CRANFIELD UNIVERSITY

SAM, KABARI SIMEON

ENVIRONMENTAL MANAGEMENT OF OIL CONTAMINATED SITES IN NIGERIA: IMPROVING POLICY AND RISK-BASED FRAMEWORK

SCHOOL OF WATER, ENERGY AND ENVIRONMENT
ENVIRONMENTAL TECHNOLOGY

PhD
Academic Year: 2015 - 2016

Supervisor: Prof Frédéric Coulon
Co-supervisor: Dr George Prpich
October 2016

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OCTOBER 2016

This thesis is submitted in partial fulfilment of the requirements for the degree of PhD

ABSTRACT

Contaminated land management has become a major concern for Nigeria. Sites affected by petroleum hydrocarbons from oil exploitation activities have been identified as a major environmental and socio-economic problem in the Niger Delta region. Though air and water regulations have received the most attention, the regulatory system for contaminated land remains largely undeveloped. As a result, Nigeria oil contaminated land governance lacks a clear and well-established policy framework; administrative structure and capacity; technical methods; and incentive structures. A consequence of these limitations is the inevitable ad hoc management of contaminated land in Nigeria. This thesis aims to provide a comprehensive and integrated contaminated land management policy framework for Nigeria. This work adopts a qualitative approach including critical review methodology and field surveys to investigate the current practice in contaminated land management in Nigeria. Key findings from this research clearly indicate an urgent need for a regulatory policy supported by a holistic and coordinated structure, coupled with improved technical capacity and additional resources to prevent new contamination and to address legacy contaminated sites. A technical strategy to identify and characterise contaminated land in terms of Source-Pathway-Receptor (S-P-R) linkages, a liability regime and the establishment of land use standards are required in Nigeria. Field surveys were used to pilot a proposed stakeholder engagement approach that integrates consideration of social values that could influence contaminated land management policy. Top ranked social values included drinking water, soil quality, and food and local supply chain. Based on this research a pathway for improving the current policy was proposed. The pathway identifies the need to engage stakeholders, educate and improve awareness, increase trust and transparency and integrate societal values into contaminated land management decision-making. An integrated risk assessment framework for contaminated land management in Nigeria was also proposed, and completed with a pathway for integrating the social values and sustainability indicators identified previously. The study proposes a timeline for achieving comprehensive contaminated land management policy in Nigeria. Finally, a multi-attribute methodology for contaminated land prioritisation in Nigeria was developed to identify and promptly respond to sites that pose the highest risk to receptors, considering the limited nature of resources for contaminated land management.

Keywords: Oil spill, risk-based, regulatory policy, sustainability, Niger Delta, prioritisation

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LIST OF ABBREVIATIONS

CARACAS	Concerted Action on Risk Assessment for Contaminated Sites in Europe
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CL:AIRE	Contaminated Land: Applications in Real Environments
CLARINET	Contaminated Land Rehabilitation Network for Environmental Technology
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
CSR	Corporate Social Responsibility
DEFRA	Department for Environment, Food and Rural Affairs
DPR	Department of Petroleum Resources
EA	Environment Agency
ECA	Excess Crude Account
EGASPIN	Environmental Guideline and Standard for Petroleum Industry in Nigeria
EU	European Union
GAC	Generic Assessment Criteria
GMOU	Global Memorandum Of Understanding
HRS	Hazard Ranking System
HYPREP	Hydrocarbon Pollution Environment Restoration Agency
IA	Impact Assessment
MCDA	Multi-Criteria Decision Analysis
NCP	National Contingency Plan
NDDC	Niger Delta Development Commission
NESREA	National Environmental Standards and Regulations Enforcement Agency
NICOLE	Network for Industrially Contaminated Land in Europe
NOSDRA	National Oil Spill Detection and Response Agency
NPL	National Priority List
NY	New York
OPEC	Organisation of Petroleum Exporting Countries
PRP	Potential Responsible Person
RAG	Risk Assessment Guidance
RCRA	Resource Conservation and Recovery Act

RENA	Remediation by Enhanced Natural Attenuation
RSL	Regional Screening Levels
SARA	Superfund Amendment Re-authorisation Act
SG	Statutory Guidance
SGV	Soil Guideline Value
SI	Site Inspection
SPOSH	Significant Possibility of Significant Harm
SSTL	Site Specific Target Level
SSV	Soil Screening Value
SuRF-UK	UK Sustainable Remediation Forum
TPH	Total Petroleum Hydrocarbon
UK	United Kingdom
UNEP	United Nations Environment Programme
USA	United States of America
USEPA	United States Environment Protection Agency
WHO	World Health Organisation

1 Introduction

1.1 Overview

This research critically reviews land contamination management policy and frameworks in Nigeria and provides key insights and comparison with the most recent advances made in risk science and the mature land contamination regimes developed in the United Kingdom (UK) and the United States of America (USA). Opportunities for change in the Nigerian regime are identified and analysed drawing on the lessons learnt from the UK and the USA regimes and recommendations for moving towards a comprehensive contaminated land management policy and frameworks in Nigeria is proposed.

This chapter introduces the research context and is subdivided into eight sections. First, the context of land contamination management is discussed, followed by the research focus. Then the aim and objectives of the research along with the research questions are formulated. Next, the general research methodology is presented followed by the thesis structure, and lastly the publications from this research.

1.2 Research context

Land contamination is a global challenge to the protection of human health and ecological systems. Human activities including industrialisation and commercialisation (e.g. coal combustion and crude oil extraction) over the last six decades have led to the flux of contaminants into the environment, and increased contaminant levels in ecological systems (Bird, 2016; Marx et al., 2016). This has been associated with deleterious impacts on human and environmental health (Schiedek et al., 2007; Nathanail et al., 2013; Xu et al., 2014). In the case of crude oil extraction and exploitation, the industrial processes have led to considerable contamination of land and groundwater (Cundy et al., 2008; Rodrigues et al., 2009a, 2009b; Sorvari et al., 2009; Swartjes, 2011a) which has resulted in the significant degradation of soil and groundwater quality.

By definition, contaminated land contains introduced substances of potential concern that can cause significant harm to humans and the natural biota (DEFRA,

2012). These contaminants cause both acute and/or chronic defects in humans and other forms of life (Swartjes et al., 2012; Swartjes et al., 2013). Given the adverse effects of potential contaminants there is a need for stringent and timely legislation and cost effective and sustainable remediation strategies for the protection of human health and ecological systems (Vegter et al., 2003; Sorvari et al., 2009; Swartjes, 2011; Samuels, 2012; Bardos et al., 2016).

Several approaches for preventing and or managing land contamination issues have been developed, most notably within the scientific community (CERCLA, 2002; DEFRA and EA, 2004). These approaches are implemented by the regulators to provide procedures and guidance for pollution prevention and risk reduction (Vegter et al., 2003; Thavamani et al., 2015). For example, the mature land contamination management regimes in the UK (Luo et al., 2009; Rodrigues et al., 2009b; Forton et al., 2012) and the USA (Kiel, 2013; Kapp, 2014) have developed strategies for addressing legacy sites and preventing new sites contamination.

Land contamination management has developed over the past few decades through extensive scientific investigation (Vegter et al., 2003) from being cost-centric in the 1970s, techno-centric in the 1980s and risk-based in the 1990s (Pollard et al., 2004a). More recently, experts in contaminated land have transitioned from a focus on prevention of significant risk to the integration of sustainability (Bardos, 2009; Bardos et al., 2011; Bardos et al., 2016). Particularly, the UK and USA land contamination management regimes have evolved over three-decades of experience and are supported by evidence-based decisions (Kiel, 2013; Nathanail et al., 2013; Thavamani et al., 2015). As a result, the land contamination management community including among others, scientific experts, developers, engineers, site owners, regulators in both countries showcased a high level of experience in this area of research. This informed the choice of these regimes as templates for land contamination policy and management improvements in Nigeria.

Evidence suggests that as land contamination management advances, new strategies, technologies and policies are developed to effectively address land

contamination (Nathanail et al., 2013; Bardos et al., 2016). For example, the UK and the USA have adopted clear statutory definition for contaminated land, liability regimes, standards for land use, funding mechanisms, and technical strategies to identify and characterise contaminated land in terms of source-pathway-receptor (S-P-R) linkages. As a result, both regimes have developed land contamination management models for which developing regimes are emulating (Luo et al., 2009; Forton et al., 2012; Rodrigues et al., 2009b; Brombal et al., 2015).

In less developed regimes, one of the major barriers to land contamination management is the lack of comprehensive policy frameworks (Luo et al., 2009; Forton et al., 2012). For example, the land contamination management regulatory regime in Nigeria is fragmented, not well developed and poorly implemented by multiple agencies (UNEP, 2011; Ambituuni et al., 2014; Könnet, 2014). As a result, regulators are unable to deal with legacy sites and prevent new contaminations.

1.3 Research focus: Oil contaminated sites management in Nigeria

Land contamination issues, especially due to oil exploration and exploitation, in Nigeria are more recent (from 1959 onwards) than developed countries such as the UK and the USA and therefore the land contamination regime and regulations are still developing compared to these regimes. As a result land contamination legislations in place are largely fragmented, poorly implemented and lack appropriate technical and scientific expertise. Also the current Nigerian's management framework for land contamination lacks a statutory definition for contaminated land, options appraisal, structured risk assessments, and sustainable remediation (DPR, 2002). As such, Nigeria can to a large extent benefit from a comparative study of advanced and mature risk-based land contamination management policies and frameworks such as those developed in the UK and the USA.

Most research in Nigeria have investigated on the nature (Kadafa, 2012; Kadafa et al., 2012), extent (UNEP, 2011), impacts (Zabbey, 2004; Pegg and Zabbey,

2013) and causes of oil spills (Orubu et al., 2004; Nwilo and Badejo, 2005, 2006; Chinweze et al., 2012). However, there is to date little or no research on developing an integrated and sustainable management framework for oil contaminated sites in Nigeria.

There is therefore a need to develop a comprehensive and sustainable risk-based framework for managing oil contaminated sites in Nigeria. To enable this, it will require a clear understanding of the current legislative and policy frameworks, the administrative organisations and roles and the current tools available for managing oil contaminated sites. Further to this, by referring to lessons learnt from the UK and the USA experiences, it will allow the identification of areas where challenges and opportunities are for Nigeria in implementing an effective and integrated land contamination regime.

In addition to this, in the efforts to improve the implementation of the current policy, this research aims to understand the social values that influence land contamination management decision making in Nigeria.

1.4 Motivation of the research

Over five decades of oil spills and consequent land contamination has devastated rural economies and social livelihood in the Niger Delta. Similar occurrence of oil spills, e.g. the Exxon Valdez and the Deepwater Horizon accident, have received alarming levels of publicity and attention that has led to urgent clean-up and restoration programmes for these sites. In contrast the Niger Delta region has yet not received such level of after care management. Thus, the motivation of this research is to facilitate the process that will assist the restoration and clean-up of oil-contaminated farmlands, surface waters, mangroves and wetlands in the Niger Delta region of Nigeria.

1.5 Research aim

This research aims to investigate the environmental management of oil-contaminated land in Nigeria, and to develop approaches for improving the current policy and risk-based management framework.

The research seeks to address the following research questions:

1. What are the key lessons learnt from the risk-based contaminated land management in the UK and the USA regimes that could benefit Nigeria?
2. What social, environmental and economic factors influence contaminated land management decisions in Nigerian's context?
3. How can an integrated risk assessment framework facilitate the development of a comprehensive contaminated land management policy in Nigeria?
4. How risk prioritisation of oil contaminated sites can assist the implementation of a transparent and defensible decision making process?

In order to achieve the aim of this research and answer the research questions above, the following objectives are outlined:

1. To critically review the contaminated land management regimes in Nigeria, the UK and the USA.
2. To conduct a survey and a series of workshops on the current contaminated land regime in Nigeria to identify the key environmental, social and economic issues that hampered the implementation of an efficient management framework for oil contaminated sites
3. To develop an integrated risk assessment framework that incorporates sustainability into contaminated land decision processes in Nigeria.
4. To develop and validate a multi criteria decision analysis (MCDA) methodology to prioritise oil contaminated sites in the Niger Delta.

1.6 Research approaches

The research adopts a range of research approaches (Figure 1-1) to achieve the overall aim. The first objective is comparatively broad in nature. Substantial research has been done in the field of land contamination management globally and therefore a critical literature review is the most suitable method for achieving this objective. The outcomes of the review will identify potential disconnections or failings between regulatory intent and policy implementation in Nigeria; and then a concise, accessible and insightful summary citing key learning points and examples of effective contaminated land management practice, which will inform lessons to be drawn by Nigeria.

Objective two focuses on the Nigerian's context and experiences. This objective aims to understand the social, environmental and economic values perceived as important for oil contaminated sites management by the stakeholders in Nigeria. This will be done by conducting a series of interviews and workshop in Ogoniland in the Niger Delta. It will further allow investigating what the drivers and barriers are in Nigeria to implement lessons identified in Objective one. The outcome will be a pathway for improving the current policy having understood the social preferences that inform decision making.

Objective three provides a way forward on how to integrate social values (derived from Objective two) into an integrated risk assessment framework for Nigeria. It also provides a logical pathway for integrating sustainability indicators in contaminated land management in Nigeria.

Objective four considers ecological and socio-economic attributes for developing a MCDA-based framework for contaminated land prioritisation in Nigeria. It is expected that the framework will assist decision makers in allocating strategically limited management resources for oil contaminated sites management.

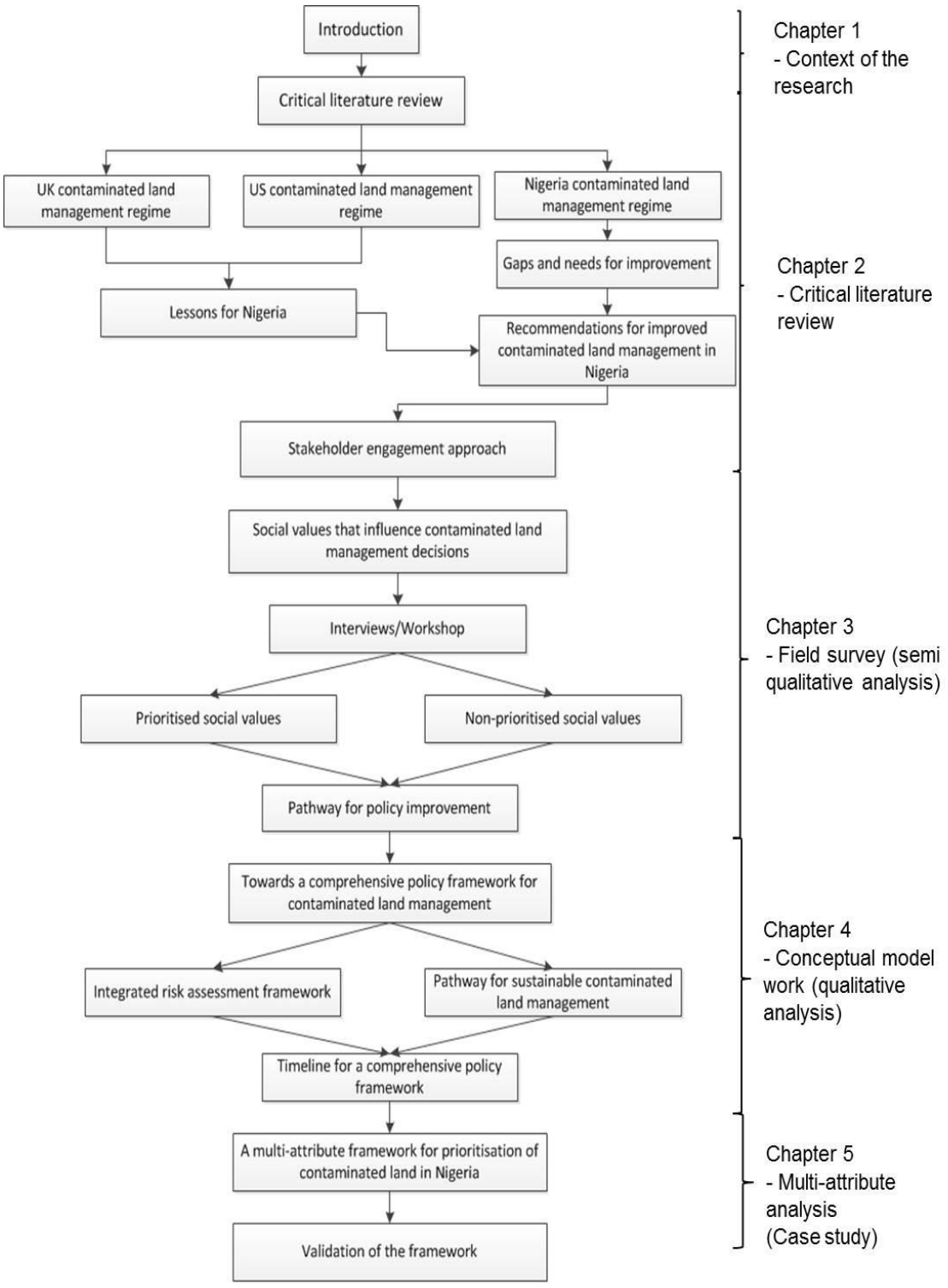

Figure 1-1: Research methodology

1.7 Thesis structure and format

The PhD thesis structure is shown in Figure 1-2 and comprised six chapters written as a collection of papers.

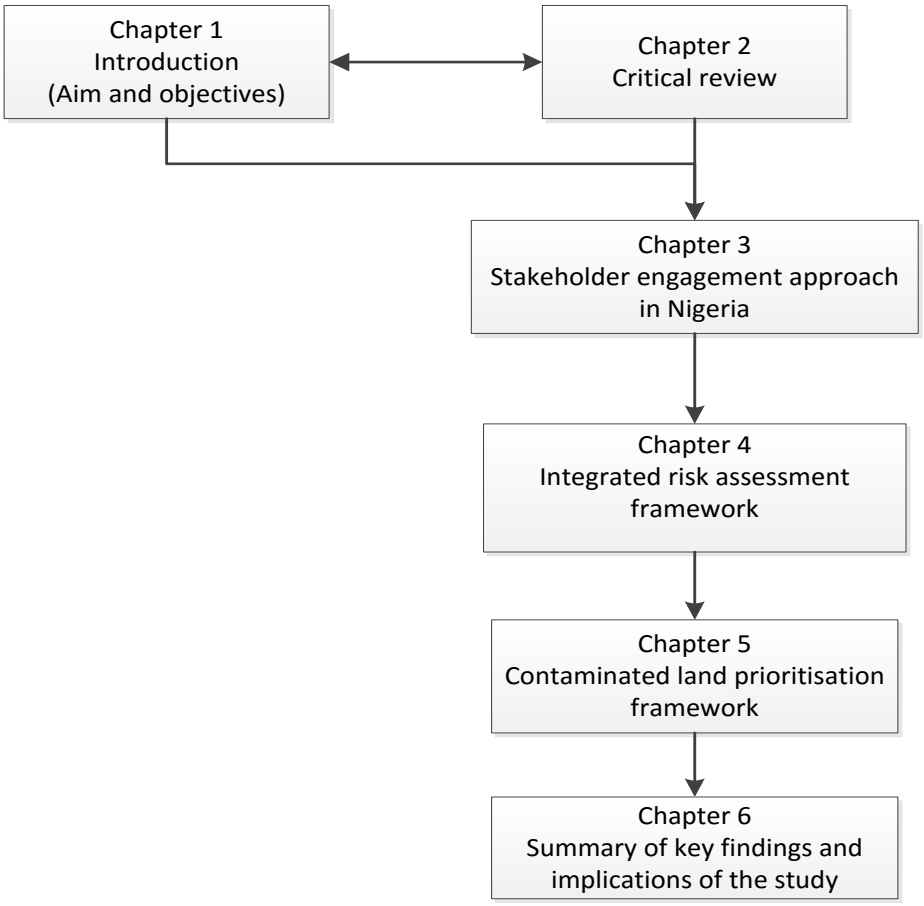

Figure 1-2: Thesis structure

The thesis offers a comprehensive analysis of contaminated land management policy in Nigeria, identifying challenges and opportunities associated with the current policy as follows:

Chapter 1: This chapter provides the background of the thesis, the research context and focus, motivation, and the aims and objectives of the research. The research methodology was also captured in this chapter.

Chapter 2: This chapter presents the status of oil contaminated land management in Nigeria thereby identifying current challenges and futures. A critical analysis of contaminated land management approaches and policies in

the UK and the USA is also presented. Insightful lessons drawing on the experiences of the UK and the USA are recommended for Nigeria.

Chapter 3: The social values peculiar to the Nigerian context that influence contaminated land management policy improvement are presented in this chapter. A pathway for improving the current policy in the advent of policy transfer from the UK and the USA is also provided.

Chapter 4: This chapter presents an integrated risk assessment framework for contaminated land management in Nigeria incorporating social values in the Nigerian context. A protocol for integrating sustainability indicators was also captured in this chapter. Lastly, the chapter provided a timeline for the implementation of the integrated risk assessment framework.

Chapter 5: A multi-attribute technique for contaminated land prioritisation in Nigeria was used to select sites with highest risks requiring priority attention. The multi-attribute framework is expected to support decision makers in allocating limited remediation resources to sites that poses highest risk to receptors

Chapter 6: This chapter provides a synthesis and summary of the outputs from each chapter (objective) and described how they contributed to the achievement of the aim of the research. This chapter highlights the novelty of this research and further provides recommendations for further studies. The chapter also presents the implication and significance of the study to stakeholders in Nigeria.

1.8 Publications

At the time of writing this thesis, two papers have been accepted for publication in international peer-reviewed journals and two are currently under review as listed below. Kabari Sam has been the first author on all publications having written the content, conducted the analysis and discussion and drawing the conclusions. Dr George Prpich and Prof Frédéric Coulon have contributed by performing a supervisory role mainly editing, proofreading and providing suggestions.

- Sam, K. Coulon, F. Prpich, G. 2016. Contaminated land management policy in Nigeria: Current challenges and future direction: Paper submitted to the Journal of Land Use Policy. (under review) **(Chapter 2)**

- Sam, K., Prpich G., Coulon F. 2015. Environmental and societal management of contaminated land in Nigeria: the need for policy and guidance changes. In: *Clean-up Conference 2015 proceedings*, Australia, WF1, 427-428. **(Chapter 3)**

- Sam, K., Coulon, F., Prpich, G., 2016. Gaining insights into contextual issues on contaminated land management decisions in Nigeria to promote efficient policy transfer: Paper submitted to Environment International Journal. (submitted) **(Chapter 3)**

- Sam, K., Coulon, F., Prpich, G., 2016. Working towards an integrated land contamination framework for Nigeria. Sci. Total Environ. doi:10.1016/j.scitotenv.2016.07.075 **(Chapter 4)**

- Sam, K., Coulon, F., Prpich, G., 2016. A multi-attribute methodology for contaminated land prioritisation in Nigeria: Sci. Total Environ. Journal. (submitted) **(Chapter 5)**

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2 Management of petroleum hydrocarbon contaminated sites in Nigeria: current challenges and future direction

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Abstract

Sites affected by petroleum hydrocarbons from oil exploitation activities have been identified as a major environmental and socio-economic problem in the Niger Delta region of Nigeria. The current Nigerian regulatory instruments to manage these contaminated sites are fragmented and the roles and responsibilities of government agencies, such as the Department for Petroleum Resources (DPR), and the National Oil Spill Detection and Response Agency (NOSDRA), are not well defined. This lack of coordination has led to ineffective land contamination policy and poor enforcement more generally. Appropriate, risk-based policy instruments are needed to improve regulatory capacity, and to enhance the regulator's ability to manage new and existing petroleum hydrocarbons contaminated sites. Lessons can be learned from countries like the UK and the USA that have experience with the management and clean-up of historically contaminated land. In this paper, we review the status of petroleum hydrocarbon contaminated sites management in Nigeria and identify the gaps in existing policy and regulation. We review the contaminated land policies and regulation from the UK and the USA, and identify lessons that could be transferred to the Nigerian system. Finally, we provide a series of recommendations (e.g. source – pathway-receptor approach, soil screening criteria, clean-up funding, liability) that could enhance contaminated land legislation in Nigeria.

Keywords: Contaminated-land, risk management, Niger Delta, environmental policy, oil spill

2.1 Introduction

The Federal Republic of Nigeria, commonly referred to as Nigeria, is located in West Africa, covering an area of 923,773 km^2 (Nwilo and Badejo, 2006), and is comprised of 6 regions, 36 states, and 774 Local Government areas (Adeyemi, 2013). Nigeria has a diversity of natural resources, such as bitumen, coal, iron ore and crude oil. Nigeria is the 12^{th} largest producer of petroleum hydrocarbons in the world and its main oil producing region is the Niger Delta. The Niger Delta is located at the apex of the Gulf of Guinea on the west coast of Africa and within Nigeria's southern geopolitical zone (Figure 2-1). Approximately 31 million people live within the Niger Delta (NDDC, 2014). Geographically, the Niger Delta covers an area of 112,000 km^2 and encompasses one of the most bio-diverse ecosystems on the planet (Ugochukwu and Ertel, 2008). Ecologically sensitive regions include, for example, coastal barrier islands, mangrove swamps, and freshwater swamps (NDDC, 2014).

In the late 1950s, Britain (British Petroleum) discovered crude oil in the region and in 1958 the country started commercial production at Oloibiri – a village in the Niger Delta – producing 6000 barrels per day (Kadafa et al., 2012). Today, about 606 oil fields (355 situated onshore and 251 offshore), 5,284 oil wells, and 7,000 km of oil and gas pipelines are operated by 13 multi-national companies in the region (Nwilo and Badejo 2006; Kadafa 2012). The region prides itself as the hub of oil exploration and production infrastructure in Nigeria (Eke, 2016), and currently produces on average 1.7 million barrels per day as of 2015 (OPEC, 2015).

The oil sector has become vital to the Nigerian economy. Reports estimate the export value of oil from the region to be $89b USD per annum (OPEC, 2015), or in excess of $600b USD since 1960 (Ite et al., 2013). This translates into a contribution of up to 35% of Nigeria's gross domestic product (GDP), and over 90% of its foreign exchange wealth (Akpabio and Akpan, 2010; OPEC, 2015). Despite the country's oil wealth, the majority of the population, including the oil producing communities in the Niger Delta, remain relatively poor (Eke, 2016). The

common employment is agriculture, food production, and fisheries (NDDC, 2014).

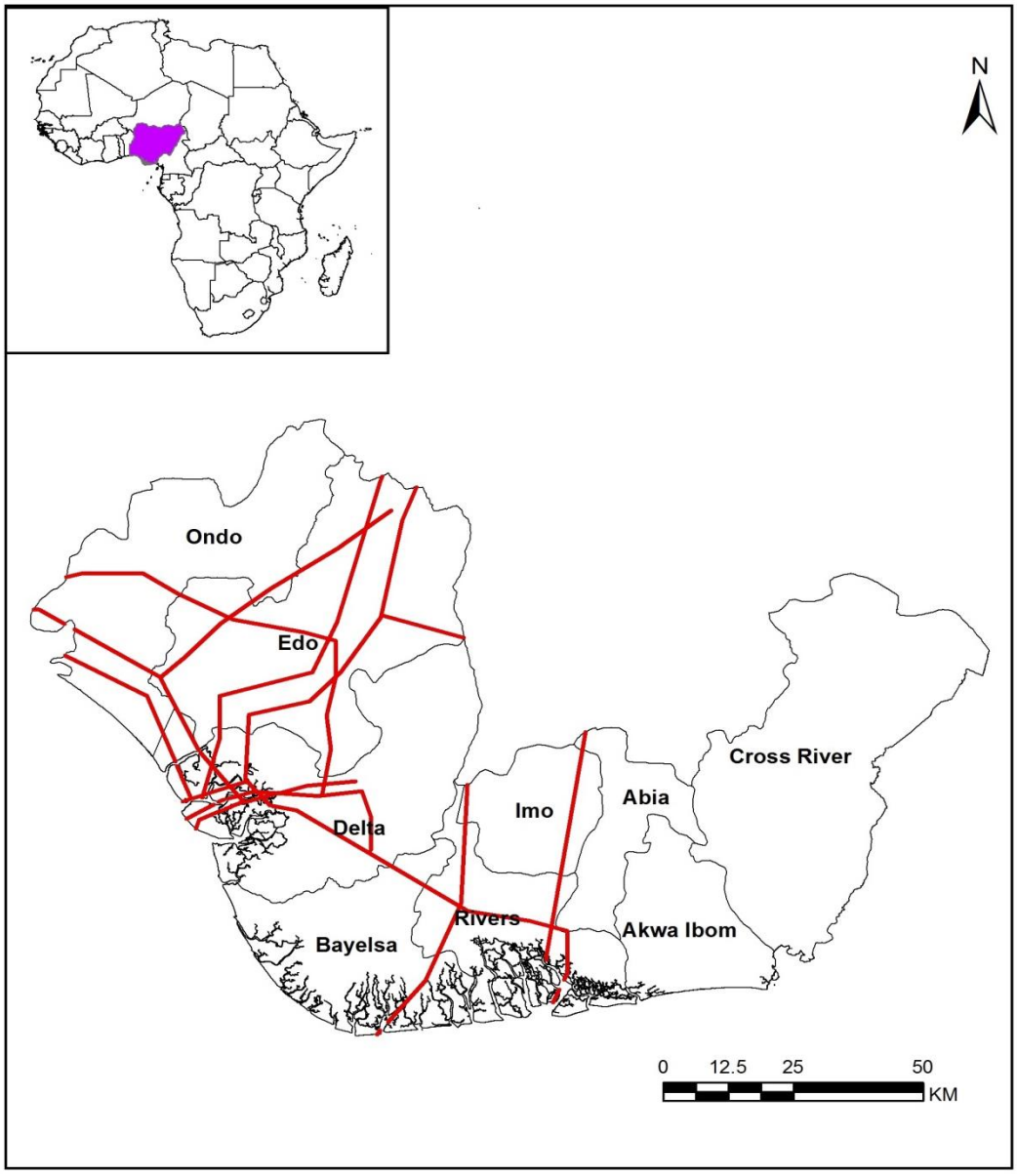

Figure 2-1: Africa showing the Niger Delta region and oil pipeline network (red lines).

The Niger Delta has been reported as one of the most heavily oil-impacted regions in the world due to over five decades of oil exploitation activities (Zabbey and Uyi, 2014). Since the inception of the Nigerian oil sector, 13 million tonnes of hydrocarbons have been reported as spilled in the Niger Delta (Nwilo and Badejo, 2006; Kadafa, 2012) as a result of sabotage, pipeline vandalism (individuals that break pipeline during oil theft), well blowout, and engineering failure (e.g. pipeline

rupture) (Nwilo and Badejo, 2006; Ambituuni et al., 2014; Könnet, 2014). Considerable oil contamination of the land has been reported (Ite et al., 2013; Linden and Palsson, 2013) and recent estimates suggest that over 2000 land-based oil-contaminated sites exist (Ite et al., 2013).

