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Research article

Developing a framework for stakeholders collaboration in the management and mitigation of oil pipeline disasters in Nigeria

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Abstract: Multi Stakeholders collaboration becomes imperative when a single agency such as the NNPC or the Oil Companies alone cannot adequately address a recurring menace such as oil pipeline disasters. Thus, agencies such as National Emergency Management Agency (NEMA), NOSDRA, FMHDSD, Fire Service, Oil Companies, Health and Security agencies, the Media and Academia, as well the Community must seek to promote cooperation in order to achieve successful oil pipeline disaster policy implementation. To achieve this goal efficiently and effectively, a framework for stakeholders' collaboration in the management and mitigation of oil pipeline disasters in Nigeria was developed in this study, following a logical path and adopting the use of interviews conducted among the main stakeholders and with industry experts. In a bid to achieve an un-biased opinion, questionnaires and document analysis of data obtained from secondary sources was carried out.

A framework for the mitigation of oil pipeline disasters before, during and after disaster occurrence was developed. The framework captures the relevant stakeholders as well as their roles in disaster mitigation.

Keywords: collaboration framework; disaster management; disaster management; oil pipeline disasters; Multi-Stakeholders

1. Introduction

1.1. Background

With a capacity of 2.5 million barrels per day, Nigeria was ranked the largest oil producer in Africa and sixth in the world in 2018, according to the Nigerian Petroleum Development Company [1]. United States Energy Information Administration (EIA) reported that the estimated value of Nigeria's oil reserves is between 16 and 22 billion barrels (2.5 x 10^9 and 3.5 x 10^9 m^3) [2]. Thus, Nigeria is ranked tenth on the list of the most petroleum rich countries and by far the most opulent in Africa. Nigeria produced over 2,200,000 barrels (350,000 m^3) of crude oil per day in 2001 [3]. Oil vandalism, militancy, unintentional spills related to oil transportation, and ecological damage have all been brought on by Nigeria's massive oil production and oil potential [4]. If proper measures are not carried out to reduce the risks linked with the oil crisis, the possibility of a disaster happening increases under these scenarios. This might create significant issues, particularly in the communities that produce oil.

The resource regions became more vulnerable to a succession of armed attacks and regional pressure as the importance of petroleum resources as a significant source of economic advantages became increasingly apparent [5,6]. The Niger Delta or South-South region of Nigeria, which contains the majority of the nation's primary reserves, is the area where oil-related problems are most prevalent [7].

The Nigerian Petroleum Pipeline network (Figure 1) is a system of lines designed to transport goods containing petroleum over long distances. These line-frameworks are designed to transport either mixed liquids or monotype liquids from one part of the country to the next. The Nigerian pipeline network today spans the entire nation. They are used to transport crude oil and its byproducts from the oilfields to the terminals, at which point they are either exported or used as raw materials by refineries to produce refined products.

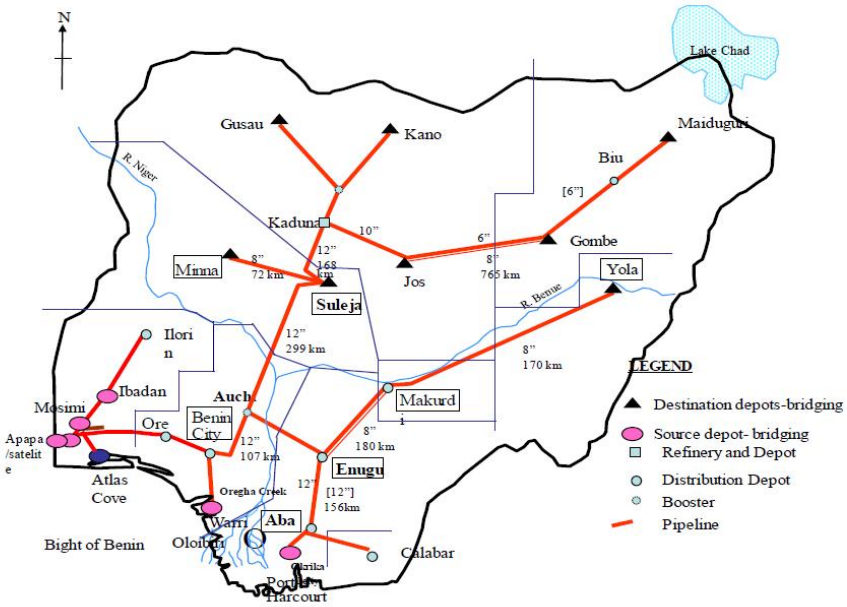

Figure 1. The network of pipelines in Nigeria. Source: Nigerian National Petroleum Corporation.

In some developing countries, the extraction, processing, and transportation of petroleum have caused ecosystem disruption, environmental damage, and fatalities [8–10]. The difficulties related with oil, which are mostly oil spills, crude oil theft, illegal refining of crude oil, oil truck accidents, pipeline vandalism, and explosions, were caused and made worse by the government's incompetence to regulate the procedures around petroleum management [11,12]. All of these issues, which pose a threat to human life and the environment, are regarded as the main issues with regard to oil extraction in almost every region of the world. A disaster is an unanticipated event or a natural catastrophe that significantly disrupts a community's or society's functioning and, as a result, causes disruptions in human and economic activity [13]. It is a phenomenon that causes significant loss and misfortune, and when it occurs, it can ruin peoples' socioeconomic and cultural well-being as well as their lives and their property. Disasters can range from devastating natural occurrences like earthquakes, wildfires, floods, windstorms, and tsunamis to those that are caused by human activity, including pipeline disasters brought about by explosions or pipeline vandalism.

1.2. Statement of the problem

Nigeria being a major oil producing country has been investigated to have rich crude reserves and therefore, contributes significant quota to OPEC basket through its oil exploration particularly in the Niger Delta region of the country [14]. With three refineries and substantial import of refined products through Lagos port, the length and breadth of the vast country is service through pipelines and tanker deliveries [4]. In recent years, the country has been plaque by several disasters involving oil pipelines and tankers. Amongst the incidents include the April 29, 2019 Chevron oil field inferno in Ondo State, pipeline explosion near Umuahia in 2018, which led to the death of more than 105 people. Furthermore, based on the figures released by the Nigerian Red Cross in 2006 (NPC, 2006), at least 200 people were killed at Abule Egba as a result of pipeline disaster. Also, pipeline explosion in 2000 killed about 250 villagers in Warri. Prior to this was the pipeline fire of 2003 in Ebute, Lagos which killed 60 residents.

Apart from human loss associated with these disasters, the effect on ecological impact has devastating [4]. Throughout these incidences, the recurring factor is that residents were always at the scene of a leaked pipe scoping product for commercial gains due to ignorance and widespread poverty. It seems therefore that either lessons were not learnt from previous occurrences or every stakeholder was not carried along in mitigating the risks associated with oil pipeline disasters. Most often, emergency mangers often arrived late and ill-equipped. For this purpose, this research aims at examining the role of stakeholders' collaboration in mitigating losses and occurrence of oil pipeline disasters in Nigeria.

Merger work has reported the role of individual stakeholders in disaster management. However, collaborative work on pipeline disaster management has not received extensive reviews. Within the disciplines of both planning [15] and emergency management [16], scholars have noted the value of collaboration for long-term disaster mitigation. Sustainable disaster mitigation requires the integration of multi-stakeholder's emergency management and planning [17]. This research provides evidence that collaboration across stakeholders can influence mitigation. This research is one of few studies that analyses 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 disaster in Nigeria and sustainable approaches to mitigate it.

1.3. Objectives

i. To examine the level of pipeline disaster awareness among stakeholders.
ii. To identify relevant stakeholders in disaster management.
iii. To examine the roles of stakeholders in preventing and managing oil pipeline disasters.
iv. To design a framework for the management and mitigation of oil pipeline disasters in Nigeria.

2. Empirical literature review

2.1. Pipelines disasters

Among all these anthropogenic disasters in relation to crude oil processing and transportation, pipeline disaster has been considered the most frequent and of more negative environmental and health impact than others in the 21st century. Nigeria, covering an estimated land area of 923,800 km^2 with 5120 km network of pipelines, has suffered a number of pipeline disasters over the years. A burst hydrocarbon pipeline can release large quantities of flammable compounds (Figures 2 and 3), igniting forest, natural habitats and residential homes. Pipeline disaster in Nigeria have occurred as a result of several causes. These include vandalism, pipeline ruptures resulting from lack of maintenance, operational error, environmental factors, etc.

