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The impacts of multi-stakeholders collaboration on management and mitigation of oil pipeline disasters in Nigeria.

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Research article

The impacts of multi-stakeholders collaboration on management and mitigation of oil pipeline disasters in Nigeria

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Abstract: Pipeline disasters have caused large losses to Nigeria in terms of economic, ecological, and human lives. A single incident can have devastating consequences for the environment, individuals, and communities. Research to date has recommended the significance of stakeholders, collaboration in overseeing these issues. This study examines the impacts of multi-stakeholders, collaboration on the management and mitigation of oil pipeline disasters in Nigeria, adopting the use of questionnaires and semi-structured interviews. The benefits of stakeholders, collaboration in the context of this study include but are not limited to: better information/intelligence sharing; improved decision-making; enhanced coordinated and timely intervention; improved response. The challenges associated with collaboration are: conflicts in shared responsibilities; inadequate resources; inadequate enforcement of environmental laws and guidelines; and inefficient communication systems. The goals of the collaborative pact will be effectively achieved if these challenges are properly addressed. This study recommends a framework for multi-stakeholders collaboration toward effective and efficient management and mitigation of oil pipeline disasters in Nigeria.

Keywords: stakeholders; stakeholders collaboration; pipeline disasters; disaster management; disaster mitigation

1. Introduction

Nigeria, like the rest of the world, is prone to a variety of natural and man-made disasters. While some of these disasters occur quickly, others develop gradually, causing devastating circumstances that result in the loss of life and property, environmental degradation, and ruins. These

terrible disasters include desertification, dam failure, flood-related epidemics, coastal erosion, building collapses, oil spills, maritime accidents or mishaps, bomb explosions, inter-communal strife, fire, air crashes, and boat incidents, among others. Disaster management is all about the ability to prepare for, guard against, respond to, and recover from compromised or truly natural or human-actuated calamities. It organizes and incorporates the efforts necessary to do this. Disaster management is the integration of all efforts required to create, maintain, and increase the capacity for disaster preparedness, relief, response, and recovery [1]. Following the definition given above, Haddow and Bullock define disaster management as a planned strategy used to protect vital facilities in the event of a disaster [2]. Disaster management, according to John, is a practice or policy that is carried out in advance, during, or following any kind of catastrophic incident [3].

A lot of management processes have been discussed in previous studies, with the most effective being the role of stakeholders in mitigating oil pipeline explosions [4]. A stakeholder is “any person or persons whose decisions can influence the achievement of a set goal” [5]. This is inclusive of the government, the parliament, and parastatals. A strong synergism among stakeholders could be a useful utility in managing and mitigating oil pipeline disasters [6,7]. This is known as a multi-stakeholder partnership.

Based on this idea, the goal of this study is to look at how the collaboration of different stakeholders affects the management and mitigation of oil pipeline disasters in Nigeria.

1.1. Statement of problem

As one of the major oil producers in the world, Nigeria has suffered several incidences of pipeline disasters and there seems to be no solution in sight. The frequency of tragic pipeline incidents in Nigeria has drawn attention from around the world [8]. This negative impact on people and the environment, which includes continuous human and animal deaths, pollution of the water and air, soil contamination, eradication of the ecosystem (flora and fauna), destruction of property and infrastructure, and loss of crude oil and refined products, is what has garnered this attention on a global scale. This global attention has necessitated the case study.

Merger work has reported the role of individual stakeholders in disaster management. However, collaborative work on pipeline disaster management has not received extensive review. Within the disciplines of both planning [9] and emergency management [10], scholars have noted the value of collaboration for long-term disaster mitigation. Pearce argued that sustainable disaster mitigation requires the integration of multi-stakeholders emergency management and planning [11]. This research provides evidence that collaboration across stakeholders can influence mitigation. This research is one of the few studies that analyze the collaborative efforts of stakeholders in pipeline disaster mitigation in Nigeria. The findings provide policymakers and planners with information about the occurrence, ecological and human impacts of pipeline disasters in Nigeria and sustainable approaches to mitigate it.

1.2. Objectives

- i. To examine the level of pipeline disaster awareness among stakeholders.
- ii. To examine the current level of multi-stakeholders' collaboration.
- iii. To identify the benefits of stakeholders' collaboration as a disaster management technique.

- iv. To identify the possible challenges of collaboration.

2. Empirical literature review

2.1. Outline of the Nigerian oil and gas industry

The Nigerian oil and gas industry has been dynamic since the disclosure of unrefined petroleum in 1956 by the Shell Group [12]. In any case, the area was generally overwhelmed by global organizations until the mid-'90s when Nigerian organizations started to make an entry into the business. Local involvement was supported by the execution of the Nigerian Content Directives dispensed by the Nigerian National Petroleum Corporation (NNPC) about 10 years prior, and in the end, by the declaration of the Nigerian Oil and Gas Industry Content Development (NOGIC) Act (The Act) in 2010 [13]. The Act looks to advance the utilization of Nigerian organizations and assets in the granting of oil licenses, agreements, and tasks. As far as the organization of the industry is concerned, it is extensively partitioned into upstream, downstream, and services sectors. The midstream activities are generally incorporated into the downstream segment. In any case, differentiation is presently being made between the two sectors. Midstream activities have to do with the handling, stockpiling, promoting, and transportation of unrefined petroleum, gas, gas-to-liquids, and liquefied gas.

2.2. The structure of Nigeria's oil pipeline system

Table 1. Nigerian pipeline grid and distribution network [14].

S/N	System	Network
1	System 2A	Warri – Benin – Ore – Mosimi
2	System 2AX	Auchi – Benin
3	System 2B	(a) Atlas Cove – Mosimi – Ibadan – Ilorin (b) Mosimi – Satellite (Ejigbo in Lagos) (c) Mosimi – Ikeja
4	System 2C	Escravos – Warri – Kaduna (Crude lines)
5	System 2D	(a) Kaduna – Zaria – Kano – Zaria – Gusau (b) Kaduna – Jos – Gombe – Maiduguri
6	System 2E	PH – Aba – Enugu – Makurdi
7	System 2EX	PH – Aba – Enugu – Makurdi – Yola
8	System 2CX	(a) Enugu – Auchi (interconnection) (b) Auchi – Suleja – Kaduna
9	System 2DX	(c) Jos – Gombe

The introduction of the petroleum industry in Nigeria was marked by the detection of crude oil in commercial capacity in Oloibiri in 1956. From that point forward, the Nigerian economy has been pretty much reliant on petroleum. To expedite the conveyance of crude petroleum products from the oil-rich Niger Delta to different regions of the country, a system of oil pipeline linkages was developed to connect a few states strategically located [14]. Nigeria has an aggregate pipeline

network of 5001 kilometers. This includes crude oil pipelines spanning a distance of 666 kilometers and multiproduct pipelines spanning a distance of 4,315 kilometers. These pipelines cut across various parts of the country, thereby establishing a linkage system that connects various locations within the country, including the 22 petroleum stockpiling depots, the four petroleum refining plants at Port-Harcourt (I and II), Kaduna and Warri, the off-shore terminals at Bonny and, Escravos, and the jetties at Atlas Cove, Calabar, Okirika, and Warri [14]. This network of oil pipelines covers a total distance of 719 kilometers and is used to transport crude petroleum to the refining facilities located in Port-Harcourt (I and II), Warri, and Kaduna. The multi-product pipelines are utilized to convey refined products from the refining facilities/import receiving jetties to the oil stockpiling depots at different locations in the country. The entire pipeline framework and oil products dissemination network are outlined in Table 1.

2.3. The concept of disasters

A natural disaster can be characterized as a natural event that leads to a disturbance in the working of the monetary framework, with a critical adverse consequence on resources, factors of production, yield, business, or utilization [15]. The Tampere Convention characterizes “disaster” as a “genuine interruption of the working society, representing a huge, inescapable danger to human existence, wellbeing, property or the climate, regardless of whether it was brought about coincidentally, naturally or by human action, and whether escalating unexpectedly or as the after effect of multifaceted long haul processes” [16].

According to Lindsay, the ASEAN Agreement on Disaster Management and Emergency Response resolved that “disaster” implies a genuine disturbance in the working of a society or community, causing a wide range of human, material, financial, or environmental losses [17]. UNISDR describes a disaster as: “a serious disruption of the functioning of a community or a society involving widespread human, material, or environmental losses and impacts that exceeds the ability of the affected community to cope using only its own resources” [18].

2.4. Disaster management in Nigeria

There is no single definition of disaster management that is accepted by everyone. This is due to the fact that various academics and institutions have defined it in a variety of ways, depending on their ideological leanings or their multi-disciplinary perspectives. Disaster management is described as “the managerial role responsible for providing the framework within which communities reduce exposure to danger and react to disasters,” as stated by the Federal Emergency Management Agency (FEMA) [19]. Traditionally, disaster management, as defined by the UNDP is “the body of policy and administrative decisions and operational activities which pertain to the various stages of a disaster at all levels” [20]. Figure 1 depicts these various stages.

The traditional disaster management cycle comprises the pre-disaster reduction phase and the post-disaster recovery phase. In the pre-disaster reduction phase, prevention, mitigation, preparedness, as well as early warning are carried out. The post-disaster recovery phase involves all the processes aimed at recovering from the disaster that has already occurred. This phase involves the rescue and relief efforts as well as rehabilitation and reconstruction processes.