Nigeria has made few attempts to clean-up oil-related contaminated land and the most common approach used is remediation by enhanced natural attenuation (RENA) (UNEP, 2011; Orji et al., 2012). This approach has been reported as ineffective as concentrations of contaminants in soil remain significantly high, even after sites have been certified remediated (UNEP, 2011). RENA is an inappropriate approach because of the extent and scale of the spills with oil penetrating soil to depths of over 5 m and leaching into groundwater aquifers (Ebuehi et al., 2005; Orji et al., 2012). Moreover, RENA is ineffective for the treatment of contaminated aquifers and this has led to some communities no longer having access to safe drinking water (UNEP, 2011). Of the few attempts made to remediate contaminated land, none have involved stakeholder inputs (Rim-rukeh, 2015), and this has led to conflict and protest against the government and industry operators (UNEP, 2011).

The United Nations Environment Program (UNEP) report (Environmental Assessment of Ogoniland) is the most influential account to document the scale of pollution in the region (UNEP, 2011). A major recommendation from this report highlighted the need for development and adoption of oil pollution mitigation strategies. In general, Nigeria lacks the policies necessary to manage pollution, and this has been attributed to a number of different factors, e.g. a fragmented governance structure, a lack of decision transparency, and poor policy implementation (Ajayi and Ikporukpo, 2005; Ite et al., 2013).

Examples of countries with effective policies to manage pollution and contaminated land exist. Two of such examples include the United States of America (USA) and the United Kingdom (UK). These countries have spent considerable time and effort to develop governance structures and strategies that provide effective management of contaminated land (Hird, 1993; Luo et al., 2009; Rodrigues et al., 2009; Swartjes et al., 2012; Kiel, 2013). Though the drivers (or

conditions) that led to these developments will differ from that of Nigeria, the overarching principles should remain the same, i.e. environmental mitigation and reduction of human health impacts (Ferguson, 1999; Rodrigues et al., 2009a; Swartjes, 2011b).

Therefore, Nigeria could benefit from the lessons learned in the USA and UK as they seek to improve their contaminated land management policy. In this study, the research focused on petroleum hydrocarbon contaminated sites in the Niger Delta region. Using this region as a case study, the study review the current contaminated land management situation in Nigeria to identify the gaps in policy and regulation. The study also review the UK and USA experiences to identify the elements of those policies that could support progress in Nigeria. Finally, the study propose recommendations for Nigeria that could support further development and implementation of a more effective contaminated land management regime.

2.2 Contaminated land management in Nigeria

2.2.1 Regulatory history of contaminated land in Nigeria

Contaminated land management regulation in Nigeria can be classified as three distinct periods: (1) no legislation; (2) non-specific legislation; (3) specific legislation (Figure 2-2). From 1956 – 1968, there was no legislation (1956-1968) while oil exploitation was initiated in 1956. The regional management of the sector was being developed (1956 – 1959) and Nigeria achieved Independence (1960). No specific regulations to manage contaminated land were in place at this time, nor were there any legal instruments available to discourage contamination (Ite et al., 2013).

At the end of this period oil contamination incidents were on the rise and this elicited a response from Nigeria and marked the beginning of the period of non-specific legislation (1969-2001) (Anago, 2002; Ogbodo, 2009). During this period the Petroleum Act (1969) was developed to provide an overarching legislation for the prevention of environmental pollution in different environmental media, e.g. water, air and soil. Other notable legislations, such as the Harmful Waste Act

1988 and the Environmental Impact Assessment Act 1992, were established but were not designed specifically to address contaminated land management (Ajayi and Ikporukpo, 2005; UNEP, 2011).

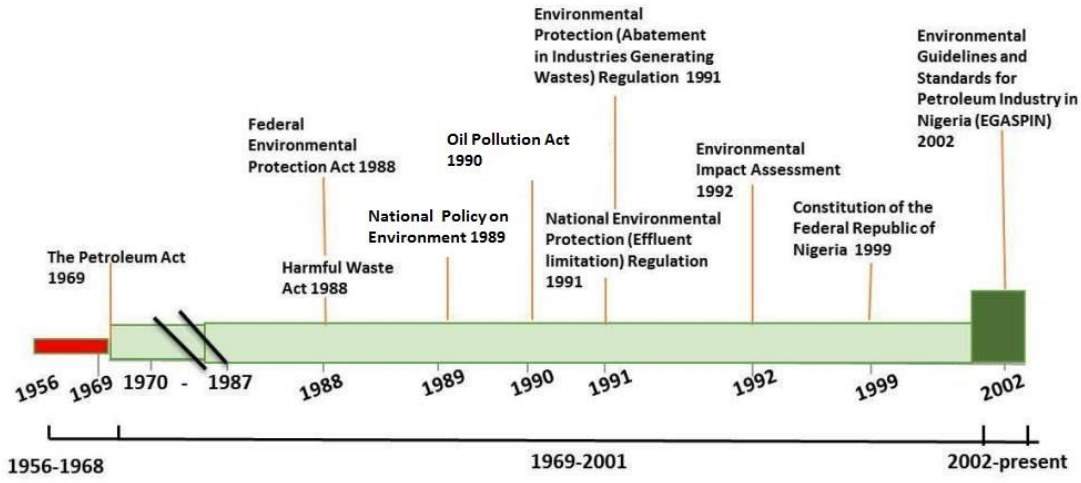

Figure 2-2: Timeline presenting the development of contaminated land management policy in Nigeria from 1956 to present.

Increases in oil production, incidents of oil pollution (Badejo and Nwilo, 2004; Nwilo and Badejo, 2005), and community protests specifically in Ogoniland (Osaghae, 1995), led to a response from Government in the form of the Environmental Guidelines and Standards for the Petroleum Industry (EGASPIN) (2002). The EGASPIN marks the final period of specific legislation (2002 – present), and forms the regulatory basis of the current environmental mandate in Nigeria. Many of the guidelines for environmental quality standards described within the EGASPIN have been adopted from other countries (mainly from the USA). This has been attributed to Nigeria's lack of technical capabilities and expertise to develop such guidelines (Ajayi and Ikporukpo, 2005). Of those in place, there are concerns that these guidance lack contextualisation; that the conditions in the USA for land use, soil type, and soil total organic carbon differ from those in Nigeria. This difference could have an impact on the appropriateness and efficacy of the guidelines to assess and thus manage risk (Ajayi and Ikporukpo, 2005, UNEP, 2011).

2.2.2 EGAPSIN - Current approach to contaminated land management

The EGASPIN describes environmental quality control guidelines that cover oil exploration, production operations, hydrocarbon processing, transportation, permits, sanctions, and pollution abatement technologies (DPR, 2002). Specific to contaminated land, the EGASPIN provides a set of guidance to mitigate the risks of contaminated land to human health and ecological systems. This is a risk-based framework that uses a multi-tiered contaminated land risk management approach In the event of a new spill, the EGASPIN requires the operator to report it to the Department of Petroleum Resources (DPR), however, in practice operators report to both the National Oil Spill Detection and Response Agency (NOSDRA) and DPR. Next, a risk assessment is conducted at the discretion of the operator and the director of DPR. The risk assessment process requires the development of a conceptual site model (CSM) that identifies all pollutant linkages. Finally, a risk ranking exercise is performed (DPR, 2002) to identify priority sites requiring attention.

In Nigeria, risks are assessed using soil screening values (SSVs) that are predicated on contaminant concentrations for which soil functionality, plant life, animal, and human health are deemed to be threatened or could be seriously impaired. Management actions are triggered when certain contaminant threshold levels are exceeded (DPR, 2002). These values were directly adopted from the American Society for Testing and Materials (ASTM), a standards organisation that develops and publishes voluntary technical standards for materials and products (ASTM, 1995). Developed for specific conditions in the USA, it is unclear how appropriate these are for assessing risk under Nigerian conditions (Boulding and Ginn, 2003).

2.2.3 Governance and regulatory organisational structure

Environmental management falls under the responsibility of numerous governmental departments and agencies at the federal, state, and local levels (Figure 2-3). Only two agencies have the responsibility to manage contaminated land, and these are the DPR and the National Oil Spill Detection and Response

Agency (NOSDRA). DPR is responsible for managing legacy sites and NOSDRA is responsible for the detection and management of emergency oil spills (Oyefusi, 2007; Ambituuni et al., 2014; Rim-rukeh, 2015).

Despite this difference, agency roles often conflict. For example, when an oil spill occurs the operator must notify both agencies, each of which will then initiate an independent risk assessment of the site. Conflict might thus arise from different assessments, which could impact the legitimacy of the management recommendations provided by NOSDRA who has the mandate to address new spills. Duplication of responsibility exists elsewhere, for example, pollution prevention and management of the oil sector falls under jurisdiction of four different federal agencies sitting across two different ministries (Figure 2-3) (Eneh, 2011). Overlap will ultimately lead to inefficiencies in the governance process, such as the double budgeting for management of contaminated sites, and conflicting standards (Ajai, 2010; Eneh, 2011; Ambituuni et al., 2014).

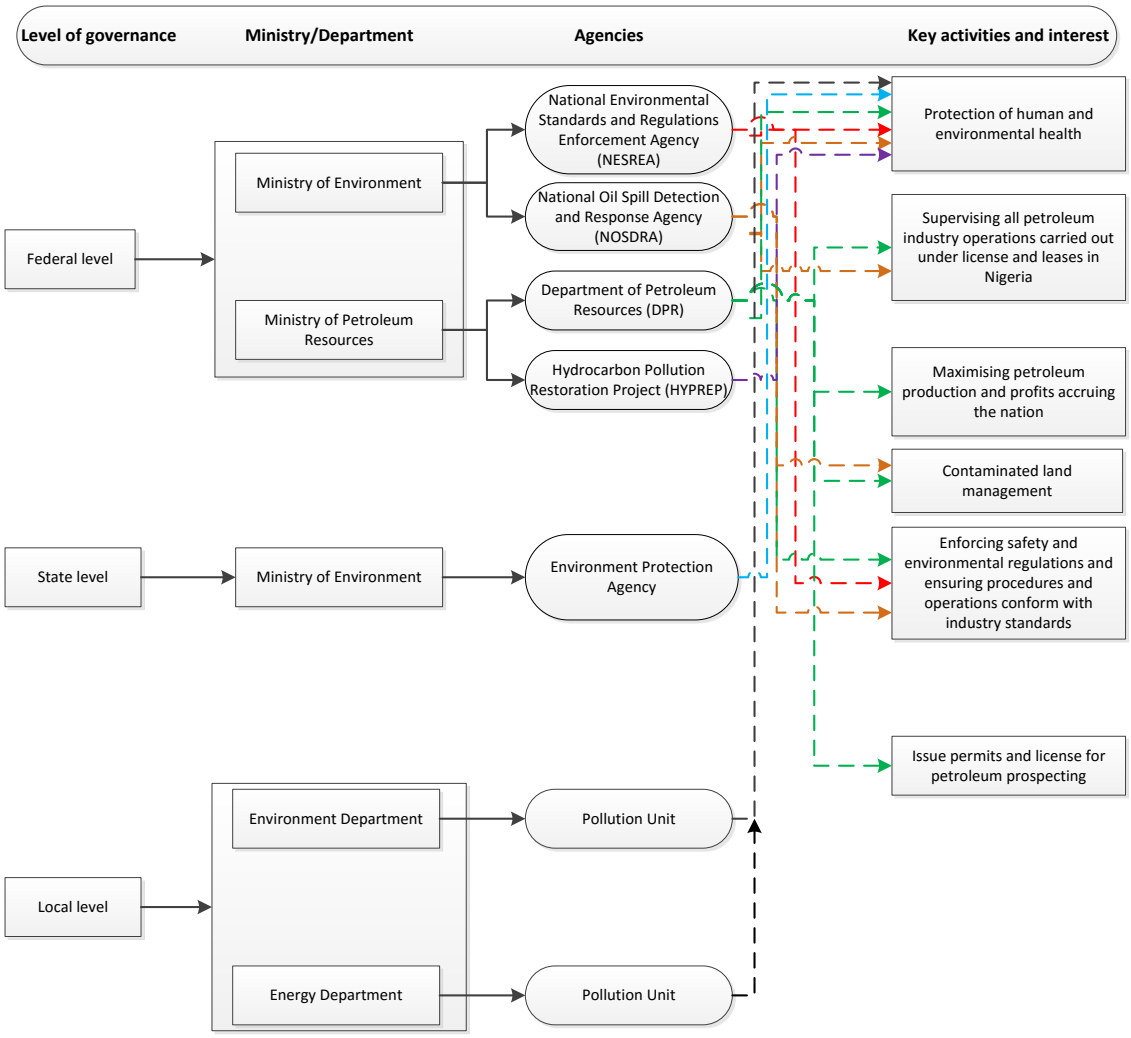

Figure 2-3: Map of the Government departments and agencies that are responsible for environmental management in Nigeria. This map shows the overlap of activities between different departments and agencies. Functions performed by each agency are represented in colour: NESREA (red), DPR (green), NOSDRA (orange), HYPREP (purple), Environment Protection Agency (blue), Pollution Unit (black).

Concerns about conflict of interest exist in DPR's dual role for contaminated land management and responsibility to maximise oil production and collect oil related revenues (Okotoni, 2004). This arrangement has led to reports of unethical behaviour, i.e. corruption (Eneh, 2011; UNEP, 2011). Countries such as the USA and UK specifically separate these two roles to avoid such occurrences (Ramseur and Hagerty, 2013).

2.2.3.1 Shortcoming in governance

Nigeria suffers from a number of operational shortcomings that have an impact on the development of effective governance. One shortcoming is a lack of adequately trained and experienced personnel who understand the technical aspects of contaminated land risk assessment and management (Ajayi and Ikporukpo, 2005; Eneh, 2011; UNEP, 2011). Another shortcoming is a weak and ambiguous definition for contaminated land (Table 2-1), which is crucial for quantifying contaminated land (Walton, 1997). The definition for contaminated land as presently established in Nigeria is weak because it does not make particular reference to the source of hazard, the pathway or a receptor, and thus ambiguous. This makes it difficult identify and different what constitute a contaminated land. In other regimes such as the UK where land contamination legislation have evolved, the definition makes reference to the receptor and source of hazard. The relevance of this specificity is that it helps in the determination of what constitute a contaminated land.

Table 2-1: Statutory definitions for contaminated land in the UK, USA and Nigeria

Country	Definition	Reference
UK	Any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that – (a) significant harm is being caused or there is a significant possibility of such harm being caused; or (b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused	(DEFRA, 2012)
United States	"A real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant or contaminant. The term “pollutant or contaminant” shall include, but not be limited to, any element, substance, compound, or mixture, including disease-causing agents, which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations	(CERCLA, 2002)

Country	Definition	Reference
Nigeria	The presence in the environment of an alien substance or agent or energy, with a potential to cause harm	(DPR, 2002)

Other shortcomings include insufficient funding to support the assessment and management of contamination, as well as enforcement of regulations. Lack of funding manifests in areas such as training, logistics, and facilities (Eneh, 2011), and it has been observed that operators, with sufficient resources, are often willing to assist regulators during their assessments and investigations (Oyefusi, 2007). For example, most spills in the Niger Delta occur in remote locations where transportation is limited (e.g. helicopters and boats used to access spill sites). Under these circumstances, regulators will depend on operators to provide access to spill sites. Experts suggest that this type of engagement might interfere with the completion of a risk assessment leading to biased reporting of the cause, volume, and extent of an oil spill (Eneh, 2011; UNEP, 2011; Könnet, 2014). At a higher level, this type of engagement could potentially present opportunities for corruption or abuse of the regulatory process.

Fragmented legislation, insufficient funding, and a lack of expertise pose a significant challenge to contaminated land management in Nigeria. In addition, the regulation does not effectively assign liability. Rather than outlining a process to identify and apportion liability, the EGASPIN states that the operator is liable for all oil spills (DPR, 2002). Because there is no action in place to ensure that the polluter pays, if land contamination results from pipeline vandalism by a third party the operator remains responsible (Könnet, 2014). To understand how Nigeria might address these challenges, we review the UK and the USA contaminated land management regimes to identify lessons that could be learned and transferred to a Nigerian context.

2.3 Contaminated land management in the UK

In the UK, contaminated land is defined as outlined in Table 2-1. The UK definition is specific and reflects the source-pathway-receptor model, which makes it easier for a regulator to identify contaminated land and determine the level of contamination.

The birth of the Industrial Revolution over 200 years ago, marked the onset of land contamination in the UK (Swartjes, 2011b; Kossoff et al., 2016; Pizzol et al., 2016). There had been concerted efforts from the Government, regulators, the regulated and policy makers to ensure that the legacy of contaminated land and associated risks is addressed (Forton et al., 2012). Today, the UK contaminated land management regime is a reference point for many countries such as China (Brombal et al., 2015), Cameroon (Forton et al., 2012) and European countries (Rodrigues et al., 2009b). Different approaches for decision making on contaminated land has been developed and evolved over the past few decades through extensive scientific investigation from being cost-centric in the 1970s, techno-centric in the 1980s and risk-based in the 1990s (Pollard et al., 2004a) to a much more integrated and sustainable technique (Bardos et al., 2016).

A contaminated land management strategy was first developed in the UK in 1976 with the development of the Inter-departmental Committee on the Redevelopment of Contaminated Land (ICRCL) (Rodrigues et al., 2009a). The mandate of the ICRCL was to provide experts with the necessary tools to assess and manage the risks associated with contaminated land. In particular, the ICRCL published a set of guidance for the management of human health hazards that might result from exposure to contaminated land (Guidance Note 59/83, 1987). The ICRCL also developed trigger values for three groups of pollutants (i.e. toxic metals, aggressive substances, and phenols) and assigned land use categories to support risk assessment and management decisions (Rodrigues et al., 2009a).

As time passed, concerned stakeholders like landowners and developers, regulators, and local authorities, demanded more specific contaminated land regulation. As a response, the UK Government developed two principal regulations: the Town and Country Planning Act 1990 and Part 2A of the Environmental Protection Act 1990 (Catney et al., 2006). The main purpose of these regulations was to improve the identification of contaminated land that posed an unacceptable risk to human health and environmental receptors (EA, 2002). Additionally, Part 2A was intended to prevent new contamination, promote remediation and redevelopment of legacy sites, and to intervene where

development might not be feasible because a site could pose risks to receptors (Brombal et al., 2015; Luo et al., 2009). Founded on risk-based principles, Part 2A was intended to promote voluntarily clean-up on about 10% of sites in the UK, while the majority of sites were remediated as part of normal land development processes under the Town the Country Planning Act 1990 (Luo et al., 2009). Stakeholder consultations are a central tenet of the redevelopment process, and are used to create awareness, harness contributions to new policies, and educate the public about changes or updates to contaminated land management policy. The precautionary and polluter pays principles are also significant components of UK contaminated land management. The precautionary principle promotes discretion in the presence of uncertainty, seeking to protect the public from exposure to harm (Reinikainen and Sorvari, 2016), while the polluter pays principles assigns liability for clean-up on the person or persons responsible for the release of a polluting substance (Catney et al., 2006; EA, 2009a). Appropriate persons are classified further: Class A persons are those who knowingly, or unknowingly, permitted polluting substances in, on, or under land while Class B persons are the owners or occupiers of a site who may be liable if the actual polluter is not found (DEFRA, 2012). If neither a Class A nor B person is found, the site is classified as an 'orphan site' and becomes the responsibility of the local council (DEFRA, 2012). The Local authority takes responsibility for the clean-up of orphan sites pending the identification of an appropriate person whom will pay the clean-up and other cost incurred in the remediation process. In the long term where the appropriate person is not identified, the local authority takes responsibility. Latest report reveals that between 2000 and 2007, only 9% of cases did the original polluter fund the remediation cost (EA, 2009a). The UK's polluter pays principle has been adapted by other countries, including the Netherlands, and Finland (Rodrigues et al., 2009a; Sorvari et al., 2009).

Pragmatically, Part 2A provides practitioners with a series of steps to assess the risk associated with contaminated land. These steps include: identification, determination, liability, appeals against remediation notice, and offences of non-compliance, among others (UK Government, 1990). Statutory Guidance (SG) to aid implementation has also been refined over the years to clarify the objectives

of legislation and thus support its implementation. Also, as new scientific knowledge becomes available it is integrated into the SG documents, thus providing a routine update that demonstrates a desire for continuous improvement of legislation. For example, to achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised SG presented in 2012 established a new four category system for considering land under Part 2A. Categories range from Category 4, where the likelihood that land poses a significant possibility of significant harm (SPOSH) is low, to Category 1, where the likelihood that land poses a significant possibility of significant harm is unacceptably high (CL:AIRE, 2014). The Impact Assessment (IA) that accompanies the revised SG explains this system in more detail and identifies a potential role for Category 4 Screening Levels (C4SLs) to provide a simple test for deciding that whether land is suitable for use and thus not contaminated.

Overall, the UK's contaminated land legislation uses a risk-based, tiered approach to support decision making as outlined in CLR 11 (DEFRA and EA, 2004; DEFRA, 2012). Tier 1 requires that a connection be identified between a hazard and a receptor, and this is done using the source, pathway and receptor S-P-R model (EA, 2004). The S-P-R model is a critical component for determining a pollutant linkage, which indicates the presence of risk (EA, 2004; Rodrigues et al., 2009; Nathanail et al., 2013). If a pollutant linkage is established, the process moves to Tier 2, which requires the completion of a generic quantitative risk assessment. This assessment is supported by soil guideline values (SGVs). SGVs are scientifically derived contaminant thresholds designed to protect human health from exposure to long-term contamination in soil (EA, 2009b). SGVs are based on specific land use, assumptions about contaminant behaviour, and the sources, pathways, and receptors (Cheng and Nathanail, 2009). However, the EA has withdrawn SGVs developed before 2009 (CLAIRE, 2016). The EA stated that the withdrawn SGVs were prepared using the previous framework guidance published in 2002 which has been superseded. The EA indicated that practitioners will be able to develop site specific assessment criteria using the contaminated land exposure assessment (CLEA) software and

handbook. In addition, the C4SLs represent a more pragmatic and robust generic screening levels and could screen a higher level of risk compared to the SGVs and other similar derived numbers (DEFRA, 2014). If guidance values are unavailable, professional bodies (e.g. Land Quality Management) might provide generic assessment criteria (GACs) to simplify the risk assessment process and provide a benchmark for decision-making (DEFRA and EA, 2004; Forton et al., 2012). At a high level, SGVs serve as screening tools to determine whether or not a site requires remediation action, based on the effects to human health. If SGVs are exceeded, the process moves to Tier 3, which requires the completion of a detailed quantitative risk assessment (Carlon et al., 2007). In such instances, there is need to develop and use site specific information to inform the risk assessment process. This will necessarily require the development of Site Specific Assessment Criteria to enable informed decision-making in the risk assessment process. Overarching this process is the consideration of sustainability, whereby risk assessors and policy makers ensure that the decision-making process integrates stakeholders, and that the final decision returns environmental, economic, and societal benefit to the public (Bardos et al., 2016; Hou et al., 2014).

Funding to manage contaminated land is provided through the land capital grant scheme. This is a grant given to local authorities by DEFRA to help them remediate determined contaminated sites. Thus local authorities bid for the funding and upon approval by DEFRA are given the funds (EA, 2016). Local authorities can use the fund to clean-up historic sites, however this funding has been reduced over time and is expected to end in April 2017 (Mills and Reeve, 2015).

Responsibilities within government to manage contaminated land are divided between departments. Local Authorities are responsible for delivery, and focus on the protection of human health, inspection, identification, and maintenance of a contaminated site registry. They also play a role in the management and monitoring of clean-up actions, and the facilitation of public consultations. The Environment Agency (EA) provides support to Local Authorities and is

responsible for managing Special Sites, which are those where soil is contaminated by explosives or radioactive substances, are owned by the Ministry of Defence, or directly impacts on drinking water supplies (EA, 2009a, Catney et al., 2006; Defra, 2012). The EA, together with Defra develop policies and supervise implementation.

2.4 Contaminated land management in the USA

The statutory definition for contaminated land in the USA is outlined in Table 2-1. Similar to the UK definition, it identifies what constitutes a hazard, and specifies the need to protect human and environmental receptors. This provides regulators with direction to identify and quantify contaminated land.

Throughout the course of the USA's ascent to industrial giant, the USA lacked the regulations to handle and manage hazardous waste. As a result, most waste was disposed by dumping it into nearby water bodies or burying it underground (Delong, 1997). Over time, concerns about the effects of contaminated soil and water on human health and the environmental began to increase (Bearden, 2012). The first legalisation for contaminated land management was part of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), which was developed in response to the *SS Torrey Canyon* oil tanker spill off the South West coast of the UK in 1968 (USEPA, 2016a). This strategy was developed to help officials cope with similar types of spills in the USA, and served as a blueprint for response to land contamination from oil spills and hazardous substances in the USA. In 1976, the Resource Conservation and Recovery Act (RCRA) was established to manage hazardous waste disposal sites. The RCRA addressed the management and disposal of hazardous wastes and was the basis for improved contaminated land management in the USA (CERCLA, 2002; Nathanail et al., 2013). Incidents such as the Santa Barbara oil spill of 1969 (Hendy et al., 2015), and the hazardous waste deposited at the Love Canal, NY in 1978 (Austin et al., 2011) further raised the profile of contaminated land in the USA, and in 1980 the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) was developed. Commonly referred to as the Superfund programme, this act was used to designate funding (generated from

taxation of the chemical and petroleum industries) to the remediation of historically contaminated sites (Rodrigues et al., 2009a). In 1986 the Superfund programme was updated (i.e. Superfund Amendments and Reauthorisation Act) (Nathanail et al., 2013) to include the introduction of community awareness initiatives, and to broadened the public's access to information about the potential threats posed by contaminants. The Superfund program has been very effective with remediation action taken on 2436 sites, of which 428 sites have been completely remediated (USEPA, 2012). In addition, 1,361 sites have been listed on the National Priority List (NPL), which is a list of national priority sites based on the type of contamination and the threat it poses to public health.

Similar to the processes of the UK, the Superfund process comprises a series of steps that support the decisions that lead to the remediation of contaminated lands. These steps include definition of contaminated land, prescription on how to issue abatement notice, financial liability, clean up (including removal and remedial measures), and litigation procedures, among others. Risk Assessment Guidance for Superfund (RAGS) was developed to clarify the procedures and aid practitioners' implementation of the CERCLA (USEPA, 1997; Kowalski et al., 2002).

The USA approach is risk-based (the existence of risk is depended on the S-P-R model), similar to the UK, but the two systems differ in how they score and assess priorities to human health and ecological receptors. To assess the risk to public health and the environment the USA uses a Hazard Ranking System (HRS) that comprises a score based on the assessment of likelihood to cause harm, the behaviour of a substance, and the proximity of receptors in the area. These scores are used to determine the status of a site and if a site scores sufficiently high, it is listed on the USEPA's NPL, thus classifying it as requiring long-term clean-up (DeLong, 1995; Rahm, 1998). The USA also enforces the polluter pays principle once a potential responsible party (PRP) has been identified. Where no PRP is identified, the regulator takes up remedial action and 'apportions liability' to a PRP when one is identified (CERCLA, 2002). Regarding sustainability, the USA also ensures that final decisions on contaminated land management will

provide benefits to society, will reduce environmental footprints, and will lessen economic impacts (Hou and Al-Tabbaa, 2014; Hou et al., 2014).

Guidance documents are available to support practitioners and these include ASTM International's health-based site clean-up criteria (Salhotra, 2008; Rodrigues et al., 2009b), the Regional Screening Levels (RSLs) for human health and different land use (USEPA, 2015), and the contaminated sediment remediation guidance for hazardous waste sites (USEPA, 2005). Programmes have also been initiated to support remediation work on superfund sites and these include the site-specific risk based corrective action programme, and voluntary clean-up programmes (De Sousa, 2001; Rodrigues et al., 2009).

Responsibility to regulate contaminated sites falls within the jurisdiction of the USEPA and the RCRA at the federal level. At the state level other programmes and contaminated land legislation exist (regulated by State Environment Protection Agencies) in order to ensure the achievement of national and state environmental policy goals. Oversight of risk assessments and remediation activities is the responsibility of the State, except in the instances of contaminated land emergencies (e.g. spills) and hotspots (sites that require urgent attention) where regional teams take the lead and report to the USEPA (CERCLA, 2002).

2.5 Lessons learned: recommendations that could benefit contaminated land management in Nigeria

The Nigerian contaminated land management system lags behind those in the UK and the USA in terms of its effectiveness to identify relevant sites, conduct appropriate detailed risk assessments, and to initiate remediation activities. Nigeria lacks a comprehensive regulatory framework for contaminated land management that integrates sustainability appraisal. More specifically, Nigeria requires a more effective statutory definition for contaminated land, better regulatory coordination, a mechanisms to apportion liability, soil screening values, training, proportionate fund, and technical expertise. In the following section we will discuss how lessons from the UK and the USA might be used to address these gaps (Table 2-2).

Table 2-2: Lessons based on the UK and US experiences that might benefit contaminated land management in Nigeria

	UK	USA	Nigeria
Statutory definition	Clear statutory definition for contaminated land that makes reference to the S-P-R and pollutant linkage methodology.	Clear definition for contaminated land that makes, and identifies the significance of the S-P-R relationship.	Revise existing guidance to provide a statutory definition for contaminated land that refers to the S-P-R model.
Regulator structure and capacity	The local authorities and the EA are well coordinated with clarity of roles and standards. Both authorities are equipped with technical personnel.	The USEPA is well coordinated and they understand their roles. Both agencies are provided with appropriate training, technical, and human resources.	Revise existing guidance to clearly define roles and responsibilities of agencies. Provide regular training to improve capacity for contaminated land identification and remediation techniques.
Funding contaminated land	Government funding has been reduced. Policy encourages voluntary remediation by private land owners.	Government funds contaminated land clean-up via the Trust Fund. Voluntary remediation is encouraged.	Adequate legislation including the polluter pays principle should be enforced for pollution events and approaches to deal with 'orphan sites' outlined. In the short term, a Trust Fund should be established with contributions from crude oil sales to fund contaminated land clean up. This has started in Ogoniland although the source of funding is not sustainable.
Technical approach	Land use is considered in the assessment. Scientifically derived values such as GACs are used for screening contaminants.	Land use is considered in the assessment. Scientifically derived endpoints and the HRS method are used to screen sites (CERCLA, 2002)	Produce nationally consistent methods for deriving human health and ecologically appropriate screening values that consider land use (i.e. fit for purpose).