Oil pipeline vandalism is likewise referred to in Nigeria as oil bunkering, which is the demonstration of penetrating into the pipelines with the plan to steal oil products. An aggregate of 16,083 pipeline breaks were recorded inside the most recent 10 years adding that while 398 pipeline breaks corresponding to 2.4 percent were because of ruptures, the operations of treacherous vandals represented 15, 685 breaks which meant around 97.5 percent of the total number of cases [1].

The unending assaults on pipelines by unpatriotic hoodlums over the last 20 years brought about the idea of the prospect of burying the pipelines 12 m subterranean level by the Nigerian Government as they will be less vulnerable to assault [18]. This has not solved the problem. The activities of pipeline miscreants according to Nigerian National Petroleum Corporation (NNPC), brought about a huge loss of over N174.57 billion in products losses and replacement and fixing of pipelines in the last 10 years. The ecological implications of these incorporate far reaching biological damage, loss of biodiversity and financial issues. Without a doubt, the rate of oil pipeline vandalism has been on the increase in Nigeria [19]. Another form of pipeline disaster is the rupturing of the pipelines. Indeed, ruptured pipelines pose great risks to life, properties and environment. Most of the pipeline installations seem to rupture as a result of poor maintenance and surveillance which consequently leads to corrosion of these pipelines [20]. Since there is an extensive network of pipelines in the Niger Delta, corrosion causes leakage in pipes which results to oil spillage in the region [6]. As for the onshore areas, a lot of pipelines are exposed to rupture as they lay above ground [21]. More so, since these pipelines lack the required maintenance and end up being used above their life spans usually 15 years, they become vulnerable to corrosion and ultimately rupture [6].

Figure 2. Pipeline Disaster, Ijegun area of Lagos, Nigeria (CGTN, 2019).

Figure 3. Pipeline Disaster, Warri, Nigeria (NOGTEC, 2019).

2.2. Previous considerations of collaboration in disaster management

In light of the upsurge in the occurrence of disasters across the country, the Federal Government of Nigeria through Decree No 12 of 1999 set up the National Emergency Management Agency (NEMA) as the pinnacle public sector organization for the management of emergencies. The empowering enactment contains ideas like co-ordinate, liaise, monitor and collect, among others which surmises that NEMA is a coordinating agency [22].

Findings have revealed that the stakeholders' perspectives on their collaborative relationship are patterned. In the NOPR, for example, there is a "uneven" connection between oil firms, government agencies, and communities when it comes to oil disaster and its management. Government agencies act in isolation and only involve one another when disasters occur. Communities are not informed about the government's consultation with oil firms. Even when the government takes action, the

communities are excluded from the decision-making process.

Similarly, when the responsibilities of stakeholders were examined, it was shown that different stakeholders have distinct interests, practices, drives, and barriers. Various stakeholders have contributed at one point in time or the other towards oil disaster management. However, these stakeholders have never really worked as a group with a common goal. The responsibilities of government agencies; MNOCs; security and health agencies; media and academia; and host communities in the NOPR have a significant impact on the oil pipeline disaster management decisions. For example, the Shell Petroleum Development Company of Nigeria (SPDC) frequently mentions its collaborative involvement with the National Coalition on Gas Flaring and Oil Spills in the Niger Delta in their stakeholders' treatise on the oil leak case (NACGOND). Similarly, the SPDC expresses their views on community relations [23].

Ecological issues from oil production have contributed to immense environmental debasement and effects on the existences of individuals in the Nigerian oil-producing region (NOPR). Research till date has recommended the significance of stakeholders' collaboration in overseeing ecological issues. A framework for stakeholders' collaboration was created by Onuoha [21], to add upon existing information in the advancement of a collaborative environmental management in the NOPR. The Ostrom's institutional analysis and development (IAD) framework and the theory of common pool resource were extended to inform the interpretation of collaborative roles of stakeholders in managing environmental issues in the NOPR. Adhering to the theoretical suggestions of stakeholder analysis/IAD framework and to allow a robust investigation of stakeholders' collaboration. Key stakeholders identified in the research include Nigerian government agencies, multinational oil companies and host communities.

2.3. Collaboration as a disaster mitigation technique

Various researchers have strongly opined that collaboration amongst relevant stakeholders can be a veritable tool in the management and mitigation of disasters. The significance and effectiveness of of collaborative approach in mitigating farmer-herdsmen conflicts in North-central Nigeria have been established [24]. Bodin and Nohrstedt investigated the performance of collaborative disaster management strategies from a Swedish wildlife response [25] . Other researches on collaboration include: Inter-agency collaboration and disaster management, a case study of the 2005 earthquake disaster in Pakistan [26]; Supply Chain Resilience: Unleashing the Power of Collaboration in Disaster Management [27]; Challenges in multi-agency collaboration in disaster management: a Sri Lankan perspective [28]; Nguyen et al. (2017), Public-private collaboration for disaster risk management: A case study of hotels in Matsushima, Japan [29]; Disaster management collaboration in Turkey: Assessing progress and challenges of hybrid network governance [30]; Fostering collaboration for knowledge and action in disaster management in South Africa [31]; Collaborative disaster management: An interdisciplinary approach [32], and many more.

The study reaffirmed the need for moving beyond single actors in response to disasters to a collaborative approach involving all stakeholders by enabling more precise decisions and actions to mitigate the disaster. Some challenges such as how to integrate activities and tasks of various stakeholders may affect the collaboration network.

Also, previous researchers have extensively discussed the role of individual actors in disaster management [33,34]. However, natural disasters are known to present multiple societal and

environmental challenges beyond the realms and capabilities of single actors and therefore complex collective actions are imperative [35]. Furthermore, studies rarely investigate the possibilities of collaborative approaches in disaster mitigation and management. Hence, it is the intention of this study to assess the collaborative effects of these stakeholders simultaneously during and after the oil pipeline disaster in Nigeria. Collaboration in oil pipeline disaster management is discussed further.

3. Research methodology

The research adopts semi-structured interviews which was conducted among the main stakeholders and with industry experts in a bid to achieve an un-biased opinion. Semi-structured interviews is advocated since it accommodated asking incisive questions in view of the research focus thereby allowing for follow-up questions and comprehensive engagement [36] . Interviews were conducted for 10 different participants (Table 1). The interview data collection and analysis following the sequence illustrated in Figure 4.

Table 1. Stakeholders interviewed.

Interviewee	Code Name	Role
01	RP/NEMA/01	National Emergency Management Agency
02	RP/NNPC/01	Nigeria National Petroleum Corporation
03	RP/CRS/01	Community Resident
04	RP/CRL/01	Community Leader
05	RP/SA/01	Security Agency (Civil Defence monitoring Pipeline)
06	RP/NOSDRA/01	National Oil Spill Detection and Response Agency
07	RP/MNOC/01	Multi National Oil Company 1
08	RP/MNOC/02	Multi National Oil Company 2
09	RP/HS/01	Health Sector
10	RP/FMHDSD/01	Federal Ministry of Humanitarian Affairs, Disaster Management and Social Development

Source: Author Generated

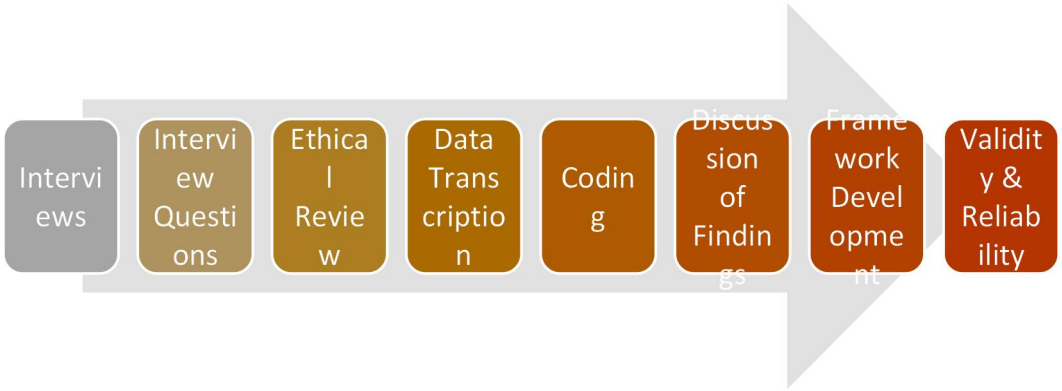

Figure 4. Data collection and analysis.