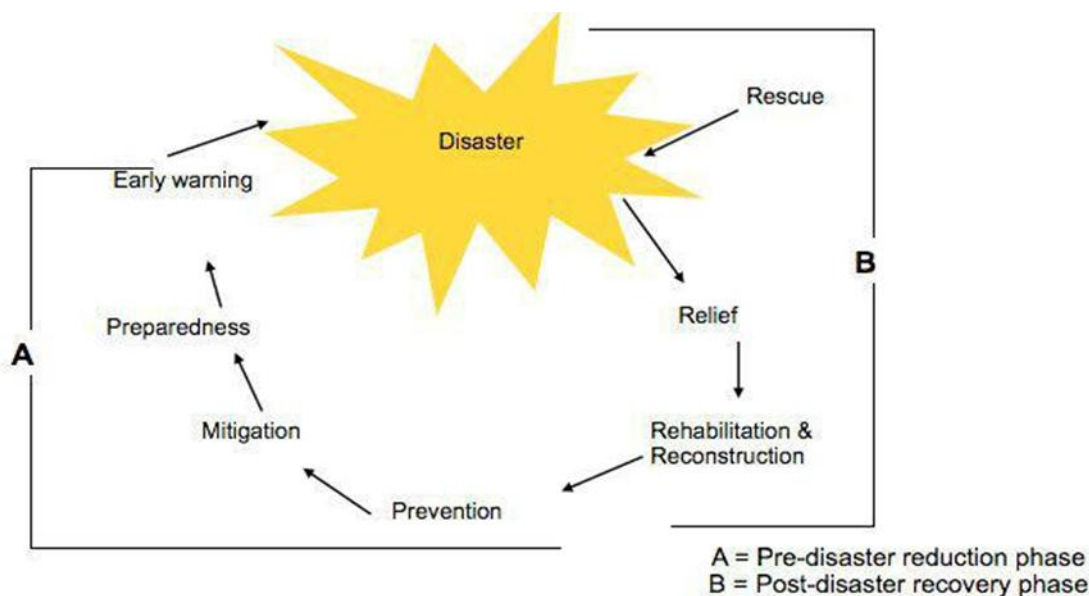


Figure 1. The traditional disaster management cycle [21].

Disaster management in Nigeria follows a similar pattern to the traditional disaster management cycle, however, it requires coordination between six distinct but linked categories of tasks: national development planning and disaster management; disaster prevention; disaster mitigation; disaster preparedness; disaster response; disaster recovery [22].

Dam construction to prevent river flooding; urban master plans to reduce urban flooding; these are all examples of national development planning and disaster management techniques. Also included are; enforcing the Environmental Impact Act to make sure that building projects do not exacerbate any environmental problems already present; planning for the delivery of essential medical care in the face of potential disease pandemics; fostering interfaith understanding and cooperation through mediating, resolving, and preventing internal conflicts [23].

Afforestation projects which lower the frequency and severity of floods by reducing runoff and increasing penetration of rain water into the soil; better regulation of building and land use to prevent population growth in flood-prone areas; flood control in low-lying areas by the building of dams and drainage canals; constitution of security committees at Federal, State and Local Government levels; and better intelligence gathering system of the Nigeria Police and other security agencies; adherence of fire codes; adherence of building codes; adherence to civil aviation safety regulations; adherence to the highway code; and; adherence to laws and regulations governing the handling, use, storage, and transportation of explosives, etc. are all measures to prevent disasters [19].

Nigeria has put in place things like building and development control measures, safety regulations for high rise buildings and the handling of explosives and other dangerous materials, safety codes for land, water, and air transportation, irrigation projects to deal with drought, and shelterbelts to deal with the effects of drought and desertification [23].

Disaster preparedness measures include: The three (3) tiers of government shall ensure that First Aid training forms part of the curriculum at all educational levels; Disaster management contingency plans; Disaster relief stocking such as building materials, blankets, buckets, food items etc.; Early warning system; Emergency communication systems; Disaster response training and public awareness campaigns.

Responding to a disaster is taking action during or immediately after the disaster has struck in order to preserve lives, care for the victims, safeguard property and make emergency repairs to infrastructure. These include search and rescue operations, damage assessments, victim evacuations, and mass medical care [24].

The term "recovery" refers to the steps taken to restore a disaster-affected territory to its condition before the catastrophe. All three levels of government must work quickly to make sure that buildings, utilities, and infrastructure that were damaged or destroyed by the disaster are fixed or replaced; and people who were affected by the disaster can go back to their homes and communities and start putting their ordeal behind them [23].

2.5. Pipeline disaster in Nigeria

Pipeline accidents have caused large losses to Nigeria in terms of economic, ecological and human lives. Several incidences have been reported where lot of lives have been lost. An incidence occurred in Abule Egba, Lagos state, in December 2006 where over 500 lives were lost. This incidence led to the incineration of vehicles and a dozen houses including a mosque and two churches [25]. Another incidence occurred in the village of Imore, in December 2004 which claimed over 500 lives [14].

The rupture of a pipeline at every level is dangerous to humans and the environment. Apart from the high death rate and loss of property; soil, land, water and air deterioration have also been witnessed in these regions. The activities of fishermen and other recreational activities are also affected by pipeline disasters. It was estimated that Nigeria incurs losses amounting to N29.4 billion naira, equivalent to about \$10.4 million per day, as a result of pipeline sabotage. According to other reports, an average of 200,000 barrels per day of crude oil, or about 10% of total output, is stolen [26,27].

One of the major challenges are cases of vandalism and militancy, and as a result, the Niger Delta region suffers the most. Although the activities of militancy have been immensely suppressed since the amnesty program that was launched in 2009 [28], they seem to have resurfaced in recent time. Details of causes and consequences of pipeline disasters as obtained from relevant literature is presented in the Appendix section of this report.

2.6. Stakeholder theory

Several definitions of stakeholders suggest that the organization and its stakeholders are interdependent [29] and that the organization's goals can only be reached with the help and support of its stakeholders [30]. The Stakeholder theory relies on a consensual foundation of risk mitigation and value creation through collaboration with those that count. It argues that other groups who are not shareholders also matter and need to be integrated so as to ascertain the effectiveness of organizational service delivery.

This stakeholder integration process embodies first a valid and accurate identification process (otherwise referred to as "the normative theory of stakeholder identification") and secondly an effective engagement strategy (the instrumental stakeholder approach) [31]. The stakeholder model illustrates the relationships among the various groups of actors in and around the organization. Stakeholder theory also addresses the ethical and moral values of organizations. Roloff maintains

that stakeholders from business, civil society, and governmental or international institutions come together to find a common approach to an issue that affects them all and that is too complex to be addressed effectively without collaboration [32]. Arguably, such collaboration among petroleum industry stakeholders in developed nations is much better established and defined than in developing countries. Given this contention, it is therefore inexplicable that the implementation of the Stakeholder Theory in the management and mitigation of oil pipeline disasters in Nigeria has not been given adequate attention in the extant literature. Accordingly, the theory lays a foundation for the testing of the main hypothesis of the study, which states that a sustainable model for the mitigation and management of oil pipeline disasters can be attained through stakeholder collaboration.

2.7. Stakeholders' collaboration

“Collaboration” comes from the Latin word “collaborare,” which means “to cooperate” [33]. Collaborare comes from the words *com*, which means “with” and *labore*, which means “to work.” This suggests that rather than being individual, collaborative activities are done as a group. Given the topic, it may be argued that collaboration is best characterized as an endeavour to find solutions through group efforts and to turn a situation where people would typically act separately into one in which they work together to accomplish shared purposes [33]. The formation of common rules and structures that regulate the nature of the connection and the behaviour of the companies is part of the collaboration process.

Collaboration is a process in which entities share information, resources, and responsibilities to jointly plan, implement, and evaluate a program of activities to achieve a common goal [34]. To attain a common goal, Himmelman suggests exchanging information, altering efforts, sharing resources, and developing the potential of another directed towards attaining a mutually beneficial purpose [35].

Using a diagram, Camarihna-Matos and Afsarmanesh explained the relationship and distinction between the concepts of networking, coordinated networking, cooperation, and collaboration [34]. From the diagram, collaboration was positioned a step forward from the other four notions since it incorporates shared goals, identities, and responsibilities attained by all people working together.

Nigeria as a country recognizes the value of international cooperation in resolving the majority of its challenges, which range from economic, political, social, educational, religious, and technological concerns. Several policymakers and government officials have called for more collaborative efforts to bring about a more long-term developmental effort, such as: curbing Boko Haram's threat to the country's lives and security [36,37]; oil theft and pipeline vandalism [38]; scientific and technological advancement; economic growth and so on.

With this knowledge of the benefits of working with other countries, if Nigeria's policymakers can come up with a good plan for the country's future, the oil sector and all other parts of the economy will be able to grow, on the long run.

2.8. The need for collaboration

If properly explored, the collaborative method has a lot of advantages. These benefits, according to the National Environmental Policy Act, [39] include, but are not limited to:

- i. Better Information: by bringing together a variety of experts, a collaborative group can arrive at a more well-informed consensus and provide guidance to decision-makers. Similarly, collaboration encourages creative thinking by fostering a range of perspectives, transparency, and openness, all of which can lead to more informed and better judgment [40].
- ii. A More Equitable Process: effective collaboration involves the majority, if not all, of the parties involved in a problem. As a result, people with vested interests, especially those from historically marginalized or under-represented groups, are more likely to be asked to participate.
- iii. Improved Integration: because cooperation stresses the exchange of ideas, perspectives, and sometimes resources, it has the potential to improve party integration and coordination. Using NEPA's interdisciplinary framework, for example, can empower agencies to streamline multiple assessments and analyses linked to various legal or permitting requirements, thereby minimizing delays and boosting predictability [41].
- iv. Conflict Prevention: when parties work together, they often avert or at least lessen the impact of future conflict by addressing issues as they develop.
- v. Social Capital: collaborative techniques generate trust among people who will collaborate on future initiatives, foster partnerships, and strengthen public trust in government.
- vi. Easier Implementation: putting a choice into action can be made easier with collaboration. Stakeholders that have an interest in the outcome of a decision will also have an interest in how it is carried out. Decisions about monitoring, enforcement, and other matters may benefit from the lessons they've learned during the collaborative process.
- vii. Improved Environmental Responsibility: through mutual understanding and cooperation, collaboration may encourage stewardship of people and environmental resources.
- viii. There will be less litigation since key players are included early on, problems are solved at the lowest possible level, and agreements between parties are developed.