	UK	USA	Nigeria
Liability	Appropriate Person (AP) is identified through a structured process. An AP could be Class A or B polluter (EA, 2009a).	Potential Responsible Party (PRP) is identified through a structured process. The regime practice both strict and joint liability (CERCLA, 2002).	Stringently implement the polluter pays principle. Implement means to identify a polluter and apportion liability
Sustainability appraisal	Contaminated land management decisions are based on maximising societal benefits, while reducing costs, and environmental damage.	Sustainability is geared towards reducing the environmental footprint of contaminated land management decisions. The green remediation programme is designed for superfund sites and the SURF US encompasses different types of site contaminations.	Develop a policy to integrate sustainability indicators that maximise societal benefits, reduce cost, and environmental footprint into management decisions.
Public awareness	Extensive consultations are held to educate the public and create awareness of new policies and changes to contaminated land management policies.	Public awareness programmes are undertaken to educate stakeholders and members of the public of changes to policy and identified contaminated sites	Increase public awareness via different media such as symposia and workshops in rural and urban areas to inform the public about contaminated land policies and impacts.

2.5.1 Statutory definition for contaminated land

To distinguish between lands that are deemed contaminated and those that are not requires a clear statutory definition (Catney et al., 2006). The provision of a definition sets the basis for quantifying the extent and scale of contamination (Walton, 1997), and informs the risk management approach used to contain and treat contamination. For example, the UK statutory definition (Table 2-1) identifies receptors (i.e. human health, land and controlled waters) that must be protected (Luo et al., 2009), as well as the authority responsible for management. Definitions from the USA provide details about what constitutes a release, or a hazard, which can guide management activities. Elements of the source—pathway—receptor model are present in both definitions.

Definitions for contaminated land management in the EGASPIN are broad and generic (see DPR, 2002), which could lead to ambiguity about the risks presented by contaminated land (e.g. hazards, receptors, exposure). The current definition (see Table 2-1) might benefit from more information about the environment (e.g. land and water), the hazard, and the harm. For example, in the UK the definition includes harm to ecological as well as human receptors. Subtle changes in language are needed to improve the specificity of the definition, to differentiate land use and to reduce ambiguity.

2.5.2 Regulatory coordination

Effective implementation of regulation requires a coordinated regulatory system across government. Nigerian regulatory coordination for contaminated land management is flawed, evidenced by fragmented responsibility across Government (e.g. federal, state, and local) and between agencies (e.g. DPR and NOSDRA) (Figure 2-3). Poor coordination could lead to a duplication of efforts, discordant environmental governance, and unethical behaviour, such as corruption (Ajayi and Ikporukpo, 2005; Eneh, 2011; Ajai, 2010; Ambituuni et al., 2014).

Both the UK and USA contaminated land regulatory regimes are decentralised, and their functions are facilitated by clear roles and responsibilities spread across

different stakeholders so as to avoid duplication of effort (Catney et al., 2006). For example, UK responsibilities are shared between the EA and local authorities, with each actor responsible for a specific activity so as to minimise duplication and the chance of conflicting reports (DEFRA, 2012). Similar structures are present in the USA where the roles of the USEPA and the Regional Decision Teams are clearly defined and separated (CERCLA, 2002). Learning from the UK and USA, the roles and responsibilities between DPR and NOSDRA need to be redefined and where possible, a system should be developed to coordinate actions for human health, water, environmental management, as well as emergency response (EA, 2009; Luo et al., 2009).

When redefining roles and responsibilities, Nigeria must separate responsibility for environmental enforcement and revenue collection to avoid opportunities for corruption. Lessons can be learned from the USA where the potential for conflict of interest within the USA Department of Interior (responsible for the collection of oil royalties and environmental pollution management) became apparent during the Deep Water Horizon oil spill in 2010. In response, the USA divided responsibility between the US Bureau of Safety and Environmental Enforcement (inspection and environmental management) and the Office of Natural Resources Revenue (revenue collection) (Ramseur and Hagerty, 2013). Similar examples for redefining roles exist elsewhere that relate more closely to developing economies (e.g. Thailand) (Singkran, 2014).

Coordination can also be used to improve the promptness of reporting and response time by locating teams near to communities that are prone to contamination (e.g. oil spills), or home to legacy sites (i.e. past spill sites). The USEPA uses this approach to locate regional teams across the country; a process that expedites the identification and reporting of spills and contamination. In Nigeria, this mechanism could be used to involve local committees to monitor pipelines and report spill incidences to the central regulator. This small-scale approach might also address issues about pipeline vandals or spontaneous pipeline cracks (Orubu et al., 2004).

2.5.3 Risk-based decisions

Governments must prioritise the allocation of limited resources to clean-up contaminated sites. Decisions to prioritise sites are often risk-based, and frameworks to assess risk adopt the source-pathway-receptor (SPR) model (Luo et al., 2009; Reinikainen and Sorvari, 2016). The SPR model determines whether there is a linkage between pollutant and receptor (Rodrigues et al., 2009b; Swartjes, 2011; Defra, 2012). If no pollutant linkage is identified then there is no risk, but if risk exists, an assessment of severity can be used to identify those sites that pose a significant risk to receptors (Nathanail et al., 2013). Importantly, this process promotes the use of evidence to justify decisions (Reinikainen and Sorvari, 2016).

Both the UK and USA use risk-based models to identify and manage contaminated sites (CERCLA, 2002; Defra, 2012; Kiel, 2013). Nigeria, on the other hand, lacks a comparable risk-based framework despite reference to the establishment of pollutant linkages in the EGASPIN (DPR, 2002). Opportunity exists for Nigeria to directly adopt risk-based best practices from either the UK or USA. By adopting these practices, Nigeria can avoid unnecessary assessments and the associated economic burden. For example, in the absence of risk (where no pollutant linkage exist), the requirement for a detailed site assessment should be negated (see DPR, 2002). The most profound benefits that Nigeria could realise by adopting a risk-based approach would be the increased transparency, logic, and evidence-base for decision-making about contaminated land.

2.5.4 Soil screening values

Soil screening values (SSVs) are pre-determined contaminant concentrations found in soil or groundwater that represent a threshold concentration, above which further risk assessment might be necessary (EA, 2004b; Cheng and Nathanail, 2009). SSVs focus on harm to human health and ecological receptors (MfE, 2006). The UK has developed soil guideline values (SGVs) that are specific to human health protection (CL:AIRE, 2010), but exceedance of SGVs does not expressly indicate the existence of risk, because other factors like pollutant linkages must also be considered (DEFRA, 2012). The USA has developed soil-

screening levels (SSL) that protect both human and ecological receptors from exposure to harm and are also used as target levels for clean-up. These values are dependent upon soil type and land use classifications, so they will vary from site to site and might not be transferable to different countries (Rodrigues et al., 2009; Defra, 2012).

Nigeria uses generic SSVs to assess contaminants in soil. These values were taken from different international guidelines, which has led to conflicts in terminology (e.g. acceptance criteria, trigger values, maximum acceptable values, environmental quality guidelines, intervention levels), receptors, and methodologies and assumptions. Concerns about the appropriateness of SSVs used in Nigeria (derived from ASTM for the USA) have been raised, along with their presumed fit for purpose (Cheng and Nathanail, 2009), which has contributed to the uncertainty experienced by practitioners and regulators when investigating contaminated sites (UNEP, 2011; Ambituuni et al., 2014). Nigeria needs an overarching national guideline that sets out a method to derive contextually relevant SSVs that protect human and ecological receptors.

2.5.5 Liability and funding

Clean-up of contaminated sites can be prohibitively expensive and funding is arguably the most important challenge facing contaminated land management. Funding availability is an on-going concern in Nigeria, despite the one-off investment of 1 billion USD provided by the Nigerian Government and liable operators to clean-up contamination in Ogoniland (Orubu, Odusola and Ehwarieme, 2004; Steiner, 2010; Anyanwu, 2012). The effectiveness and sustainability of this type of fund is unknown (Könnet, 2014). The US addresses funding challenges through their Superfund mechanism, which transfers funds from the chemical and petroleum industries (as a tax) to clean-up activities. UNEP (2011) suggested a similar approach for Nigeria whereby a percentage of the Excess Crude Account (petroleum royalty scheme) could be assigned to a contaminated land management fund.

In the UK and USA, funding is a function of liability (the process of identifying the person or group of persons that have unknowingly or deliberately contaminated

land) (Alberini et al., 2005; Catney et al., 2006; Larson, 2005; Luo et al., 2009; Zhao, 2013). In the UK, the polluter pays principle ensures that the liable parties pay for the damage done to the natural environment, (Luppi et al., 2012; Zhu and Zhao, 2015). Nigeria could adopt the polluter pays principle, or assign responsibility to the operator, or the owner of an exploratory license (EA, 2009a), but these approaches might not identify the actual polluting party. Nigeria has a history of pipeline sabotage and vandalism and it is unclear how liability can be assigned under these conditions (Meyer et al., 1995). Regardless, Nigeria could benefit from the adoption of structured approaches for assigning legal responsibilities similar to those used in the UK and USA (Nathanail et al., 2013). While we recommend an effective policy detailing the different elements of a contaminated land policy, Nigeria's structure should also include a protocol for polluter identification, evidence to determine liability, site investigation, nature of polluter's involvement and polluter's potential defence.

2.5.6 Training and expertise

The practice of contaminated land management continues to evolve (Brombal et al., 2015) and in order to remain current, practitioners must receive regular training and retraining. Skills acquisition is a means to build and maintain expertise and many countries integrate regular training into their contaminated land management policy frameworks (Luo et al., 2009; Brombal et al., 2015).

Agencies for managing contaminated land in the UK and US continually train and educate their personnel to keep up with innovation and change (Luo et al., 2009). In the UK, practitioners have access to numerous training platforms e.g. the CL:AIRE and the land quality management provide training for contaminated land risk assessment and management practitioners. Other organisations including SuRF UK (Bardos et al., 2016), Network for Industrially Contaminated Land in Europe (NICOLE) (Bardos, 2010), and the Contaminated Land Rehabilitation Network For Environmental Technologies in Europe (CLARINET) (Vegter et al., 2002)**,** have also developed frameworks for improved expertise in land contamination management in Europe.

The level of contaminated land management expertise in Nigeria is low, and training networks like those in the UK are not readily available. In the absence of technical expertise, agencies like DPR and NOSDRA depend on the knowledge of operators to conduct site investigation (Ambituuni et al., 2014), which might influence the assessment about the volume of a spill or its perceived level of impact (Eneh, 2011). We believe that Nigeria has two options to improve the technical expertise levels. The first is to develop training platforms like those in the UK, to provide a mechanism for regulators and other practitioners to exchange knowledge and develop skills. Development of such networks requires time and effort, and therefore a more immediate solution might see Nigeria develop strategic partnerships with organisations like SuRF and NICOLE to provide training. Advantages of this approach would include a rapid up-skilling of the workforce and an immediate introduction of global best practice into Nigeria.

2.5.7 Public Engagement

Public engagement comprises elements of education, communication, and understanding, and the facilitation of awareness requires mechanisms that enable the public to actively participate in the management of contaminated land (Sorvari et al., 2009; Erdem and Nassauer, 2013). These mechanisms include seminars, workshops, exhibitions, conferences, or websites, which are used to initiate open dialogues between different contaminated land stakeholder groups.

Public engagement about contaminated land, spills, and regulations in Nigeria is low (Ugochukwu and Ertel, 2008) and one might argue that this has led to the deliberate release of crude oil into the environment (e.g. pipeline vandalism) or restrained urgency in dealing with contamination (Nwilo and Badejo, 2005). By contrast, public engagement about contaminated land in the UK is high due to the inclusion of stakeholders in the decision-making, in particular the planning process (DEFRA, 2012). This is usually done in to form of extensive stakeholder consultation and is used to raise awareness, and educate residents, land developers, and the public about the issues associated with land contamination. Prior to publishing Statutory Guidance in the UK, stakeholder consultations were held to ensure that the public and interested parties could contribute to the

guidance and be made aware of the issues (DEFRA, 2012). The use of public consultation is ingrained in UK governance, whereas it would be a new concept for Nigeria. To initiate public engagement Nigeria could use local mechanisms (e.g. town-crier) to reach out to the local population to make them aware of the impact of spills on, for example, soil fertility or fishing waters. Education might discourage acts of deliberate contamination (Ukeje, 2001; Ugochukwu and Ertel, 2008), and would improve awareness of environmental issues and their governance.

2.5.8 Sustainability appraisal

The trend in contaminated land management is towards sustainability, whereby decisions about contaminated land management integrate socio-economic and environmental concerns (Bardos et al., 2016; Sam et al., 2016). Sustainable approaches are intended to ensure long-term benefits and to avoid unsustainable clean-up decisions (Kiel, 2013; Kapp, 2014). Both UK and USA regimes have developed initiatives that integrate sustainability principles into their contaminated land management decision-making processes (Bardos, 2009; P. Bardos et al., 2011; Bardos et al., 2011; CL:AIRE, 2015). For example, the USA encourages operators to reduce the environmental footprint of remediation strategies (Hou et al., 2014; Hou and Al-Tabbaa, 2014).

With the benefit of time, the UK and USA have been able to incrementally improve their contaminated land management programs, but Nigeria has the opportunity to rapidly advance their program by integrating sustainability principles from the beginning. Introducing frameworks like the UK's protocol for sustainability appraisal, or the USA's approach for minimising the environmental footprint of remediation practice (Bardos et al., 2012; Hou et al., 2014), would provide a step-change advancement that would benefit Nigeria by ensuring that solutions consider social, economic, and environmental factors fairly (UNEP, 2011). Implementation will require education, for example, communication amongst stakeholder groups affected by contaminated land (Booth, 2015). Sustainability forums that encourage the exchange of innovative ideas might also be

considered, for example, the Sustainable Remediation Forum US (SuRF US), SuRF UK, and SuRF Australia (Bardos et al., 2016).

2.6 Conclusion

Contaminated land management in Nigeria suffers from a number of gaps, or limitations: lack of a clear statutory definition for contaminated land, poor coordination of governance, lack of a risk-based approach, inexperience, weak policy frameworks, and limited funding, yet there is opportunity for Nigeria to learn lessons from other countries (e.g. UK, USA) to improve their system. In this paper, we reported on a number of recommendations that Nigeria could adopt from the UK and the USA regimes. Specifically, Nigeria could benefit from an improved definition of contaminated land, better regulatory coordination, adoption of risk-based decision tools, development of soil screening values, improved determination of liability, a means to generate additional funding, and the integration of a sustainability assessment. Progress to develop and implement contaminated land management regulation in Nigeria has been slow, yet despite Nigeria's urgent need for clear regulatory policy we do not believe it should rush into the transfer of policy from elsewhere. This is because success will depend on how well Nigeria is able to contextualise policy to meet their unique environmental, economic, cultural, and political needs. We suggest that further research is needed to understand these contextual needs, how they might affect policy transfer, and how knowledge about these needs can be used to improve contaminated land management in Nigeria.

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3 Gaining insights into contextual issues on contaminated land management decisions in Nigeria to promote efficient policy transfer

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ABSTRACT: An important barrier to effective transfer of land contamination management policy from one country to another is difference in social values. Stakeholder engagement plays an important role in understanding social values. However, context specific approaches are required for successful stakeholder engagement. We propose an approach for stakeholder engagement to gather data on social values that could influence contaminated land management decisions for improved policy. The approach was piloted through a series of workshops and interviews to investigate the social values that are affected by contaminated land due to oil spills in the Niger Delta region of Nigeria. The workshops were undertaken for participants involving community groups from the Niger Delta (N=35), while interviews involved contaminated land management regulators (N=8), experts in contaminated land management in the Niger Delta (N=6), and operators in the oil exploration industry (N=7). The proposed engagement approach was well received and supported inclusive data gathering from all stakeholder groups. Water quality, soil quality for agriculture, food and local supply chain and human health/wellbeing were identified as the core social values that influenced decision making for oil contaminated sites management in Nigeria. These social issues are primarily basic needs thus raising questions about the appropriateness of policy transfer from countries such as the United Kingdom (UK) and the United States of America (USA) to Nigeria. In these countries the basic needs of the local population (e.g. access to safe drinking), are largely met, thus their current contaminated land management frameworks are focused on long-term issues such as sustainability. Our argument does not diminish the value of policy transfer as a mechanism for the advancement of policy development, but highlights the importance of understanding the context to which a policy will be applied. Therefore, it is recommended that Nigeria should

focus on transferring policy that meets present needs following the outlined pathway in this study. By doing so, it will improve the current contaminated land management policy rather than stark policy transfer from developed economies.

Keywords: Contaminated land, Social values, Policy transfer, Niger Delta, stakeholder engagement

3.1 Introduction

Over five decades of oil spills have caused an epidemic of contaminated sites in the Niger Delta region (UNEP, 2011; Kadafa, 2012; Umukoro, 2012); causing harm to the environment, human health, and the region's socio-economic wellbeing (Orubu et al., 2004; Chinweze et al., 2012). Response by the Nigerian Government to manage contaminated land (i.e. clean-up) has been unhurried, and the number of contaminated sites has grown to over two thousand (Ite et al., 2013). The lack of action has been driven by fragmented legislation (Ajayi and Ikporukpo, 2005), which is undeveloped, poorly enforced, and ineffective at meeting stakeholder expectations (Ajayi and Ikporukpo, 2005; UNEP, 2011).

In their seminal report on contamination in the region, the United Nations Environment Programme (UNEP) stated that there was an urgent need to improve contaminated land policy in order to address the scale of contamination (UNEP, 2011). Because Nigeria lacks a robust contaminated land management policy framework, there is an opportunity to adopt best practice and learn lessons from countries with established policy infrastructure (Sam et al., 2015). Countries with effective legislation include the United Kingdom (UK) and the United States of America (USA), whose established policies address legacy and newly contaminated sites, incorporate stakeholder expectations, and integrate the principles of sustainability into assessments (Nathanail et al., 2013; Hou et al., 2014). This process of emulating, or replicating established policies from other countries has been described as policy transfer (Rose 1991; Rose 1993; Dolowitz and Marsh 1996; Stone 2001).

3.1.1 Policy transfer

Many factors might motivate a country to carry out policy transfer, e.g. absence of policy (Rose, 1993), ineffective policy (Page, 2000), technical inability to implement a policy (Dolowitz and Marsh, 1996), lack of resources, or desire to improve existing policy (Page, 2000). In all instances, policy transfer becomes a tool that is used to learn lessons from the experiences of other countries (Bache and Taylor, 2003; Evans, 2006). This has been applied in different contexts, e.g.

in politics to improve political administration (Conde Martinez, 2005), in finance to improve monetary policy (Bulmer and Padgett, 2005), in land contamination management to reduce risks to human and environmental health (Luo et al., 2009). Specific to contaminated land management, Cameroon and China are two examples of countries that have emulated the institutional frameworks of other countries (i.e. UK) in efforts to improve their own systems (Luo et al., 2009; Forton et al., 2012; Coulon et al., 2016). There is no published evidence to indicate the success of these programmes, however, land contamination experts continue to urge countries with perceived ineffective policies to explore opportunities to collaborate with international expertise (Brombal et al., 2015; Coulon et al., 2016).

Various mechanisms are used to achieve policy transfer, including: penetration, emulation, hybridisation, synthesis, and inspiration. For an overview of these mechanisms, please refer to the works of Luo et al., (2009), Rose (1993), Dolowitz and Marsh, (1996) and Stone (2001). Determining which mechanism is appropriate for the given problem requires an understanding of the drivers that motivate a country to change. These drivers are conceptualised on a continuum (Figure 3-1), and range from voluntary lesson learning to coercive transfer motivated by direct imposition (Dolowitz and Marsh, 1996).

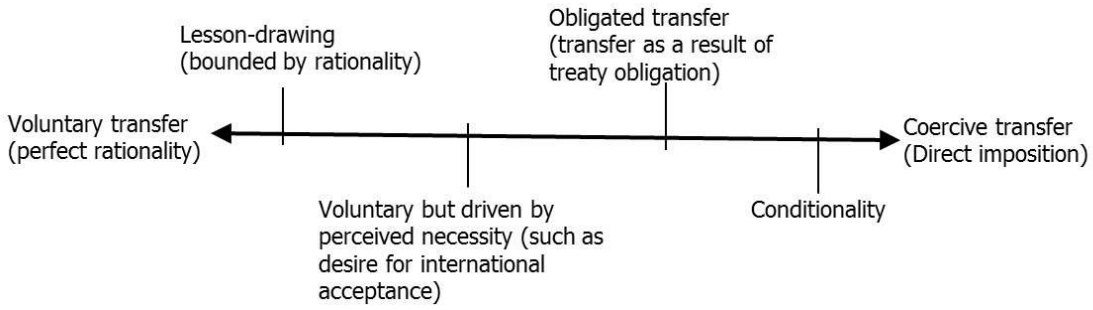

Figure 3-1: Policy transfer continuum (reproduced from Dolowitz and Marsh, 2000)

Voluntary lesson learning takes place when a country perceives a need to change or improve, and self-initiates the process themselves, as was the case for China and their deliberate action to adopt policy and programmes for contaminated land management from the UK (Luo et al., 2009; Brombal et al., 2015). Coercive transfer occurs when a programme or policy is directly (or indirectly) imposed on

a nation (Stone, 2001). Nations that request loans from the World Bank or the International Monetary Fund might be required to domesticate certain laws, regulations or institutions as a prerequisite for the loan agreement (Dolowitz and Marsh, 1996; Stone, 2001). Regardless the mechanism or the drivers, successful policy transfer will be contingent on the perceived benefit to the people (Bache and Taylor, 2003), and will be influenced by a number of different factors (e.g. existing policies, bureaucracy and financial resources).

How countries develop and implement policies will vary, dependent on differences between administration and governance frameworks (e.g. procedures, expertise and experience) (Dolowitz and Marsh, 1996), institutional structures (e.g. a multi-agency system of governance as against unitary), policies (e.g. policy goals) (Evans, 2006), socio-cultural factors (e.g. social values and expectations) (Page, 2000), and economics (e.g. sufficient funding, economic priorities) (Peck and Theodore, 2001; Benson, 2009; Evans, 2009). If these differences between the transferring and adopting country are too great, and not enough is done to adapt to or mitigate these differences, then it is likely that policy transfer will not be successful (Dolowitz and Marsh, 1996).

Policy makers must find a balance between innovation and integration. The more innovative a policy, the more radical (and potentially beneficial) the change, but the less likely the policy is to integrate, and be accepted within the existing infrastructure (Rose, 2005; Luo et al., 2009; Atela et al., 2016). Thus, the issue of compatibility, or how compatible a policy is with other policies in the same sector, becomes an issue (Atela et al., 2016). Integration is influenced by socio-cultural effects (Dolowitz and Marsh, 1996; Rose, 1993; James and Lodge, 2003) and because culture is distinct and peculiar to a setting or group of people, these effects will vary within and across nations and states (Peck and Theodore, 2001). If the cultural values of two countries differ too greatly (e.g. introduction of a risk-based policy into a risk-averse culture), there might be resistance to transfer (Bache and Taylor, 2003, Evans, 2009). Inputs from different stakeholder groups (e.g. the public, policy makers, experts) are necessary to understand the socio-cultural factors that will contribute towards the working of a unified solution

(Ramirez-Andreotta et al., 2014). Public engagement strategies to collect these inputs have been useful in this respect (Curtain, 2003).

Studies about policy transfer often examine the benefits of one system with a view to transferring lessons to another (Forton et al., 2012; Brombal et al., 2015). To our understanding few studies have sought to understand the contextual differences between countries that might influence a successful transfer.

In this paper, we address this gap in the literature and describe a method to collect information about the socio-cultural values held by a local population that can be used to support policy transfer for land contamination management in Nigeria. We applied our findings to a case study taken from the Niger Delta region. Our study provides insights about the socio-cultural values of different populations in the Niger Delta region, and we use these insights to recommend strategies for practitioners to tackle contextual issues that might impact on the success of the transfer of contaminated land policy into Nigeria.

3.1.2 Stakeholder engagement

Stakeholder engagement has been used to inform, consult, involve, collaborate with, and empower affected people involved in a decision making or policy-forming process (Rowe and Frewer, 2005; IFC, 2007; Cundy et al., 2013; Ramirez-Andreotta et al., 2014). To be successful, stakeholder engagement processes must clearly define the objectives, identify relevant stakeholder groups, and emphasise empowerment, equity, and partnership (Geaves and Penning-Rowsell, 2016). In practice, stakeholder engagement is often used to build consensus and bring together different stakeholder viewpoints, e.g. regulators, the public, operators and experts (Cundy et al., 2013; Sam et al., 2016). By integrating multiple viewpoints the quality of a decision is expected to improve (Reed, 2008).

How stakeholders engage with the process will depend on the relevance of the method used (Chess and Purcell, 1999). Methods must be meaningful, accessible, e.g. using common language that is understandable to all stakeholders, and culturally appropriate (Cundy et al., 2013). Care must be taken

to avoid issues like social framing (Buhr and Wibeck, 2014), exclusion of individuals (Cox, 2012), or misinforming the public (Wodschow et al., 2016). For engagements that comprise individuals from diverse cultural backgrounds, language can become a barrier (Ramirez-Andreotta et al., 2014). Members of indigenous communities, for example, might find it difficult to engage with technical information presented using typical scientific language (Lewis and Sheppard, 2006). Efforts to overcome language barriers include the use of visual aids (e.g. postcards, landscape visuals) that are used to convey technical messages to non-technical individuals (Lewis and Sheppard, 2006; SEAT, 2013).

Protocols to conduct stakeholder engagement have been designed to ensure that public knowledge and social values are considered alongside technical and scientific information (IFC, 2007; Reed, 2008; Cundy et al., 2013;World Bank Group, 2014). Protocol deployment must be sensitive to country specific socio-economic conditions. Technologies (e.g. emails, text messaging, online surveys) are often used in the UK to inform stakeholder groups of the engagement process, aim, and venue, as well as support meeting facilitation, and question and answer sessions (Smith and Gallicano, 2015). However, this approach might not be appropriate in regions where technology is not available and in some instances might become a barrier that hinders the engagement process (Chess and Purcell, 1999). Selecting context specific techniques requires an acknowledgement of cultural differences (Wodschow et al., 2016). In Nigeria, communication relies on physical contact, persuasion, and negotiation (Lawrence, 2002; Idemudia, 2014; Aluko et al., 2015). Processes that do not integrate these considerations might make stakeholders reluctant to participate in the policy process, which could lead to feelings of exclusion or distrust (Boele et al., 2001; Okoh, 2007). Stakeholder engagement processes in South Africa and Botswana have accommodated for these types of cultural differences by integrating elements of increased direct and face-to-face contact with stakeholders (Department of Environmental Affairs and Tourism, 2002; Department of Water Affairs, 2012; Obasi and Lekorwe, 2014). Nigeria lacks a published framework to guide stakeholder engagement processes during policy development (Adomokai and Sheate 2004; Idemudia 2009;Amadi et al. 2014)

and this has resulted in the adoption of simplified approaches that often exclude relevant stakeholders (Idemudia, 2014, 2010). In the following section, we present a case study, and then an approach for stakeholder engagement in Nigeria that we used to gather socio-cultural information that could be used to support the transfer of contaminated land management policy in the Niger Delta region.

3.2 Case study – Nigerian Niger Delta

Case study research methodology is a technique that is used to explore questions that require an in-depth understanding of a phenomenon, as well as enables researchers to study a phenomena in its natural environment (Yin, 2012; Byrne and Ragin, 2013). This technique has been shown to be useful for exploring social issues, such as the impact of social values on policy transfer (Ranangen, 2015; Wu et al., 2016). In this study, we use a case study research methodology to understand the social values held by individuals who live with hydrocarbon contamination in the Niger Delta region of Nigeria (Figure 3-2). We also used a modified stakeholder engagement method to collect information about social values from different groups within the region.

The Niger Delta region was chosen as a case study because of its high number of contaminated sites, the breadth of affected stakeholder groups, and the duration of exposure (> fifty years) (UNEP, 2011). Approximately 31 million inhabitants live in the Niger Delta, most of who reside in rural communities. The region is rich in cultural heritage with about forty different ethnic groups speaking over 250 languages and dialects (NDDC, 2014). Economically, the population generates their livelihoods from agriculture, food production, and fisheries (UNEP, 2011; Chinweze et al., 2012), however, the area also contains vast oil reserves (OPEC, 2015). As a result, the region has become the hub of oil extraction and processing for Nigeria, which has led to significant hydrocarbon contamination of land, surface water, and groundwater. Hydrocarbon contamination in this region has affected the economic viability of the local population via the loss of soil function, destruction of farmlands, and widespread

river pollution (Zabbey, 2004, Kadafa et al., 2012; Umukoro, 2012; Pegg and Zabbey, 2013).