3.1. Analysis of qualitative data from survey

The interview was recorded and listened to severally, after which transcription was done to achieve a comprehensive understanding [37] . Transcribed data was coded into structured codes thereby making it easy to derive themes following hierarchical categorization [38]. The research was guided by Nvivo [39] while the analytic thinking was undertaken by the researcher [40]. This led to summary of results, description and critical analysis. This was further validated with some of the research participants before the outcome of final result and discussion [38]. Adopting Nvivo software, analysis of the interview recording was carried out using the steps described by [37]. This present study follows the philosophical assumptions as regards the ontological, epistemological as well as methodogical viewpoint.

4. Data analysis & results presentation

4.1. Level of awareness amongst stakeholders

The level of awareness among stakeholders was tested using online questionnaires designed on kobo toolbox software and administered via web by sms and emails as a result of the coronavirus pandemic which led to total and partial lockdown across Nigeria in 2020. The response analyzed using IBM SPSS Software showed that 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 oil pipeline disaster, having experienced as few as 1 case or as much as more than 3 cases of oil pipeline disasters as observed in Table 2.

Table 2. Cross tabulation of pipeline disaster awareness level and Niger delta region residency.

		Are you from the Niger Delta Region of Nigeria?		
		No	Yes	Total
Are you aware of pipeline disasters?	No	5	9	14
	Yes	84	202	286
Total		89	211	300

Source: IBM SPSS Analysis Software

Table 2 shows the cross-tabulation of respondents from the Niger Delta region if Nigeria and respondents' awareness of oil pipeline disasters. From the table, out of the 286 respondents that indicated awareness of pipeline disasters, 202 are from the Niger Delta region while 84 are not from the region. Only 14 respondents are not aware of pipeline disasters, 9 from the region and the remaining 5 respondents are not from the region.

4.2. Collaboration elements

Review of Literature shows that the major elements in a collaboration pact are; trust, accountability, mutual interdependence, and, transparency.

Understanding the nature of trust and how to use it will be extremely beneficial to collaborative partners in terms of how to build, develop, and manage their relationships. During the collaboration process, it is advantageous for partners to reflect on what they have learned and how that learning improves the partnership [41]. Deliberate development of trust mechanisms is one important challenge that should be pursued to improve trust in collaborative setups.

Accountability is a component of the institution's checks and balances system, according to [42], and is linked to partners' internal obligations. They argue that "accountability" entails more than just being held accountable, and that accountability can have far higher consequences. When goals and obligations are clearly specified, it is believed that accountability may be more effectively attained in formal partnerships when these things are publicly stated [43].

Governance ethics defines transparency as each partner agency's right to be informed about matters and decisions that affect the partnership process [44]. Clear and simple descriptions of each viable course of action, as well as thorough information on the rationale for each decision, are critical decision-making aids [45]. Closer collaboration between partners promotes better trust and, as a result, more fruitful collaboration, according to these proponents. As a result, they will be more productive and confident in the collaborative process.

To summarize, this study defines collaboration elements in partnership working as (a) the "mutual interdependence" of the stakeholders involved in the collaborative pact; (b) "trust" between stakeholders in the collaboration; (c) "transparency" in disaster mitigation decision-making processes; and (d) the "accountability" of the stakeholders in the partnership working to each other and to the local communities involved (Figure 5).

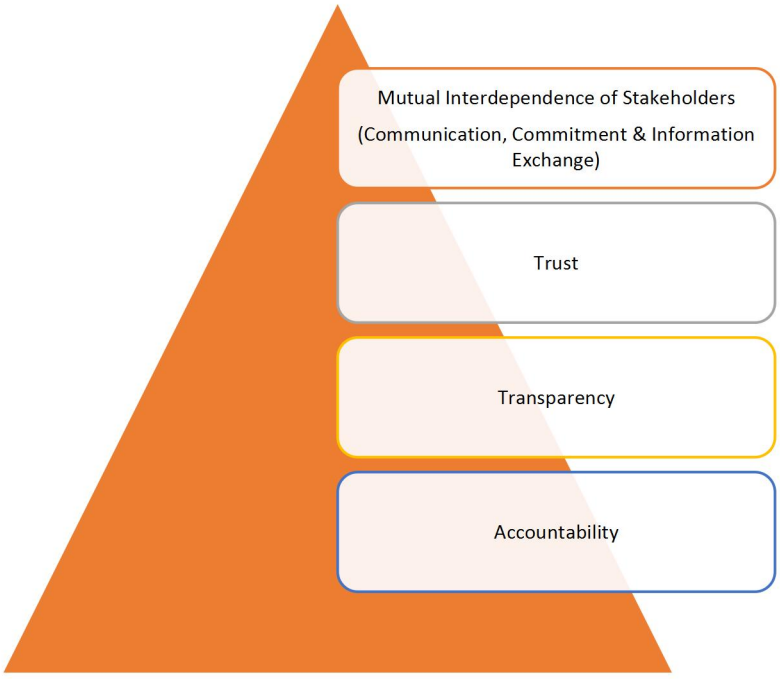

Figure 5. Elements of collaboration in pipeline disaster management (Author Modified).

4.3. Communication in collaboration

Goodman and Dion define communication as the formal and informal exchange of reliable and

relevant information between parties [46]. The importance of communication in achieving a good partnership among stakeholders cannot be overstated. It is critical to open up more channels of communication because this can influence how decisions are made [47]. According to Kasper-Fuherer and Ashkanasy, sufficient attention to collaboration processes in the cooperation framework is required for communication of trust and transparency [48]. Maintaining reciprocal dependency, trust, transparency, and responsibility in the collaborative framework is critical.

Fast and reliable communication is critical in this approach, especially when pipeline mishaps occur. Before, during, and after the occurrence of oil pipeline disasters, the framework will explicitly specify the mode of communication that will be used. This could include emails, text messages, emergency phone lines, and virtual meetings, depending on the situation. An overview of the communication model is illustrated in Figure 6.

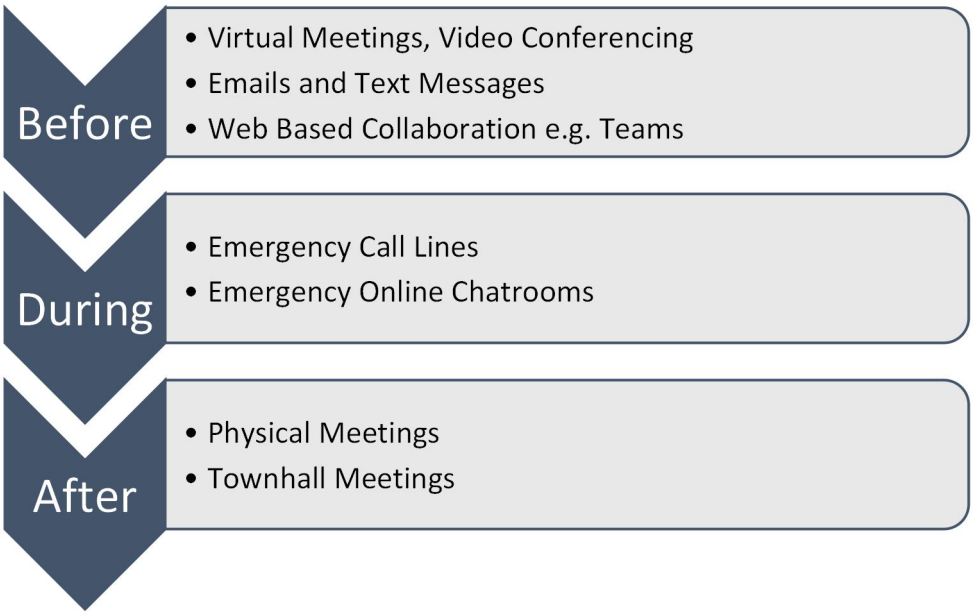

Figure 6. Communication model (Author Generated).

This model proposes a virtual means of communication prior to the occurrence of pipeline disasters as this will be more convenient and create opportunity for an increased frequency of meetings and information dissemination. During disasters, emergency call lines and chartrooms are proposed due to the nature of the occurrence while physical meetings are proposed in the aftermath of disasters so that an on-site assessment can be achieved especially the agencies responsible for environmental clean-up and rehabilitation of victims.

4.4. Level of stakeholder collaboration

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 exists between stakeholders in Nigeria but only in terms of interaction. This was also observed during the interview. Some of the responses are presented in the Appendix section of this research.