Collaboration can lessen the likelihood of litigation. Even if a lawsuit is filed, the collaborative method may help to limit concerns and make them more agreeable. The value of collaboration in Nigeria cannot be overstated. More developmental plans undertaken by the Nigerian government that failed, according to Lawal and Oluwatoyin, include: Operation Feed the Nation Green Revolutionary Program, Structural Adjustment Program (SAP), Vision 2010, National Economic Empowerment and Development Strategy (NEEDS), and the Seven-Point Agenda by previous administrations. Because of corrupt officials, stakeholder non-involvement, the country's mono-economic foundation, and bad leadership, the government's developmental initiatives have failed [42].

As the world has become a global village, international collaboration is required for a country to properly prosper. Lawal and Oluwatoyin opined that the best path forward for Nigeria is to emulate Asian countries' developmental achievements, which necessitate the entire commitment from leaders, stability, and continuity of previous programs [42].

2.9. Inter-agency collaboration in Nigeria

As the activities of armed opposition in the Niger Delta eventually escalated into real violence, hostage-taking, and pipeline bombings, the Nigerian government deployed military forces to the area

to quell the developing conflict. The Nigerian Army, Navy, Air Force, Police, and State Security Service (SSS) all contributed combatants to the Joint Military Task Force (JMTF), popularly known as Operation Restore Hope, which was sent to the Niger Delta in May 2009. They were initially tasked by the Nigerian government with guarding oil sites and waterways in the Delta region as a result of persistent complaints of ethnic youth activists vandalizing oil facilities in the region [43].

With the emergence of transnational crimes like terrorism, illegal drugs, the spread of weapons, kidnapping, murder, and people trafficking, as well as the effects of globalization, the job of national security transcends individual agencies and includes the cooperation of all other authorities [44]. The Multinational Joint Task Force (MNJTF) was established in 1994 by the Federal Republic of Nigeria to checkmate trans-border armed banditry around the general area of the Lake Chad Basin (LCB) and facilitate free movement along Nigeria's northeast border. Initially, the Force had only troops from the Nigerian Army but operated in liaison with the militaries and security agencies of the Lake Chad Basin Commission (LCBC) member countries [45]. However, in 1998, the Force received a boost and was made fully multinational by the inclusion of Chadian and Nigerien troops, who, alongside their Nigerian counterparts had the mandate of dealing with common cross-border security challenges within the Lake Chad Region. Up until 2009, when the Boko Haram terrorist organization first appeared in the region, the foundation of this Force substantially turned the tide of events in the region and significantly reduced the level of instability in the LCB. The AU Peace and Security Council resolved to support the LCBC Member States' and Benin's efforts by authorizing the deployment of the MNJTF during its 484th Meeting of Heads of State and Government, which was held in Addis Ababa on January 29, 2015. As a result, the MNJTF was redesigned, operationalized, and given a capacity boost of around 10,000 personnel. It also received a new headquarters in N'Djamena, Chad [46]. The new Force was given instructions by the LCBC to "establish a safe and secure environment in the areas affected by the actions of Boko Haram and other terrorist groups, in order to considerably reduce violence against civilians and other abuses, including sexual and gender-based violence, and aid the implementation of overall stabilization programmes by the LCBC Member States, in complete conformity with international law, including international humanitarian law, and the UN Human Rights Due Diligence Policy [46]. Cameroon, Chad, Niger, and Nigeria were the Force's troop-contributing nations when it began operations on July 30, 2015, with a Sector of Brigade strength based in each of those nations [45].

According to Gimba, collaboration by anti-human trafficking units with various stakeholders and development partners has been progressive and noteworthy [47]. The National Agency for the Prohibition of Traffic in Persons and Other Related Matters (NAPTIP), which serves as the country's focal point for all concerns relating to human trafficking, is foremost among these collaborators. He goes on to say that 12 police officers, ranging in rank from sergeant to deputy superintendent, are working as the first members of the national joint investigative Task Force of NAPTIP, making the Nigerian Police a proud partner in the development of the program. The Police also participate in NAPTIP's quarterly National Consultative Forum of Anti-Human Trafficking Stakeholders.

Additionally, the Independent National Electoral Commission established a common ground where overlapping areas of concern could be peacefully resolved before the fieldwork in coordination with the Federal Government and the top hierarchy of the various security agencies [48]. The committee was named ICCES (Inter-Agency Consultative Committee on Election Security) and was made up of stakeholders from the Office of the National Security Adviser, Police Service Commission, Nigerian Air Force, Nigerian Army, National Intelligence Agency, Nigerian

Immigration Service, Federal Road Safety Corps, Nigerian Prisons Service, Nigerian Police Force, Ministry of Police Affairs, Nigerian Navy, State Security Service, National Drug Law Enforcement Agency, Nigerian Security and Civil Defence Corps were the security organizations that made up this organization and also the National Youth Service Corps (NYSC). It served as INEC's primary tool for containing insecurity. Other election management bodies are interested in implementing this synergy between the electoral management body and the security sector because it has emerged as a best practice [49].

Before smartphones, banks and technology companies in Nigeria had a business arrangement where the latter constructed platforms while the former provided services. In the early 2000s, companies like Interswitch and Systemspecs helped banks extend services across platforms and collect payments, paving the way for the current fintech boom [50]. Fintech companies and banks are collaborating to create platforms and provide financial services today. Fintechs began as platforms for lone goods but are now starting to package services in ways that are similar to the early phases of traditional banking [51]. Fintechs and banks are currently working together in a variety of ways that may already reflect this frontend-backend relationship. For instance, the digital-only bank Kuda has agreements with GT Bank and Zenith Bank that allow customers to fund their app-based accounts by making over-the-counter deposits in these conventional financial institutions [52]. Additionally, Kuda collaborates with Access Bank to provide free ATM cash withdrawals to its clients. The savings and wealth management platform, Piggyvest, collaborates with Providus Bank to give users of the fintech direct deposit account numbers [50].

The introduction of the Bank Verification Number, among other key catalysts like increased mobile and broadband coverage, has been crucial to the growth of fintech in Nigeria [52]. BVNs, which were introduced by the Central Bank of Nigeria and the Bankers' Committee in 2014, have been essential for coordinating client information across platforms. Nowadays, fintechs frequently ask for it as a Know Your Customer tool to confirm users [50,51]. The development of new BVN-like tools will encourage collaboration as the sector expands.

On March 9, 2020, President Muhammadu Buhari established the Presidential Task Force on COVID-19 to direct and coordinate Nigeria's multi-sectoral intergovernmental efforts to stop the spread and lessen the effects of the COVID-19 pandemic in Nigeria [53]. The Task Force was composed of the Secretary to the Government of the Federation, Mr. Boss Mustapha, who serves as the task force's chairman, The National Coordinator of the committee is Dr Sani Aliyu. Other members include: Prof. Osagie Ehanire, Minister of Health; Ogbeni Rauf Aregbesola, Minister of Interior; Hadi Sirika, Minister of Aviation; Sadiya Umar-Farouk, Minister of Humanitarian Affairs, Disaster Management, and Social Services; Adamu Adamu, Minister of Education; Mohammed Mahmoud, Minister of Environment; Yusuf Bichi, Director-General, Department of State Services; Dr. Chikwe Ihekweazu; and World Health Organization Country Representative. The Task Force was able to satisfy its mandates satisfactorily [54].

Also, Nigeria and Equatorial Guinea have inked a historic Memorandum of Understanding (MoU) to supply gas from Nigerian offshore fields to the neighbouring Equatorial Guinea Gas Processing Facility at Punta Europa as part of strategic collaboration in economic cooperation across the Gulf of Guinea [55]. The large natural gas deposits in Nigeria complement the top-notch Gas Processing and Liquefaction infrastructure in Equatorial Guinea. The fastest time to market for a Nigerian offshore gas asset will be made possible by this agreement, which would enable a large portion of that stranded gas to enter the global gas market within 18 to 24 months. Due to a lack of

infrastructure, the NNPC and its JV partners are given the chance to profit from gas that would otherwise be left stranded offshore.

2.10. Current state of multi-agency response to oil spill incidents in Nigeria

The multi-agency response paradigm is supported by various provisions in the country's current laws. These rules, which are dispersed among a number of sources, frequently create parallel and rival institutions. As a result, the multi-agency response idea has not been effectively accomplished. Some of the barriers to implementing a successful multiagency response regime include: uncoordinated spill detection requirements and tiered response mechanisms across different agencies; and a lack of institutional coordination among key agencies and ministries [40]. The execution of a multi-agency strategy for oil spill detection and cleanup in Nigeria is hampered by these issues. This is not to say that the idea cannot be used, but its ability to be operationally defined in practice as a model for handling oil spill events is being seriously questioned. As soon as an oil spill is discovered or reported, response should begin [56].

2.11. Management and mitigation of oil pipeline disaster in Nigeria

Management of pipeline disasters is in three-folds; which are: readiness, reaction, and recuperation. The first part, which is readiness, deals with setting up measures that will prevent the occurrence of disasters. As for reaction, it refers to measures that are put in place to arrest the occurrence of a disaster to reduce its spread and effects. Recuperation involves processes that are designed to revamp the oil exploration processes as well as affected communities [15,57]. In managing pipeline disasters, stakeholders have different roles to play, and the collaboration of multi-stakeholders will help in setting up strong systems that will aid in the prevention of pipeline disasters.

Effective coordination and collaboration among various stakeholders involved would effectively mitigate the occurrence of pipeline disasters in Nigeria. This research measures the collaborative efforts of multi-stakeholders' in approaching oil and gas related disasters and the relevant government policies that support their collaboration in managing and mitigating disasters. This study opines that disaster could be significantly controlled if all stakeholders understood their roles and defined government policies were in place to support the formulation of this collaboration.

Various analysts have classified various ways in which pipeline disasters can be effectively managed. For example, Gupta proposed a template for the management of disasters. The template incorporated the following: Database, Logistics, Technological Needs, Self-Sufficiency, Correspondence Framework, Crisis Preparedness, and Forecasting. Also, Mojtahedi and Oo explained that there are some key stakeholders that are always involved in pipeline disasters [7]. Their efforts shape the possibility of a subsequent occurrence of pipeline disaster. They also play a key role in managing and mitigating the effects of a pipeline disaster. The stakeholders include the governments, ministries, departments and agencies, health sectors, non-governmental organisations, academia, the media and members of the impacted community.