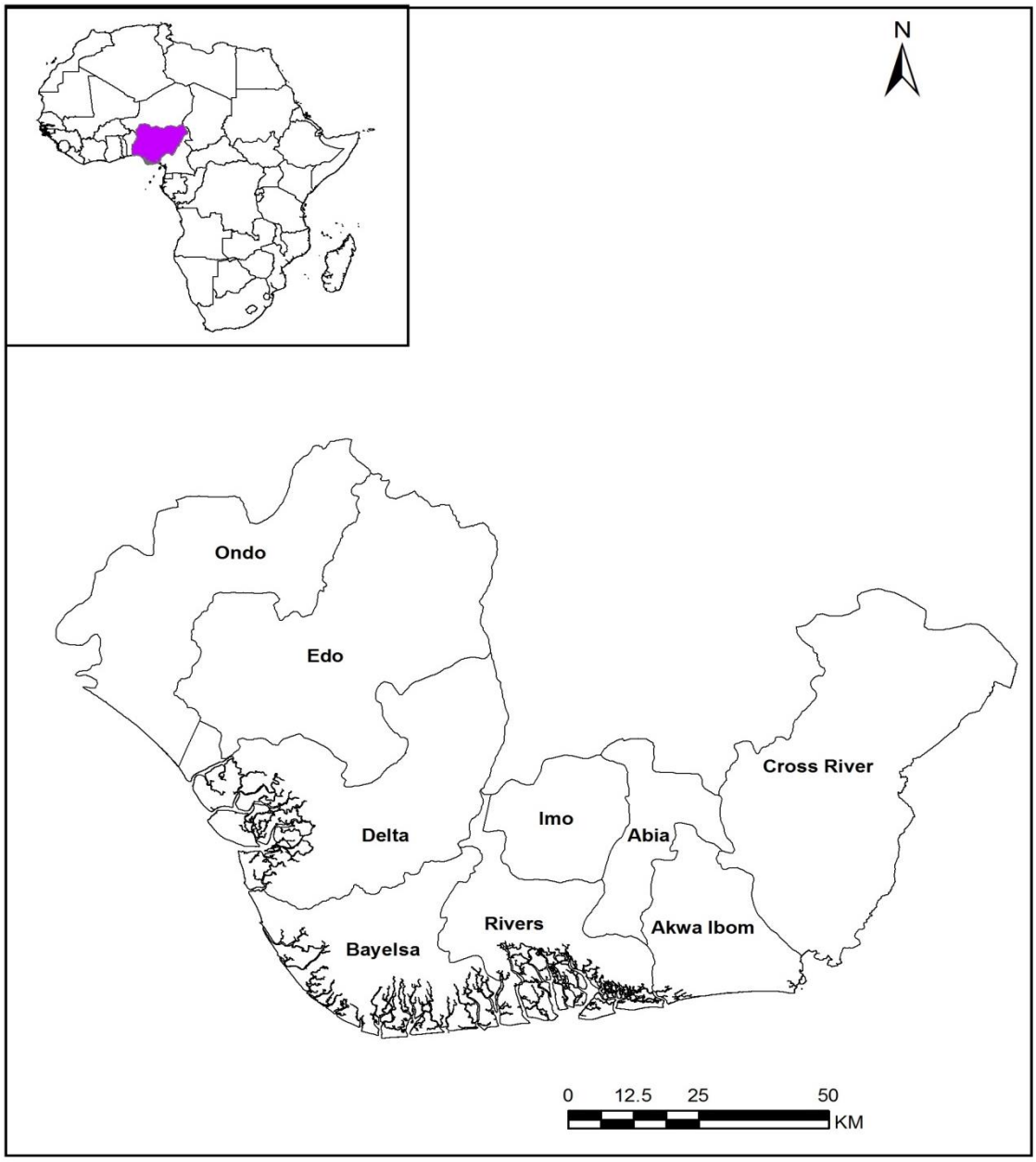

Figure 3-2: Niger Delta showing States that make up the region

3.3 Methodology for stakeholder engagement and application

The widely accepted five-step framework for stakeholder engagement (inform, consult, involve, collaborate with, and empower) was used to identify and gather information about social values related to hydrocarbon pollution (IFC, 2007; Cundy et al., 2013; World Bank Group, 2014). We modified the framework to overcome issues of communication, language, and understanding. The process is described in Figure 3-3.

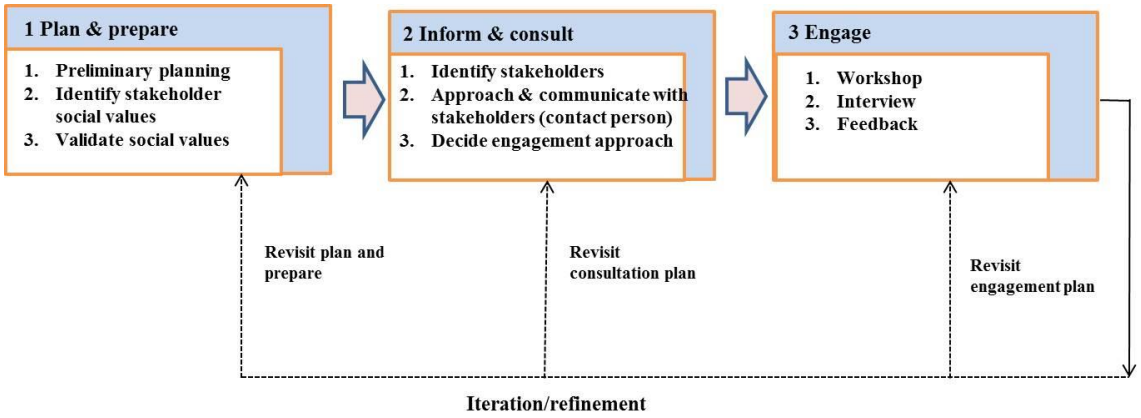

Figure 3-3: Proposed stakeholder engagement framework used to collect information about socio-cultural values relative to contaminated land policy transfer in Nigeria

Based on the literature, and our collective experiences, three socio-cultural challenges that were specific to the Niger Delta region was identified (Table 3-1). We addressed each challenge by varying our technique and we discuss the impact on the method later in the paper. The following sections describe in further detail the method presented in Figure 3-3.

Table 3-1: Identified challenges and proposed solutions to stakeholder engagement

Identified challenges	Proposed solutions	Reference
Less technological-driven context	Town crier, face to face (rather than survey)	Amadi et al., 2014; Ohuruogu et al., 2015
Language/comprehension	Postcards, multi-lingual, workshops	Lewis and Sheppard, 2006; Jude, 2008; Idemudia, 2014b
Negotiation and persuasion	Face to face contact (discussions)	Ihugba and Osuji, 2011; Idemudia, 2014a; Alukoet al., 2015

3.3.1 Plan and prepare

Plan and prepare is underpinned by three activities:

1) Preliminary planning: the scope of the study is defined (e.g. who should be engaged, how should they be engaged, what will they be engaged about, and to what extent will they be engaged), a statement of objectives, and an assessment of the resources (Cundy et al., 2013; Rangarajan et al., 2013). For this study, stakeholders were selected from the Niger Delta region as this region is highly impacted by petroleum hydrocarbon pollution (Kadafa, 2012). Further to this, four categories of stakeholders were identified including community members, experts, regulator, and operators (UNEP, 2011; Kadafa, 2012; Idemudia, 2014).

As a culture, Nigerian communication preferences tend to involve contact and discussion (Idemudia, 2014). Engagement to satisfy this preference might include one-to-one interviews, but this can be resource intensive (e.g. time, staff and cost). The study therefore proposed the use of workshops, consisting of small groups, and interviews, with individuals unable to attend the workshops, as a means to address cultural preferences and minimise resource inputs.

2) Development of a list of social values: the socio-cultural, economic and environmental issues were identified via a critical review of the academic databases (e.g. Science Direct, Scopus) and online databases (e.g. Google Scholar) using key phrases and words such as values, impacts, oil spills, land contamination, socio-economic and environmental impacts, stakeholder values, stakeholder concerns, contaminated land concerns, Niger Delta, Nigeria.

3) Organisation and validation of the identified social values: a process that initially grouped values based on their similarity (Table 3-2), and was then validated through unofficial discourse with contaminated land experts in Nigeria. The output of the validation exercise formed the basis for the stakeholder engagement process.

Table 3-2: Stakeholder values as identified from literature and validated by experts

Values	Elements	Description
Socio-cultural	Communal crisis	Communal crisis refers to crisis that exists between communities, oil companies and government.
	Cultural places	Cultural places include places of worship and cemeteries
	Family and household	Children, parents and relatives.
Environmental	Drinking water quality	The water used to provide drinking water to communities.
	Loss of biodiversity	Loss of variety of flora and fauna in the local environment
	Resource conservation	How you use, allocate and protect your natural resources such as fishes and mangrove habitats.
	Soil quality for agriculture	Maintenance of soil quality to enable agriculture for nutritional and economic value
	Food and local supply chain: farming and fishing	Sources of local food supply such as farming and fishing, and nutrition
	Legacy for future generation	Natural resources you wish to transfer to your grandchildren are in decline
Economic	Human health/wellbeing	Health and wellbeing (sickness and diseases)
	Financial issues/income security	Financial health, the ability to sustain an income
	Reputation	The reputation of your community or institution
	Collaboration/ co-existence	Collaboration and cooperation among operators, regulators, community members and government

3.3.2 Inform and consult

The study focused on participants from oil impacted regions mainly from Nsisioken, Ogale, Kpean and Kwawa. Participants included community members, experts, regulators, and operators. Experts were those individuals who have had extensive contaminated land experience, through either research or occupation. Experts were selected from the list of individuals who participated in the UNEP risk assessment of Ogoniland (UNEP, 2011). Industrial participants were identified from oil companies operating in the Niger Delta region. Policy

experts were those individuals working within the Department of Petroleum Resources at the time of the study.

To increase the number of community participants, a snowball sampling approach was used which relied on communication between notified participants and the wider community to share information about the project and workshops (Noy, 2008; Rizzo et al., 2015). Prospective participants were provided with additional information about the workshop via mailed letters, telephone, and the use of town-criers.

Only participants with prior knowledge about hydrocarbon contaminated land (e.g. we asked if they have experienced, or lived with hydrocarbon contaminated land) were chosen to participate in the study. All individuals provided their consent prior to engagement. Consent was achieved through face-to-face discussions, appeals, telephones (e.g. operators), and letters (e.g. local communities), with individuals asked about their willingness to participate in the workshops and interviews. Participation was on a voluntary basis and individuals' identities and responses were made confidential and anonymous respectively (Interview and engagement protocols are presented in Appendix B).

To build trust with stakeholder groups we used a primary contact (or sympathetic representative) to communicate the benefit of our study to the region, the legitimacy of our approach, and the value of our outcomes. The contact person also located a suitable venue (for the workshop), and arranged a date and time for the engagements.

3.3.3 Engage

A stakeholder engagement process was conducted using a mixed methods approach that included workshops and interviews. Workshops were attended by the public (N=35), while interviews were used to gather data from operators (N=7), regulators (N=8), and experts (N=6), who were unable to attend the workshops. All engagement activities were conducted between July 2014 and December 2014. A questionnaire was used to drive both the workshops and the interviews (Table 3-3). The questionnaire was divided into two sections: the first

section aimed to investigate social values, and the second section explored the knowledge and perceived effectiveness of current contaminated land regulation in Nigeria (See Appendix A for detail semi-structured interview questions). Probing questions were used to explore the depth of participant knowledge about different subjects (e.g., we asked operators why they lacked knowledge of contaminated land management in other regimes despite working in an international organisation).

Table 3-3: Questionnaire used to drive the engagement process

	Question	Assessment scale	Rationale
1	Have you personal experience dealing or living contaminated land?	1=not at all; 5=considerable	To determine whether participants has contaminated land experience in order to be able to answer the questions.
2	Any other comments you wish to add on your experience?	Open ended	To explore stakeholder experiences
3	Confirm that images contained on postcards reflected stakeholder values.	Open ended	To validate stakeholder values and reach a consensus
4	Prioritise a set of postcards, choosing the first as most important and the last as least important	Line postcards up from worst to first	To determine stakeholders' priorities of values that are impacted by the presence of contaminated land
5	How might you assist other stakeholders to help with the clean-up of contaminated land if you had the chance" and "How can the Government help the people in the affected region?	Open ended	To reveal subjective beliefs held by the participants and to explore other social values that were not represented by the postcards that could be affected by contaminated land
6	How would you rate your knowledge about contaminated land management?	1=not at all; 5=considerable	To determine participants' knowledge of the contaminated land management regime in Nigeria
7	Are you satisfied with the Nigerian approach to land contamination management?	1=not at all; 5=considerable	To measure participants satisfaction with Nigeria's current approach to contaminated land
8	Please explain why you are satisfied or no	Open ended	To explore the reasons for participant's response,
9	How familiar are you with foreign contaminated land regulation?"	1=not at all; 5=considerable	To assess if stakeholders had heard of other regimes so they could learn from them
10	Do you believe policy transfer from a foreign country or institution will work in Nigeria?	1=not at all; 5=considerable	To assess participants' willingness to accept policy transfer
11	Do you foresee any barriers preventing policy transfer?	Opened ended	To understand fears to policy transfer assuming a better policy was identified abroad

A pilot study was carried out using a small group of students from the Ogoniland community of Luere-Beeri to assess the clarity of the questions and to identify any potential for misunderstanding during the interview. Following the pilot study

changes were made to the questionnaire for community members, in particular, questions about knowledge on contaminated land regulation in Nigeria.

Thirty-five individuals (twenty people in the morning session and fifteen in the afternoon session) across the four local councils of Ogoniland attended the workshops that took place in August 2014 at the community town hall in Ogale. Participants were divided into seven groups of five people each. English was the main language of communication, but if participants were not comfortable with English then the language of the region was used. The facilitator was fluent in English and several other regional languages. The workshop comprised of morning and afternoon sessions, and each averaged two hours in length. The process of engagement is described in Figure 3-4.

The study collected data on social values using postcards. The postcards contained images that represented the different social values (Table 3-2) and were used to overcome potential communication barriers, such as language and comprehension (Zhao et al., 2016). Participants identified images represented on the postcards and this helped them to select the social values that were of concern to them.

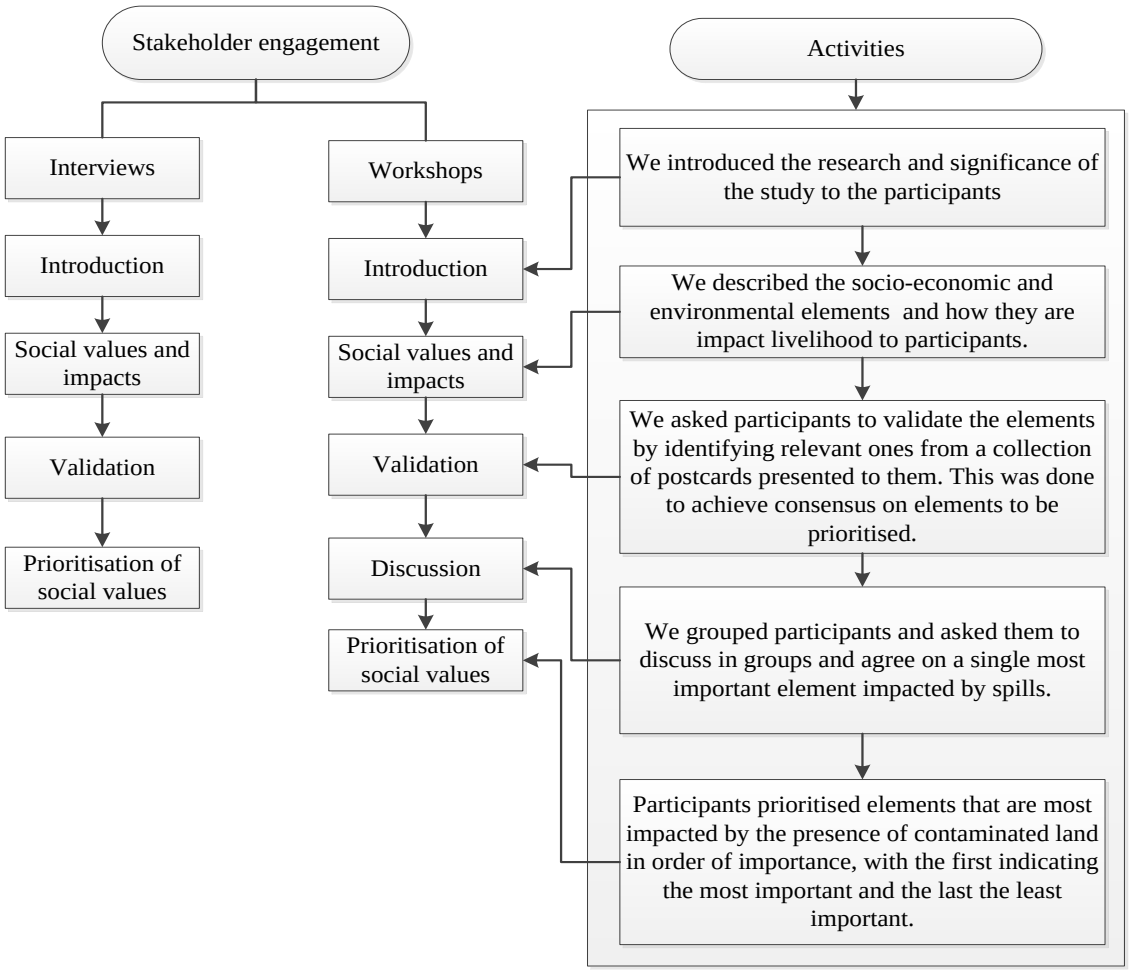

Figure 3-4: Procedure for engaging with stakeholders (workshops and interviews) to obtain information about the value and prioritisation of different social values.

The prioritisation process was divided into two stages. First, participants were allotted thirty minutes to discuss each social value (postcard), and to then identify the three most important values – as determined by the group. Second, participants ranked these three values according to their importance. These outputs were fed back to the entire workshop by a single group representative.

During the prioritisation exercise the facilitator used open-ended questions (e.g. “How might you assist other stakeholders to help with the clean-up of contaminated land if you had the chance?” and “How can the Government help the people in the affected region?”) to reveal subjective beliefs held by the participants. Answers were captured using an electronic voice recorded and transcribed for later analysis. The engagement process was concluded with a

question and answer session to allow for all participants to feedback about the process and outcomes.

3.3.4 Data analysis

Responses to closed ended questions (both workshops and interviews) were tabulated using Microsoft Excel. Because of the nature of the interview questions and the sample size, descriptive analysis using percentages was used to describe the respondents' views on each theme. Qualitative data taken from both the workshop and interviews were captured using audio recordings, transcribed, and analysed using the thematic content analysis methodology (Sandelowski, 1995; Krippendorff, 2012). An inductive content analysis technique was used to objectively and systematically identify features in the text and to quantify the frequency that different themes were mentioned (Krippendorff, 2012; Green and Thorogood, 2013). Briefly, all transcribed text was read thoroughly and the raw data was divided into segments of text that shared similar themes. Next, thematic codes were assigned to segments of relevant text and similar codes were grouped (Braun and Clarke, 2006). Finally, the frequency of codes was calculated. This analysis enabled us to search for and form units of relevant issues that were used to create clusters of similar information (Table 3-4). Consistency was validated by a second researcher (expert in contaminated land) who reviewed the coding rules and a sample of the assessed data as recommended by Carey et al., (1996).

Table 3-4: Thematic coding system

Main category	Themes	Sub themes	Theme definition	Example of quotes for each theme	Frequency of theme
Environmental issues	Clean-up	Timely response Restoration	Statements that connote the need for clean-up, land restoration and urgency of clean-up.	*"If I were the President I would ensure proper sanitation, we need some clean-up to wash the soil and ensure the soil is clean; if that is not immediately possible, Government can provide alternative source of water"*	81
	Environmental degradation	Pollution Environmental damage	Statements on pollution, impacts of oil spill, bunkering, sabotage activities and insecurity	*More than 95% of spillages in Ogoniland since 2012 are as a result of illegal bunkering and sabotage. The trend has caused untold devastation on the aquatic and agricultural sectors in Ogoniland*	25
Social/Economic issues	Economic loss and welfare	Livelihood welfare	Statements that suggest economic loss (livelihood) as a result of oil spill and express concerns about water, soil, health and safety	*"..their main source of occupation is farming and fishing and some cultural crafts like canoe making and so, they derive their livelihood from the environment, so if the environment is impacted, the quality of their socio-economic and cultural life will also be directly impacted"*	106
	Participation and collaboration	Stakeholder engagement cooperation	Statements that suggest the impact of stakeholder participation/collaboration in the decision making process.	*"Very importantly the three stakeholders in the spill of crude oil; which are the oil companies themselves the multinationals, the regulators and the communities where this oil is situated or where the pipelines transverse"*	45
	Unethical practices	Trust and transparency	Statements that concern corruption, trust and	*"According to several authors in literature, the spills that have been*	32

Main category	Themes	Sub themes	Theme definition	Example of quotes for each theme	Frequency of theme
			transparency between contaminated land management stakeholders	*reported so far, is just about probably half of what actually goes out into the environment in terms of spill. So it is never, it is never a proper mechanism"*	
Policy transference	Regulation performance	Monitoring and implementation	Statements that concern regulatory performance, monitoring and implementation, as regards contaminated land decisions	*"Nigeria's policies are ok, it is implementation that is a concern"*	59
	Political and cultural issues	Constraints	Statements that suggest resistance to transfer policy due to socio-cultural, political and economic issues	"*..Yes I foresee a barrier because there is no political will that is the major barrier. If there is a political will in favour of the people …a desire by the politicians to do the right thing for the people"*	40

3.4 Results and discussions

3.4.1 Stakeholders overview

The demographic distribution of stakeholders chosen for this study was broadly consistent with the demographics of the Niger Delta region, (e.g. more males 54% than females 46%) (NDDC, 2014), with the majority of the participants (64%) between the ages of 40-59 years. This age group is the most literate age group in the region (78%) (NDDC, 2014) (Table 3-5).

Participants from all stakeholder groups stated that they had been affected directly, or indirectly, by hydrocarbon pollution. In many instances, interview attendees had upwards of 10 years' experience dealing with oil spill contamination, while many workshop participants had been living with hydrocarbon contaminated land since their birth. One workshop participant explained: *"Since I was born I have been living here, I am almost 60 years in age. What experience about oil spill sites do you still want me to have? I have experienced it all my life" (community member).*

Table 3-5: Demographic breakdown of the stakeholders

	Number of stakeholders	**% of total**
Sex		
Male	30	54
Female	26	46
Age		
18-25	3	5
26-39	10	18
40-59	36	64
60 and above	6	11
Missing	1	2

3.4.2 Appropriateness of the engagement technique

The use of postcards to communicate the thirteen socio-cultural, economic and environmental values (Table 3-2) to the stakeholder groups was in general, well received. However, some individuals suggested that the postcards could have communicated a stronger message. A workshop participant noted: "*the images on the photo cards are good but they are soft. They are not strong enough to explain the pains we pass through. We drink polluted rain water from our roof but you just have health and safety"(community member).* An interview participant corroborated this view*: "We are aware that the people suffer more severe impacts, however your photo cards represent the issues associated with contaminated land in the area" (regulator).*

Participant's desire for language to be more commensurate to their experiences might suggest that they have been exposed to impacts greater than expected. In particular, the perceived subtlety of our postcards might undervalue the extent of the actual harm, as expressed by one workshop participant "*oil spill has made us suffer from diseases in the past and the present. We go to the hospital almost all the time. Mere saying health/wellbeing on the photo card is not strong enough" (community member).*

The participant's views are valid, however, the aim of this study was to provide a fair and reasonably objective representation of different values in order to ascertain and compare priorities. The use of strong terms like cancer (as suggested by some participants) are likely to elicit emotion, are not representative of all health effects, and might overstate the severity of impact or the link between pollution and health. We believe the use of subtle language allowed us to capture a broader view of impacts while still providing a simplified approach that benefited comprehension and risk communication (Klein et al., 2016). Overall, stakeholders were pleased that the social values identified represented the concerns of the region, and this acceptance enhanced their willingness to participate and contribute to the engagement process.

3.4.3 Determining stakeholder priorities

Participants assigned priority votes to the following values (in descending order of total votes): drinking water quality, soil quality, food and local supply chain, human health/wellbeing, loss of biodiversity, communal crisis, resource conservation, future generation, collaboration/co-existence, cultural places (Figure 3-5).

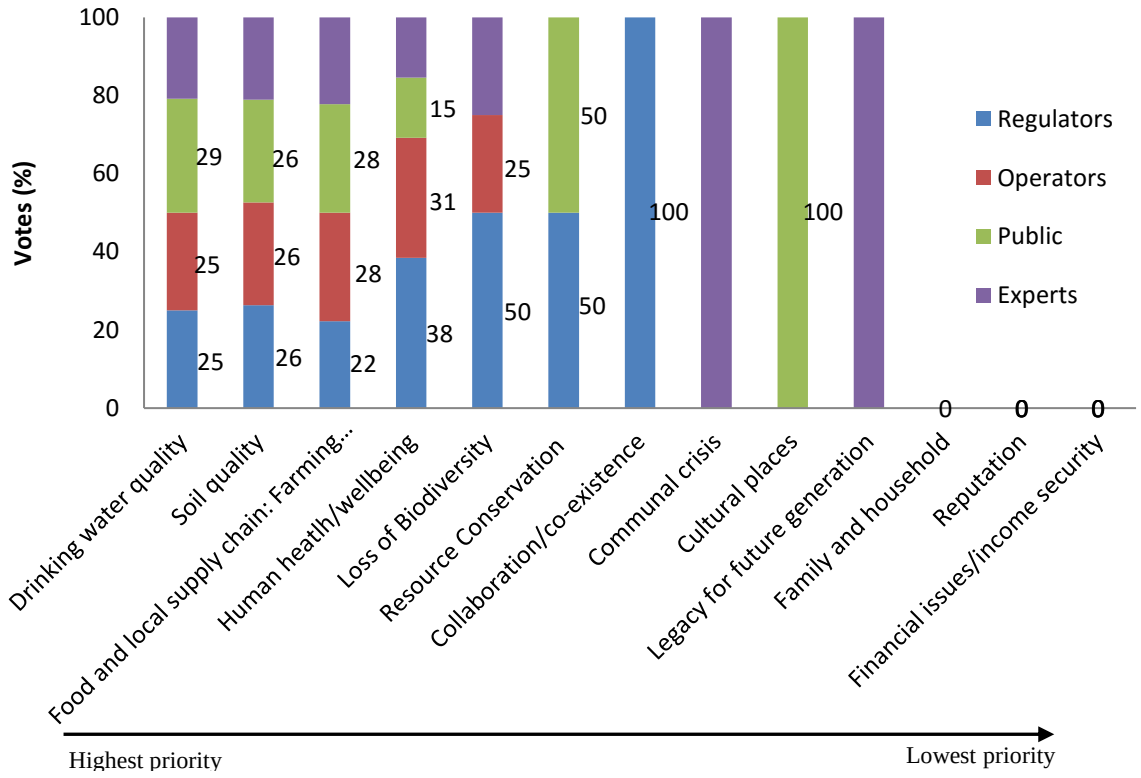

Figure 3-5: Social values ranked by order of importance by the stakeholders. The figure shows that drinking water was the most prioritised social values by stakeholders followed by soil quality, food and local supply chain and human health/wellbeing.

Three social values did not receive votes and these were family and household, reputation, and financial issues/income security. Values that received few or no votes were not considered unimportant by the participants; rather, they found it difficult to prioritise values that did not have an immediate impact on their lives, as stated by a workshop participant:

"…it is difficult to think or prioritise other values because we cannot satisfy ourselves not to talk of legacy for future generation. We need to eat first before thinking of next generation" (community member).

The top ranked values play significant role in the day-to-day life of stakeholders but this should not suggest that other values that received fewer votes, e.g. biodiversity loss and future generation, are not important. A workshop participant rationalised their ranking as such: *"for our community to survive and want to keep land or river for the next generation, we have to be alive first*". A regulator also commented: "*well I would say biodiversity is important to us as regulators but the people are more interested in what gets to them now and satisfy them*". These findings suggest that stakeholders understand the importance of all of the values discussed, but placed priority on those values that address the immediate, basic needs of the population.

The study assessed the priority scores between different stakeholder groups to determine if differences between the scores were significant. A statistical analysis (Shapiro-wilk test) was conducted on the data set to evaluate whether or not the data was normally distributed and thus appropriate for t test. Results from the test indicated group sizes did not differ greatly and that the data set was normally distributed. Following this, using a t-test the study determined that differences in the ranked order of priorities between stakeholder groups was not statistically significant ($p > 0.05$) between groups. This finding shows that stakeholders share a similar perspective about the socio-cultural priorities as they relate to oil pollution. It has been suggested that if stakeholder groups share fundamental goals that there is potential to build consensus and trust, which could lead to shared decision-making (Snape et al., 2014).

Some differences were observed for the ranking of the four priority issues: drinking water quality, soil quality, food and local supply chain: farming/fishing and human health (Figure 3-5).

All stakeholders acknowledged the existence of hydrocarbon pollution and its impact on water and health, as one expert stated: *"We understand what the problem of oil spill is, majorly drinking water and the health of the people ...it could*

vary but these are most important". Yet despite this common understanding the basis from which different group evaluate the priorities will differ, relative to their needs and responsibilities. One workshop participant said: *"if you have to provide us now with anything, clean water and occupation is the most important right now". (community member).* Another workshop participant added: *"We need drinking water first, then something to do to earn money since the farms are no longer yielding" (community member).* On the other hand, a regulator, whose main responsibility is to protect human and environmental health, perceived values differently, stating: "*There are two issues to consider in this prioritisation, one is the people who are suffering due to oil spill and another is our responsibility as a regulator".* Similarly, an operator said: *"As an international organisation we ought to imbibe best practice to protect people and the environment and ensure the people are happy*" – relative to commercial profitability (author's addition).

Community members viewed impacts as impediments to their pursuit of a healthy livelihood, while regulators consider impacts relative to their organisational mandates, and operators view impacts relative to their capacity to conduct business. How stakeholder groups formulate their beliefs will differ, and despite a thin veneer of consensus (i.e. shared priorities), deeper misunderstanding about the fundamental objectives or principles that inform prioritisation could pose a challenge to shared decision making. This study believes additional efforts are necessary to understand how different stakeholder groups make decisions and how these differences might affect the shared decision making process (Snape et al. 2014).

In the following sections the study provides more detailed analysis that is focused on the top ranked priorities.

3.4.3.1 Safe drinking water

Safe drinking water was the highest ranked social value regardless of the category of stakeholder group (Figure 3-5). Research has shown that the majority of the local population accesses unsafe drinking water from sources polluted with hydrocarbons (Etim et al., 2013; Daminabo and Frank, 2016). Our results corroborate these findings with one workshop participant stating: *"Our water is*

polluted all the time by oil spills and this has made us suffer different sicknesses. Water is a serious issue in our community because of oil spill. We drink water with oil and rainwater is bad". Another workshop participant said: *"When rain falls, we cannot drink because it is black, and the water from the rivers smells crude oil and the one from the wells have oil on the surface. We have no alternative but to buy good water".* An operator expressed a similar observation during the interview: *"truly, portable drinking water is perennial problem in the communities. Each time we go for field work we pity the community people because of the kind of water they drink".*

Options for the public to access clean water are limited. Commercial water vendors are expensive and sometime provide untreated water that is unsafe for consumption (Akpabio et al., 2015; Ansa and Ukpong, 2015). Safe drinking water is thus a multiplex issue that threatens the health and wellbeing of individuals, as well as their economic viability (Nganje et al., 2015).

Nigeria's national water policy aims to ensure availability, conservation, and equitable distribution of safe water resources to the population (FGN, 2004), but this policy has not achieved its goals due to weak enforcement and implementation (Nwankwoala, 2014). Many opportunities for Nigeria to transfer water quality policy from other countries exist (Khan et al., 2015). The European Union's Water Framework Directive (WFD 2000/60/EC) is an exemplar that acknowledges a linkage between ecological health and safe drinking water (Muxika et al., 2007; Hering et al., 2010). More meaningful to Nigeria is the case of Zimbabwe who reformed its national water policy to address concerns about protection of water resources and distribution (Nicol and Mtisi, 2016). Sharing similar socio-economic characteristics with Nigeria, Zimbabwe was able to reduce institutional complexity, develop distribution infrastructure, and overcome implementation challenges. Lessons from the Zimbabwe experience could be used to inform a Nigerian reform, and given the link between hydrocarbon pollution and water quality, steps can be taken to integrate water quality policy with contaminated land policy reform.