Where collaboration happens to exist, it is not sufficient. An interviewee responded that his ministry collaborates with just one agency which happens to be in the same ministry.

The NEMA Boss in April 2019 mentioned that the collaboration of stakeholders in disaster management was key in reducing the impact of the disaster on people [49]. In another call for collaboration by the Director-General for NEMA as reported on the official NEMA website, the DG called upon the enhancement of the already existing working relationship between the agency and the military to an interoperability level adding that 70 Disaster Response Units (DRUs) were created in Army, Navy and Air force formations across the country to boost up the emergency response [50].

4.5. Role of stakeholders in preventing/managing oil pipeline disasters

To achieve the desired goal of effectively preventing and mitigating oil pipeline disasters, certain roles must be played by key stakeholders. In the analysis of the interview, a word cloud was generated from Nvivo 12 software used for the analysis, as illustrated in Figure 7. In the figure, certain words occur very frequently when the question of "who do you consider relevant in the prevention, management and risk reduction of oil pipeline disasters, and what should be their roles?". Some of these very frequent words include agencies (i.e., government agencies, security, community, government, companies (oil companies) amongst others.

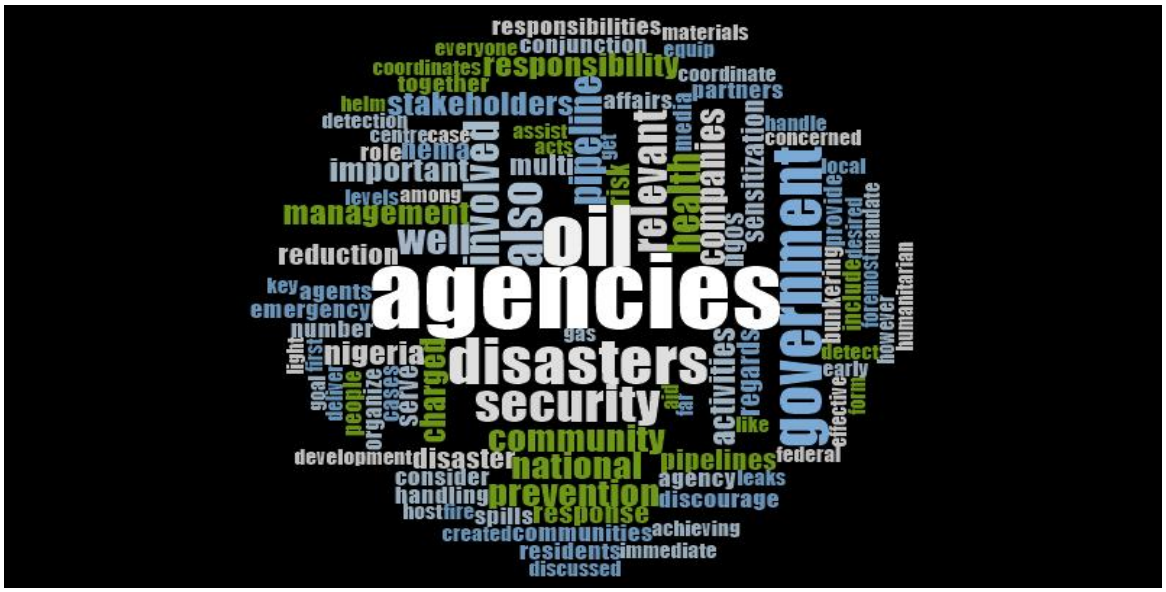

Figure 7. Word cloud on relevant stakeholders in prevention and mitigation of oil pipeline disasters.

These frequently occurring words are key stakeholders considered relevant in the prevention, mitigation and risk reduction of oil pipeline disasters. Also in the course of this interview, respondents have identified some of these roles. These roles have been streamlined in the framework.

4.6. Developing the conceptual framework

As defined by the United Nations Development Program [51], disaster management encompasses a wide range of policy and administrative decisions, as well as operational operations, at all levels of disasters. Certain fundamental concepts must be examined from a collaborative perspective to properly create a framework to account for such. In light of the Nigerian oil pipeline tragedies, components that make up the ideal disaster management processes, as stated by [52], have been modified to include disaster prevention, disaster mitigation, disaster preparedness, disaster response, and disaster recovery, leaving out National development planning and disaster management (Figure 8).

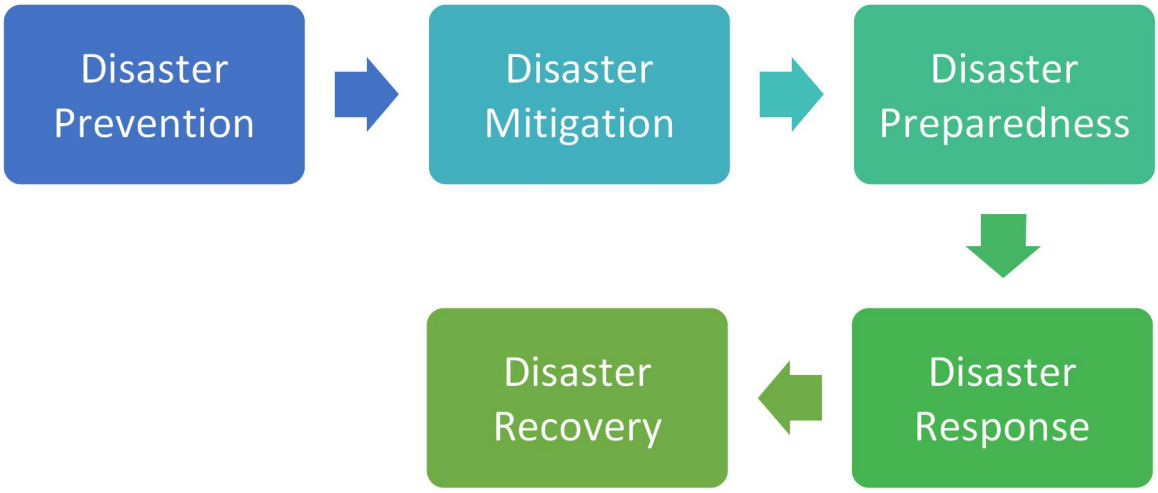

Figure 8. Oil pipeline disaster management model (Author Modified).

4.7. Identification of stakeholders for collaboration

Stakeholders are defined as people who have an interest in something. Based on current literature, several stakeholders have been identified. This is supported by the findings of pilot tests conducted during the preliminary stages. Relevant stakeholders as identified are illustrated in Figure 9. These stakeholders will be responsible for the performing the function of disaster management as illustrated in Figure 8 which includes; disaster prevention, disaster mitigation, disaster preparedness, disaster response, and disaster recovery. Working together in a collaborative manner, some of the stakeholders will be involved in prevention and mitigation as in the case of early warning systems, while others will be involved in disaster response and recovery as in the case of search and rescue, provision of relief materials, environmental clean-up and rehabilitation of victims.

Figure 9. Stakeholders involved in management and mitigation of pipeline disasters in the study area (modified from the work of [34] to capture the role of Security Agencies).

In this proposal, the emergency management agencies at government levels (NEMA, SEMA and LEMA) are charged will the overall coordination of the stakeholders' collaboration activities. To achieve this, they will among other responsibilities be responsible for policy formulation, monitoring preparedness, collecting data to enhance forecasting and planning, mobilizing financial resources from donors and partners as well as collecting materials for distribution.

Communities which will include community-based organizations (CBOs), Non-Governmental Organizations (NGOs) as well as neighbourhood associations will carry out sensitization and capacity building for an initial response, ensure commitment and preparedness of community members, mobilize resources and build community capacity and resilience to prepare, respond and mitigate disasters. They will also be involved in creating awareness on Disaster Risk Reduction (DRR), Early Warning Systems (EWS), as well as training and re-training on basic first aid skills.

Disaster Response Units (DRUs) are assigned in designated military formation to include police, Red Cross, as well as volunteers to aid search and rescue, provision of emergency medical care, render logistics support and assist in firefighting.

The Media will be mainly involved in issuing press releases and granting interviews while the Academia will handle education, research and training.

5. Approach to design of a framework for stakeholders' collaboration

Collaboration is a difficult process, and its chances of success depend on several factors. Sapat et al. opined that when two or more people work together, they must have a common purpose or an issue that must be addressed [53]. Parties need more than just a shared vision. Cooperative endeavours necessitate several preconditions for success, including but not limited to working together, such that the parties must agree to each other's contributions. As a result, each party has a model of the other's talents.