3. Materials and methods

The research method adopted is the mixed method approach, which encompasses both quantitative and qualitative data collection. This method was adopted to explore the research objectives from both qualitative and quantitative perspectives; such that, the qualitative aspect will look from an in-depth perspective while the quantitative looks at the numbers. By so-doing, the accuracy, validity, and reliability are enhanced. The quantitative data was collected using online questionnaire designed using kobo toolbox software and administered via web links. The web link (<https://ee.kobotoolbox.org/x/fa9RGCwo>) was sent to respondents via emails and SMS texts while the qualitative data was collected using semi-structured interviews. According to the 2006 census [58], there are over 30 million people living in the Niger Delta Region. About 75% of these people live in creeks and villages [59].

3.1. Analysis of quantitative data from survey

Using a purposive sampling technique adopted for this research work, the target number of respondents for this survey was 300. At the moment this target was achieved, the survey instrument was archived to prevent further submissions. The data obtained from the survey was downloaded from the KoboToolbox control portal in Microsoft Excel format, and the summary of the collected data was carefully and painstakingly extracted using a Microsoft Excel Workbook. The extracted data was grouped accordingly and tabulated. Analysis was carried out using IBM SPSS Software. In this study, reliability testing was done through the use of Cronbach's alpha. Taber indicates that Cronbach's alpha with a value of greater than 0.6 is acceptable [60]. This emphasis is maintained by Islam et al. who measure the Cronbach's Alpha, as the inter-item consistency and the coefficient that reflects how well items in a set are positively correlated to one another [61]. They state that Cronbach's Alpha measurements that are less than 0.6 are generally considered to be poor. However, those over 0.7 range are considered good; the closer the reliability coefficient gets to 1.0, the better.

3.2. Analysis of qualitative data

The interview was recorded and listened to several times, after which transcription was done to achieve a comprehensive understanding [62]. Transcribed data was coded into structured codes, thereby making it easy to derive themes following hierarchical categorization [63]. The research was guided by Nvivo software [64] while the analytic thinking was undertaken by the researcher [65].

3.3. Ethics approval of research

Prior to the commencement of data collection, approval was sought from the research board arm of the Robert Gordon University (RGU) so as to ensure strict compliance with the necessary legal and ethical requirements as stipulated by the University. All ethical procedures and guidelines were followed so as to protect the research participants' anonymity and confidentiality, maintain the study integrity and data security.

4. Results

4.1. Respondents background

Table 2 shows the respondents' firms or institutions. These were classified into major stakeholder groups ranging from disaster emergency services to the local communities where these oil pipelines pass through. The oil corporations and servicing firms that own the oil pipelines had the highest number of respondents with 55. This was closely followed by disaster emergency services made up of NEMA/SEMA/LEMA, Fire service, and Red Cross with a total of 54 respondents. Respondents from government and government agencies made up of the civil service, NNPC, NOSDRA, Local government staff as well as staff of the Delta State Oil producing area development commission were 49. The security agencies, made up of police, civil defence and other security outfits in the study area, accounted for 35 of the respondents. The local community, made up of community residents, traders, and fishermen or fisherwomen, were 31 while respondents from academia were 17. There were 16 respondents working with NGOs while the media was represented by 6 respondents.

Table 2. Respondents' firm/institution.

Firm/Institution	Frequency	Percentage
Emergency Services	54	18.00
Oil Corporations & Servicing Firms	55	18.33
Security Agencies	35	11.67
Local Community	31	10.33
Health Services	15	5.00
Government and Government Agencies	49	16.33
Media	6	2.00
Academia	17	5.67
Private Firms	22	7.33
NGOs	16	5.33
Total	300	100

4.2. Level of Awareness amongst stakeholders

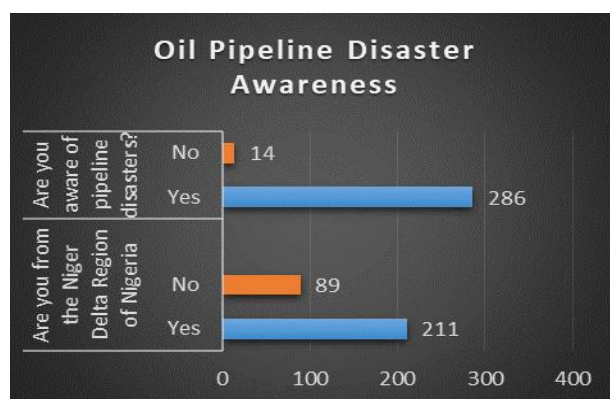


Figure 2. Oil pipeline disaster awareness.

From Figure 2, the number of respondents from the Niger Delta region was 211, more than 70% of the total number of respondents. 95.3% (286 respondents) indicated awareness of this disaster. Also, a large number of the respondents have experienced one form of loss or the other as a result of an oil pipeline disaster, having experienced as few as 1 case or as many as more than 3 cases of oil pipeline disasters as observed in Figure 3.

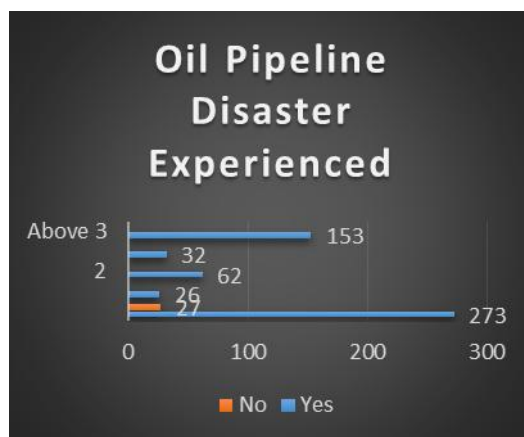


Figure 3. Oil pipeline disaster experienced by the respondents.

4.3. Firms/Institutions' participation in oil pipeline disaster management

Out of these respondents detailed in Table 2, Figure 4 shows that only 226 were disaster management experts, with approximately half of the respondents indicating that their firm/institution does not partake in oil pipeline disaster management (Figure 5). This is indeed very discouraging.



Figure 4. Illustration of disaster management experts among the respondents.

This could be as a result of the lack of a collaboration medium that will bring together relevant stakeholders in this all important aspect of the oil and gas industry.



Figure 5. Firms/institutions participation in oil pipeline disaster management.

4.4. Causes of oil pipeline disasters

Table 3 shows the statistical analysis of the causes of oil pipeline disasters. From the table, Vandalism has the highest mean score of 0.8833 and a standard deviation of 0.32156. The activities of vandals are considered by the majority of the respondents as the major cause of oil pipeline disasters. Lack of collaboration amongst stakeholders (mean = 0.8700, S.D. = 0.33687) is also a major cause of oil pipeline disasters. This study is interested in investigating the reasons for this. However, other contributing factors are inadequate maintenance (mean = 0.4667, S.D. = 0.49972), operational error (mean = 0.4133, S.D. = 0.49325), mechanical failure (mean = 0.4133, S.D. = 0.49325), inadequate surveillance (mean = 0.4000, S.D. = 0.49072), ecological factors (mean = 0.2467, S.D. = 0.43179), environmental factors (mean = 0.2433, S.D. = 0.42981), as well as others (mean = 0.0133, S.D. = 0.11489). Other identified causes of pipeline disasters during the field survey include; metal fatigue, defective products, damage caused by chemicals, as well as violation of applicable codes.

Table 3. Causes of oil pipeline disasters.

	N	Minimum	Maximum	Mean	Std. Deviation
Operational Error	300	.00	1.00	.4133	.49325
Mechanical Failures	300	.00	1.00	.4133	.49325
Vandalism	300	.00	1.00	.8833	.32156
Inadequate Maintenance	300	.00	1.00	.4667	.49972
Inadequate Surveillance	300	.00	1.00	.4000	.49072
Environmental Factors	300	.00	1.00	.2433	.42981
Ecological Factors	300	.00	1.00	.2467	.43179
Lack of Collaboration amongst Stakeholders	300	.00	1.00	.8700	.33687
Others	300	.00	1.00	.0133	.11489

4.5. Interval interpretation of the scales

Table 4 shows the various intervals for the likert scale used in the study survey. An interval of 0 – 0.83 represents don't know, 0.83 – 1.67 is interpreted as strongly agree, 1.67 – 2.50 represents disagree, neutral is represented by 2.50 – 3.33, 3.33 – 4.17 represents agree, while strongly agree is represented by 4.17 – 5.00.

Table 4. Interval interpretation of the likert instrument.

Level	Scale	Interval Length	Lower Limit	Upper Limit	Interval
Don't Know	0	0.83	0	0.83	0 – 0.83
Strongly Disagree	1	0.83	0.83	1.67	0.83 – 1.67
Disagree	2	0.83	1.67	2.50	1.67 – 2.50
Neutral	3	0.83	2.50	3.33	2.50 – 3.33
Agree	4	0.83	3.33	4.17	3.33 – 4.17
Strongly Agree	5	0.83	4.17	5.00	4.17 – 5.00

4.6. Aftermath of oil pipeline disasters



Figure 6. Pictures from a spilled site in Nembe Community (Field Survey, 2021).

Table 5 shows the mean and standard deviation of factors relating to the aftermath of pipeline disasters. From the table, it was generally agreed that areas where oil pipeline disasters occur are often deserted (mean = 4.07, S.D. = 0.956). Respondents disagreed that victims of oil pipeline disasters are compensated financially (mean = 2.21, S.D = 1.206). Various court verdicts ordering some of the multinational oil companies to victim compensation have been disobeyed. The

respondents also disagreed that areas where oil pipeline disasters occur are often cleaned up (mean = 2.41, S.D = 1.117).