3.4.3.2 Soil quality

Soil quality plays a significant role in the financial security of stakeholders given the likelihood of reliance on agriculture produce for livelihood. Studies have shown that hydrocarbon contamination in the region has led to a decline in soil quality, as determined by a reduction of microbial activity, organic matter content (Okeke and Okpala, 2014), and agricultural yields (Oyebamiji and Mba, 2013). The local population relies on subsistence farming for their economic survival (Omeire et al., 2014; NDDC, 2014; Elum et al., 2016) and thus was prioritised by all participants. A workshop participant expressed the importance of soil quality, stating: "*farming is the major occupation around here, it serves for food and also we sell our crops to earn money".* Similarly, an operator acknowledge this importance*: "It is very obvious that the hardship in the area is as a result of the inability of the people to farm"*, recognising the intrinsic link between economic survival and soil quality (Elum et al., 2016). A workshop participant acknowledged that: *"we are in a terrible situation, as long as the soil is not restored to its fertile state we will have no job to do".* Current contaminated land policy does not adequately acknowledge the relationship between hydrocarbon pollution and soil quality, and its effect on the local population to produce food. Certainly the fragmented nature of the current policy limits its effectiveness (Ajayi and Ikporukpo, 2005), however concerns were also raised about how the policy is delivered, as stated by a regulator: *"when you go to oil producing communities you will know we are not doing enough. Farmlands are polluted for years …. Even some areas that they said they have cleaned, the people have not been able to farm there".*

Nigeria has generic soil standards which is poorly enforced due to a number of factors which include institutional, funding, and capacity of the regulators (Ajayi and Ikporukpo, 2005; Ambituuni et al., 2014; Sam et al., 2015). As a result, despite the availability of regulations, the government remains incapable of implementation (Ajayi and Ikporukpo, 2005). Policies that ensure prompt response to, and restoration of contaminated sites exist in developed countries such as the UK, USA and Canada (Nathanail et al., 2013); and also in developing countries such as Cameroon (Forton et al., 2012). These policies set and

implement standards for the restoration of contaminated land for different land use including agriculture. Lessons from the USA and Cameroon experiences could be used to inform changes to contaminated land policy implementation, and given the connection between soil quality and hydrocarbon contamination, efforts should be made to involve the locals to regularly inspect and monitor soil quality.

3.4.3.3 Food and local supply chain and human health

The local population relies on subsistence farming and fishing to provide food to meet their nutritional requirements. Hydrocarbon contaminated water and soil reduce the ability of the local supply chain to produce this nutrition, which in turn affects individuals' health (Babatunde et al., 2015; Nriagu et al., 2016). A workshop participant explained this relationship, stating: *"it is very difficult for us to survive. Sometimes we eat food from our farmlands and we get sick. We do not know what the cause is, but we experience this when oil spill became frequent on our cultivated farmland".* Unable to transfer their agricultural production to soils that are not contaminated, farmers have few options other than to continue producing contaminated food, as noted by an operator: *"Since they have no other option but to feed on polluted land, they are likely to get sick when they feed from such produce".* Contaminated seafood, such as shrimps and fishes have also been reported to be consumed (Nriagu et al., 2016) and noted by a workshop participant: *"The problem with oil spill is that it kills fishes. Whenever spill occurs we pick fishes from the shores and as we cook and eat, they smell crude oil. Each time we eat these fish we suffer one sickness or the other".* Without available alternatives, the local population will continue to consume these products and suffer the attendant health impacts (Amirah et al., 2013).

Prompt communication of hydrocarbon spills and associated risks is necessary to mitigate the public's exposure, but government lacks the capacity to respond to spill situations (Pegg and Zabbey, 2013; Akpan, 2014). A regulator explained: "*sometimes before we get into the communities to educate them about effects of eating or selling such fish, the deed is already done. Moreover, it is difficult to regulate these things due to the economy"*. Regulators do not reside in affected

communities and this introduces a communicative distance between the groups that delays the delivery of messages that might restrict activities, which could reduce exposure. More needs to be done to minimise the communicative distance, either through improved local involvement in identifying and reporting spill incidences, or increasing the number of visits a regulator makes to an area. Nigeria could learn from the USA, where contaminated land emergencies and hotspots (sites that require urgent attention) are identified by regional teams that report to the USEPA (CERCLA, 2002). Using this model, local residents would identify and communicate issues to regulators in order to expedite the process. In additional, these residents could be used to communicate issues about risks and actions via the local media to the local population.

In recent years Nigeria has transformed its food supply chain to promote farm-to-table production (Federal Ministry of Health, 2014), but in doing so failed to regulate the quality of food in circulation. Food produced on contaminated land will satisfy the farm-to-table policy, but has resulted in regional incidents of food toxicity (Omemu and Aderoju, 2008). As one expert noted, more can be done by the government to prevent consumption of contaminated food "*They know that we eat polluted fish, even when we can smell the crude oil in the fish we still hope to eat and not get sick".* Acknowledging the link between contaminated land and food is a first step towards reform. Lessons to improve food policy (e.g. standardised inspection, monitoring, regulation) can again be learned from Zimbabwe (Macheka et al., 2013), and this should be linked with changes to the contaminated land policy.

Stakeholders were unified in their recognition that the basic needs of the local population must be met before long-term. The results suggest that before addressing concerns for the future, the basic needs of the present that determine liveability needs to be addressed (De Haan et al., 2014). Findings in this study show that all stakeholders share the belief that basic needs such as the provision of clean drinking water and safe food should have priority over other needs such as sustainability and protection of natural ecosystem (De Haan et al., 2014).

This raises questions about the appropriateness of policy from regions that are economically well off, e.g. UK and USA. In these countries the basic needs of the local population e.g. access to safe drinking, are largely met, which enables them to focus on long-term issues like sustainability. Therefore, for Nigeria to integrate sustainability into contaminated land policy before the basic needs of the population are met might be counterproductive and appear misguided. As a workshop participant asserted: *"let's be truthful, why should I bother about sustainability or the next generation when the resources has been degraded? We should have our daily needs before thinking of the future".* This argument should not diminish the value of policy transfer as a mechanism for improving existing policy. Instead, it highlights the importance of understanding the context from which a policy was taken and to which it will be applied. We recommend that Nigeria should focus on the transfer of policy that meets their present needs and we suggest a pathway in Table 3-6.

3.4.4 Wider socio-economic and environmental concerns

Additional concerns were raised by stakeholders including environmental degradation, economic loss, clean-up and participation, and cooperation (Figure 3-6). Within each theme, a number of sub-themes emerged (Table 3-4) that represents wider socio-economic concerns.

Economic loss was the most frequent theme mentioned and this can be attributed to integral role that the environment (i.e. soil and water quality) plays in day-to-day life (Pegg and Zabbey, 2013; UNEP, 2011). This is the most mentioned theme by the public and could be linked to the impacts of contaminated land on their farmlands and rivers which are primary sources of economic value to the local population has affected their income security (Anejionu et al., 2015; Elum et al., 2016). Operators most frequently referred to participation and cooperation and this is because the ability of operators to conduct their business is linked to good relationships with the public. An operator explained "*We want peace in the land but if the communities continue to fight and threaten our workers there is very little we can do. This affects our operations.* On another hand, operators often make pledges to meet societal expectations through global memorandum

of understanding (GMOU). When a GMOU cannot be agreed, or is not met, confidence and trust between groups degrades and has resulted in conflict (Elenwo and Akankali, 2014). Regulators on the other hand most frequently mentioned their inability to address environmental degradation and clean-up spill sites and expressed their disappointment: (i.e. "*When you go to oil producing communities you will know we are not doing enough. Farmlands are polluted for years …. Even some areas that they said they have cleaned, the people have not been able to farm there*")

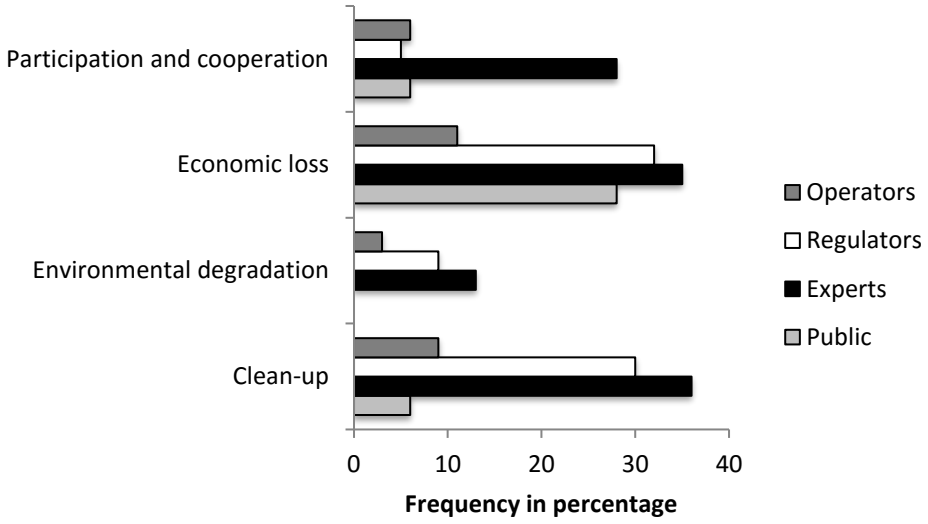

Figure 3-6: Other concerns posed by oil-contaminated sites in the Niger Delta (Number of times themes were mentioned by stakeholder groups)

Reflecting the needs of each group and inability to achieve targeted goals, these thematic issues highlight the ineffectiveness of the current policy. The ability of regulators to address contaminated land is due to inherent weakness in the regulation, the lack of funding and expertise and the need of a management framework. This was further supported by the expert views: *"We don't have the technical expertise, we might have the knowledge theoretically but practically no, because for you to achieve the desire result within the framework of international best practice, you need certain things in place"*

This inability of the regulators to address contaminated sites has in turn affected the ability of the public to meet their food and economic obligations due to their

dependency on land (Elum et al., 2016). This has led to lack of confidence in the regulatory regime and resulted in distrust among stakeholder groups. This distrust has affected the relationship between operators and local communities and the regulators, and expressed as lack of cooperation between these stakeholders groups. To address these issues, more needs to be done to increase the capacity of experts and regulators through training and improved policy to enable them do their job effectively. For the public, provide them with alternative source of livelihood, and for the operators a conducive environment to operate and make profit. Addressing these needs is subject to an improved contaminated land management policy.

3.4.5 Comparing ranked social values and current policy

Countries like the UK and the USA understand the social values of their stakeholders and meet these needs via stringent regulations, the creation of environmental awareness campaign, and the establishment of funding mechanisms (Luo et al., 2009; Forton et al., 2012; Sam et al., 2015; Brombal et al., 2015). The needs of Nigerian stakeholders, however, are different to those highlighted in developed countries. Basic amenities, hunger and struggle for survival are the present challenges in Nigeria (Oyebamiji and Mba, 2013; Eke, 2016; Elum et al., 2016), despite the wealth generated in the region.

Existing contaminated land policy does not meet these needs, nor does it account for the social values identified in this study. Various reasons have been given for why current policy is ineffective: lack of funding, limited expertise, failure of the existing regulation, corruption and stakeholder engagement (Sam et al., 2015). Despite these challenges, this study believes that awareness of the social values of contaminated land stakeholders could benefit Nigerian policy development in a number of different ways. Understanding priorities will enable government and operators to plan for and implement mitigation actions that provide appropriate support for local communities. For example, this information could prompt government to focus on policy that manages contaminated land such that it provides for basic amenities and alternative livelihoods for the local population (Godden et al., 2008; Basu et al., 2015). Operators might use this information to

inform local community engagement, for example, they might provide treated water for affected communities as part of their corporate social responsibility (Idemudia, 2010).

3.4.6 Improving current contaminated land management policy through policy transfer

The study investigated whether participants were familiar with foreign contaminated land management policy. This was done to assess other contaminated land management regimes stakeholders are familiar with should they want to transfer such policy. The results show that participants are generally less familiar with foreign contaminated land regulations, for example, experts were the most familiar (45%) followed by operators (34%) and regulators (21%). It is unexpected that regulators would have least familiarity with foreign contaminated land regulations among the stakeholders. This is because it is expected that regulators compare their approaches to contaminated land restoration with those of other regions e.g. Cameroon or UK, to help them identify areas that require improvement, innovations and training needs. This is an indication contaminated land management practitioners in Nigeria require platforms for collaboration, training and knowledge sharing with other advanced regimes (Sam et al., 2015).

Despite limited familiarity with advanced regimes, stakeholders repeatedly commented that policy transfer could improve the regulation in practice. However, there is need to consider issues in the Nigerian context as noted by an expert: "*Well, a stark jacket transfer of policy should be discouraged*". Nigeria is a culturally diverse nation, the Niger Delta region alone has nine states with different policy and economic directions (NDDC, 2014), that might affect the integration of policy transfer (James and Lodge, 2003). An expert explained: *"But workable policy around the world that have been tested and found working can be adapted within the context of the socio-cultural setting of Nigeria".* A regulator also said "…*we have made request for the laws to be reviewed and strengthened".* Thus, in contemplating improving current regulation with lessons

abroad, it is necessary to take into account different contextual issues that might affect the effectiveness of policy transfer in Nigeria.

In order to successfully identify an appropriate policy and ensure effective and efficient implementation, a pathway to follow is proposed (Table 3-6). This is expected to serve as a guide in the policy transfer process.

Table 3-6: Pathway for policy transfer

DOs	DONTs
Engage stakeholders in local communities in the Niger Delta	Avoid policy importation without stakeholder input
Allow stakeholders to explore societal values that characterise the environment	Exclusion of any stakeholder group or interested party
Educate and raise awareness of stakeholders particularly in Khana local council	Avoid bias in the selection of countries for lesson learning
Identify developed and appropriate policy for Nigeria to transfer	Avoid political interest and sentiment
Compare identified policy with the Nigerian policy	Avoid conflicting policies
Evaluate the applicability and workability within Nigeria	Avoid stakeholder coercion
Train stakeholders and provide opportunity for knowledge exchange specifically for DPR	Avoid policy duplication
Increase capacity of DPR personnel for trust and transparency	
Integrate stakeholder values into the policy	
Present to stakeholders for ratification	

3.4.7 Contextual barriers to policy transfer in Nigeria

Three contextual barriers were identified that could limit the effectiveness of policy that is transferred into Nigeria, and these include political and cultural issues, regulatory performance, and trust and transparency.

Political and cultural differences between countries can affect successful policy transfer. Diplomatic row, for example between Nigeria and USA on a different policy, might make Nigeria not to want to learn contaminated land management lessons from the USA (Olanrewaju et al., 2015). As such, the political will for Nigeria to learn lessons from such country will be lacking. One expert stated: *"Yes I foresee a barrier because there is no political will that is the major barrier. If there is a political will in favour of the people, what I mean by a political will, a*

desire by the politicians to do the right thing for the people". On the other hand, differences in political goal and philosophy could vary greatly between two countries and might affect successful policy transfer (Evans, 2006). For example, an improve policy could be averse to the policy direction of a particular government. Thus, politics is a key factor in successful policy transfer. In addition, Nigeria is a culturally diverse with different cultural practices that might affect successful policy implementation. Cultural practices could impede prompt response to spill containment or restoration of an identified contaminated site. For example, if a shrine is affected by spills, until certain sacrifices are performed procedures for spill containment will not be initiated. . An expert explained:*"…I wouldn't assume that in the United Kingdom, they still have places that they consider as shrines for worshipping but in Nigeria we strongly still have places like that; and if there is spill and you go there; first, you cannot even attempt to clean up unless the priest in charge of that shrine is consulted".* Such cultural practices will vary from other developed regimes, such as the UK, where the regulation stipulates prompt unhindered response to contaminated land (DEFRA, 2012). This implies that the effectiveness of such policy as practiced in the UK will be hampered in Nigeria (Benson, 2009; Evans, 2009). Therefore, for Nigeria to address differences in cultural practices, education (e.g. inclusion in school curriculum) and increased awareness (through local media) of the local population to lax these practices is essential.

Failure of the existing regulation to meet scientific and societal expectations might limit the effectiveness of a transferred policy. The effectiveness of a new policy partly depends on its integration with the existing policy (Atela et al., 2016; Rose, 2005), thus compatibility with multiple self-conflicting ineffective policy could be a challenge for a transferred policy. A regulator stated: *"In terms of policy there is the need to have a holistic policy that is not self-conflicting, that will deal with the issue of contamination and clean up and restoration of contaminated land in Ogoni, Nigeria".* This suggests challenges faced by the current regulatory framework which include overlap and double standards should be addressed for a transferred policy to integrate and function effectively for contaminated land management.

Corruption and unprofessional conduct (e.g. taking bribes) introduce a lack of trust in the regulatory process which affects regulatory compliance and implementation (Eneh, 2011;Adekola et al., 2015; Rim-rukeh, 2015). A regulator explained: "*we have made request for the laws to be reviewed and strengthened; probably this will address the loop holes and consequent corrupt acts*". In efforts to satisfy vested interest in, and maintain economic benefits from the oil industry, key stakeholders might want to arm twist a new policy in Nigeria (Adekola et al., 2012, 2015). Previous studies suggest that corruption practices have systematically affected the enforcement of the current contaminated land management policy, for example, where environmental regulations are violated, operators face no penalty, while in most cases, operators often pay their way through and abandon spill sites (Idemudia and Ite, 2006; Edoho, 2008). An industry operator commented: *"Our responsibility is to work according to available policy. We desire a policy that discourages corrupt practices".* While this undermines the credibility of the regulator, reduce trust and confidence of the public, it mostly results in environmental deterioration. For Nigeria to achieve a successful policy transfer, the issue of corruption has to be addressed.

3.5 Conclusion

Our evaluation of stakeholder values and public views are not definitive but gives an indication of factors in the context of the Niger Delta region that should be taken into account for contaminated land policy improvement. The proposed engagement approach and the techniques adopted were well-received and supported inclusive data gathering from all stakeholder groups. Water quality, soil quality for agriculture, food and local supply chain and human health/wellbeing were identified as the core social values that influenced decision making for oil contaminated sites management in Nigeria. These social issues are primarily basic needs and therefore raise concerns on the appropriateness of policy from advanced countries in Nigeria, where basic needs of the local population are largely met, and current policies are now focused on long-term issues like sustainability. This study therefore proposed a pathway through which policy makers can identify and transfer an appropriate contaminated land policy for

Nigeria. The study recommends policy makers to consider these social values when contemplating policy adoption and in the process of contaminated land risk assessment and management in Nigeria and regions with similar contextual issues. The approach adopted in this study collects evidence about the needs of the stakeholders that will ultimately serve the policy. Drawing on the findings of this study, the following recommendations are presented for improving contaminated land management in Nigeria:

- **Educate and create awareness –** educate stakeholders to protect biodiversity and practice effective resource conservation. Raise awareness on the importance of sustainability.
- **Take responsibility –** all stakeholders should play a role in reducing impact of contaminated land on the population.
- **Engage all stakeholders –** frequent stakeholder engagement and consultation is required for knowledge exchange. Increased knowledge will shape the land contamination management policies.
- **Be transparent and collaborate –** all stakeholders should be engaged, accountable, transparent and collaborate with each other for effective contaminated land management.
- **Fill the gap –** fill the gap between science and stakeholder views. Educate stakeholders on the implications of cultural practices and address political issues that might affect implementation of an improved policy.

A more pragmatic starting point might be wide public engagement on the impacts and implications of land contamination in the region accompanied by risk communication. For example, religious gatherings, specialised seminars, and engagement fora could be used for this purpose. In addition, procedures moving towards a more transparent land contamination regime should commence in Nigeria. This can begin with the processes for developing a new comprehensive policy for land contamination management in Nigeria.

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4 Working towards an integrated land contamination management framework for Nigeria

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ABSTRACT: Over the past five decades Nigeria has developed a number of contaminated land legislations to address the damage caused primarily by oil and gas exploitation activities. Within these legislations exist elements of risk assessment and risk-based corrective action. Despite this progress, this study argues that contaminated land management approaches in Nigeria need further development to be able to integrate new scientific information, and to address environmental, economic, and social values. By comparison, advanced contaminated land regimes in the United Kingdom (UK), the Netherlands, Australia, New Zealand and the United States of America (USA) apply a number of integrative approaches (e.g. sustainability appraisal, liability regime, funding mechanisms, technology demonstration) that enable them to meet the environmental, economic, and social needs of their populations. In comparison, Nigerian governance lacks many of these mechanisms and management of contaminated land is ad hoc. In this paper we propose an integrated risk assessment framework for Nigeria that incorporates the principles of sustainability and stakeholder engagement into the decision-making processes for contaminated land risk assessment and risk management. The integrated approach relies on transparency to promote acceptance and build trust in institutions, and uses stakeholder engagement to address data deficiencies. We conclude this paper with a roadmap for how Nigeria might implement such an integrative approach into their existing contaminated land regulatory system, as well as identify a series of policy priorities that should be addressed.

Keywords: Contaminated land, integrated framework, Policy, Niger Delta, Risk assessment, Sustainability

4.1 Introduction

Over the last 50 years the growth of the Nigerian oil and gas exploitation industry has resulted in significant soil and water contamination issues, particularly in the Niger Delta region. Though policies and regulatory actions to protect the environment have been implemented in Nigeria to prevent deliberate pollution, and more recently to address pollution prevention at source (Ajayi and Ikporukpo, 2005; Ajai, 2010; Fentiman and Zabbey, 2015), deficiencies remain. Most notably, there is a need for a better integration and implementation of an environmental management strategy that reflects scientific and societal expectations (UNEP, 2011; Ambituuni, et al., 2014; Rim-rukeh, 2015), which both are viewed as necessary to manage land contamination (Idemudia and Ite, 2006; Eneh, 2011; Enuoh and Eneh, 2015).

Soil protection and management have been featured in Nigerian policy discussions since the late 1970s, for example see the Petroleum Act 1969 (FGN, 1969). More recently, this topic has become a priority concern for regulators and the public who regard the role of soil as a resource, independent of the functions that it carries out (Sojinu et al., 2010; UNEP, 2011; Adekola et al., 2015; Haslmayr et al., 2016). This perspective is shared internationally (Swartjes et al., 2012; Artmann, 2016), and can explain the motivation for soil protection in other sectors including among others soil contamination (Baveye and Laba, 2016; Cachada et al., 2016), construction (Liu et al., 2015), and agriculture and amenity value (Stupak, 2016).

Frameworks for pollution prevention and risk-based management of contaminated lands are well established in North America and Europe. In the UK, risk-based approaches to land contamination management have resulted in a number of lessons that can be shared globally, in particular, the development of innovative cost effective approaches to land contamination management (Nathanail et al., 2013). Arguably, Nigeria could benefit from these experiences by adapting best practices now established in the UK. By leveraging existing knowledge and know-how, Nigeria might expect a decrease in both the cost and timeline for similar policy and regulatory development; however, changes must

integrate with current initiatives. Management elements that should be considered in a comprehensive risk and sustainability assessment system include:

1. risk management decision making;
2. verification of remediation outcomes;
3. systems for record keeping and preservation and integration of contamination issues into land use planning, along with procedures for ensuring effective health and safety considerations during remediation projects; and
4. effective evaluation of costs versus benefits and overall sustainability, both for remediation and in the broader brownfields regeneration context.

In this study we discuss the challenges and opportunities for change in the current land contamination management regime in Nigeria, and suggest a way forward to establish an integrated risk assessment framework. Finally, we present a road map for the integration of environmental, economic and social values into a sustainable land contamination management plan for Nigeria.

4.2 What is an integrated risk assessment framework?

Risk assessment is a systematic approach to identify, evaluate, manage and communicate the likelihood of occurrence and consequences of harm resulting from land contamination (Defra, 2011; Prpich et al., 2015). Risk assessment is used to support decisions by providing a structured means to gather and organise evidence in support of rational and objective arguments. Risk assessment can be used to determine levels of harm, to prioritise issues, or to inform policy, and comprises a series of logical steps: identification, definition of scope, development of a conceptual model, assessment, characterisation, management, communication, that enable the assessment of any environmental activity (DEFRA, 2011). A significant step in the risk assessment process is the development of the conceptual site model (CSM), which is used to establish the links between source-pathway-receptors (Simon et al., 2016; Thomsen et al.,

2016). Within the risk assessment framework, social, environment, and economic values are often considered to provide a holistic perspective.

The same principles are applied to risk assessment for land contamination (Briggs, 2008) and specific measures might include e.g. assessment of exposure and effects and impacts on local populations, identification of contaminant fate and transport and pollutant linkages, assessment of effects on multiple species/target organisms, toxicological endpoint identification, and socio-technical assessment (Suter et al., 2003). To assess these components as a whole requires an integrated risk assessment framework, which is a risk-based framework that takes into account holistic factors such as social values, environmental and economic concerns, and sustainability, when making an estimation of risk (Suter et al., 2003). The inclusion of environmental, economic, societal values, as well as public concerns, augment the conventional technical analysis associated with risk assessment to provide a broader perspective that has been shown to improve acceptance and reliability of risk assessment outputs (Péry et al., 2013; Wilks et al., 2015). In addition, integrated risk assessments provide greater opportunity for engagement between risk assessors, decision makers, regulators, experts, operators and the public, because of the multiple information inputs (Figure 4-1).

4.2.1 Stakeholder engagement

Stakeholder engagement is the process of informing, consulting, involving, collaborating with, and empowering affected people involved in a decision making or policy-forming process (Rowe and Frewer, 2005; Cundy et al., 2013; Ramirez-Andreotta et al., 2014). In practice, stakeholder engagement integrates the views of different stakeholder groups, e.g. experts, public, regulators and operators, to arrive at a consensus decision (Cundy et al., 2013). Stakeholder engagement is a fundamental aspect of any integrated risk framework and is used to inform, consult, create dialogue, and empower interested parties to participate in the decision-making process (Reed, 2008; Benson et al., 2016). Evidence suggests that through involvement, stakeholders will enhance the quality of decision-making via introduction of variable information inputs (Garmendia and Stagl,

2010; Cundy et al., 2013; Sardinha et al., 2013). This is achieved by accessing, sampling, and integrating diverse stakeholder perspectives (including experts and non-experts) through an inclusive participatory process that facilitates new idea generation, while seeking to develop common understanding of shared perspectives (Sardinha et al., 2013). Stakeholder engagement can also be used to identify gaps in knowledge or reveal risk perceptions (Reed, 2008), and is often used to build trust and promote transparency, particularly for complex issues (Péry et al., 2013; Prpich et al., 2015).

However, the quality of outputs derived from stakeholder engagement processes will depend on the nature and relevance of the approach (Chess and Purcell, 1999). Communication must be meaningful and accessible, e.g. using common language that is understandable to all stakeholders, and culturally appropriate (Cundy et al., 2013), and therefore must be context specific (IFC, 2007). In the EU and USA technology (e.g. emails, text messaging, online surveys, and other forms of social media) are often used to inform stakeholder groups about the engagement process and aims, and the venue location while also supporting facilitation of meetings and seminars, and question and answer sessions (Smith and Gallicano, 2015). In regions where these types of technologies are not available, these approaches could be counterproductive to the engagement process (Chess and Purcell, 1999). For example, stakeholder engagement processes in South Africa and Botswana accommodate for cultural differences in communication, advocating for the use of direct and physical contact with stakeholders in these regions (Department of Environmental Affairs and Tourism, 2002; Department of Water Affairs, 2012; Obasi and Lekorwe, 2014). In Nigeria, stakeholder engagement processes should involve a degree of physical contact, persuasion, and negotiation (Lawrence, 2002; Idemudia, 2014; Aluko et al., 2015) and if these techniques are not integrated into the process it might make stakeholders reluctant to participate in the policy process, possibly leading to feelings of exclusion or lack of trust, (Boele et al., 2001; Okoh, 2007).

4.2.2 Sustainable contaminated land management

Sustainability is defined as the aggregate of environment, social, and economic assessment. One of the first land contamination assessments to consider social and economic benefits was the Lower Swansea Valley Regeneration assessment in the UK (Bardos et al., 2016). Sustainability has since become the basis for contaminated land management in the UK and these practices have been shared with several European partners through the establishment of technical networking projects (e.g. CARACAS and CLARINET) (CARACAS, 1998; Vegter et al., 2002; Döberl et al., 2013). Specifically in the EU, the Concerted Action on Risk Assessment for Contaminated Sites in the European Union (CARACAS) created a knowledge sharing platform about contaminated land risk assessment for academics and experts (CARACAS, 1998), while the Contaminated Land Rehabilitation Network for Environmental Technologies (CLARINET) provided an interdisciplinary knowledge exchange network for the sustainable management of contaminated land management. The contaminated land applications in real environments (CL:AIRE) is another example of a network platform used to communicate information about contaminated land research, technology, and demonstrations worldwide (CL:AIRE, 2015; Bardos et al., 2016). Additional information exchanges include NICOLE (www.nicole.org) and COMMON FORUM (www.commonforum.eu). Work is also underway to develop a sustainable remediation network in China via collaboration between the UK Sustainable Remediation Forum (SuRF-UK) and its Chinese equivalent. The aim of this partnership is to support the rapid progression of a sustainability debate about contaminated land in China, and to facilitate the development of guidance and training (Coulon et al., 2016). More generally, consensus is building that sustainable land management should be incorporated into an ISO standard (Bardos et al., 2016). Contextually, Nigeria might benefit from synergistic relationships with countries owning experience in sustainable land contamination management, for example, a collaboration with the SuRF-UK network could progress the sustainability debate in Nigeria, promote knowledge sharing, and support capacity building.

International consensus suggests that sustainable remediation should provide a net benefit across a range of environmental, economic, and social concerns. The first framework for sustainable remediation (SuRF-UK) was published by the UK and serves as the basis for similar frameworks in other countries (SuRF-UK, 2010; Bardos et al., 2016). The scope of sustainability is fluid, but can be summarised across these three key elements (Table 4-1).

Table 4-1: Examples of commonly used criteria (receptors and impacts) considered when conducting a sustainability assessment. Criteria are spread across the three key elements of sustainability (Bardos et al., 2011, 2016; Hou and Al-Tabbaa, 2014; Hou et al., 2014; Rosén et al., 2015).

Environment	Economic	Social
Soil	Income loss	Protection of human health
Fauna and flora	Economic burden	Safe working practice
Groundwater	Employment opportunity	Local air quality
Surface water		Equity
Sediment		Cultural heritage
Biodiversity loss		Local participation
Resource conservation		Local acceptance
Ecosystem services		Impact on property
Minimising waste		Impact on livelihood
Fumes		Impacts on drinking water
Emissions		Communal peace

4.3 What are the opportunities for integrated risk assessment in the present Nigeria land contamination management regulatory landscape?