To achieve this, the processes must be well defined. These processes as outlined by Giesen [54] is shown in Table 3.

Table 3. The collaboration process.

Processes
i. Identifying key stakeholders;
ii. Organising a meeting of identified relevant stakeholders;
iii. Defining the scope of the collaboration and the expected outcomes;
iv. Defining the structure in terms of leadership, roles, responsibilities, ownership, channels and processes for communication and decision-making, resource access, planning and milestones for collaboration;
v. Defining the metrics, techniques, and procedures for review and assessment;
vi. Identifying key potential risks and design methods of action [54]

Furthermore, according to O'Brien and Toms, a conceptual framework should address three crucial issues. First and foremost, what is the framework's goal? Second, how is it envisioned? What are the components, thirdly? The first question establishes the research's general goal. The goal of the framework is to achieve pipeline disaster management and mitigation. The framework is envisioned to involve Stakeholders collaborating at various stages of the disaster; before, during and after occurrence. The Roles of the stakeholders, communication medium and feedback models are major components captured in the framework.

The construction of a framework (Figure 10) for stakeholder collaboration followed a logical path. This method has been proposed as a means of facilitating collaborative decision-making [55,56]. The structure of the framework for stakeholders' participation is separated into three stages based on this methodology, as shown in Figure 8. This is further explained in stages.

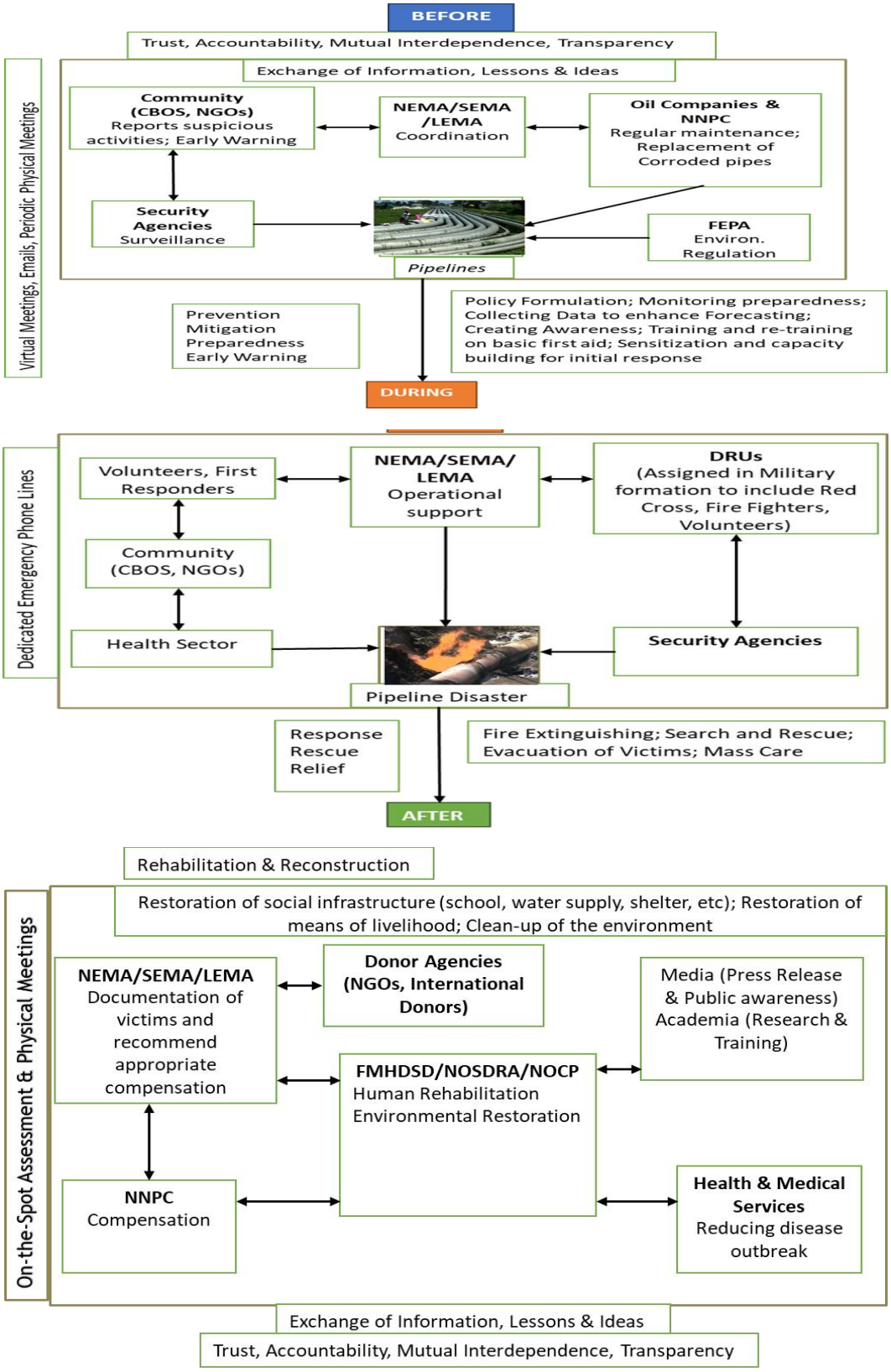

Figure 10. Collaboration framework for pipeline disaster mitigation.

5.1. Before disaster occurrence

In this framework, management of disaster is divided into three phases. Phase one is before occurrence of disaster which has to do with prevention, mitigation, preparedness and early warning (Figure 11). Disaster prevention measures are designed to impede the occurrence of a disaster event or to prevent such a disaster event from having a devastating impact on people, infrastructures and the economy. Disaster mitigation measures specifically designed to reduce or minimize the impact of disaster whenever they occur in Nigeria. Disaster preparedness measures are activities and measures undertaken in advance to make it easier for all levels of communities and individual to respond quickly and effectively to disaster events. Major stakeholders directly involved in this stage include the Emergency Management Agency (NEMA, SEMA, LEMA) saddled with the responsibility of coordination of all activities involving emergencies and disasters. This involves coordinating the different stakeholders involved in disaster management. It explains the process of harmonizing or bringing together diverse activities to achieve the goal and objectives of oil pipeline disaster management. It also describes required actions for harmonizing individual and organizational activities to maximize impact and achieve synergy. The multi-national oil companies (MNOCs) referred to in this framework as oil companies play the role of ensuring adequate maintenance of pipelines as well as replacing corroded pipelines. They are also involved in ensuring a good relationship exist between them and their host communities so as to forestall issues that can bring rise to uprising and conflicts. The Federal Environmental Protection Agency (FEPA) under the Federal Ministry of Environment are also involved in the disaster prevention stage (Figure 11). They are to ensure that necessary preventing actions are taken to prevent oil spill which also pollutes the environment. Their presence will serve as a deterrent to unwholesome environmental practices by the oil companies. The communities play very major roles as they serve as custodians of the pipelines. The security agencies provide surveillance system for the pipelines and thwart activities of illegal refineries and vandals. Other measures considered in this stage of oil pipeline disaster management framework include; relief stocking such as building materials, blankets, buckets, food items etc.; early warning system which refers to an organized structure for predictions and disseminations of timely and effective information to allow individuals who may be at risk to take action to avoid or reduce their risk and prepare for effective response; emergency communication systems; public education and awareness, and training programs for disaster responders. In this pre-disaster phase, respondents have proposed regular virtual meetings, emails as well as physical meetings held periodically as the best channel of communication.