Table 5. Aftermath of pipeline disasters descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation	Interpretation
Areas where oil pipeline disasters occurred are often deserted.	300	0	5	4.07	.956	Agree
Areas where oil pipeline disasters occurred are often cleaned up.	300	0	5	2.41	1.117	Disagree
Victims of oil pipeline disaster are compensated financially.	300	0	5	2.21	1.206	Disagree
Investigations were usually carried out to identify the cause(s) of the disaster.	300	0	5	2.76	1.289	Neutral
Lessons were learnt	300	0	5	3.11	1.299	Neutral

4.7. Current Level of Interagency Collaboration

This section of the findings presents the level of interagency collaboration as presently obtainable. The perception of respondents with regards to the existence of collaboration, their response to incidences of oil pipeline disasters, and the means of communication between stakeholders are tested.

Table 6. Cross-tabulation of existence of inter-agency collaboration and response to incidences of oil pipeline disasters.

				Has your firm/institution ever responded to incidences of oil pipeline disaster?		
				No	Yes	Total
Are there any interagency collaborations between your firm/institution and other stakeholders?	No	113		102		215
	Yes	13		72		85
Total		126		174		300

From Table 6, 215 respondents indicated that there are no interagency collaborations between them or their firm/institution and other stakeholders. Out of these, 113 have not responded to incidences of oil pipeline disasters, while the remaining 102 have responded to cases of oil pipeline disasters. In a similar vein, 85 respondents indicated there are interagency collaborations between them or their firm/institution and other stakeholders. 13 out of this number have not responded to incidences of pipeline disasters, while 72 have responded to incidences of oil pipeline disasters.

Table 7 indicates that interagency collaboration between the respondents' firm/institutions and other stakeholders is virtually non-existent (mean = 0.2833, S.D = 0.45137). With a mean of 0.5800, the response of firm or institution to incidences of oil pipeline disasters is fair enough.

Table 7. Level of Inter-agency collaboration descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation
Has your firm/institution ever responded to incidences of oil pipeline disasters?	300	.00	1.00	.5800	.49438
Are there any interagency collaborations between your firm/institution and other stakeholders?	300	.00	1.00	.2833	.45137

From Table 8, with a mean of 4.18 and standard deviation of 1.210, the respondents strongly agree that collaboration can be a very effective tool in disaster management if embraced. Also, it was disagreed that the current level of collaboration between firms/institutions and other stakeholders has been effective (mean = 2.45, S.D = 1.303). Finally, there is a general neutrality on firms/institutions having clear policy and practice for collaboration with other agencies (mean = 2.60, S.D = 1.417).

Table 8. Current level of collaboration descriptive statistics.

	N	Minimum	Maximum	Mean	Std. Deviation	Interpretation
My firm/institution has clear policy and practice for collaboration with other agencies.	300	0	5	2.60	1.417	Neutral
The current level of collaboration between my firm/institution with other agencies has been effective in response to cases of disaster management.	300	0	5	2.45	1.303	Disagree
In my experience, collaboration between stakeholders has been an effective tool in disaster management.	300	0	5	4.18	1.210	Strongly Agree

4.8. Reliability Test for the Likert Scale Questions

Table 9 shows the Cronbach's alpha reliability test for all the Likert scale items tested during the survey. These include the emergency preparedness rating, the aftermath of the oil pipeline disasters; and the current level of collaboration amongst stakeholders. A value of 0.745 was obtained. This is quite satisfactory, indicating that the data obtained is reliable.

Table 9. Reliability statistics.

Cronbach's Alpha		
Cronbach's Alpha	Based on Standardized Items	No of Items
.745	.761	14

4.9. Collaboration as a Disaster Management Technique

This section tests the respondents' opinions on the concept of collaboration as a disaster management and mitigation technique. It considers the agreement of stakeholders to this view. Table 10 shows that 72.3% of the people asked think that working together is a good way to handle oil pipeline disasters.

Table 10. Collaboration as disaster management technique.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	83	27.7	27.7	27.7
	Yes	217	72.3	72.3	100.0
Total		300	100.0	100.0	

With a mean of 0.7233, Table 11 indicates a high degree of agreement, with collaboration being a very good pipeline disaster management technique.

Table 11. Collaboration as Disaster Management Technique Descriptive Statistics.

				N	Minimum	Maximum	Mean	Std. Deviation
Does	your	firm/institution	consider	300	.00	1.00	.7233	.44810
collaboration with other stakeholders as a disaster management technique?								

From Figure 7, the null hypothesis that "collaboration with other stakeholders is not a disaster management technique" is rejected.

	Null Hypothesis	Test	Sig.	Decision
1	The categories defined by Does your firm/institution consider collaboration with other stakeholders as a disaster management technique? = No and Yes occur with probabilities 0.5 and 0.5.	One-Sample Binomial Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 7. Hypothesis test summary.

4.10. Managing and mitigating pipeline disasters

Multi-stakeholder collaboration is a strategic cooperation that brings together diverse groups that can participate in a common assembly with public agencies to partake in making agreeable decisions. Among the benefit of collaboration is its power to strengthen networks and connections between stakeholders by developing interpersonal trust that can prove useful during a disaster. Some stakeholders were interviewed in the course of this study. Some of the responses provided by the interviewees are presented in Table 12.

Table 12. Stakeholders' collaboration in disaster management.

Present Level of Collaboration	Roles of Collaborating Stakeholders	Impact of Stakeholder Collaboration
<p>“.....Occasionally, yes. We collaborate with security agencies, fire service, NGOs and health agencies. Though such collaborations always exist during disaster occurrence.” RP/NEMA/01</p>	<p>“.....Government agencies are very relevant in the prevention, management and risk reduction of pipeline disasters. These agencies should be charged with the responsibility of early warning signals and prompt response to disaster cases.”RP/NEMA/01</p>	<p>“.....as keenly anticipated by all actors involved, it is believed that multi stakeholders collaboration will reduce the frequency of occurrences of these disasters as it tends to develop a well-articulated means of managing and mitigating it.”RP/MNOC/01</p>
<p>“.....Collaborate with Community Leaders and residents as well as government agencies, though mostly at discussion levels.”RP/MNOC/01</p>	<p>“.....Government and government agencies are key stakeholders in this regards as they coordinate the activities of all other stakeholders towards achieving the desired goal. Security agencies should provide security and strict surveillance to detect oil leaks and prevent the activities of vandals and miscreants. The health agencies and other emergency services like fire service should provide immediate response during the occurrence of disasters. The community residents should serve as partners in securing pipelines as well as aid during search and rescue missions. NGOs should partner in sensitization activities and assist in providing relief materials to victims of oil pipeline disasters. RP/FMHDS/01</p>	<p>“.....there are obviously very positive effects of multi stakeholders' collaboration on managing and mitigating oil pipeline disasters. It is said that two good heads are better than one. When stakeholders put their efforts and experiences together, they will be a tremendous achievement in the reduction of pipeline disaster occurrences.”RP/MNOC/02</p>
<p>“.....we relate majorly with our host communities as well as government representatives from time to time. No concrete collaboration exist between us and other stakeholders.”RP/MNOC/02</p>	<p>“.....Government agencies charged with the responsibility of handling oil spills and oil disasters, security agents should also be involved. Health agencies are also very important in the risk reduction. The multi-national oil companies should be more involved in the prevention of oil pipeline disasters. The media should organize sensitization in conjunction with NEMA to discourage people involved in oil bunkering.”RP/NNPC/01</p>	<p>“.....a lot has been achieved in the developed nations of the world from stakeholder collaboration in the area of disasters as well as other critical sectors where such is required. The case of Nigeria wont be different. I anticipate that stakeholders' collaboration will be very helpful in this regards.”RP/HS/01</p>

Continued on next page

Present Level of Collaboration	Roles of Collaborating Stakeholders	Impact of Stakeholder Collaboration
<p>“.....Yes, we do, especially when such disasters occur. We usually collaborate with NEMA during such occurrences. We recommend a better collaboration framework or pattern with other agencies as well as NGOs and also the community residents so that we can move past this ugly incidence.”RP/NNPC/01</p>	<p>“.....the government been at the helm of affairs have the number one responsibility. They need to get their acts together. Having created a number of agencies to handle such cases, they should equip these agencies to deliver on their mandate. Among them include NEMA who coordinates all activities relating to disasters in Nigeria. Health agencies, security agencies and we, the community should be involved also.RP/CRL/01</p>	<p>“.....at this point, only multi stakeholders’ collaboration efforts can possibly save us from the ever occurring disaster. When all stakeholders directly and indirectly involved come together with a singular aim of managing and mitigating these disasters, only then can we begin to heave a sigh of relief.” RP/CRS/01</p>
<p>“.....We only join efforts with some stakeholders when these disasters have occurred.”RP/CRL/01</p>	<p>“.....I first and foremost recognize the role of the community in the prevention and mitigation of these disasters. The National Emergency Management Agency needs to do more in this regards as they are at the centre of any form of disaster in Nigeria. National Oil Spill Detection and response Agency is also very relevant as well as the Federal Ministry of Humanitarian Affairs, Disaster Management and Social Development of Nigeria. Also very relevant are the health agencies and NGOs.”RP/SA/01</p>	<p>“.....when collaboration in a multi stakeholder scale is adopted and practiced as it should be, there will be a tremendous improvement in the management and mitigation of pipeline disasters.” RP/FMHDS/01</p>
<p>“.....Not really. We only respond when our attention is called.”RP/HS/01</p>	<p>“.....Government agencies charged with the responsibility of handling oil spills and oil disasters, security agents should also be involved. Health agencies are also very important in the risk reduction. The multi-national oil companies as well as NNPC should be more involved in the prevention of oil pipeline disasters. The media should organize sensitization in conjunction with NEMA to discourage people involved in oil bunkering.”RP/CRS/01</p>	<p>“.....the possible effects of multi-stakeholder collaboration is a rapid reduction in the number of cases of oil pipeline disasters as have been observed in other sectors where collaboration has been practiced.”RP/NNPC/01</p>
<p>“.....Yes, we work hand in hand with NOSDRA.”RP/FMHDS/01</p>	<p>“.....All government agencies saddled with this responsibilities as well as the multi-national oil companies and the community where these pipelines pass through.”RP/NOSDRA/01</p>	<p>“.....if properly organized and arranged, collaboration by multi stakeholders will help reduce these incidences drastically.”RP/NOSDRA/01</p>