Nigerian legislation for land contamination management is stretched across ten distinct pieces of legislation that cover five key areas of management (Table 4-2). Though all of the legislations address the prevention of land contamination and the protection of human and environmental receptors, only one legislation specifically describes the management of contaminated land – the Environmental Guideline and Standards for Petroleum Industry in Nigeria (EGASPIN). Despite this legislation, land contamination remains an ongoing issue across the Niger

Delta, in particular the prevention of new contamination (Pegg and Zabbey, 2013). Nigeria needs a comprehensive legislative framework that can provide a definition for contaminated land, identify planning controls, assign liability, organise a funding structure, and develop sustainability indicators (Könnet, 2014). There is also a need for mechanisms to identify and investigate actual volumes and causes of spills (Rim-rukeh, 2015), remediate contaminated sites (UNEP, 2011), protect human health, and promote access to contaminated land information (Sam et al., 2015).

Table 4-2: Legislations that relate to land contamination management in Nigeria and assessment of their effective management areas. The current land contamination legislation does not comprise of sustainability appraisal and the provision of a central contaminated land register for easy access to land contamination information.

Legislation	Prevention	Protection of human health and the environment	Management	Access to information	Sustainability appraisal
The Petroleum Act 1969	☑	☑	☒	☒	☒
Federal Environmental Protection Act 1988	☑	☑	☒	☒	☒
Harmful Waste Act 1988	☑	☑	☒	☒	☒
National Policy on Environment 1989	☑	☑	☒	☒	☒
Oil Pollution Act 1990	☑	☑	☒	☒	☒
National Environmental Protection (Abatement in Industries Generating Wastes) Regulation 1991	☑	☑	☒	☒	☒
National Environmental Protection (Effluent limitation) Regulation 1991	☑	☑	☒	☒	☒
Environmental Impact Assessment 1992	☑	☑	☒	☒	☒
Constitution of the Federal Republic of Nigeria 1999	☑	☑	☒	☒	☒
Environmental Guidelines and Standards for Petroleum Industry in Nigeria (EGASPIN) 2002	☑	☑	☑	☒	☒

*Green – elements covered by the current land contamination regulations in Nigeria.

Red – elements that are not currently covered by the current land contamination management regulations in Nigeria, but are needed.

Nigeria's current contaminated land regulations lack a definition for contaminated land, funding mechanism for land remediation, a strategy for identifying and assigning liability, and an effective risk-based framework for land contamination management (Sam et al., 2015). In addition, the regulations lack the technical capability to identify, record, investigate, and validate contaminated sites, which limits the ability of regulators and operators to track pipeline vandalism and to identify oil spills promptly (Adelana and Adeosun, 2011; Rim-rukeh, 2015). Also lacking are a means for prioritising the clean-up of high-risk areas and mechanisms for the exchange of research between international and national regulatory agencies and experts (Egwu, 2012; Könnet, 2014; Rim-rukeh, 2015). Given these challenges, the need for a comprehensive legislative framework is obvious, however, implementation of such a framework will require significant policy changes (Yeeles and Akporiaye, 2016). We described and prioritise these challenges in Table 4-3.

Table 4-3: Overview of the opportunities for change of the key elements of the Nigeria land contamination framework

Element	What is already in place	Level of achievement	Opportunities for change	Priority[a]
A legislative framework	EGASPIN 2002	Partial	This is in place but not appropriate. Produce a new guidance or review existing one to provide a clear definition for contaminated land, planning control liability regime and roles and responsibilities for agencies	High
Measures to prevent land contamination	Petroleum Act 1969	Partial	A clear inclusion of the precautionary principle to use technology to detect and monitor pipeline cracks and vandals	Medium
Access to contaminated land information	Nil	Nil	Produce a guidance to develop a database for extent and status of contaminated land in Nigeria	Low
Funding	Nil	Nil	Produce a funding mechanism for contaminated land	High
Sustainability appraisal	EGASPIN 2002	Partial	A clear framework for integrating sustainability indicators in the contaminated land decision making	Medium
Protection of human health and environment from the impacts of contaminated land	EGASPIN 2002	Partial	Produce nationally consistent methods for deriving human health and ecological soil screening levels for Nigeria	Medium
Mechanisms to help identify, investigate, manage and remediate contaminated land	EGASPIN 2002	Partial	Consider a new guidance; review and revise existing guidance	Medium

[a]We define a high priority as a necessary starting point for an inclusive integrated approach, while a low priority is one that is not considered a necessary starting point. A medium priority is an element that should be given intermediate attention. Partial

achievement indicate elements that are either in practice but poorly implemented or exist partly. Nil indicates an element that is yet to be developed.

Of the priorities that we identified, we believe that the highest priority should be the review and revision of the current land contamination management framework. Fundamental to this revision is the development of an appropriate definition for contaminated land that would provide the basis for risk quantification (UNEP, 2011). Development of the definition could borrow from countries with vast experience in land contamination management, e.g. UK and US. A working definition could help to mitigate disputes between regulators and operators that arise due to discretional definitions often provided by the regulator (DPR, 2002). Though the federal agency or government should assume the lead in the development and implementation of a statutory definition for contaminated land, the process should be inclusive of levels of government. A similar approach is practiced in the US (a federal state) where the United States Environment Protection Agency (USEPA) ensures the inclusion of regional and state environmental management agencies in land contamination decision making processes.

As a second priority, a funding mechanism for land contamination management should be institutionalised. The United Nations Environment Programme (UNEP) report on Ogoniland, indicated that clean-up will require an investment of over 1 billion USD (UNEP, 2011) and because funding constraints limit the effectiveness of clean-ups (Könnet, 2014), the lack of a funding mechanism is concerning. Examples of funding mechanisms include diversion of a percentage of the income on the sales of petroleum products to a clean-up fund or strict enforcement of the polluter pays principle (Sam et al., 2015). With a revised regulatory framework and adequate funding it is expected that the additional medium- and low-priority actions could be addressed in reasonable timeframe.

It is clear that the strategy to manage land contamination in Nigeria is at an early stage of development (i.e. Nigeria developed a specific land contamination regulation in 2002) (DPR, 2002; Ajayi and Ikporukpo, 2005). Changes to this strategy are necessary to achieve the level of comprehensive policy that is

envisioned. We believe that at its core, a land contamination management system should comprise an integrated approach that combines risk-based principles, stakeholder engagement, and sustainability assessment to provide a comprehensive land contamination policy. In the following section, we describe such an approach, and discuss how it could be used to promote better land contamination management in Nigeria.

4.4 An integrated risk assessment framework for Nigeria

Integrated risk assessment frameworks have been developed previously, e.g. for organophosphorus pesticides (Vermeire et al., 2003), ultraviolet radiation effects on amphibians, coral, humans, and oceanic primary productivity (Hansen et al., 2003), persistent organic pollutants in humans and wildlife (Ross and Birnbaum, 2003), and for assessment of tributyltin and triphenyltin compounds (Sekizawa et al., 2003). These examples demonstrate how an integrated risk assessment framework can redefine a traditional risk assessment process in terms of better inputs (more inclusive), streamline the process, include stakeholders, and share information (Suter et al., 2005).

The proposed framework will seek to achieve two aims:

(i) integrate environmental and socio-economic inputs (i.e. sustainability) into the risk assessment, and risk management processes;

(ii) provide a trusted and transparent approach to risk analysis that meets stakeholder expectations and promotes involvement (Wilks et al., 2015).

The proposed framework was designed to address issues about data availability, and does this via an iterative stakeholder engagement process that connects all elements of the risk analysis process (i.e. risk assessment, risk communication, and risk management) and also includes stakeholder values. This study acknowledges the fears of regulators regarding the inclusion of all stakeholders in the risk assessment process – for purposes of diluting the final decision. This study envisions a more advantageous situation if stakeholders are included at the risk assessment stage. One of these is the inclusion of local knowledge in the risk assessment process which leads to robust identification of a comprehensive

possible pollutant linkage. Nigerian regulators will benefit from this approach given their limited experience and knowledge of possible hazard pathways in the communities (UNEP, 2011). Stakeholders are urged to contribute and review findings at each step in the process with the level of interaction depending on the nature and complexity of the assessment.

The integrated assessment framework consists of five steps:

1. **Problem formulation:** the objective and scope of the risk assessment are defined, a conceptual site model is developed to identify all Source-Pathway-Receptor linkages, all relevant stakeholders are involved at this stage, and the nature and extent of stakeholders' future involvement is defined.

2. **Hazard identification:** hazards are identified, their source is identified, and the properties of both hazards and sources are defined and classified as posing a risk or no risk.

3. **Exposure assessment:** the likelihood of a receptor being exposed to a hazard is defined, which takes into account the magnitude, and duration of the exposure, as well as who and what are exposed, for how long, and how often.

4. **Risk estimation:** risk is estimated by multiplying the likelihood of probability and the extent of the harm.

5. **Risk characterisation:** a quantitative or semi-quantitative estimate of risk is determined and this includes an estimate of uncertainty, and a statement of significance, i.e. is a risk something to worry about?

By integrating environmental, economic and social values into the generic assessment of land contamination in Nigeria (Figure 4-1), the framework considers the principle of sustainability.

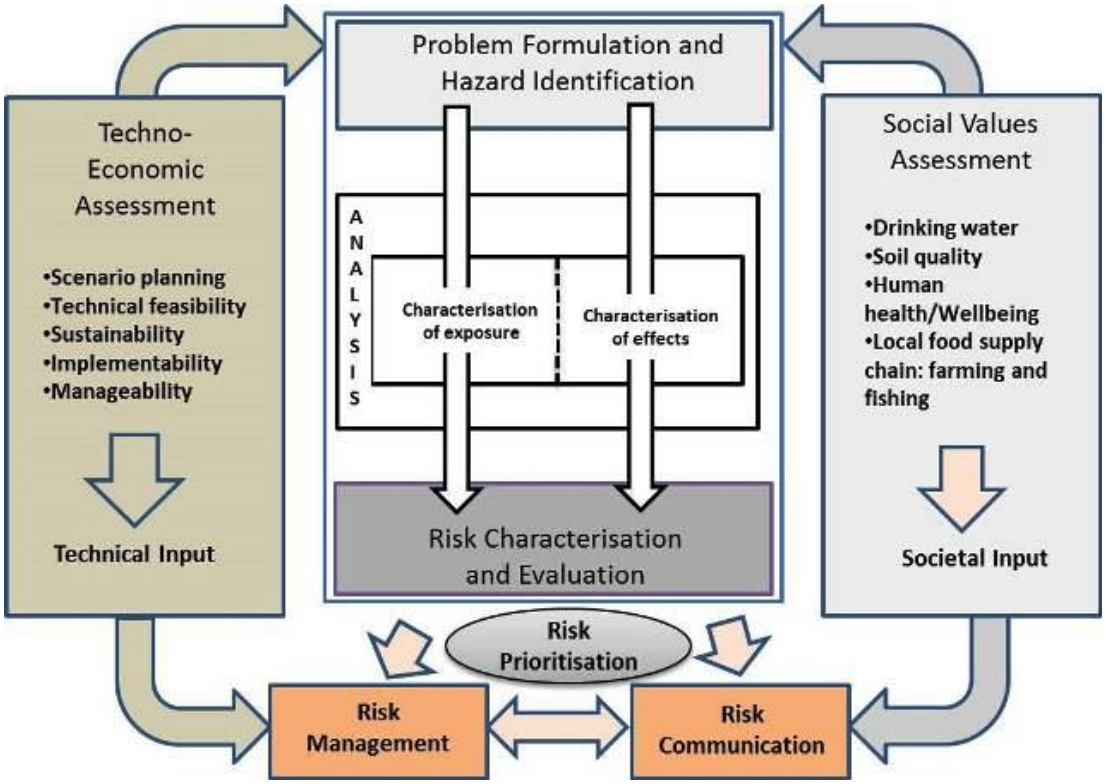

Figure 4-1: Integrated framework for sustainable land contamination risk assessment in Nigeria.

A central feature of any integrated risk assessment framework is the ability to combine independent sources of relevant information (Wilks et al., 2015). In the proposed framework, the study envision this being provided via stakeholder engagement whereby input from relevant stakeholder groups is used to contribute to the risk assessment and management, and decision making processes.

An added value of the integrated risk assessment framework is that the engagement process provides opportunity for consideration of all impacts of land contamination that are normally kept separate during traditional risk assessment (Briggs, 2008; Suter et al., 2005). For example, local communities can better characterise different pathways through which they might be exposed because of their local knowledge (Pollard et al., 2004; Reed, 2008; Bardos et al., 2016). This type of inclusivity enables stakeholders to also assist with the screening of environmental impacts and to integrate socio-political and economic factors that might influence environmental decision-making (Pollard et al., 2004a). This

inclusive approach is specifically important in Nigeria to address issues related to trust in, and transparency of final decisions made. The local population in particular consistently expressed lack of trust in decisions made by the regulators and operators of the oil industry (UNEP, 2011), thus, an initial inclusion approach could build trust in all stakeholders. At subsequent stages where technical inputs are required, stakeholders with such skills should be retained.

Using this framework, sustainable decisions about land contamination management can be arrived at because it provides a mechanism for the coordinated exchange of information, the sharing of assumptions and data between stakeholders, and the inclusion of local knowledge. This provision is intended to garner wider consultation and consideration, which should translate into an improved and efficient assessment process (Garmendia and Stagl, 2010; Sardinha et al., 2013; Bardos et al., 2016). As a consequence of this framework, it might be expected that Nigeria seeks to develop a more structured and informative risk assessment that would be relevant to sustainable contaminated land management (i.e. inclusion of the environmental and socio-economic effects). From the public's perspective, this framework could be expected to build trust between stakeholders and establish confidence in the process of contaminated land management through improved transparency. In the following sections we provide further detail about the key aspects of the framework.

The Nigerian Government could deploy this framework at all levels of government (e.g. national site prioritisation, regional management, or local site assessment) to address stakeholder concerns about participation in the land contamination management process (Rim-rukeh, 2015; UNEP, 2011). The framework could be used to facilitate workshops (Idemudia, 2014), or guide site investigations that require inclusion of different stakeholder groups (Rim-rukeh, 2015), and also to determine remediation action (UNEP, 2011). By doing so, the outcome of the engagement process will reflect stakeholder expectations and might reduce the conflict that exists between land contamination stakeholders (Umukoro, 2012; UNEP, 2011).

4.4.1 Facilitating collaboration and interactions between stakeholders

The framework provides a structured process for all stakeholder groups to engage at the beginning (problem formulation stage) through to the end of the assessment process. This ensures that relevant and wider issues affecting all stakeholder groups can be integrated into the decision process, thereby fostering mutual understanding and closer collaboration (Garmendia and Stagl, 2010; Bardos et al., 2016). As such, integrated risk assessment frameworks can bridge the gaps between stakeholder groups in the decision making process by providing them a role in the engagement process, which in turn engenders transparency in the decision process (Reed, 2008; Sardinha et al., 2013).

4.4.2 Fostering expectation from all stakeholders

Early and continual engagement is expected to foster group interactions (between risk-assessors and stakeholder groups) (Reed, 2008) through workshops (Idemudia, 2014), and by enabling all actors to communicate expectations and risks clearly, and at the local level, better understanding of the process can be expected among stakeholders (Pollard et al., 2004a). However, effective management of expectations requires that all stakeholder groups participate in this process, because this will ensure that stakeholder views are shared and that opportunities to clarify misunderstandings (e.g. values, language, culture) are made available.

4.4.3 Resolving capacity issues among stakeholders

Clean-up of contaminated land in the Niger Delta has been limited by the availability of technical capacity to conduct risk assessments and carry out management processes, and this has been linked to inadequate funding (UNEP, 2011). Accessing knowledge exchange and data sharing using the integrated framework can overcome capacity issues overcome without the need for additional funding. It could be expected that dedicated training programmes to implement the integrated risk assessment framework might also be used to enhance understanding of risk assessment and management amongst stakeholders. By increasing the communal knowledge about the complexity of

risk, we should observe an improvement in contaminated land management in the region.

4.4.4 Data harmonisation, sharing and use

Risk assessment quality is dependent on the input data used to populate it (Wilks et al., 2015). Using low quality data (e.g. incomplete, inaccurate) introduces uncertainty to the assessment that could be transferred or amplified elsewhere in the process. Subjective judgement can be used to supplement data and this approach benefits from many different perspectives. Based on this concept, the framework relies on stakeholder engagement to supplement existing knowledge and to verify data about land contamination decisions. Inputs from the local population might be used to identify exposure routes that might not be obvious to experts, for example, the uptake of contaminants via the soil by a local plant that is used for traditional medicine. Input from locals can help to characterise, define, and prioritise risks based on actual or observed impacts that might also have otherwise been overlooked. Relevant information that is generated can then be harmonised through the integrated approach via assessment according to the different elements of sustainability.

4.4.5 Considering socio-economic factors

Most conventional risk assessments provide outputs in terms of technical surrogates (e.g. a margin of safety) that might challenge stakeholders' comprehension (EC, 2013). By expressing risk assessment outputs in terms of socio-economic values, outputs become more meaningful to the individual and this should improve both engagement and understanding amongst different stakeholder groups (Wilks et al., 2015). Improved understanding at the local level could lead to better risk management of day-to-day concerns (e.g. consumption of contaminated drinking water, fishing in contaminated waters) thus preventing secondary and tertiary impacts of land contamination. In addition, social values might include a multitude of issues, e.g. ecosystem services, non-quantifiable natural resources, cultural and economic resources (Pegg and Zabbey, 2013). It

has been established that the inclusion of social values into a risk assessment process facilitates the achievement of societal expectations (Munns et al., 2003; Suter et al., 2003), and might lead to better risk communication and management (Burger, 2008).

4.5 Defining and incorporating sustainability into land contamination management decisions in Nigeria

The current contaminated land policy in Nigeria does not account for sustainability in a meaningful manner, nor does it take into account the socio-economic aspects of land contamination management (WCED, 1987; Orubu et al., 2004; UNEP, 2011). The study believes there is scope for joint actions between relevant stakeholders to address these gaps and we argue that an emphasis should be placed on the development of risk assessment, remediation, human health impact assessment, and regulatory frameworks. Ideally, these aspects would be included under a single, overarching framework, but to do so will require a new and comprehensive policy.

The study propose a pathway to integrate the principles of sustainability into the land contamination management decision-making process (Figure 4-2). The pathway comprises six steps that are intended to help decision makers at all levels to consistently structure and think through this process. The steps are as follows:

1. Identify sustainability indicators used to assess sustainability compliance. These indicators might include (but are not limited to) drinking water quality, fishing, human health, soil quality, groundwater condition, local food supply chain and income.

2. Organise indicators according to the main pillars of sustainability, i.e. environment, economic and social. If necessary, for each family of indicators (e.g. social), identify different sub-indicators (e.g. human health).

3. Determine each indicator's impact on the decision process using stakeholder input, e.g. regulators, experts, operators, and the public

(Krajnc and Glavic, 2005). Where necessary, identify sub-indicators. For example, drinking water is considered the most sensitive receptor to contamination in the Niger Delta suggesting that drinking water should receive a high impact rating (Nwidu et al., 2008).

4. Assign weights to the indicators based on local context using expert judgement and stakeholder engagement at local level (Kiker et al., 2005; Linkov et al., 2005; Burger, 2008; Mayes et al., 2009). Weights could be expressed in qualitative terms based on localities since the local population often share similar perception on the importance of indicators.

5. Rank indicator importance for the Nigerian context based on the assigned weights of impact, giving priority to indicators that own higher weights.

6. Apply the weights to the land contamination management decision-making process for Nigeria.

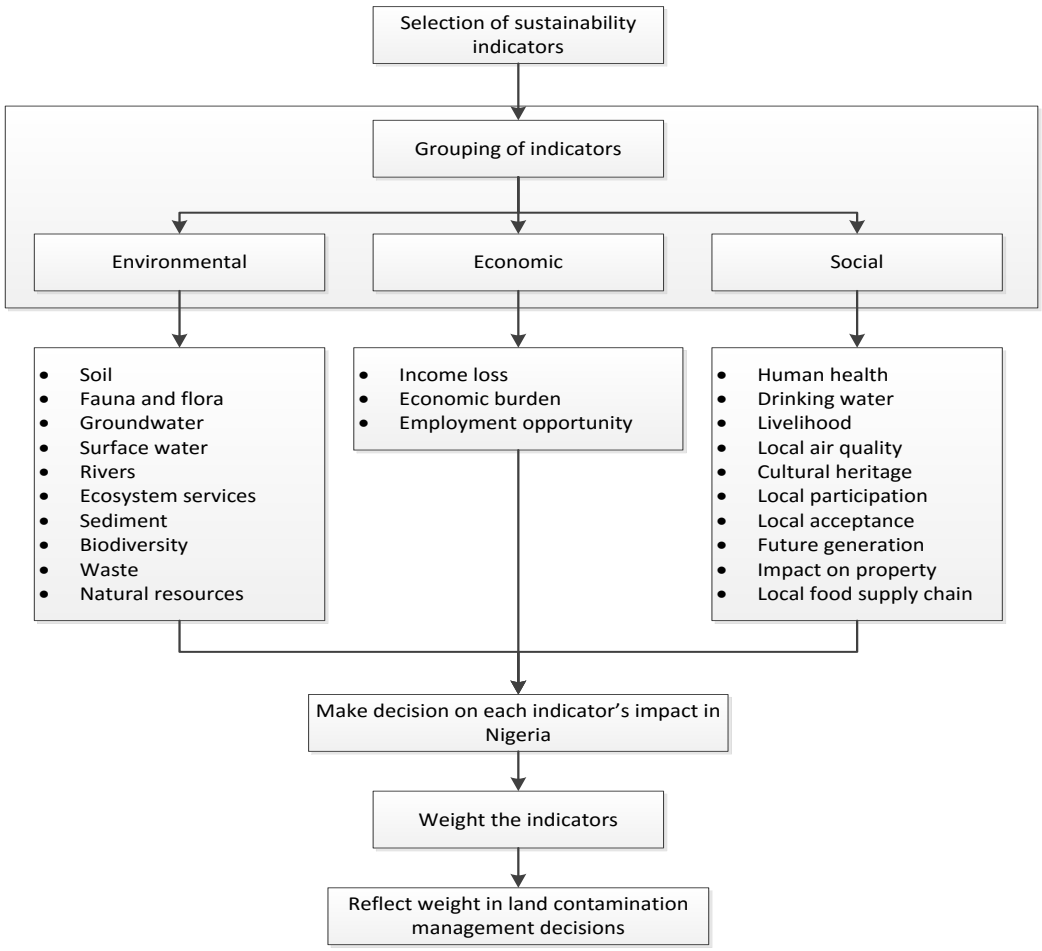

Figure 4-2: Proposed procedure for integrating sustainability in contaminated land management in Nigeria

4.6 Implementation of the integrated risk assessment framework

Time, resource, and technical capacity will be needed to implement an integrated risk assessment framework. In this section we identify a number of mechanisms that can be used to promote implementation, and these include building awareness, training, regulatory development, and gradual replacement of the existing contaminated land framework.

4.6.1 Create mechanism for awareness and training

Nigeria needs to raise awareness about the benefits of sustainable contaminated land management. This can be achieved through stakeholder engagement, seminars, and consultations at the local, state, and federal levels. The aim is to provide an opportunity for all stakeholders to have access to the framework and to contribute to the implementation process. This can be achieved via seminars, conferences and workshops, involving operators in the oil exploration industry, local communities impacted by oil spills, experts, and regulators of contaminated land. This type of engagement should also involve academics and scientists from different disciplines to explore other opportunities such as knowledge sharing presented by the framework. Effort should primarily focus on familiarising stakeholders with the concept, before shifting to integration into the existing regulatory regime.

Structured education and training programmes are required for all stakeholders to build capacity in the use of the framework. The multidisciplinary nature of the integrated risk assessment framework requires a dedicated and cross-functional training programme for risk assessors, local communities, regulators, and experts. Training programmes can improve levels of scientific knowledge among stakeholders and can be used to communicate understanding across institutional boundaries. Pragmatically, training might take the form of certification provided by professional bodies (e.g. Institute of Environmental Management &

Assessment (IEMA) in Nigeria) or workshops used to raise public awareness of the issues.

Case studies have been shown to provide convincing and pragmatic evidence to demonstrate how a framework like ours can advance the current practice (Vermeire et al., 2007; Wilks et al., 2015). This study recommends that real life proof-of-concept case studies be used to validate the process and to demonstrate the cost-benefits offered. Where necessary, guidance should be developed to provide stakeholders the consistent means to define standards, expectations, and goals.

4.6.2 Multidisciplinary input

Integrated assessments augment conventional scientific and technical risk assessment processes by using expertise from other disciplines. This type of participation can aid definition of, for example, spatial scenarios, and can be used to describe exposure of wider populations and protected areas. Increasing the number of stakeholders involved in the process does add to the complexity of the process, and this might lead to a difference of opinions about the nature of analysis. However, our process is intended to avoid disagreements by setting out the scope and level of involvement of stakeholders at the beginning of the framework (Wilks et al., 2015). Multidisciplinary input (e.g. chemists, agriculturalists, economists, hydrologists, toxicologists, ecologists, among others) will enhance the credibility of the process, expand the reach of the message, and should reduce inherent biases (Dreyer et al., 2010; Wilks et al., 2015).

4.6.3 Replacement of existing framework with integrated risk assessment framework

As familiarity and confidence in the framework grows, this study would expect a gradual replacement of the original risk assessment approach with our proposed integrated framework. This study might also expect that the inherent transparency associated with the proposed framework will build stakeholder trust, and thus promote further this gradual replacement. A regulatory guidance will

finally be required to formalise the acceptance and incorporation of the framework into the land contamination management regime in Nigeria.

4.6.4 Create knowledge exchange platforms

The US, Netherland, Australia, New Zealand and the UK have made significant progress to incorporate sustainable development into land contamination management, and this has been done through knowledge exchange platforms such as the Sustainable Remediation Forum (SuRF) (SuRF-UK, 2010; Bardos et al., 2011a, 2016). SuRF enables industry experts to exchange knowledge about sustainable remediation approaches, and this forum has advanced these concepts in the UK and European context (Hou et al., 2014). Nigeria would benefit from a similar platform, e.g. SuRF Nigeria, which would be used to introduce and facilitate the inclusion of sustainable ideas into land contamination management. Such a forum should be established at all levels of land contamination management governance in Nigeria including the federal, state and local council's levels.

4.6.5 Funding

The implementation of a land contamination management programme is capital intensive and a funding mechanism is needed to contribute to real on-the-ground actions. Currently no funding mechanism to support contaminated land risk assessment or remediation of identified sites exists (UNEP, 2011), and this lack of funding structure is likely responsible for the lack of publishable evidence regarding implementation of the 2011 United Nations recommendations (Könnet, 2014).

4.6.6 Access to contaminated land information

At a national level, Nigeria does not have a clear understanding of the extent of land contamination that requires assessment and remediation (UNEP, 2011). Data on estimates on the scale of land contamination is lacking, and this poses a considerable challenge to future clean-up. A central contaminated land database, developed in collaboration with local communities, is needed to help identify, monitor, and manage sites. Information contained within the database

might include location, volume and type of contamination, scale of contamination, identity of receptors, proximity to receptors, date of spill, and where applicable actions taken to mitigate contamination. Such a database would provide the evidence necessary to enable the prioritisation of actions, national reporting on the effectiveness of land contamination policy (e.g. assessing changes in the number and severity of contaminated sites), and the improvement of policy development (MfE, 2006). Currently, neither regulators nor operators are mandated to make contaminated land information publicly available and therefore, a first step towards development of a database is a regulation that makes reporting about land contamination an obligation and accessible to other practitioners.

4.7 Proposed roadmap for implementing the land contamination risk-based management framework for managing contaminated land in Nigeria

Implementation of an integrated risk assessment framework for land contamination in Nigeria will require concerted effort to generate agreements between stakeholders regarding the approaches used to incorporate the framework into regulatory practice. In the following sections we identify the short-, mid-, and long-term priorities that Nigerian government should endeavour to effect the proposed changes.

4.7.1 Short-term priority (within 4 years)

High priority within the shortest term includes:

- revise the current policy to include a definition for contaminated land and process for identifying a responsible person for land contamination;
- develop a funding mechanism to support land contamination management in Nigeria.

The rational here is that steps towards the management of land contamination should be based on a comprehensive legislation, and that implementation will require sufficient funding. We believe that these two elements should receive

urgent attention. Following this, a multi-stakeholder working group to guide implementation should be developed. The working group should coordinate and harmonise implementation strategies, for example, structuring approaches and timelines on how the framework can be merged into the existing regulatory structure. Real-life case studies should be used to demonstrate proof of concept and framework usefulness. Finally, the working group should detail a pathway for the creation of professional contaminated land management groups (e.g. SuRF Nigeria).

4.7.2 Mid-term priority (5 – 10 years)

In the medium term, guidance should be provided on the:

- specific roles and responsibilities of different stakeholders;
- mechanisms for integration of sustainability indicators in the decision-making process;
- development of a national information centre/database about the scale and status of contaminated land;
- development of contextual standards for the protection of human and ecological health in the Niger Delta (e.g. soil screening values). In the interim, practitioners should develop a policy guidance to support the development of site specific assessment criteria.
- Raise awareness of stakeholders on contaminated land to reduce the impact of cultural issues on effective land contamination management.

This study recommends that efforts be made to harmonise land contamination risk assessment practices (e.g. identify acceptable methods to establish and assess source-pathway-receptor linkages) across government and that this should be facilitated by the regulator at all government levels. In addition, increased consultations between stakeholders should be encouraged to promote public awareness, and education should be provided to all stakeholder groups about policy development and the impacts this might have on operations.

4.7.3 Long-term priority (11 - 15 years)

In the long-term, a comprehensive legislation that incorporates water and soil contamination management in Nigeria should be developed. Facilitated by the regulator responsible for the protection of human and environmental health, the new policy framework should clearly define what is contaminated land, and the roles of different regulatory agencies and of other stakeholder groups in sustainable land contamination management, as well as identify the need for planning controls, mechanisms for funding contaminated sites, and liability mechanisms. Plans should also be developed for training of personnel, provision of logistics, contaminated land clean-up, identifying and monitoring of spills, pipeline cracks and vandalism. Due to the extent of land contamination in the region, the development of such a framework is timely. Moreover, a framework that promotes stakeholders participation could be used as a reference for other countries in the region that face similar challenges related to oil exploitation (e.g. Ghana).

It is worth mentioning that due to time and resource constraints it was not possible to investigate further how the road map will be received by the regulators and the likelihood it could be implemented. However there was a general consensus during the workshop and interview, that it could take between 5 and 10 years depending on the political will of the government in power to implement a robust and holistic contaminated land management framework and policy in Nigeria.