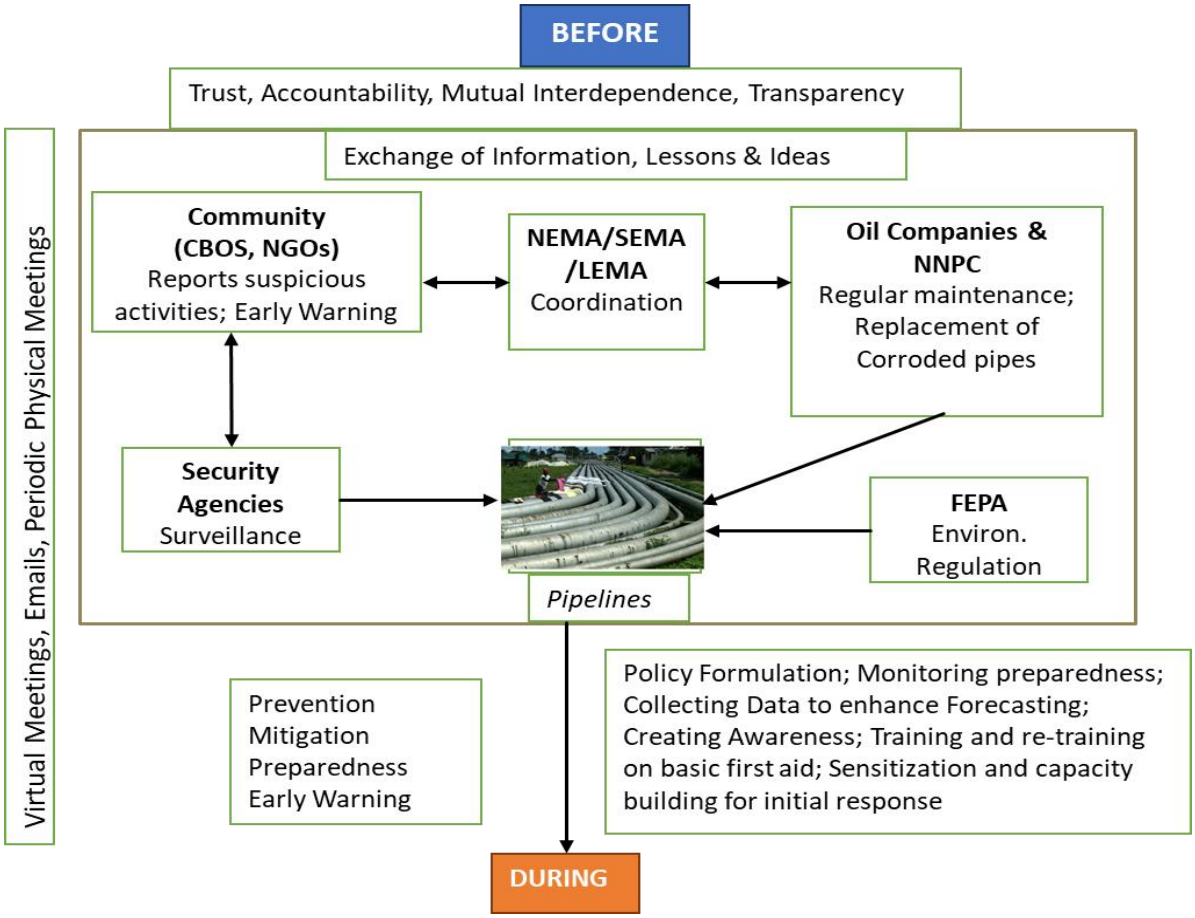

Figure 11. Before the occurrence of disasters.

5.2. During disaster occurrence

In the eventual occurrence of oil pipeline disasters (Figure 12), all disaster response activities are coordinated by the Emergency Management Agency (NEMA, SEMA and LEMA) whose major aim is to eliminate the source of the disaster and minimize the humans and environment effects. Disaster response are measures to be taken during or immediately after a disaster impact to save lives, care for the victims, protect properties and effect emergency repairs to infrastructures. To achieve this effectively, this framework proposes a synergy between the coordinators, community, volunteers and first responders, security agencies and disaster response units aligned in military formations to include Red Cross, Fire Fighters among others. The goal is to provide adequate response, comprising rescue and provision of relief to victims of oil pipeline disasters. These include activities ranging from fire extinguishing, organising search and rescue, evacuation of disaster victims and mass care for victims. Despite the existence of any disaster response outfits in Nigeria, both governmental and non-governmental agencies, a number of things were lacking that made response to certain disaster as well as civil strife incidents that have occurred in various parts of the country, not as timely and effective as they should have been. These inadequate include lack of effective coordination, inadequate training, lack of equipment, lack of relief materials and absence of adequate early warning system. It is hereby proposed by this framework that; there shall be effective coordination of the efforts of the numerous disaster responders with the Emergency management

Agency (NEMA, SEMA, LEMA) at the centre; adequate training of people for search and rescue and relief operations; there shall be adequate First Aid training for the Nigerian Police Force, Fire Service, Nigeria Security and Civil Defence Corps, and all other paramilitary structures for effective emergency response; availability of relief materials and adequate early warning system mechanisms. In this stage of the disaster management framework, critical stakeholders have proposed that emergency phone lines should be dedicated for the purpose of communication among stakeholders.

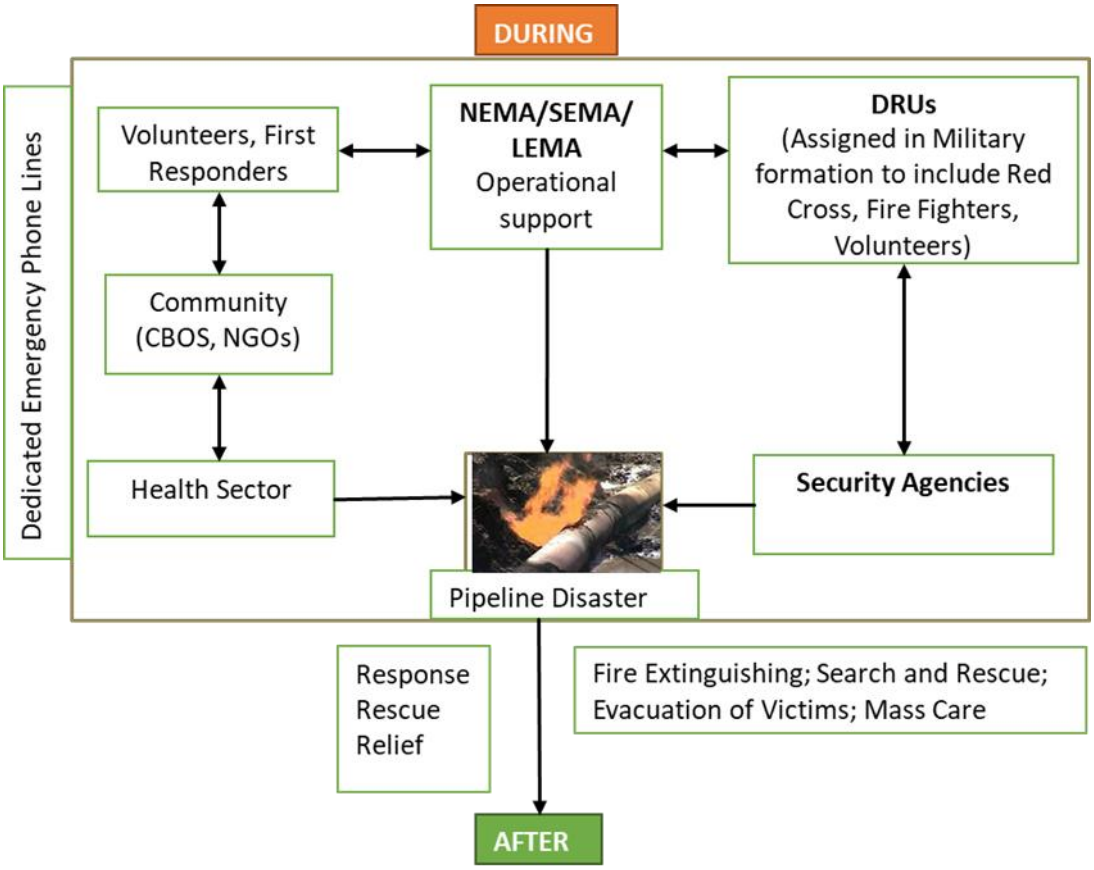

Figure 12. During the occurrence of pipeline disasters.

