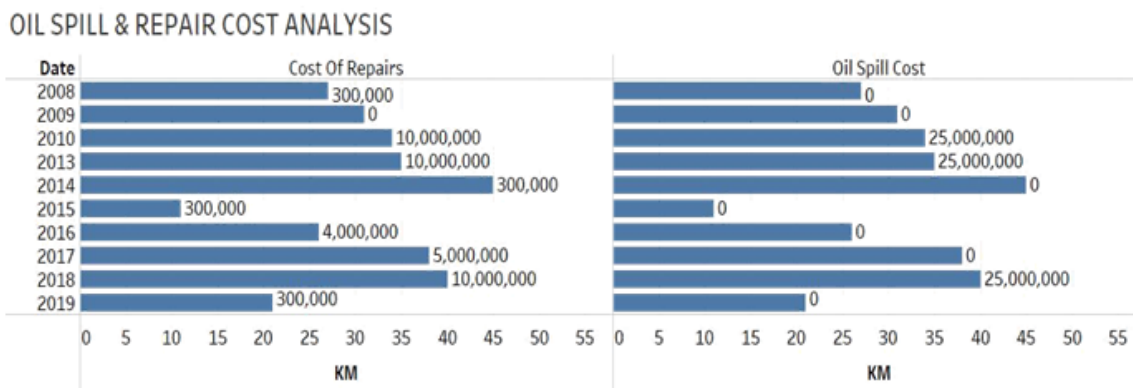


Figure 6: Cost analysis (Source: author (2020))

VI. Discussion

THE RISE OF SABOTAGE AND THEFT SABOTAGE AND THEFT FROM PIPELINES

Oil and gas export lines are ‘high value’ targets, for attacks. Pipelines extend over a long distance making it very difficult to protect. A typical attack may involve 2 or 3 vandals, three shovels, dynamite or explosives, a roll of wire, and a battery. With increasing sabotage and terrorism around the world, the pipeline systems are repeatedly a prime targets. Nations like the Russian government has allowed its oil major, Gazprom, to form a private army to protect its infrastructure. P.Hopkins (2002). To further illustrate the scale of this problem:

1. Sabotage to an oil pipeline in Colombia in 2001 cost Occidental Petroleum \$445 million in lost production. Colombia's Caño limón oil pipeline has been attacked 654 times by the National Liberation Army, or ‘ELN’, since 1986.
2. Iraq’s pipeline system is regularly attacked: one attack on the main oil pipeline from the Kirkuk oilfields in northern Iraq to Turkey's Mediterranean port of Ceyhun in 2003 caused losses of \$7 million/day. Between 2003 and 2007 there were 449 reported attacks against Iraqi oil infrastructure targets. This infrastructure is protected by the Iraqi Government Facility Protection Service and Coalition which comprises of tens of thousands of military personnel, and 14,000 private security personnel are employed protecting this infrastructure.



Figure 7: Pipeline sabotage. (Source: author, 2020))

Crude oil theft is a major cause of ‘failure’ in many pipelines around the world especially in poor countries, which reflects social economic problems resulting to poverty within the local communities.

Oil theft can take several forms:

1. Small scale, local theft. This small scale theft are perpetuated by individuals from within the local communities, they are usually ‘amateurs’. This theft has the highest consequences in terms of casualties and environmental pollution.

2. Large scale crude oil line theft, by criminals, using valves permanently fitted to the pipeline. This scale of theft can fill ocean tankers.

In Nigeria, oil theft otherwise known as ‘bunkering’, has caused huge loss of life. According to the BBC (26/12/06) report, examples of such loss are as followed:

- a. December 2006: >260 killed in Lagos
- b. May 2006: >150 killed in Lagos
- c. December 2004: >20 killed in Lagos
- d. September 2004: >60 killed in Lagos
- e. June 2003: >105 killed in Abia State
- f. July 2000: >300 killed in Warri
- g. 1 March 2000: >50 killed in Abia State
- h. October 1998: >1,000 killed in Jesse

These illegal ‘hot tapings’ can be sophisticated and difficult to detect; hence theft will not be an easy problem to solve. This has grown into a large scale industry within the Niger delta, with international collaborators who daily sabotage the effort of genuine investors. (Adishi and Hunga, 2017). Over four incidences of bunkering attempt has been made on the Delta North pipeline since inception, with no visible attempt from the state managers to eradicate this menace. Considering the growing population and lack of job opportunity, this grievous crime seems entice-able in the eyes of the upcoming youths seeking survival and quick riches.