4.8 Conclusion

The challenge of managing land contamination is not a new one. It has been recognised by governments internationally for at least thirty years and is closely associated, technically and legislatively, with the issues of waste and hazardous waste disposal, the regeneration of derelict land, groundwater pollution and industrial site decommissioning. While there is some evidence that the policies in Nigeria have had some effect, there is still considerable scope for strengthening the implementation of environmental policies and developing integrated risk-

based assessments for the management of land contamination. In order to increase effectiveness of the environmental regulations and to limit negative environmental and health impacts of rapid economic growth, the Nigeria authorities should consider the following:

- Development of more consistent, transparent, and integrative environmental laws;
- Increased levels of public participation in the regulatory process that can be facilitated through the integrated risk-based approach proposed in this paper;
- Strengthen the capacities of environmental administrations in Nigeria and align their responsibilities with appropriate levels of funding;
- Recommend an overarching guidance structure and establish an independent information bureau like CL:AIRE;
- Develop an appropriate compliance assurance strategy through awareness raising, capacity building, and incentives for better environmental behaviour;
- Increase international collaboration with professional organisations such as SuRF-UK, for the management and sustainable development of land contamination to gain access to a shared experience.

In sum, this paper proposed an integrated risk assessment framework for the management of contaminated land in Nigeria. The framework stressed the inclusion of stakeholder engagement and social values into the decision process and shows that adoption of this framework might enhance institutional trust, promote equity of decision making, and improve risk reporting activities across the region. This paper contributes towards the advancement of sustainable land contamination management practice in Nigeria, and could serve as an exemplar for other oil producing countries in the region.

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5 A multi-attribute methodology for contaminated land prioritisation in Niger Delta

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ABSTRACT: Selecting contaminated sites for remediation is a complex decision-making process especially as it concerns resources, stakeholder values and environmental conditions. As such, strategies for the defensible allocation of public fund require comprehensive, transparent and systematic framework by which high risk sites are identified and prioritised for urgent attention. Here, a multi-attribute prioritisation methodology for oil spill sites was used for selecting a set of attributes relevant to a specific area or region of the Niger Delta including site location, social sensitivities, surrounding communities, proximity to residential areas, rivers and farmlands. The methodology identified contaminated sites and took into account not only the chemical and ecological impacts but also the socio-economic factors such as livelihoods, which can both impede or complement efforts to remediate contaminated sites. Key findings revealed that among the 66 sites for which data was provided in the UNEP report on Ogoniland, 8 sites exceeded by more than 5 times the regulatory threshold for Total Petroleum Hydrocarbon (TPH) in soil, while 30 sites exceeded by more than 5 times the threshold for groundwater; impacting over 110 communities. As it is economically not feasible and sustainable to deal with all sites and there is huge technical and scientific uncertainty in addressing the scale of oil contamination in the Niger Delta, our proposed approach provides a more realistic and rationale approach for prioritising contaminated sites in the region. A successful implementation of the methodology will facilitate better informed decision-making when taking actions and allocating resources on identified impacted sites.

Keywords: Oil contaminated sites, Niger Delta, farmland, River, Niger Delta, Ogoniland, MCDA

5.1 Introduction

Hydrocarbon contaminated sites in the Niger Delta region of Nigeria are commonplace due to over five decades of oil exploitation activities (UNEP, 2011; Ite et al., 2013; Sam et al., 2015). Attempts to address the problem of hydrocarbon contamination has been constrained by a lack of expertise and capacity (Ajai, 2010; Eneh, 2011), weak regulatory agencies (Ambituuni et al., 2014; Sam et al., 2015), and poor legislative policies and management frameworks (Ajayi and Ikporukpo, 2005; Sam et al., 2016). Immediate attention to clean-up these sites is needed, however, like most nations Nigeria lacks the necessary funds to address all contaminated sites accordingly (Ambituuni et al., 2014; Sam et al., 2016). In order to tackle this problem, decision-makers must prioritise their clean-up activities to maximise the benefit derived from limited funds (Harold et al., 2014; Guo et al., 2016).

Site prioritisation is a complex task that must integrate information about a multitude of socio-economic and physical factors. Prioritisation frameworks are often founded on risk-based principles that assess the likelihood that a hazard will have an adverse impact on a receptor (DEFRA, 2011). By comparing and contrasting these risk scores, decision makers are able to determine priorities. Various countries employ risk-based approaches to prioritise their contaminated sites for remediation (e.g. the UK, Australia, Canada and the USA) (Nathanail et al., 2013; Pizzol et al., 2015, Stewart, 2015).

Problem definition is the first stage of a risk assessment and involves the setting of boundary conditions, the identification of potential receptors, and determination of a link between receptor and hazard (DEFRA, 2011). For contaminated land, a variety of potential receptors must be considered, including controlled water bodies, the public, or an agricultural product (Wcisło et al., 2016). A receptor's exposure to a contaminated site hazard (e.g. petroleum hydrocarbon) will be influenced by a number of factors such as ecology (Mayes et al., 2009), population density or proximity to a site (Alvarez-Guerra et al., 2009), or land use (Zabeo et al., 2011). The character of the hazard, in particular the contaminant levels and toxicity (Alvarez-Guerra et al., 2009: 2010), will also influence

exposure, as will soil characteristics such as organic fraction, porosity, and soil make-up (Carter et al., 2006; Brassington et al., 2007; Jiang et al., 2016). Decision makers must also consider broader socio-economic concerns, e.g. economic resources, social acceptance of remediation decisions, availability of expertise (Apitz and White, 2003; Alvarez-Guerra et al., 2009). Which elements to include in a prioritisation framework will depend on the needs of the decision-maker, but more importantly, will be influenced by the availability of data.

When considering multiple sites decision makers need to objectively assess and compare a variety of physical and socio-economic attributes in a single, unified framework. Multi-criteria decision analysis (MCDA) techniques (see Table 5-1) are a family of frameworks that are commonly used to evaluate decisions that comprise multiple attributes (Zabeo et al. 2011; Rosén et al. 2015; Thokala et al. 2015). In general, these techniques enable decision-makers to evaluate options through a process of ranking alternatives based on a set of defined attributes (Alvarez-Guerra et al. 2010; Pizzol et al. 2011; Lin et al. 2016). Beneficially, MCDA techniques can accommodate different types of data (e.g. qualitative and quantitative) (Rosén et al., 2015), which is useful when considering both the physical and socio-economic aspects of a decision (Linkov et al., 2009, 2015). MCDA techniques provide a structure for organising and integrating data, thus they are flexible and able to accommodate different types of data (Rosén et al., 2015). For example, Bello-Dambatta et al., (2009) used the analytic hierarchy process (AHP) technique to organise contaminated land data for prioritisation decisions; while Sorvari and Seppala (2010) adopted the multi-attribute value theory (MAVT) approach to structure data for risk management options decisions. Alvarez-Guerra et al. (2010) used MCDA to prioritise high risk sites with the aim of allocating limited resources. Impetus to prioritise sites in nearly all instances can be attributed to a need to allocate limited resources effectively (Semenzin et al., 2007; Stefanopoulos et al., 2014; Pizzol et al., 2015). For a summary of MCDA techniques applied to environmental management studies see Table 5-1.

Table 5-1: Application of MCDA techniques and the unique attributes considered to address complicated environmental decisions

Application area	Method	Attributes considered	Citation
Flood management	Spatial probabilistic multi-criteria decision making (SPMCDM)	Flood depth, velocity, cost and duration	Ahmadisharaf et al., (2016)
Sustainability of contaminated land remediation approaches	Sustainable Choice Of Remediation (SCORE) MCDA	Sediment, cultural heritage, social profitability, health and safety, local acceptance, environmental quality, groundwater, and flora and fauna	Rosén et al., (2015)
Soil function evaluation	MCDA	Non-recyclable waste, non-renewable natural resources, air, surface water and equity	Volchko et al., (2014)
Waste management	VIKOR + AHP	Recovery of raw materials, annual operation cost, employment, maintenance and emissions to environment	Vučijak et al., (2016)
Contaminated land management	AHP	Regulatory obligation, cost effectiveness, technical efficacy, societal considerations and wider environment	Bello-Dambatta et al., (2009)
Contaminated land management	MAVT	Risk reduction, ecological risks, groundwater quality, soil loss, emission to air and energy consumption	Sorvari and Seppala, (2010)
Ground water protection	MAVT	Groundwater, cost, realisation time, measure efficiency and income	Stefanopoulos et al., (2014)
Water protection	PROMETHEE	Investment cost, operating cost, risk to water resources, feasibility	Kuang et al., (2015)
Land Management	ELECTRE + GIS	Impacts, air quality, accessibility, noise, climate. landslide, view and technical works	Joerin and Musy, (2000)
Contaminated land management	MAUT	Flood control, wetland habitat, water supply, recreation, hydropower, interior drainage and groundwater	Prato, (2003)

MCDA requires data sets to support each identified attribute. If objective data is not available, subjective data can be used, but this introduces an element of uncertainty to the assessment (Hyde, 2006; Coelho et al., 2016). Data to characterise contaminated sites is often limited, particularly information that links the likelihood of harm to a receptor. One approach to address this data

shortcoming is to develop a proxy for likelihood, for example, by determining the proximity of a receptor to a hazard (Kingsley et al., 2015). To this end, geographic information systems (GIS) have been used to assess the distance between a hazard and a receptor to determine the likelihood that a receptor will be exposed to a hazard (definition of risk) (Zabeo et al. 2011; Pizzol et al. 2016).

5.2 Contaminated sites in the Niger Delta

The Niger Delta region is situated in southern Nigeria at the apex of the Gulf of Guinea. The region comprises nine States with a total land mass of 112,110 km^2 and a population of approximately 31 million people (NDDC, 2014; Figure 5-1). The population is highly reliant on the land and natural resources for their livelihoods, which includes subsistence farming and fishing (Chinweze et al., 2012). Settlements across the region largely consist of small and scattered hamlets. The Niger Delta region contains considerable oil reserves that have made the region the active hub for oil extraction and processing in Nigeria for the past 50 years (OPEC, 2015). Over this period, oil spills caused by engineering failure, oil theft, pipeline vandalism and natural factors have resulted in land contamination (Kadafa, 2012; Anejionu et al., 2015; Onojake et al., 2015), which in turn has impacted human health, groundwater, soil functionality, and ecological systems (UNEP 2011; Pegg and Zabbey 2013; Duke 2016; Obinaju and Martin 2016).

Clean-up costs in the region are estimated to range between US $500 million and US $1 billion, which will be used to treat sediments (watercourses, creeks and tributaries), groundwater (wells and aquifers), and soils (farmlands and residential areas) (UNEP, 2011). Although the current scale of land contamination in the region is difficult to quantify (Duke, 2016), over 2000 sites that require remediation were estimated to exist as of 2008 (Ite et al., 2013). In 2011, at the request of the Nigerian Government, the United Nations Environment Programme (UNEP) confirmed that over 200 locations in Ogoniland were contaminated (UNEP, 2011). Despite knowledge of contamination there is no evidence to date to indicate that clean-up has commenced in the region (Könnet, 2014).

For this study we use a multi-attribute value theory (MAVT) to prioritise contaminated sites in the Niger Delta region for the purpose of clean-up. MAVT is a useful method for this purpose because it aggregates attribute values into a single score, which supports a determination of a rank that benefits the decision-making process (Linkov et al., 2005).

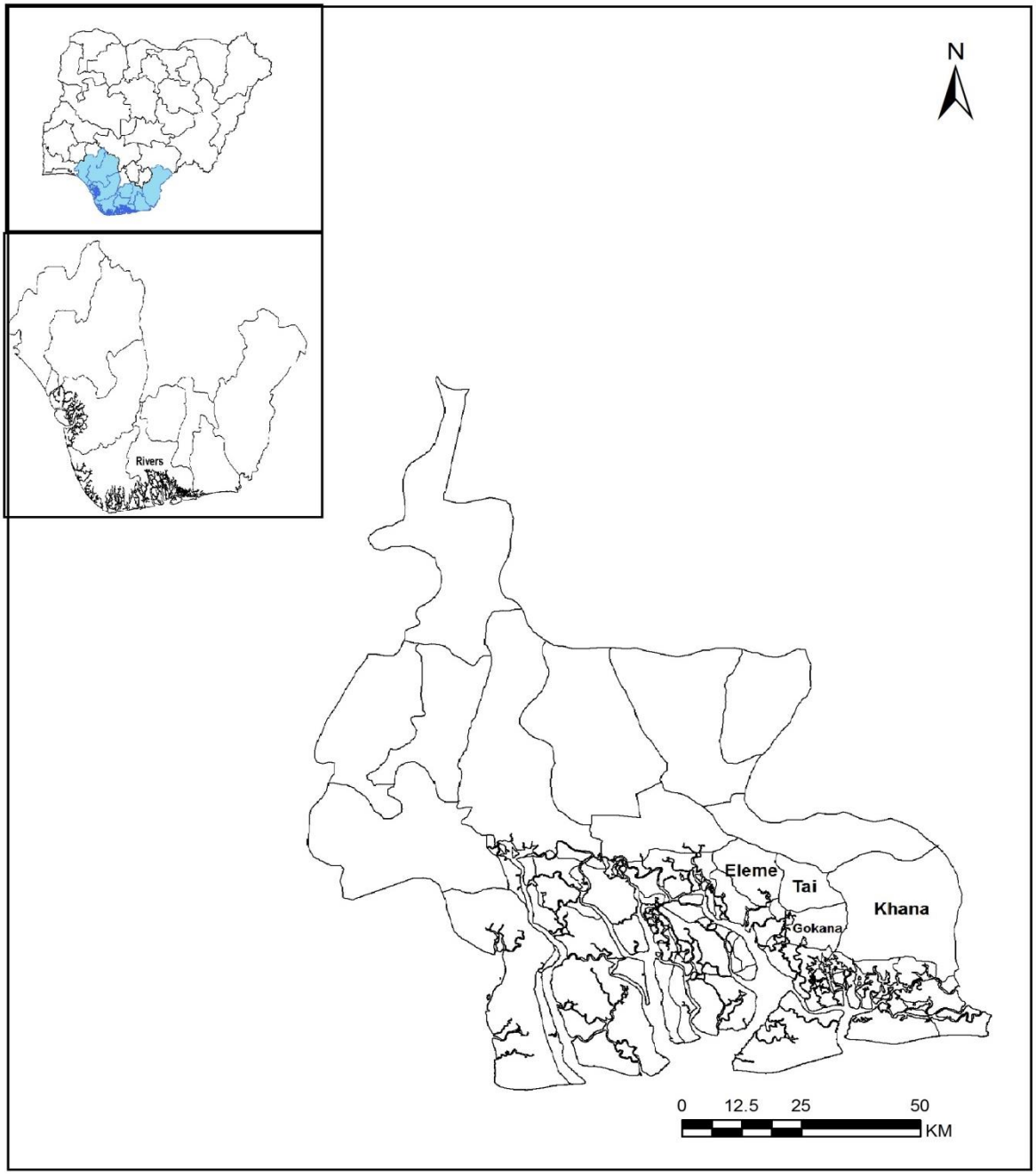

Figure 5-1: Local communities (study area) where investigated sites by UNEP are located within the Niger Delta region. Contaminated sites are located within the Rivers State and spread across the Khana, Gokana, Tai and Eleme local councils in Ogoniland.

5.3 Materials and Methods

A nine-step multi-attributes decision making technique was adopted for the study, as shown in Figure 5-2. The first step was to define the decision problem **(Step 1**). Soil and groundwater in Ogoniland are affected to different degrees by oil spills, and have different impacts on environmental and socio-economic values, associated with soil and water quality (e.g. drinking water, fishing and farming). To assess these impacts we used the UNEP published data (UNEP, 2011) that assessed oil contamination levels in soil and water at 200 locations in the Ogoniland, Niger Delta region (UNEP, 2011). Data included concentrations of total petroleum hydrocarbons (TPH) in soil and groundwater in 66 of the locations that were investigated by UNEP. The data included GIS information for each site location e.g. UTM Zone 32N 294542, 53224 (Ajeokpori-Akpajo), which was used to identify each site. In **Step 2**, risk was characterised. We characterised sites based on the level of contamination measured in soil and water. Sites were grouped according to their exceedance of Nigerian regulatory standards (Mayes et al., 2009), which were defined by the Environmental Guideline and Standards for Petroleum Industry in Nigeria (EGASPIN). Sites that exceeded regulatory thresholds were considered for prioritisation, those that did not were removed (Table 5-2). This was because under current Nigerian regulation, no action is needed where there is no exceedance of regulatory thresholds (DPR, 2002).

Table 5-2: Impact categories for soil and groundwater contamination and their scores

Impact category	TPH in Soil (5000 mg/kg)	TPH in Groundwater (600 µg/l)	Level of contamination
< EGASPIN level	< 5000 (25)*	<600 (12)*	Not contaminated
(1× - ≤ 2×)	1-10000 (27)*	1-1200 (3)*	Very low contamination
(2× - ≤ 3×)	10001-15000 (1)*	1201-1800 (2)*	Low contamination
(3× -≤ 4×)	15001-20000 (3)*	1801-2400 (1)*	Medium contamination
(4× - ≤5×)	20001-25000 (2)*	2401-3000 (2)*	High contamination
> 5×	> 25000 (8)*	>3000 (30)*	Very High contamination

*Numbers in bracket represent number of sites within each category for soil and groundwater contamination. Not contaminated indicates level of contamination does not exceed regulatory threshold; very low contamination indicates level of contamination is ×2 of the regulatory threshold; low contamination indicates ×3; medium contamination indicates ×4; high contamination indicates TPH concentration above ×5.

While MCDA inherently addressed issues of complexity and transparency (Linkov et al., 2005; 2009; Stefanopoulos et al., 2014), it uses a traditional top-down approach due to the level of expertise required to utilise the tool. MCDA uses an inclusive approach during the weighting of attributes to include stakeholder views as demonstrated by Alvarez-Guerra et al., (2009) and Mayes et al., (2009). An added benefit of this approach is that it helps decision makers to identify sites that could receive similar treatment interventions when deciding on remediation techniques (Alvarez-Guerra et al., 2009; Mayes et al., 2009).

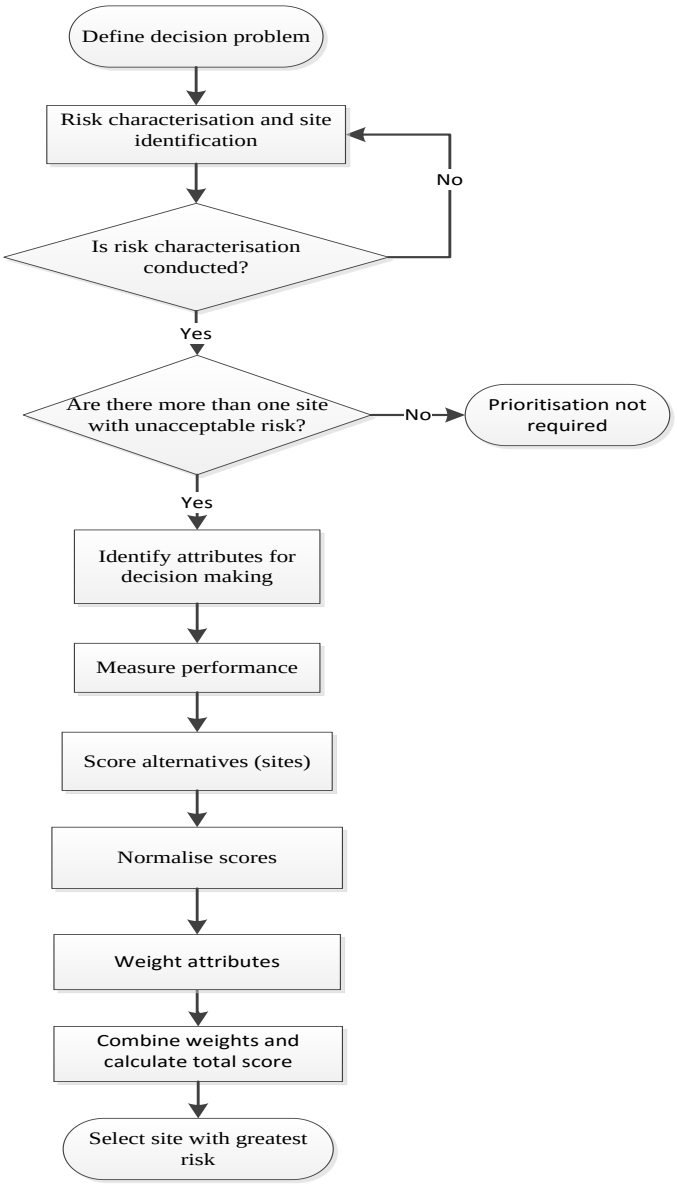

Figure 5-2: Steps taken to develop the MCDA framework

The next step was to identify the attributes to be used for site evaluation (**Step 3**). Attribute selection can be completed by reviewing previous decisions processes or by speaking with focus groups and stakeholders (Thokala et al., 2015). The study chose attributes that served two purposes: first, they presented common receptors shared by all sites in the region, and second, they represent core values as determined by stakeholder in the region. To determine the attributes we reviewed the literature and cross referenced our findings and conclusions with facilitated discussions held with stakeholders for a previous study (Sam et al., 2015). Attributes chosen included farmland, residential area, river, surrounding communities and contaminant level. Stakeholders identified these attributes as being factors that would influence their decision-making about contaminated land management issues (Sam et al., 2015).

For each attribute, the likelihood of exposure was determined. The proximity of a receptor (attribute) to a contaminated site was used as a surrogate for risk (likelihood of exposure). We based this approximation on the fact that the closer a receptor is to a contaminated site, the more likely that receptor is to be exposed to contamination and thus, is more vulnerable (Sorvari et al., 2006; Kuehn et al., 2007; Pizzol et al., 2016). For this approximation to hold valid, we assumed that the spread of contamination was held constant, regardless the type of media (e.g. soil, water, air). We view our approach as a pragmatic compromise given the availability of the data. Precedence for the use of proximity exists in the literature. Pizzol et al. (2016) used distance between regional centres and brownfields to demonstrate the likelihood of exposure of receptors to risk i.e. the longer the distance the lesser the likelihood and consequent risk to receptors. Suffo and Nebot (2016) used proximity to determine territorial risk on industrial sites to vulnerable receptors such as human health and the environment. Similarly, Kuehn et al. (2007) and Zabeo et al. (2011) used proximity to indicate the likelihood of exposure of human and environmental receptors to contaminated land risks.

Following the identification of attributes, this study scored each site based on contamination levels and proximity data (**Step 4**). Data to describe the maximum

concentration of contaminants was available for 66 sites (missing data for one site). A global positioning system (GPS) was used to collect the coordinates for receptors (residential areas, rivers and farmlands) near the contaminated sites similar to the approaches of Keisler and Sundell, (1997) and Sánchez-Lozano et al., (2013). Proximity data was determined by measuring the distance between a receptor and a contaminated site. This was done by inputting the provided contaminated site coordinates, and the estimated receptor coordinates into a GIS software (ArcGIS v. 10.3.1). From this information the distance between hazard and receptor was calculated.

Proximity data was next converted to a derived score (**Step 5**). By converting proximity data measured in metres into a single scale for all attributes we overcome the challenge of unit comparison (Mayes et al., 2009; Thokala et al., 2015) and normalise scores such that the same change along a scoring scale is equally preferred (Bello-Dambatta et al. 2009; Thokala et al. 2015). The scale used to score the attributes is shown in Table 5-3 and is similar to the approach used by Sorvari et al. (2006).

Table 5-3: Attributes scoring system and normalisation process

Distance (m) for farmland, river and residential area	Surrounding communities	TPH level	Consequence	Score	Normalised values
0-100	≥5	>25000	Very High	5	0.33
101-500	4	20001-25000	High	4	0.26
501-1000	3	15001-20000	Medium	3	0.20
1001-3000	2	10001-15000	Low	2	0.13
>3000	1	1-10000	Very Low	1	0.06

Very low = >3000 indicates farther distance between the receptor and the hazard and shows a minimal possibility of exposure; Low indicates a distance between 1001-3000; Medium = 501-1000; High = 101-500; and Very High = 0-100. The logic here is that the closer the receptor to the hazard the higher the likelihood of exposure.

Attribute values were normalised to provide a common numerical scale that would allow us to compare attributes (**Step 6**) (Bello-Dambatta et al., 2009; Pizzol et al., 2016; Zabeo et al., 2011).

Weights were assigned to each attribute (**Step 7**) and these were determined using data from previous stakeholder engagement studies (Sam et al., 2015) and focus group discussions from literature (Thokala et al., 2015). Our previous findings have shown that contaminated land stakeholders in the region placed the greatest value on farmlands, and this was due to the economic value that farming provided to the community, as well as its contribution to the local food chain (UNEP, 2011; Pegg and Zabbey, 2013; Fentiman and Zabbey, 2015). However, weightings are subjective and serves the need of the decision makers and thus are adjustable to suit contextual preferences (Adhikary et al., 2013). Based on the context of this study, the needs and values of the public, Table 5-4 constituted attributes considered for contaminated land prioritisation in the region. Table 5-4 indicates an example of attributes that could support contaminated land decisions in the region. Contaminant levels were determined to be as important as farmland. These weights reflect the values of the decision maker, and enabled the assessment of the performance of each attribute on an option (site) leading to the calculation of the total score.

Table 5-4: Attributes and weights

Attributes	Description	Weight
Farmland	Proximity of the nearest farmland to a contaminated site	4
Residential area	Proximity of contaminated site to the nearest residential area	2
River	Proximity of a contaminated site to the nearest of river	2
Contaminant level	The level of contamination on each site.	4
Surrounding communities	Number of communities surrounding a contaminated site	2

A total risk score was calculated for each option (i.e. sites) using Equation 1 (**Step 8**), which aggregated attribute scores to provide a final value for each site (Zabeo et al., 2011). Preference scores S for option *i* and attribute *j* are multiplied by the weight for each attribute *Wj*, for *n* attributes, and the overall score for each option, *Si,* is given by:

$$S_i = W_1 S_{i1} + W_2 S_{i2} + \cdots + W_n S_{in} = \sum_{j=1}^{n} W_1 S_{i1} \quad (1)$$

A final ranking of sites was constructed guided by the total score derived (**Step 9**) and this information was used to support the prioritisation exercise.

A sensitivity analysis was conducted to assess the effect that different attribute weightings might have on the final output. A stochastic approach was used whereby individual attributes weights were varied while the ratios between the weightings of the other attributes remained constant (Sorvari and Seppala, 2010; Brookes et al., 2014). Variability in weights involved reducing and increasing the original weight of attributes, however these weights were restricted between four (highest weight) and one (lowest weight), to provide a limit for the sensitivity analysis. The aim of this analysis was to identify crossover points where the rankings of the contaminated sites might change (Stefanopoulos et al., 2014).

5.4 Results and Discussion

5.4.1 Site characterisation

Essential to the prioritisation of contaminated site clean-up is a comprehensive site investigation and characterisation (Mayes et al., 2009) that provides detailed information about the level of impact contamination might have on a receptor (Stefanopoulos et al., 2014). Information about site characterisation in the Ogoniland region was provided in the UNEP report (2011) and included a description of sixty-six hydrocarbon contaminated sites (Table 5-5). However, a drawback was data limitation which was incomplete to determine the likelihood of risk to receptors. This is a reality for decision makers and thus requires pragmatic compromise to adopt approaches that supplement available data.

The data sample was heterogeneous, containing sites that contained contaminated soil, water, or both. Efforts were made to capture this variety through our categories that reflect both the breadth of site conditions and the breach conditions as explained in the EGASPIN (Table 5-5).

The findings show that 62% of the 66 sites (41 sites) were contaminated with TPH levels in soil in exceedance of the EGASPIN threshold of 5000 mg/kg. Among them 23% were contaminated with TPH levels that exceeded EGASPIN threshold by more than 5 times. Of the fifty sites reportedly having TPH contaminated groundwater, 76% exceeded the EGASPIN threshold and 60% of these sites exceeded the EGASPIN threshold by more than 5 times (Table 5-2). These sites are in close proximity to oil extraction locations which often include extensive seismic and oil drilling activities (Anejionu et al., 2015). In these regions frequent small spills can result from mechanical errors, engineering failures, artisanal wells and refining (Onojake et al., 2015), all of which can lead to larger spills. Because these sites are spread across the countryside, spills are likely to interact with and impact farmlands, residential areas, and waterways (Kadafa, 2012; Anejionu et al., 2015; Elum et al., 2016). Our findings show that all sites considered were situated within 0.08 km of either farmlands, residential areas or rivers. Nigeria does not have a threshold for distance between receptors and a contaminated site unlike other countries that have developed such thresholds. In the USA, the United States Environmental Protection Agency (USEPA) use distance to determine whether a receptor is at risk, e.g. any receptor within a distance of 61 m (200 ft.) of a contaminant is at risk (USEPA, 2016b).

Table 5-5: Location of 66 sites investigated by UNEP and their soil and groundwater contamination levels (*Numbers in bracket are used to differentiate the same sites with multiple samples; NA: not available)

Local council	Site Name	Soil TPH level (mg/kg)	Groundwater TPH level (µg/l)
Eleme	Ajeokpori-Akpajo	7570	1720
	Nsisioken-Agbi	7310	86100
	Omunwannwan-Sime	36900	133000
	Okuluebu-Ogale (001)	9220	3590
	Oboolo (003)	15300	25100
	Aluejor-Onne	442	10
	Nkeleoken-Alode	4220	16500
	Obaji Oken-Ogale	13200	NA
	Ogale	3740	NA
	Okenta-Alode (006)	11100	NA

Local council	Site Name	Soil TPH level (mg/kg)	Groundwater TPH level (µg/l)
	Okponandonwa-Alode	126	11600
	New Elelenwa M/F-Akpajo	629	9540
	Aleto	13400	NA
	Ebubu/Ejama/Agbeta	533	13200
	Ochanni-Ebubu	814	12
	Okenogban-Alode	2950	NA
	Okenta-Alode (007)	5810	NA
	Okenta-Alode (009)	7370	NA
	Nsioken Akpajo	3680	427
	Oboolo (002)	10400	1980
	Okuluebu-Ogale (002)	8580	2740
	Bera (002)	34500	32000
	Bera (001)	10400	116000
	Boobanabe-K.Dere (046)	NA	NA
	Boobanabe-K.Dere (012)	29600	588000
	Nweekol-Kegbara Dere	63800	3410
	Bera/Kpor	23200	NA
	Sivibiragbara-Bodo	1400	277000
	Kegbara Kpor	3480	10300
	Gbogozor-Bodo	331	NA
	Sibari-Gbe	1220	49
Gokana	Vuruvuru Dere	10500	NA
	Nweekol Dere	2640	NA
	Nweekol/Zorbuke K.Dere	7620	NA
	Barabeedom Dere (009)	43600	NA
	Barabeedom Dere (007)	14600	43900
	Saanako-Mogho	9990	109000
	Nweemuu Saanako-Mogho	389	4770
	Gior-K.Dere	52200	29600
	Peeteeh-K.Dere	28300	5650
	Debon-Bodo/Mogho	139000	172000
	Wiibusuu-Kpean	20400	288
	Wiiboora-Kpean	198	519
Khana	Wiieborsi-Kpean	8830	NA
	Wiikaragu-Kpean	157	2140
	Kwawa	8820	77000

Local council	Site Name	Soil TPH level (mg/kg)	Groundwater TPH level (µg/l)
	Wiikayako-Kpean	8200	358000
	Aabue Korokoro (001)	14200	769
	Bara-Alue	9200	1760
	Kporghor/Gbam (001)	6210	130000
	Kpite/Biara	34100	1140000
	Bara Akpor-Botem	12300	162000
	Muuborgbara-Kpite/Biara	23100	74700
	Buemene-Korokoro (003)	10800	22600
	Buemene-Korokoro (004)	4860	47
	Buemene-Korokoro (010)	6700	340
Tai	Aabue Ueken-Korokoro	1880	42800
	Guileeh-Korokoro	567	10
	Korokoro	4030	1180000
	Kpite (001)	9030	213000
	Kpite (002)	1040	10900
	Aabue Korokoro (007)	11200	NA
	Kporghor/Gbam (009)	5620	NA
	Baranyonwa Dere/Gio	39200	543
	Gbene-Ue Dor-Um	2930	26900
	Kebara-Kira	645	53

5.4.2 Attribute scoring for each site

This section presents the scores for each attribute (Table 5-6). Five attributes identified by decision makers and stakeholders in the Niger Delta context were considered. The selection of attributes was based on two factors: usefulness to stakeholders (e.g. farmland is a source of livelihood) and support for decision-making (e.g. contaminant levels are used to characterise contaminated sites). Attributes such as farmlands and rivers are common receptors of hydrocarbon spills and thus are used to assess the impacts of oil spills, besides their functions as primary source of livelihood for the local population in the region (Pegg and Zabbey, 2013; Elum et al., 2016).