5.3. After disaster occurrence

In the aftermath of oil pipeline disaster occurrence (Figure 13), key areas of importance are rehabilitation of humans and restoration of the environment and preventing future occurrence. This constitutes the disaster recovery process. Recovering from a disaster is the process by which a disaster stricken area returns to its pre disaster state. The three tiers of government shall rapidly ensures; the restoration of properties, essential services and infrastructure damaged by the disaster; and rehabilitation of stricken people or displaced persons so that their trauma is put behind them and they settle down to their pre-disaster lives and livelihoods. To achieve this stakeholders from the oil companies, media and academia, emergency management agencies, health and medical services and government agencies including FEPA, FMHDSD, NOSDRA, among others must collaborate. These government agencies are majorly concerned with restoration of the environment and clean-up of the oil spills left as a result of the disasters. These agencies; Federal Ministry of Humanitarian Affairs,

Disaster Management and Social Development (FMHDSD), National Oil Spill Detection and Response Agency are equipped to detect activities that pose harm and danger to the environment. To effectively perform, they should be involved in preparedness and well as Restoration and Rehabilitation activities as identified from the interview conducted. Donors, which include NGOs and international donor agencies amongst others, play a very important role in the aftermath of pipeline disasters. They liaise with the National Emergency Management Agency to assist in reaching out to the affected victims and how to carry out human rehabilitation. The aftermath of pipeline disasters is largely devastating and requires a lot of resources for reconstruction, rehabilitation and restoration, hence, the need for external sources of funding from donor agencies. The media has a role granting interviews as well as press release while the academia should be involved in research and training on ways of preventing future occurrence. The function of health and medical services at this stage of the framework is to ensure optimum adherence to healthy guidelines and reduce the outbreak of diseases while the oil companies should be involved in compensation and how to restore means of livelihood of the affected communities. All stakeholders involved should carry out an on-the-spot assessment of the situation first and foremost which can be followed by physical meetings of the stakeholders to discuss way forward.

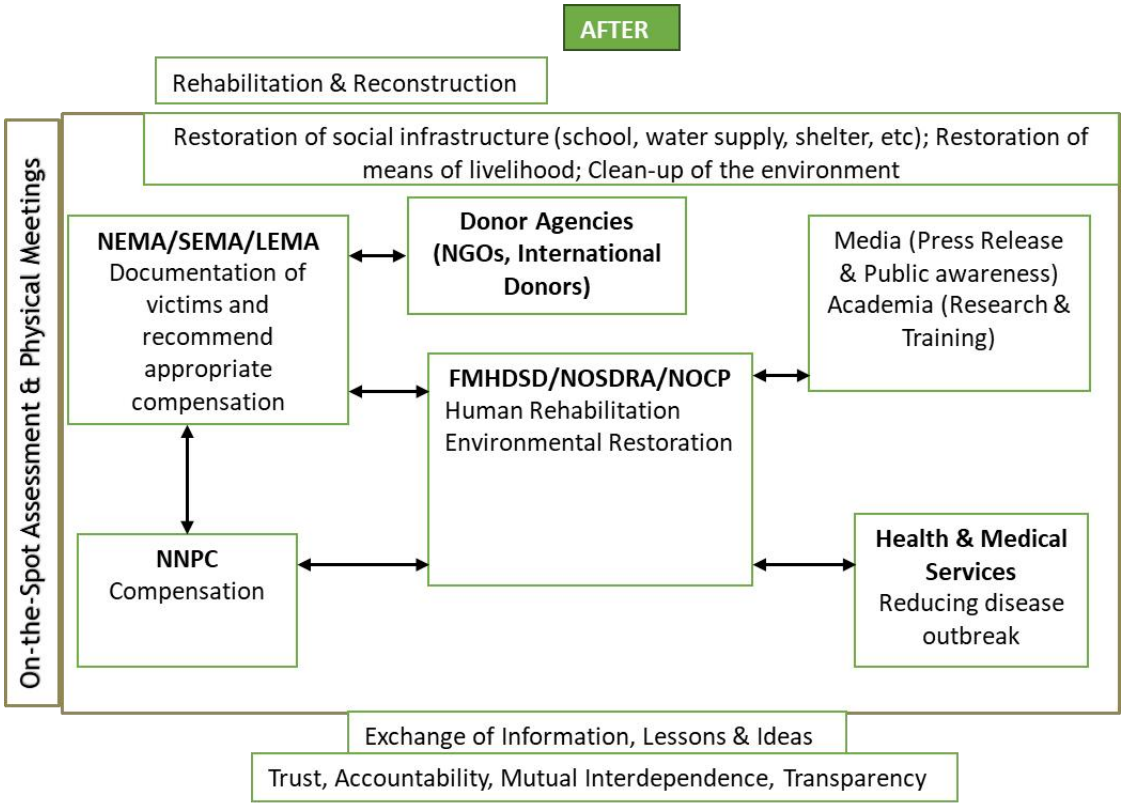

Figure 13. Aftermath of pipeline disaster occurrence.

5.4. Validation of the framework

The framework developed was validated through a 3-stage process.

Stage 1 The framework was revisited and validated against the data collected for necessary

adjustments. This was painstakingly done to achieve a workable blueprint in the search for a lasting solution to the menace of oil pipeline disasters in Nigeria. During this stage, a careful review of the data collected during the survey as well as those from the interview was carried out.

Stage 2 This framework was validated with similar frameworks among which are;

i. Horizontal and Vertical Coordination of Disaster Management in Nigeria by NEMA [57].
ii. The National Disaster Management Framework (NDMF) developed by NEMA, which offers a system that acts as a legal prescription for effective and efficient disaster management in Nigeria. The framework outlines quantifiable, adaptive, and flexible coordinating mechanisms and harmonizes the major roles and duties of stakeholders in disaster management across the country. It explains a paradigm change in disaster management that goes beyond only reaction and recovery and outlines particular authority and best practices for handling disasters.
iii. Stakeholders' collaboration framework developed by [23], to add upon existing information in the advancement of a collaborative environmental management in the NOPR.
iv. United Nations International Strategy for Disaster Reduction Framework UNISDR [58], an underlying work to place disaster risk reduction into a viewpoint given the trans-disciplinary nature of the field.
v. Integrated disaster management framework of pipeline explosion by [6]. The integrated disaster management paradigm advocated a comprehensive strategy based on strategic alliances amongst the major players. According to this approach, disaster management entails a coordinated, inclusive process with the goal of lowering the probability, severity, and frequency of oil pipeline fire disasters. The framework prioritizes prevention-focused and proactive tactics, and a recurring theme throughout is the continual sharing of knowledge, insights, and lessons learned across stakeholders to aid in the identification of issues impeding efficient disaster response.

Stage 3 This was further subjected to criticism from few of the stakeholders from the interview stage. There was a general satisfactory comment in this regard.

5.5. Possible challenges of collaboration in the context of oil pipeline disasters

Seven obstacles that prevent multi-agency collaboration have been highlighted by [53] as communication, environmental, social, political, inter-organizational, intra-organizational, and infrastructure issues. Due to the lack of a technology platform and clear criteria for data sharing among the agencies to create a shared understanding of the disaster context, communication was seen as the main issue.

Current research on networks and partnerships in disaster and natural hazard management has concentrated on a number of difficulties and constraints in cooperation. For instance, various authors have underlined the necessity for businesses to promptly and thoroughly explain their objectives and operations [52]. Others have pointed out how information flow across firms can make collaboration more difficult, especially when providing services in a complicated and uncertain environment, like during disaster response and recovery times [52]. Common norms and trust have also been found as significant influences on collaboration, as well as their absence [59].

Three types of difficulties to collaboration between and within emergency agencies were identified by the workshop's findings [60]: (1) communication between and among emergency agencies; (2) developing and maintaining common situation awareness; and (3) inter-organizational understanding.

From literature reviewed and stakeholders' perception 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;

i. Conflicts in Shared Responsibilities: if not appropriately addressed, this might be a significant problem. For instance, responsibility conflicts between NOSDRA and DPR, two government entities, might occur easily. The statutory organization charged with organizing the nation's response to oil spill incidents is the NOSDRA. This significant duty is outlined in the requirements of the National Oil Spill Detection and Response Agency (Establishment) Act No.15, 2006 (NOSDRA Establishment Act). In accordance with the Act, NOSDRA is in responsibility of organizing and carrying out the Plan (the National Oil Spill Contingency Plan) for Nigeria. It is very obvious from these clauses that NOSDRA is the organization charged with responsibility of responding to oil spills.