6.1 ENVIRONMENTAL AND ECONOMIC IMPACT

The Nigerian State, Oil companies and the Host communities are adversely impacted by this frequent interference on the pipeline asset. These implication can take the following dimensions; Adishi, (2017),

1. Crude Oil pollution and degradation of the Environment: Crude oil spills deposit heavy metals and other hazardous components that pollute the environment, destroying arable farm lands, poisoning water bodies and killing aquatic lives and marine organisms. Host communities who are heavily reliant on nearby streams and farm lands for their economic survival, are exposed to untold poverty and unimaginable health challenges from oil pipeline leaks. Ufford (2013). Oil spills are responsible for the pollution of underground water making it difficult to access drinkable water in most rural communities bounded by oil company’s activities. This results in many untreatable ailments and cancer related diseases due to heavy metal deposits. With the absence of basic health care facilities in these communities, death rate and low life expectancy are inevitable.



Figure 3: (Polluted swamp (Source: author 2020))

2. Loss of revenue to Pipeline asset Owners: Companies risk losing huge revenues from frequent facility downtime due to the activities of oil bunkerers and pipe vandals, Asu (2013). Additional costs of maintaining these tempered assets as well as the cost of carrying out crude oil spill clean-up are born by them. Adishi (2017) states that the escavos Lagos Pipe line System(ELPS) loses 160 MMSCFD of gas at a fixed cost of \$2.50 per a thousand Standard cubic feet which amounts to about \$400,000 loss in revenue per day. This huge monetary deficit suffered by the Asset Owners could have been deployed in business expansion and facility upgrade that may have led to more employment opportunities. Alawode(2013). With continual loss of revenue to crude oil theft and sabotage, small oil companies will find it difficult to make even in the face of declining oil price per barrel. Their corporate social responsibilities to their host communities will be frustrated leading to possible protest and interruption of operational activities from the communities.

3. National Loss of revenue: Pipeline incidents leading to operational shutdown or declared force majeure from Shell can cause the Nigerian State to lose as much as N1.458 billion (\$7.29 Million) in revenue. This loss can deprive the nation from carrying out its strategic development plans and guarantee national security of its populace. The seriousness of this threat was further laid by Salau (2016) showing that the Nigerian OPEC production quota declined to 1.1 million bpd in May 2016 owing to high rate of pipeline attack. The Nigerian gas to power strategic master plan can be derailed if this continues. A minimum loss of 200 MMSCFD translates to a power loss of 700 MW that could have been used to trigger economic activities along the energy value chain. Adedoyin (2010). Perpetuators of oil theft and sabotage are therefor enemies of the state that requires urgent national response to completely uproot their chain of operations.

VII. Conclusion

From this study, five Right Of Way Host communities experienced various levels of pipeline attacks. Kilometer 34, 35 and 36 were severely hit with the highest number of Oil Spills. The four sabotage attacks recorded happened in one community, this shows the risk the pipeline asset is exposed to, this could be due to the internal political struggle amongst rival groups seeking attention according to our findings and increasing level of youth restiveness from many years of deprivation. Notably, Delta North corridor has the presence of an international oil company with an historic operational base. The entrance of the marginal field operators into this zone is currently bringing some relief in terms of visible corporate social responsibility projects within the host communities. The pipeline failure at km 40 was due to the 2018 natural disaster (flooding). The asset owners immediately took action to avoid subsequent failure by treating all shallow streams crossing as river crossing.

The persistent attack on the pipeline has direct impact on the integrity of the crude oil evacuated line servicing over four marginal field operators thereby reducing its life span. The cost implication of carrying out frequent maintenance and sectional pipe replacement does have direct bearing on the ability of the asset owners to meet up her corporate social responsibilities to the pipeline right of way host communities. More importantly operational downtime incurred during pipeline maintenance frustrates the financial projections of the cluster companies utilizing the evacuation lines denying them the ability to meet up their daily financial obligations.

There must be a collective drive by all stakeholders to reduce pipeline failures and its intending consequences. Learning from these failures is key, hence we should never allow a pipeline failure to pass without a thorough and wide ranging ‘lessons learnt’ and shared with the pipeline community.

Due to the current economic reality and high rising poverty within the Oil producing region of the Niger Delta there will be increasing rate of Oil theft and sabotage attacks. Therefore, prevention will be the best approach, including a wide range engagement with the Right of Way Host Communities as part of advance security architecture to protect the pipeline asset. As a preventive measure, Asset owners must deplore their best management and skilled staff to manage this high value infrastructure. Special attention must be paid to the high prone areas exposed to frequent attacks.

VIII. Recommendations

1. Asset Owner should deplore multi-leak detection system.
2. Carry out ground patrol and aerial surveillance of the pipeline using drones.
3. Aerial surveillance can help, but the thefts can occur both in daylight and at night;
4. Fiber optic cables can be buried along a pipeline to detect disturbances of impact.
5. Partner with all stakeholders, particularly Right of Way Host Communities, Local security presence and Joint task force (JTF).
6. Constantly conduct pipeline security workshops amongst local communities on pipelines, and their role in the community;
7. Conduct special Patrol of pipelines on high prone areas.

8. Work with police to destroy the 'organized' crime (many of the thefts are for a criminal with an organization selling to customers). This will require special detective work.
9. Review internal staffing (often Oil thieves are working with pipeline staff).

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