Continued on next page

Present Level of Collaboration	Roles of Collaborating Stakeholders	Impact of Stakeholder Collaboration
<p><i>".....Other sister agencies in the Federal Ministry of Environment." RP/NOSDRA/01</i></p>	<p><i>".....we the oil companies together with all government agencies as well as the local communities and security agencies all have a role to play in this all important struggle."RP/MNOC/01</i></p> <p><i>".....the host communities where pipeline traverse are very important in the prevention of pipeline disasters. When they are partners in progress, they serve as security for these pipelines. Other relevant stakeholders previously outlined include government at all levels, government agencies charged with specific responsibilities in the oil and gas sector, security agencies, health agencies and NGOs."RP/MNOC/02</i></p> <p><i>".....everyone is relevant as far as disasters in Nigeria is concerned. However, in light of the topic been discussed, I consider the community residents as relevant stakeholders in the effective management of these disasters. I also consider government agencies who serve as representatives of the government in this case. The oil companies are also very relevant in this regards as well as security agencies."RP/HS/01</i></p>	<p><i>".....as earlier stated, multi stakeholders' collaboration is the only way to go as far as this issue is concerned. It will possibly ensure that this menace is reduced drastically if not completely eliminated."RP/CRL/01</i></p> <p><i>".....multi stakeholders' collaboration will effectively mitigate and manage oil pipeline disasters as it will bring every single relevant actor in this sector together to resolve this devastating problem."RP/SA/01</i></p> <p><i>".....Multi-stakeholder collaboration will reduce to the barest minimum, occurrence of pipeline disasters as it will aid the efficient management as well as mitigate these occurrences."RP/NEMA/01</i></p>

The value of collaboration in Nigeria cannot be overstated. It is believed that lessons have been learnt from previously failed projects undertaken by the government and corrections will be made as regards collaboration of stakeholders in tackling oil pipeline disasters. The interviewees are however optimistic in this regards. Some respondents consider stakeholder collaboration as the only solution as far as effective mitigation and management of oil pipeline disaster is concerned.

In conclusion, the benefits of stakeholders' collaboration include but not limited to; better information/intelligence sharing, improved decision making, enhanced coordinated and timely intervention, and improved response.

4.11. Collaboration of stakeholders on disaster management in Nigeria

The government agency charged with the responsibility of disaster management in Nigeria is the Nigerian Emergency Management Authority (NEMA). An examination of various press reports from 2018 to date indicated no active collaborative measures in terms of interoperability exist

between stakeholders in Nigeria, but only in terms of interaction. A report by Tribune Newspaper [66] indicated that the leadership of NEMA suggests collaboration of stakeholders in disaster management as an important utility. The NEMA boss stressed the importance of collaboration between stakeholders and explained that there is no single stakeholder competent and well-equipped to single-handedly manage disasters in Nigeria.

Another report by Daily Nigerian Newspaper [67] showed the efforts of NEMA in promoting collaboration of stakeholders as an important tool in disaster management, indicating that humanitarian actors in Nigeria needed collaboration that would help to facilitate efficient coordination and response to a disaster. A critical look at literature and stakeholders perceptions reveals that when there is a lack of stakeholder collaboration or when it is insufficient, the ability to reduce risks and plan effectively is reduced. Poor collaborative networks, according to McGuire and Silvia are at least partially to blame for the unsuccessful outcomes of disaster management [68]. A good example of a significant disaster with numerous collaboration challenges is hurricane Katrina [69].

Oil communities in Nigeria's Abia State have urged greater cooperation among the stakeholders in order to improve security around the country's oil pipelines and prevent vandalism and oil bunkering since they recognize the significance of the issue [38]. According to one of the respondents from the oil companies, they are very willing to engage with other stakeholders to end the activities of vandals;

“.....we have tried to reduce agitations that usually result to vandalisation. We have also given our inputs whenever and wherever required and very willing to collaborate with relevant stakeholders when the need arises.” RP/MNOC/02

Resulting from the collaborative pact, sensitization and campaigns could be organized to enlighten those engaged in vandalisation on the negative effects of their activities on the environment, human lives as well as infrastructural relegation. Such sensitization as observed from a respondent cited below could be further strengthened when other stakeholders become involved.

“.....Within my domain, I have continuously organized sensitization among my kinsmen to stay away from all acts of sabotage that could lead to pipeline leaks or tantamount to vandalisation. Also, when these disasters eventually occur, we combine efforts with other stakeholders to manage the situation.”RP/CRL/01

In stakeholders collaboration, there is a pool of resources, including advanced technologies, available for deployment towards regular inspections and monitoring activities. When stakeholders, or people who are affected by these disasters, are included in the compliance system, cutting corners and inefficiency are greatly reduced, if not entirely eliminated. At the level of stakeholder debate, pipeline integrity techniques could be explored and accepted.

The concept of collaboration, if fully adopted in the aftermath of oil pipeline disasters, will go a long way in properly managing the disasters. Greater collaboration among nongovernmental organizations (NGOs) after disasters is important in helping them deliver services, share information, and avoid resource duplication. Following a disaster, numerous NGOs, including a large number of faith-based NGOs, typically offer disaster assistance. An active plan should be prepared to allow for a system where all stakeholders can draw on the collective strength of one another and build a formidable group of highly mobile, motivated, dedicated and trained disaster managers.

4.12. *Limitations of Collaboration*

Examples of collaborations that failed to deliver major outcomes, ran out of funding, failed to acquire enough interest or support from community leadership, or stagnated, owing to irreconcilable stakeholder issues were cited by Scott [70]. As Barbara Gray points out, “many well-intentioned measures to involve the public in government decisions, for example, are exercises in irritation” and “often worsen rather than relieve the issue”.

- i. It is best not to collaborate if one party has unchallenged power to influence the outcome;
- ii. When the conflict is rooted in deep-seated ideological differences;
- iii. When power is unequally distributed;
- iv. When constitutional issues are involved or legal precedents are sought;
- v. If a legitimate convener cannot be found.

4.13. *Challenges of Collaboration*

Each stakeholder has stated their roles and involvement as regards oil spills and oil disasters. What is lacking, however, is the collaborative efforts to put all these efforts together towards achieving greater effectiveness and efficiency. From the literature reviewed and stakeholders’ perceptions on the subject, multi-stakeholders’ collaboration will likely face a number of challenges, which if properly resolved, will ensure an effective delivery of the goals of the collaborative pact. Among these challenges are; conflicts in shared responsibilities, inadequate resources, inadequate enforcement of environmental laws and guidelines, and an inefficient communication system.

5. **Conclusion**

95.3% (286 respondents) indicated awareness of this disaster. Also, a large number of the respondents have experienced one form of loss or the other as a result of an oil pipeline disaster, having experienced as few as 1 case or as many as more than 3 cases of oil pipeline disasters.

Approximately half of the respondents indicate that their firm/institution does not partake in oil pipeline disaster management. This is indeed very discouraging. This could be as a result of the lack of a collaboration medium that will bring together relevant stakeholders in this all important aspect of the oil and gas industry. 88.3% of the respondents agree that vandalism is one of the major causes of oil pipeline disasters. Next to vandalism is the lack of collaboration amongst stakeholders (87%), thus necessitating the urgent need for collaboration.

Using a Likert scale of 5 for strongly agree, 4 for agree, 3 for neutral, 2 for disagree, 1 for strongly disagree, and 0 for don’t know, it was generally agreed that areas where oil pipeline disasters occur are often deserted. Respondents disagreed that victims of oil pipeline disasters are compensated financially. Various court verdicts ordering some of the multinational oil companies to pay victim compensation have been disobeyed. The respondents also disagreed that areas where oil pipeline disasters occur are often cleaned up. Respondents were of the opinion that there exists an insufficiency of security personnel to protect oil pipelines from vandalism. In addition, replacement of worn out or overdue pipes is not regular, and spill response equipment are not readily available on site.

The perception of respondents with regards to the existence of collaboration indicates that

interagency collaboration between the respondents' firms or institutions and other stakeholders is virtually non-existent (mean = 0.2833, S.D = 0.45137). The respondents strongly agree that collaboration can be a very effective tool in disaster management if embraced. Also, it was disagreed that the current level of collaboration between firms or institutions, and other stakeholders has been effective. Finally, there is a general neutrality on firms or institutions having clear policy and practices for collaboration with other agencies (mean = 2.60, S.D = 1.417).

The null hypothesis that "Collaboration with other stakeholders is not a disaster management technique" is rejected, with 72.3% of the respondents agreeing that collaboration can be a very good technique for the management of oil pipeline disasters if properly harnessed.

The benefits of stakeholders' collaboration include but are not limited to; better information/intelligence sharing, improved decision making, enhanced coordinated and timely intervention, and improved response. Among the challenges of collaboration are: conflicts in shared responsibilities, inadequate resources, inadequate enforcement of environmental laws and guidelines, and inefficient communication systems. However, if these challenges are properly resolved, an effective and efficient delivery of the goals of the collaborative pact will be realized.

6. Research Contributions

The research assesses the role of a collaborative approach between all stakeholders involved in disaster management, to ensure mitigation of cases of pipeline disasters in Nigeria. It provides evidence that collaboration across stakeholders can influence mitigation. This research is one of the few studies that analyses the collaborative efforts of stakeholders in pipeline disaster mitigation in Nigeria. The findings provide policy makers and planners with information about the occurrence, ecological and human impacts of pipeline disasters in Nigeria and sustainable approaches to mitigate them.

To improve the governance process, the government should be ready to work with non-governmental organizations. In this sense, civil society organizations should use their expertise to support public awareness campaigns and efforts to hold those in positions of authority responsible for their actions.