However, all oil spillage occurrences must be reported to the Director of Petroleum Resources under the Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) [61]. Therefore, the aforementioned EGASPIN requirement is in violation with NOSDRA Establishment Act section 6 (1) (b). The objective of an efficient multi-agency response to oil spill situations is to offer prompt and effective response, but these conflicting regulations allow for "double reporting," which is a waste of time and defeats that goal. Such a conflicting clause should not be included in regulations governing the sector.

ii. Inadequate Resources: Agencies tasked with mitigating oil pipeline disasters frequently struggle with a lack of sufficient budget, necessary equipment, and skilled personnel. Some of these organizations are a part of the collaborative team that looks into the origin or causes of an oil spill or oil disaster. Within 24 hours following spill notice, the joint investigation team must be convened [61]. Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN) states that the joint investigation team looks into the cause of the oil spill and that it is anticipated that they will jointly agree and sign a report that confirms the cause of the spill, as well as other important details like the amount of oil spilled and the area affected. However, it should be highlighted that the joint investigative procedure mainly relies on the oil firms, effectively placing the reporting duty on the companies. Oil firms schedule investigations and typically offer transportation to the scene as well as technical skills that regulatory organizations like NOSDRA and the DPR lack. To this extent, several obligations, such as the "spill detection" obligation of NOSDRA, are largely nonexistent or, at best, inadequate.

iii. Inadequate Enforcement of Environmental Laws and Guidelines: It is clear that there are many laws addressing multi-agency response to oil spills. However, strict enforcement of the legislation will always be an issue because of one or more shortcomings on the side of the appropriate agency or the government as a whole. As a result, the provisions of the National Oil Spill Contingency Plan (NOSCP) and the National Oil Spill Detection and Response Agency (Establishment) Act No.15 of 2006 regulating multi-agency response may not be rigorously followed. Without strict enforcement and implementation of current environmental laws and standards relating to multi-agency response to oil spills by pertinent support agencies, the advantages of well-coordinated multi-stakeholders' response to oil pipeline disasters in the country cannot be achieved.

iv. Inefficient Communication System: this could also be a very big challenge if not properly managed. Technology and innovations in the ICT sector should be encouraged and adopted in this regards.

6. Conclusions

Findings from the qualitative aspect of this study revealed that the level of involvement ranges from the provision of relief materials, search and rescue, and giving first aid treatment among others. This was visible in some of the responses obtained. An examination of various press reports from 2018 to date indicated no active collaborative measures in terms of interoperability exists between stakeholders in Nigeria but only in terms of interaction. This was concurred to by some of the stakeholders interviewed. Where collaboration happens to exist, it is not sufficient.

Research has demonstrated that partnerships and collaboration lead to more successful outcomes, with advantages like organizational learning, cost savings, or access to more resources for organizations [62–65]. Negative consequences for communities have been linked to inadequate teamwork, as was the case during Hurricane Katrina [66,67]. Additionally, writers like [67] and [68] have noted how poor collaboration results in detrimental effects for society.

In stakeholders' collaboration, there is a pool of resources, including advanced technologies available for deployment towards regular inspections and monitoring activities. When stakeholders comprising of people who are at the receiving end of these disasters are part of compliance system, cutting corners and inefficiency becomes greatly minimized if not entirely eliminated. At the level of stakeholder debate, pipeline integrity techniques could be explored and accepted. In the context of this study, 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.

On the process of achieving collaboration in the management and mitigation of oil pipeline disasters in Nigeria, Weiss model of 1987 was adopted. This process is most suitable with regards to the various discussions with stakeholders. The three-step process, according to [69], include: (a) perceived problem must be shared across agencies; (b) resources must be available to handle problem cooperatively; and (c) institutional capacity has to be established to mount cooperation.

The construction of a framework for stakeholder collaboration followed a logical path. This method has been proposed as a means of facilitating collaborative decision-making [55,56] . The structure of the framework for stakeholders' participation is separated into three stages based on this methodology. The findings from the survey conducted as well as indexing and charting document materials revealed that the stakeholders' perspectives on their collaborative relationship are patterned. Similarly, when the responsibilities of stakeholders were examined, it was shown that different stakeholders have distinct interests, practices, drives, and barriers. This was discovered from the analysis of roles of stakeholders in managing and risk reduction of oil pipeline disasters discussed earlier in this study. Key elements of collaboration in this framework are trust, accountability, mutual interdependence and transparency. It is hereby proposed by this framework that; there shall be effective coordination of the efforts of the numerous disaster responders with the Emergency management Agency (NEMA, SEMA, LEMA) at the centre; adequate training of people for search and rescue and relief operations; there shall be adequate First Aid training for the Nigerian Police Force, Fire Service, Nigeria Security and Civil Defence Corps, and all other paramilitary structures for effective emergency response; availability of relief materials and adequate early warning system mechanisms. In this stage of the disaster management framework, critical stakeholders have proposed that emergency phone lines should be dedicated for the purpose of communication among stakeholders. In the aftermath of oil pipeline disaster occurrence, key areas of importance are

rehabilitation of humans and restoration of the environment and preventing future occurrence. This constitutes the disaster recovery process.

All stakeholders involved should carry out an on-the-spot assessment of the situation first and foremost which can be followed by physical meetings of the stakeholders to discuss way forward.

7. Research contributions

Given the challenges in pipeline disaster faced by Nigeria, especially in the oil producing regions, the results of this research have implications for policy, practice, baseline studies and planning scholarship. First, this research adds occurrence of pipeline disaster.

8. Recommendations

Appropriate support agencies should strictly execute and enforce the pertinent legislation relating to multi-agency response to oil disasters in the nation. Insufficient enforcement and implementation of laws by pertinent agencies results in legislation going inactive and pertinent agencies lacking the coordination necessary for a successful multiagency response process. The success of the multi-agency response system depends on the coordination of pertinent responding agencies. For timely, quick, and effective response from relevant agencies, implementation and enforcement are also required. The environmental impact of oil incidents can be lessened with effective response procedures in place.

Numerous sources, including but not limited to government funding, non-governmental organizations (NGOs), local and foreign donors, as well as oil firms, should be explored to provide resources for the effective and efficient handling of disasters. Such resources should be readily available when the need arises.

Finally, stakeholders should regularly examine this framework, as advised by UNEP [70] , to stay abreast of new developments, particularly in the area of environmental protection. When considered together, these provisions offer detailed information on the management approaches and operational practices that require improvement. Observations from document analysis demonstrate that, despite the interests of the stakeholders in reviewing the project implementation, issues of corruption, a lack of transparency, and issues with a money-mindset and divide and rule would need to be resolved in order to produce the desired results of the stakeholders' cooperation.

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.

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Appendix

Do you Collaborate With other Stakeholders?	Roles of Stakeholders	Your Efforts
"……..Occasionally, yes. We collaborate with security agencies, fire service, NGOs and health agencies. Though such collaborations always exist during disaster occurrence." RP/NEMA/01	*"……..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*	*"……I have been involved in the assessment of the level of destruction of the environment as a result of these disasters and drawing up plans for clean-up exercises." RP/FMHDSD/01*
"…….Collaborate with Community Leaders and residents as well as government agencies, though mostly at discussion levels."RP/MNOC/01	*"…….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/FMHDSD/01*	*"……Oversee the national oil spill contingency plan. We monitor oil spill drill exercises and carry out inspection and investigation visits. My agency is also tasked with clean-up of spilled sites to remediate the environment as much as possible with the aid of a baseline environmental sensitivity index map (ESI)"RP/NOSDRA/01*

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Do you Collaborate With other Stakeholders?	Roles of Stakeholders	Your Efforts
"…….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	*"……..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*	Shell Plc. Website: *"……..Large spills of crude oil, oil products and chemicals associated with our operations can harm the environment, and result in major clean-up costs, fines and other damages. We have requirements and procedures designed to prevent spills. We design, operate and maintain our facilities with the intention of avoiding spills. To further reduce the risk of spills, Shell has routine programmes to reduce failures and maintain the reliability of facilities and pipelines.* *For oil spills, we have created a global response network that enables us to deal more effectively with oil spills, supplementing local response capability. We routinely perform large-scale exercises with local regulatory and response organisations to practice, and improve, our response capability.*
"…….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	*"……..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*	*"…….my efforts include but not limited to coordinating search and rescue, coordination of emergency response services, provision of relief materials and providing shelter for displaced persons."RP/NEMA/01*

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Do you Collaborate With other Stakeholders?	Roles of Stakeholders	Your Efforts
"……We only join efforts with some stakeholders when these disasters have occurred."RP/CRL/01	*"……….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*	*"…….I was involved in granting first-aid attention to some of the victims of the resulting fire as a result of the oil pipeline explosion."RP/HS/01*
"…….Not really. We only respond when our attention is called."RP/HS/01		
"……No"RP/SA/01	*"……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*	
"……..Yes, we work hand in hand with NOSDRA."RP/FMHDSD/01	*"……..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*	
"……..Other sister agencies in the Federal Ministry of Environment." RP/NOSDRA/01	*"…….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*	
	"……..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	

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	"……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	