A chain of culpability that will serve as a line of accountability must be institutionalized in order to identify all people, groups, or organizations whose actions or inactions contributed to the outbreak of a disaster.

This study recommends a framework for the practice of multi-stakeholders collaboration toward effective and efficient management and mitigation of oil pipeline disasters in Nigeria.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Ibitoye V (2012) *Positioning NEMA for better Disaster Management*. Retrieved July 9, 2013, from <http://www.dailyindependentnig.com>.

2. Haddow G, Bullock J (2003) International disaster management, in Haddow G.D. & Bullock J.A (eds) *Introduction of Emergency Management*. New York: Random House, Inc.
3. John O (2004) Disaster Management as a Strategy that is implemented after any catastrophic event takes place. *Introduction of Emergency Management, New York: Random House, Inc.*
4. Saeed A, Narimah K (2019) Role of stakeholders in mitigating disaster prevalence: Theoretical Perspective. *MATEC Web of Conferences* 266: 03008. <https://doi.org/10.1051/mateconf/2019>
5. Freeman R (1984) *Strategic management: A stakeholder approach*. Cambridge university press.
6. Moe T, Gehbauer G, Sentz S, et al. (2007) Balanced scorecard for natural hazard management projects. *Disaster Prevention and Management* 16: 785–806. <https://doi.org/10.1108/09653560710837073>
7. Mojtahedi SM, Oo BL (2014) Stakeholders' Approaches to Disaster Risk Reduction in Built Environment. *Disaster Prevention and Management* 23: 356–369. <https://doi.org/10.1108/DPM-11-2013-0209>
8. Okoli A, Orinya S (2013) Oil Pipeline Vandalism and Nigeria's National Security. *Global Journal of Human Social Science* 13: 67–75.
9. Godschalk D (2003) Urban hazard mitigation: Creating resilient cities. *Natural Hazards Review* 4: 136–143. [https://doi.org/10.1061/\(ASCE\)1527-6988\(2003\)4:3\(136\)](https://doi.org/10.1061/(ASCE)1527-6988(2003)4:3(136))
10. Britton N (2002) A New Emergency Management for the New Millennium. *Australian Journal of Emergency Management, the* 16: 44–54.
11. Pearce L (2003) Disaster management and community planning, and public participation: how to achieve sustainable hazard mitigation. *Natural Hazards* 28: 211–228. <https://doi.org/10.1023/A:1022917721797>
12. Ereibi AG (2011) Oil exploitation and challenges of development in the Niger Delta region. *A Project Report Presented to the Department of Political Science, Faculty of the Social Sciences, University Of Nigeria, Nsukka.*
13. Nwokeji GU (2007) *The Nigerian National Petroleum Corporation and the development of the Nigerian oil and gas industry: History, strategies and current directions*. James A. Baker III Institute for Public Policy, Rice University.
14. Onuoha F (2007) Poverty, Pipeline Vandalism and Explosion and Human Security: Integrating Disaster Management into Poverty Reduction in Nigeria. *African security Review* 16: 94–108.
15. Moe TL, Pathranarakul P (2006) An integrated approach to natural disaster management: public project management and its critical success factors. *Disaster Prevention and Management* 15: 396–413. <https://doi.org/10.1108/09653560610669882>
16. Wilkinson S, Masurier LJ, Seville E (2006) Barriers to Post Disaster Reconstruction, Wellington.
17. Lindsay JR (1993) *Exploring the interface of urban planning and disaster management: establishing the connection between the fields.*
18. UNISDR, UNISDR terminology on disaster risk reduction, 2009. Available from: <https://www.undrr.org/publication/2009-unisdr-terminology-disaster-risk-reduction>.
19. NEMA Handbook (2010) National Emergency Management Agency: DRR Profile, 2010. Available from: <https://nema.gov.ng/documentations/National%20Disaster%20Response%20Plan.pdf>
20. UNDP, Disaster Management, 1992. Available from: https://www.physio-pedia.com/Disaster_Management.

21. Van Niekerk D (2010) *A framework for multi-sphere disaster risk reduction: The case of South Africa*. LAP LAMBERT Academic Pub..
22. Sani M, Nigeria: NEMA Develops National Contingency Plan on Disaster Management, 2012. Available from: <http://allafrica.com/stories/201206180409.html>.
23. Ezenyilimba E, Maduagwu NE, Eze JO (2018) Disaster Management in a Volatile Ecowas Region: Nigeria Perspective. *International Journal of Academic Research in Economics and Management Sciences* 7: 30–46. <https://doi.org/10.6007/IJAREMS/v7-i3/4287>
24. NDMF (2010) National Emergency Management Agency (NEMA). National Disaster Management Framework (NDMF), 2012. Available from: http://www.preventionweb.net/files/21708_nigherianationaldisastermanagementf.pdf.
25. Channels Television, Major Pipeline Explosions that took place in Nigeria, 2020. Available from <https://www.channelstv.com/2020/03/16/major-pipeline-explosions-that-took-place-in-nigeria/>.
26. Johnson S, Robinson J, Thaicharoen Y (2004) Institutional causes, macroeconomic symptoms: Volatility, crises and growth. *Journal of Monetary Economics* 50: 49–123. [https://doi.org/10.1016/S0304-3932\(02\)00208-8](https://doi.org/10.1016/S0304-3932(02)00208-8) (2004)
27. Nwachukwu C (2006) *Nigeria loses N29.4 billion per day to rebel attacks*. The Punch, 4.
28. Okoli A (2013) The political ecology of the Niger Delta crisis and the prospects lasting peace in the Post-Amnesty Period. *Global Journal of Human Social Science* 13: 37–46.
29. Hillman AJ, Keim GD (2001) Shareholder value, stakeholder management, and social issues: what's the bottom line? *Strateg Manag J* 22: 125–139. [https://doi.org/10.1002/1097-0266\(200101\)22:2<125::AID-SMJ150>3.0.CO;2-H](https://doi.org/10.1002/1097-0266(200101)22:2<125::AID-SMJ150>3.0.CO;2-H)
30. Minoja M (2012). Stakeholder management theory, firm strategy, and ambidexterity. *Journal of Bus Ethics* 109: 67–82. <https://doi.org/10.1007/s10551-012-1380-9>
31. Phillips R (2003) *Stakeholder theory and organizational ethics*. Berrett-Koehler Publishers.
32. Roloff J (2008) Learning from Multi-Stakeholder Networks: Issue-Focussed Stakeholder Management. *Journal of Business Ethics* 82: 233–250. <https://doi.org/10.1007/s10551-007-9573-3>
33. Briggs RO, Kolfshoten GL, Gert-Jan de Vreede DD (2006) Defining key concepts for Collaboration Engineering. AMCIS 2006. *Proceedings Americas Conference on Information Systems (AMCIS) 2006*: 121–128.
34. Camarihna-Matos LM, Afsarmanesh H (2008) Concept of Collaboration. *Encyclopedia of Networked and Virtual Organizations* 2008: 311–315. <https://doi.org/10.4018/978-1-59904-885-7.ch041>
35. Himmelman A (2001) On coalitions and the trans-formation of power relations: Collaborative betterment and collaborative empowerment. *American Journal of Community Psychology* 29, 277. <https://doi.org/10.1023/A:1010334831330>
36. Mustapha-Koiki AR (2019) Journalism and Risk: The Impact of Boko Haram Attacks on News Content and Journalists' Patterns of News Gathering and Reporting in Nigeria (2011-2012).
37. Usman M (2013) Corruption in Nigeria: A Challenge to Sustainable Development in the Fourth Republic. *European Scientific Journal* 9: 118–137.
38. Premium Times, 2019. Available from: <https://www.premiumtimesng.com/regional/ssouth-east/370383-how-to-secure-oil-pipelines-against-vandals-abia-community.html>.

39. NEPA (2007) *Collaboration in NEPA, A Handbook for NEPA Practitioners*. Executive Office of the President, United States of America. USA: Results of research and consultations by the Council on Environmental Quality (CEQ).
40. Olaniyan A (2015) The multi-agency response approach to the management of oil spill incidents: legal framework for effective implementation in Nigeria. *Journal of Sustainable Development Law and Policy (The)* 6: 109–128. <https://doi.org/10.4314/jsdlp.v6i1.5>
41. Emerson K, Baldwin E (2019) Effectiveness in NEPA decision making: in search of evidence and theory. *Journal of Environmental Policy & Planning* 21: 427–443. <https://doi.org/10.1080/1523908X.2019.1615421>
42. Lawal T, Oluwatoyin A (2011) National development in Nigeria: Issues, Challenges Prospects. *Journal of Public Administration and Policy Research* 3: 237–241.
43. Chilwa I (2011) Media Representation of Nigeria’s Joint Military Task Force in the Niger Delta Crisis. *International Journal of Humanities and Social Science* 1: 197–208.
44. Ngunan T (2013) Multi-Agency Approaches to Conflict Management in Nigeria. *Journal of the Society for Peace Studies and Practice* 1: 36–48.
45. Alufoge O, Duruji M (2020) November 2020. Multinational Joint Task Force’s Fight against Insurgency in the Lake Chad Basin Region. *WSEAS Transactions on Environment and Development* 16: 794–801. <https://doi.org/10.37394/232015.2020.16.82>
46. MNJTF, MNJTF. About the Force, 2022. Available from: <https://mnjtffimm.org/about/>.
47. Gimba D (2007) *War against human trafficking: The journey so far in S.E Arase & I.P.O. Iwuofor (eds.), Policing Nigeria in the 21st Century*. Ibadan: Spectrum Books Limited.
48. Mbumega A, Cyril O A (n.d.). Inter-Agency Cooperation: An Approach to Conflict Management and Security Provisioning in Nigeria. Accessed via: https://www.academia.edu/37118388/Inter_Agency_Cooperation_An_Approach_to_Conflict_Management_and_Security_Provisioning_in_Nigeria.
49. Jega A (2012) The electoral process and security sector synergy. *A Paper Delivered to EIMC 6 Participants of Institute for Security Studies (ISS)*.
50. Olaoluwa O (2020) Nigerian banks want fintech collaborations for specific needs, 2020. Available from: <https://inclusiontimes.com/nigerian-banks-want-fintech-collaborations-for-specific-needs/>.
51. TechCabal, Nigerian banks want fintech collaborations, but for specific and unique needs, 2020. Available from: <https://headlines.ng/nigerian-banks-want-fintech-collaborations-but-for-specific-and-unique-needs/>.
52. Levin A, FINTECH Africa. NIBSS is Nigeria’s Most Impactful Fintech Company, 2019. Available from: <https://www.financialtechnologyafrica.com/2019/06/12/nibss-is-nigerias-most-impactful-fintech-company-andrew-levin/>.
53. Premium Times (2021) *Nigeria’s Presidential Task Force on COVID-19 gets new role*, 2021. Available from: <https://www.premiumtimesng.com/news/headlines/453562-just-in-nigerias-presidential-task-force-on-covid-19-gets-new-role.html>.
54. StateHouse (2020) About the PTF. Seal of the President, Federal Republic of Nigeria. Available from: <https://statehouse.gov.ng/covid19/objectives/>

55. Vanguard (2022) Nigeria signs MoU with Equatorial Guinea to develop, supply natural gas. Available from: <https://www.vanguardngr.com/2022/03/nigeria-signs-mou-with-equatorial-guinea-to-develop-supply-natural-gas/>.
56. EGASPIN (2002) *Containment Procedures and Clean-Up of Spills, para 2.6.3*. Nigeria: Environmental Guidelines and Standards for the Petroleum Industry in Nigeria.
57. Altay N, Green M (2006) OR/MS research in disaster operations management. *European Journal of Operational Resources* 175: 475–493. <https://doi.org/10.1016/j.ejor.2005.05.016>
58. NPC, Nigerian Population Commission, Report of National Census of, 2006. Available from: <https://nigeria.opendataforafrica.org/ifpbxbd/state-population-2006>.
59. Okonkwo T, Etemire U (2017) “Oil Injustice” in Nigeria’s Niger Delta Region: A Call for Responsive Governance. *Journal of Environmental Protection* 8: 42–60. <https://doi.org/10.4236/jep.2017.81005>
60. Taber K (2018) The Use of Cronbach’s Alpha When Developing and Reporting Research Instruments in Science Education. *Research in Science Education* 48: 1273–1296. <https://doi.org/10.1007/s11165-016-9602-2>
61. Islam A, Khan AM, Obaidullah AM, et al. (2011) Effect of Entrepreneur and Firm Characteristics on the Business Success of Small and Medium Enterprises (SMEs) in Bangladesh. *International Journal of Business and Management* 6: 289–299. <https://doi.org/10.5539/ijbm.v6n3p289>
62. Braun V, Clarke V (2006) Using thematic analysis in psychology. *Qualitative Research in Psychology* 3: 77–101. <https://doi.org/10.1191/1478088706qp063oa>
63. Yin RK (2018) *Case Study Research Design and Methods* (6th Ed. ed.). Thousand Oaks, CA: Sage Publishing.
64. Creswell J, Poth C (2017) *Qualitative Inquiry and Research Design: Choosing among Five Approaches*. New York: Sage Publications.
65. Marshall C, Rossman G (2016) *Designing Qualitative Research* (6th Edition ed.). Thousand Oaks, CA: Sage Publications.
66. Tribune Online, NEMA Tasks Stakeholders on Disaster Management, 2019. Available from: <https://tribuneonlineng.com/nema-tasks-stakeholders-on-disaster-management/>.
67. Daily Nigerian, Stakeholders Collaborate to Tackle Disasters in Sokoto, 2019. Available from: <https://dailynigerian.com/30-stakeholders-collaborate-to-tackle-disastersin-sokoto/>.
68. McGuire M, Silvia C (2010) The effect of problem severity, managerial and organizational capacity, and agency structure on intergovernmental collaboration: evidence from local emergency management. *Public Administration Review* 70: 279–288. <https://doi.org/10.1111/j.1540-6210.2010.02134.x>
69. Kiefer J, Montjoy RS (2006) Incrementalism before the storm: network performance for the evacuation of New Orleans. *Public Administration Review* 66: 122–130. <https://doi.org/10.1111/j.1540-6210.2006.00672.x>
70. Scott L (2022) Collaboration and Community Visit. *A Report Prepared for the Pew Partnership for Civic Change*, pp. 1-16. Retrieved from www.scottlondon.com.
71. Aljazeera, Timeline of Nigeria Pipeline Disasters, 2006. Available from: <https://www.aljazeera.com/news/2006/5/12/timeline-of-nigeria-pipeline-disasters>.
72. Reuters, Timeline: Deadly Nigerian Pipeline Disasters. Available from: <https://www.reuters.com/article/us-nigeria-pipeline-disasters-idUSL156694802008051>.

Appendix

S/N	Date	Location	Cause	Human Effects	Ecological Effects	Source
1	Feb. 7, 2000	Ogwe, Abia State		17 dead	Damage to farmlands and the environment	[71]
2	March 20, 2000	Isioma, Abia State		50 dead		[71]
3	May 2000	Diebu	Vandalisation		Soil, Air and Water Pollution. Loss of arable land. Fishing activities are restricted.	
4	June 21, 2000	Okuedjeba, Warri		28 dead	Damage to farmlands, environmental pollution	[71]
5	July 10, 2000	Jesse, Delta State		Over 250 people died	Damage to farmlands, environmental pollution, dozens of people injured	[25,72]
6	July 11, 2000	Adeje	Sabotage by locals	At least 150 deaths	Damage to farmlands, environmental pollution	[14]
7	July 17, 2000	Jesse, Delta State	Sabotage by locals		Soil, Air and Water pollution. Loss of arable land. Loss of aquatic species.	
8	July 23, 2000	Afrokpe, Sapele, Warri		40 dead and 15 more (next day)		[71]
9	Nov. 30, 2000	Ebute Metta, Lagos	Pipeline leakage	Over 60 lives		[71,72]
10	August 2001	Ishiagu	Sabotage	Loss of lives and properties.	Water and Soil pollution. Loss of arable land.	
11	Nov. 5, 2001	Umudike, Imo State	Oil-leak	15 people died while several others sustained severe burns.		[71]
12	Jan. 3, 2002	Escravos	Sabotage		Water, Air and Soil pollution. Loss of ecological and aquatic species	
13	Oct. 15, 2002	Akure, Ondo State	Sabotage by locals	20 people died	Air, Water, and Soil pollution	
14	Sept. 29, 2002	Akute-Odo, Ogun State	Vandalisation	Several deaths and plenty of injuries		[71]
15	June 19, 2003	Umuahia, Abia State	Vandalisation by thieves	125 lives were lost	Dozens of people injured, damage to farmland	[25,71]
16	Sept. 26, 2003	Forcados	Sabotage		Water, Air, and Soil Pollution. Loss of Ecological and aquatic species	

Continued on next page

S/N	Date	Location	Cause	Human Effects	Ecological Effects	Source
17	Sept. 17, 2004	NNPC Lagos	VanVandalisation thieves	Over 20 lives		[72]
18	Dec. 2004	Imore Village	Sabotage by locals	500 people died	Environmental pollution	[14]
19	Aug. 2005	Oso	Sabotage by locals	200 people burnt to death. Loss of property.	Loss of arable land.	
20	March 2006	Nembe	Sabotage by locals	50 people died.	Loss of revenue. Soil, Water and Air Pollution.	
21	May 12, 2006	Inagbe Beach, Lagos		Over 250 lives were lost		[25,72]
22	May 2006	Diebu Creek/Brass	Sabotage by locals		Loss of revenue. Soil, Water, and Air pollution.	
23	Dec. 2, 2006	Ijeododo	Pipeline rupture	10 people died.	Environmental pollution and damage to farmlands.	[14]
24	Dec. 26, 2006	Abule Egba, Lagos	Vandalisation	Over 500 lives	Incineration of 40 vehicles, a dozen homes including a mosque and two churches, and innumerable business ventures comprising auto mechanic workshops, a saw mill and network of timber shops	[25]
25	Dec. 15, 2007	Ikate, Lagos	Pipeline rupture	About 50 people died. Many injured, mostly youths		
26	Dec. 26, 2007	Lagos		Over 45 lives were lost		[72]
27	May 15, 2008	Ijegu, Lagos	Damaged pipeline	150 people died. Loss of properties. Loss of revenue.	Soil, water, and air pollution.	[72]
28	Jan. 12, 2013	Arepo, Ogun State	Accidental Leak	At least 3 lives.		[25]
29	May 18, 2014	NNPC Jetty, Okrika	Vandalisation	About 7 lives and several injuries.		[25]

Continued on next page

S/N	Date	Location	Cause	Human Effects	Ecological Effects	Source
30	Mar. 29, 2016	Agip, Bayelsa	During Pipeline Repair	3 dead. Many injured		[25]
31	June 9, 2016	NPDC, Sanomo Creek, Ogidigben, Warri	Pipeline explosion	None		
32	July 29, 2016	Arepo	Pipeline explosion	105 people died. Loss of properties.	Loss of arable land.	
33	Nov. 8, 2016	NNPC Forcados				
34	July 2, 2018	Ilara, Ogun State				
35	Oct. 12, 2018	Umueze, Abia State	Fuel Scooping from vandals pipeline	19 people		[25]
36	Mar. 2, 2019	Nembe	Accidental leak	50 people died. Loss of revenue.	Soil, Water, and Air pollution.	
37	June 4, 2019	Ijegun	Vandalisation	About 10 lives. Over 30 cars burnt.		[25]
38	June 22, 2019	Komkom, Rivers	During maintenance	10 lives were lost.		[25]
39	August 30, 2019	Abura, Otu-Jeremi, Delta			Spillage in the community.	
40	Dec. 5, 2019	Gloryland Estate, Isheri Olofin, Lagos	Explosion	2 deaths		



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