The vast majority of settlements in the region are rural, and comprise dispersed village settings. These villages are characterised by network of oil infrastructures and installations (e.g. pipeline and oil well head) (Fentiman and Zabbey, 2015). Because of this integrated existence, the local population is particularly vulnerable to oil spills. Thus, nearness of residential area to spill sites increases the likelihood of threats and constitutes an attribute to be considered in contaminated land prioritisation decision-making. In connection with the residential area, the number of communities surrounding a contaminated site is very important in the decision-making process as this might amplify the risk to receptors (Vandermoere and Vanderstraeten, 2014). Surrounding communities near contaminated sites amplify the residential risk faced by the local population. For example, 100 people affected by a site is more important than 1 person. The number of communities and neighbours in close proximity to a contaminated site can potentially generate higher-order impacts and heighten the risk due to an increase in the number of plausible receptors that might be exposed to contaminants (Vandermoere and Vanderstraeten, 2014). The surrounding communities therefore contribute to the significance of the risk.

Contaminant level is a key attribute to be considered in the prioritisation of contaminated land. It helps to characterise the level of toxicity that could be suffered by human receptors should exposure occur (Semenzin et al., 2007b). Thus it provides a direction on the likely magnitude of toxicity each site could pose to human receptors depending on exposure.

The information provided in Table 5-6 can be used for decision makers' discussions on management options on the sites without explicit scoring and weighting. The proximity measure could be used to identify vulnerable receptors and immediate risk management options (Thokala et al., 2015). For example, decision makers might want to relocate the human receptors or contain contaminants based on the proximity information provided in Table 5-6 in efforts to break the pollutant linkage.

Table 5-6: Sites performance based on each attribute (* Numbers in bracket are used to differentiate the same sites with multiple samples)

Site Name	Surrounding Communities	Farmland (m)	Residential (m)	River (m)	Soil Contamination (mg/kg)
Kporghor/Gbam (009)	3	298.45	319.83	148.26	620
Okenta-Alode (007)	1	222.17	335.17	3784.05	810
Kporghor/Gbam (001)	2	2990.36	3158.76	2096.82	1210
Buemene-Korokoro (010)	2	541.24	399.64	720.32	1700
Nsisioken-Agbi	9	1245.11	1080.82	2516.23	2310
Okenta-Alode (009)	1	335.55	147.1	4001.66	2370
Ajeokpori-Akpajo	6	6523.93	6494.4	5235.07	2570
Nweekol/Zorbuke K.Dere	1	820.43	687.44	1373.35	2620
Wiikayako-Kpean	3	2460.17	2518.08	2889.25	3200
Okuluebu-Ogale (002)	3	675.42	375.31	236.15	3580
Kwawa	3	1898.04	1381.9	1522.92	3820
Wiieborsi-Kpean	3	555.31	752.85	616.86	3830
Kpite (001)	2	520.38	617.78	276.11	4030
Bara-Alue	2	796.99	978.91	1218.91	4200
Okuluebu-Ogale (001)	3	5270.09	5608.38	628.64	4220
Saanako-Mogho	4	395.05	321.57	116.38	4990
Oboolo (002)	2	259.66	171.41	1195.43	5400
Bera (001)	1	224.57	422.83	531.3	5400
Vuruvuru Dere	1	311.43	300.22	234.02	5500
Buemene-Korokoro (003)	4	518.07	839.17	3167.37	5800
Okenta-Alode (006)	2	319.7	274.56	1893.76	6100
Aabue Korokoro (007)	1	175.9	119.5	1165.23	6200
Bara Akpor-Botem	3	98.64	954.15	573.99	7300
Obaji Oken-Ogale	3	309.91	166.73	1315.74	8200
Aleto	2	177.73	156.09	135.16	8400
Aabue Korokoro (001)	3	80.31	667.66	3824.63	9200
Barabeedom Dere (007)	2	352.05	696.33	1915.9	9600
Oboolo (003)	2	3275.23	3061.97	3268.23	10300
Wiibusuu-Kpean	4	756.87	1078.56	213.1	15400
Muuborgbara-Kpite/Biara	2	3497.54	3288.7	2652.33	18100
Bera/Kpor	1	498.55	1150.69	2181.81	18200
Peeteeh-K.Dere	4	451.37	353.75	116.1	23300
Boobanabe-K.Dere (012)	2	400.06	277.24	198.3	24600

Site Name	Surrounding Communities	Farmland (m)	Residential (m)	River (m)	Soil Contamination (mg/kg)
Kpite/Biara	3	3985.3	3551.48	4453.25	29100
Bera (002)	1	3338.86	3610.65	1523.3	29500
Omunwannwan-Sime	2	3825.15	2614.29	5082.48	31900
Baranyonwa Dere/Gio	2	932.12	1218.23	848.88	34200
Barabeedom Dere (009)	3	329.47	1356.22	1746.82	38600
Gior-K.Dere	6	3489.43	3233.06	769.56	47200
Nweekol-Kegbara Dere	5	2038.22	832.93	2165.11	58800
Debon-Bodo/Mogho	1	1446.64	590.34	1035.3	134000

5.4.3 Ranking the sites using MCDA

Final scores for all assessed sites are presented in Table 5-7. The results show that certain areas suffer more from oil-related contamination than others. The top ranked site is Peeteeh K-Dere, which is located within the Gokana local council. This site covers 16.44 ha of land and is located less than 0.5 km from four communities (UNEP, 2011). Land use in this area is predominantly focused on agriculture, and a study by Fentiman and Zabbey (2015) has shown how soil contaminated with hydrocarbons has affected the ability of local communities to provide food and maintain agricultural production. These effects have extended to other economic activities in the region (e.g. fish ponds), which have reported declined production due to hydrocarbon contamination (Pegg and Zabbey, 2013; Fentiman and Zabbey, 2015). Unable to produce food, individuals have been forced to buy food for consumption (Elum et al., 2016), but without income from agriculture many locals struggle to obtain viable nutritional alternatives (Okoli and Orinya, 2013; Oyebamiji and Mba, 2013).

In general, the impact of oil spill on land use in the area could be linked to the location of oil extraction activities within the communities. For example, the Tai and Gokana councils own the highest concentration of contaminated sites in the region, as well as the highest number of oil wells and pipelines (e.g. Trans Niger crude oil pipeline) (Akinbami and Abiona, 2014; Onojake et al., 2015). Contamination in this region can be expected given that pipelines often leak, due

to corrosion (Ukpaka, 2013; Onojake et al., 2015) and fatigue due to aging (Lindén and Pålsson, 2013), often lack proper maintenance, or might be affected by and un-commissioned oil activities (Oyebamiji and Mba, 2013). For example, communities in Gokana local council are coastline and closer to the gulf with substantial oil extraction facilities making it vulnerable to spills (UNEP, 2011; Fentiman and Zabbey, 2015). While a few spills are likely due to pipeline sabotage (Ite et al., 2013), major causes of spills in the region relate to density of wells (e.g. wells often suffer small spills – many small spills lead to big spill) and blow-out (Okonkwo and Taylor, 2015), equipment failure, and un-commissioned facilities (UNEP, 2011). Equipment failure has been reported to be the root cause of 88% of spills due to material defect, lack of routine services and inadequate maintenance (Kadafa, 2012).

Data describing groundwater contamination in the region is presented in Table 5-2. Of the fifty sites identified for groundwater contamination 38% of these sites were classified as having very high levels of TPH contamination. It is estimated that over eighty communities extract drinking water from wells connected to this aquifer and are therefore at risk of exposure (UNEP, 2011). For example, seven of the thirty very high contaminated groundwater sites that exceeded the EGASPIN threshold of 600 µg/l by more than 5 times, are located in Eleme council. It is reported that drinking water wells and aquifers in some communities in Eleme council (e.g. Nsisioken) contains benzene levels 1000 times greater than the World Health Organisation (WHO) recommended standard of 10 µg/l (UNEP, 2011). This is attributed to high density of oil infrastructures in Eleme local, this includes pipeline network, refinery, petrochemical plant and oil wells. Lack of maintenance of these oil facilities (Ukpaka, 2013; Omodanisi et al., 2015), oil pipeline leakage into the aquifer (Abii and Nwosu, 2009), and incessant vandalisation and oil waste dumping has been linked to groundwater contamination in Eleme communities (Kadafa, 2012).

Inhabitants living in proximity of contaminated aquifers are recommended to obtain drinking water from elsewhere (UNEP, 2011). This activity might not be sustainable for all communities because of poor infrastructure (e.g. no access

roads) or limited economic resources (Oviasuyi and Uwadiae, 2010; Ebegbulem et al., 2013).

The goal of an MCDA framework is to use available data to provide a broad and systematic assessment of contaminated sites. Despite limited data, the MCDA approach adopted in this study prioritised contaminated sites such as Peeteeh K-Dere and Boobanabe-K.Dere (012) that pose highest risk to human health in the area. These prioritised sites are in agreement with those of other researchers, which identified a number of notoriously polluted sites in Ogoniland, e.g. Peeteeh-K.Dere and Boobanabe-K.Dere (Tanee and Albert, 2011; UNEP, 2011).

Table 5-7: Performance matrix showing attribute weighted score for each site (TPH in soil) (Numbers in bracket are used to differentiate the same sites with multiple samples)

Site Name	Surrounding communities	Farmland	Residential	River	Soil contamination	Total score
Peeteeh-K.Dere	0.52	1.04	0.52	0.52	1.04	3.64
Boobanabe-K.Dere (012)	0.26	1.04	0.52	0.52	1.04	3.38
Barabeedom Dere (009)	0.40	1.04	0.26	0.26	1.32	3.28
Nweekol-Kegbara Dere	0.66	0.52	0.40	0.26	1.32	3.16
Baranyonwa Dere/Gio	0.26	0.80	0.26	0.40	1.32	3.04
Wiibusuu-Kpean	0.52	0.80	0.26	0.52	0.80	2.90
Saanako-Mogho	0.52	1.04	0.52	0.52	0.24	2.84
Bara Akpor-Botem	0.40	1.32	0.40	0.40	0.24	2.76
Gior-K.Dere	0.66	0.24	0.12	0.40	1.32	2.74
Kporghor/Gbam (009)	0.40	1.04	0.52	0.52	0.24	2.72
Debon-Bodo/Mogho	0.12	0.52	0.40	0.26	1.32	2.62
Aleto	0.26	1.04	0.52	0.52	0.24	2.58
Okuluebu-Ogale (002)	0.40	0.80	0.52	0.52	0.24	2.48
Aabue Korokoro (001)	0.40	1.32	0.40	0.12	0.24	2.48
Bera/Kpor	0.12	1.04	0.26	0.26	0.80	2.48
Obaji Oken-Ogale	0.40	1.04	0.52	0.26	0.24	2.46
Vuruvuru Dere	0.12	1.04	0.52	0.52	0.24	2.44

Site Name	Surrounding communities	Farmland	Residential	River	Soil contamination	Total score
Oboolo (002)	0.26	1.04	0.52	0.26	0.24	2.32
Bera (001)	0.12	1.04	0.52	0.40	0.24	2.32
Okenta-Alode (006)	0.26	1.04	0.52	0.26	0.24	2.32
Wiieborsi-Kpean	0.40	0.80	0.40	0.40	0.24	2.24
Buemene-Korokoro (010)	0.26	0.80	0.52	0.40	0.24	2.22
Kpite (001)	0.26	0.80	0.40	0.52	0.24	2.22
Barabeedom Dere (007)	0.26	1.04	0.40	0.26	0.24	2.20
Kpite/Biara	0.40	0.24	0.12	0.12	1.32	2.20
Omunwannwan-Sime	0.26	0.24	0.26	0.12	1.32	2.20
Aabue Korokoro (007)	0.12	1.04	0.52	0.26	0.24	2.18
Buemene-Korokoro (003)	0.52	0.80	0.40	0.12	0.24	2.08
Bera (002)	0.12	0.24	0.12	0.26	1.32	2.06
Okenta-Alode (007)	0.12	1.04	0.52	0.12	0.24	2.04
Okenta-Alode (009)	0.12	1.04	0.52	0.12	0.24	2.04
Bara-Alue	0.26	0.80	0.40	0.26	0.24	1.96
Nsisioken-Agbi	0.66	0.52	0.26	0.26	0.24	1.94
Nweekol/Zorbuke K.Dere	0.12	0.80	0.40	0.26	0.24	1.82
Wiikayako-Kpean	0.40	0.52	0.26	0.26	0.24	1.68
Kwawa	0.40	0.52	0.26	0.26	0.24	1.68
Muuborgbara-Kpite/Biara	0.26	0.24	0.12	0.26	0.80	1.68

Site Name	Surrounding communities	Farmland	Residential	River	Soil contamination	Total score
Kporghor/Gbam (001)	0.26	0.52	0.12	0.26	0.24	1.40
Okuluebu-Ogale (001)	0.40	0.24	0.12	0.40	0.24	1.40
Ajeokpori-Akpajo	0.66	0.24	0.12	0.12	0.24	1.38
Oboolo (003)	0.26	0.24	0.12	0.12	0.52	1.26

While the study suggests that sites at the top of the list be given immediate attention given their possible impacts on receptors and social values, it is also important to note that the sites at the bottom of the prioritisation table are not less important as concentrations of some of these sites are well over 3 times greater than the EGASPIN regulatory threshold. This emphasis is necessary as such category of sites could be underestimated or misled decision makers due to the risk matrix used (Cox, 2008), thus those sites should be discussed and further investigated before final decision. We also recommend that further study should incorporate clean-up cost benefit to support the complex decision of site prioritisation.

Site investigation data for the area is now over five years old, and during this time it would be reasonable to expect that new contamination events have occurred. For sites that have not experienced additional contamination, it is reasonable to expect TPH levels to be reduced, due to natural attenuation or weathering processes (Brassington et al., 2007; Jiang et al., 2016). Sites investigations should be conducted routinely on a representative sample to validate conditions. This will avoid the costs associated with full-scale re-assessment of all contaminated sites.

5.4.4 Benefits of the prioritisation methodology

MCDA frameworks are effective and efficient at prioritising issues that lack data, require flexibility, and provides a transparent assessment (able to integrate stakeholder values).

Local stakeholders are in need of a transparent and objective approach to prioritising and dealing with contaminated sites (UNEP, 2011). The issue of where to begin contaminated site remediation has been described as a recipe for conflict in the region based on the limited fund voted for clean-up. The MAVT approach adopted in this study addresses issues related to biased selection of sites for clean-up by providing an approach that is dependent on sentiment and contaminant levels as conventionally practiced. Rather this study provides a risk-based approach to site prioritisation which identifies the site that poses the

highest risk to public health. This idea will be easily understood and accepted by stakeholders given that the parameters considered in the risk-based approach were informed by the stakeholders

This approach to contaminated land prioritisation can be applied to other types of contamination, such as the clean-up of artisanal gold mining sites in northern Nigeria (Zamfara state). Lead contamination associated with these sites has been linked to the death of over 400 children (Bello et al., 2016; Tirima et al., 2016). The decision environment about how to prioritise these sites for clean-up (assuming limited resources) will be highly emotive given the involvement of children (Alemayehu, 2015; Kim et al., 2015). In this example, our method can be adapted to prioritise the risk posed to children (e.g. proximity to schools, proximity to areas where children play) and in doing so; prioritised sties will reflect the value placed on children.

The proposed methodology is not meant to be rigid or prescriptive but flexible such that the steps can be adapted to the peculiarities of a case under study.

MAVT is intended to serve as a tool to help decision-makers reach an informed decision – in this context, prioritised identified contaminated sites for clean-up, not the tool's decision. The decision-makers therefore should deliberate on the most appropriate evidence, and which weight and score is most appropriate to derive an appropriate total score before the final decision. As a result, the MAVT should not be taken as the 'final decision' but rather be used to explore the uncertainty in the decision problem.

This MCDA approach is iterative – as new information becomes available, it can be incorporated into the framework. For example, acquisition of new contaminated soil data will help in either refining or updating the contamination categories.

5.4.5 Sensitivity analysis

Data included in MCDAs is subject to uncertainty, particularly data that involves subjective judgment (Hyde, 2006). In this study subjectivity was used to assign weightings to the attributes (Table 5-4). Therefore, we conducted a sensitivity

analysis to assess the effects that variable weightings might have on the ranking outcome. We limited the results of the sensitivity analysis to the top five ranked sites (Table 5-8).

Modifying the weightings of farmland, surrounding communities, residential area and river attributes changed the ranking outcome (Table 5-8). For the farmland attribute, reducing the weighting from 4 to 2 and 1 caused a crossover between the originally ranked second (Boobanabe-K.Dere 012) and fourth (Nweekol-Kegbara Dere) sites. This indicates that farmland has influence on the ranking of Boobanabe-K.Dere, which could be as a result of the vicinity of the site to farmland thus when the weight was reduced the priority of the site was reduced. A crossover was also observed when the weighting for surrounding communities was increased from 2 to 4, which resulted in the second (Boobanabe-K.Dere 012) and fourth (Nweekol-Kegbara Dere) ranked sites being changed (Table 5-8). This indicates surrounding communities has influence on the ranking of Nweekol-Kegbara Dere, such that the more weight given to the attribute, the higher the rank of the site. It was also observed that a change in the weight of river and residential area from 2 to 1 resulted in Boobeedom Dere 009 and Boobanabe-K.Dere 012 swapping ranks, which could be attributed to the nearness of Boobanabe-K.Dere 012 to these attributes. Thus, when the weight was reduced for the respective attributes, the priority also reduced.

Table 5-8: Sensitivity analysis illustrating changes in the ranking of the top five sites.

Attribute	Weight	Site ranking				
		1	2	3	4	5
Farmland	4	PKD	BKD	BBD	NKD	BDG
	3	PKD	BKD	BBD	NKD	BDG
	2	PKD	NKD	BKD	BBD	BDG
	1	PKD	NKD	BKD	BBD	BDG
Surrounding communities	4	PKD	NKD	BBD	BKD	BDG
	3	PKD	BKD	NKD	BBD	BDG
	2	PKD	BKD	BBD	NKD	BDG
	1	PKD	BKD	BBD	BDG	NKD
River	4	PKD	BKD	BBD	NKD	BDG
	3	PKD	BKD	BBD	NKD	BDG

	2	PKD	BKD	BBD	NKD	BDG
	1	PKD	BBD	BKD	NKD	BDG
Residential area	4	PKD	BKD	BBD	NKD	BDG
	3	PKD	BKD	BBD	NKD	BDG
	2	PKD	BKD	BBD	NKD	BDG
	1	PKD	BBD	BKD	NKD	BDG
Contaminant level	4	PKD	BKD	BBD	NKD	BDG
	3	PKD	BKD	BBD	NKD	BDG
	2	PKD	BKD	BBD	NKD	BDG
	1	PKD	BKD	BBD	NKD	BDG

Ranking key: PKD – Peeteeh-K.Dere (red); BKD – Boobanabe-K.Dere 012 (amber); BBD – Boobeedom Dere 009 (yellow); NKD – Nweekol-Kegbara Dere (light green); BDG – Baranyonwa Dere/Gio (Green). Broken lines represent weights used for decision making.

Based on the results in (Table 5-8), the sensitivity analysis shows that farmland, surrounding communities, and rivers and residential area (slightly) changed the ranking. The sensitivity analysis did not reveal a scenario whereby the highest priority site (Peeteeh-K. Dere), and the lowest priority site (Baranyonwa Dere/Gio) changed rankings. The lack of variability in the results suggests that our prioritisation method is robust, and that it will reflect subtle changes in how decision makers value (i.e. assign weights to) different attributes.

5.5 Conclusion

This is likely the first attempt to prioritise contaminated sites in Nigeria where data on oil contamination is highly limited. The proposed MCDA framework provides an objective and structured framework to prioritise contaminated sites in Ogoniland. The MCDA methodology takes into account the available geographic information which supports the comprehension and evaluation of the prioritisation results and their communication to stakeholders. The framework can strongly support the national and regional authorities in the prioritisation of impacted sites for remediation action. Furthermore, the methodology can help support decision-making on the allocation of resources (e.g. impact categories can used to determine allocation of economic resources for clean-up action). More importantly, uncertainty surrounding contaminated land management decisions

solely dependent on contaminant levels is overcome as receptors are made the main loci of decision-making. The framework is flexible such that it allows for additional data input at subsequent stages of the prioritisation process. This makes it adaptable to different regional contexts, allowing the decision maker to introduce regional relevant parameters and attributes relevant to the area studied and data availability.

Moreover, the MAVT approach embedded in the methodology allow for effective incorporation of expert judgement. This allows expert to provide weights and scores to attributes based on context, preference and expertise in the prioritisation of sites. One of the most important aspects of the proposed methodology, and also very relevant to decision making process, is the spatial feature, which is critical for regional prioritisation of contaminated sites. The GIS functionalities allowed for mapping and identification of different attributes in relation to point of contamination. To improve the quality of decision-making, remediation cost should be considered as an attribute in further prioritisation studies to help decision makers in the assessment of cost benefit analysis of remediation technologies.

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6 Summary of the key findings and implications of the work

This PhD research addressed a complex issue such as contaminated land management in Nigeria. The study primarily provided an overarching framework supported with procedures and guidance for managing oil contaminated sites in Nigeria. The multidisciplinary and integration nature of the overarching framework was needed for enhanced leadership and decision-making. This chapter provides an overview on how the different objectives contributed to achieve the aim of the study (Figure 6-1).

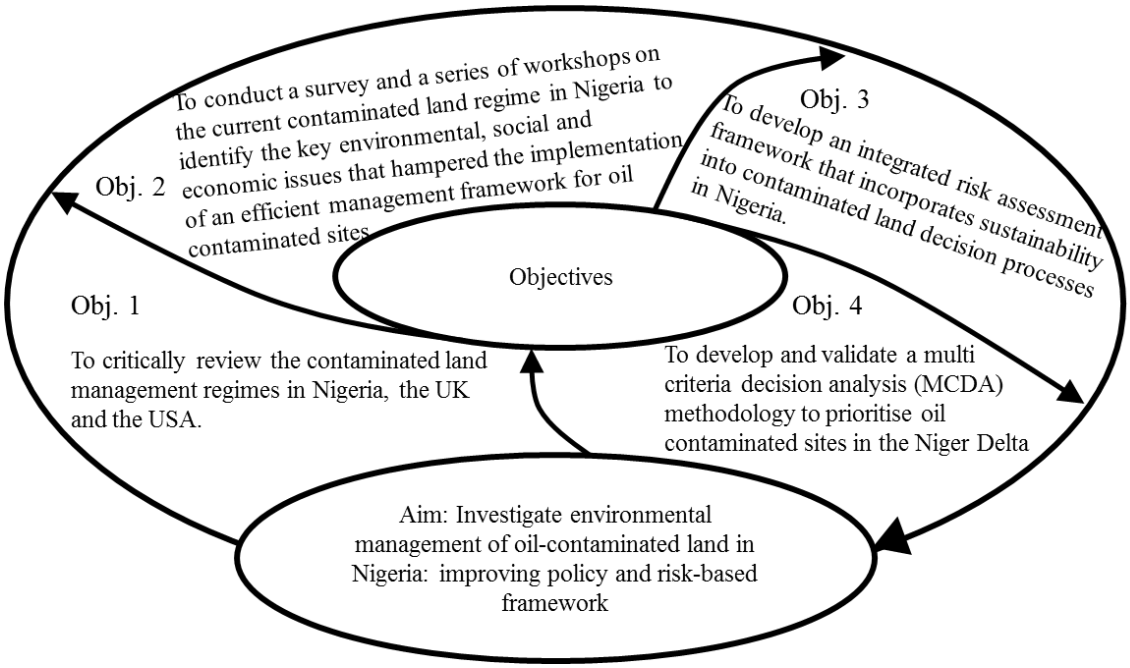

Figure 6-1: Schematic interrelations between the objectives and the aim of the study

6.1 Key findings and knowledge gaps filled by this research

Based on the UNEP report and other literatures on the Niger Delta region, this study highlighted the need for improved and integrated oil contaminated land management framework and policy in Nigeria (Chapter 1).

In Chapter 2, the study provided an exploratory investigation of the region to identify from the scientific and grey literature the status of land contamination.

Results indicated that Nigeria lacks the basic principles that constitute an effective oil contaminated land management policy (Rim-rukeh, 2015; Sam et al., 2015), which include effective statutory definition for contaminated land, a liability approach, a funding mechanism, sustainability appraisal, public awareness, soil screening standards and practical risk-based approaches. In addition, multiple regulatory agencies with conflicting interest have affected effective regulatory functions. The inability of the current regulation to address these identified gaps has hampered the ability of the regulators to address past spill sites and prevent new oil contamination. For example, the determination of whether or not a site constitutes contamination is dependent on the statutory definition for contaminated land which is currently lacking in Nigeria (Sam et al., 2015). Thus, the identification and determination of the number of oil-contaminated sites in the Niger Delta region continue to be a challenge. To address the highlighted issues, the study explored advanced contaminated land management regimes in Europe and North America. The UK and the USA contaminated land management frameworks, which both had several iterations and are now mature (CERCLA, 2002; DEFRA, 2012; Nathanail et al., 2013), were identified and critically reviewed to draw lessons and identify what could be transferred to Nigeria to improve Nigeria's current management framework. Specifically, Nigeria could benefit from an improved statutory definition of contaminated land, better regulatory coordination, adoption of pragmatic risk-based decision frameworks, improved determination of liability, a funding mechanism, and the integration of a sustainability assessment and development of contextual soil screening values. Efforts to develop and implement contaminated land management regulation in Nigeria has been slow (Könnet, 2014; Sam et al., 2015), yet despite Nigeria's urgent need for clear, coordinated and improved regulatory policy this study do not believe it should rush into the transfer of policy from elsewhere. This is because the success of a transferred policy will depend on how well Nigeria is able to contextualise policy to meet their unique socio-cultural, economic, environmental and political needs (Page, 2000; Benson, 2009; Evans, 2009). This Chapter provides the first comprehensive appraisal of what is needed in terms of frameworks, procedures and institutional structures to fill the existing

gaps and ensure effective and efficient oil contaminated land management in Nigeria. This is an improvement over previous works that identified funding challenges and weak enforcement, (Könnet, 2014), fragmented nature of available regulations (Ajayi and Ikporukpo, 2005), agency overlap (Ambituuni et al., 2014) and human and socio-economic impacts (Fentiman and Zabbey, 2015) without pragmatic recommendations. This Chapter significantly provides a template for improving weak and developing contaminated land regimes in other regions.

In Chapter 3, the study investigated the contextual issues, especially the socio-cultural, economic and environmental values that may affect the effectiveness of a transferred policy in Nigeria. This was facilitated through a stakeholders' engagement framework. The techniques adopted for the engagement included interviews and workshops and participants included regulators (N=8), community members (N=35), industry operators (N=7) and experts (N=6). Results indicated that the proposed stakeholder engagement framework developed during this PhD study supported inclusive information gathering from all stakeholder groups. The framework involves a three-stage approach – Plan/prepare, inform and consult, and engage. The framework and techniques (workshop and interview) adopted overcome issues related to persuasion, communication and comprehension, which were identified challenges with existing stakeholder engagement approaches in Nigeria (Idemudia, 2014). Using the framework, stakeholders were made to identify and prioritise socio-economic and environmental values that could influence contaminated land decisions in Nigeria. The top ranked values which included drinking water quality, soil quality, food and local supply chain, and human health/wellbeing are primarily basic needs thus raising questions about the appropriateness of policy transfer from countries such as the United Kingdom and the United States of America, in Nigeria. In these countries the basic needs of the local population (e.g. access to safe drinking), are largely met, thus their current contaminated land management frameworks are focused on long-term issues such as sustainability. The argument of this study is not to discredit or diminish the value of policy transfer as a mechanism for improving existing policy as proposed by and Dolowitz and Marsh, (1996, 2000) and Rose,

(2002), rather, it contributes to the policy transfer debate by highlighting the importance of understanding the context from which a policy was taken and to which it will be applied thereby improving on previous works in policy transfer (Luo et al., 2009; Brombal et al., 2015). The study therefore recommends that Nigeria should focus on the transfer of policy that meets their present needs and the study suggest a pathway for achieving this (Chapter 3, Table 3-6). This is relevant not only for Nigeria but other regimes contemplating policy transfer from advanced regimes.

Chapter 4 focused on the development of an integrated risk management framework to address the technical and societal expectations in the process of contaminated land management decisions. This was necessary as the existing framework oil contaminated land risk assessment and management failed to meet societal needs and expectation (UNEP, 2011; Sam et al., 2015). The proposed framework for integrated risk assessment proposed in this study included the conventional risk assessment process (i.e. problem formulation, hazard identification, exposure assessment, risk estimation and risk characterisation) and it specified the involvement of different stakeholders at the different stages of the decision-making process. It provides the local population and other stakeholder groups with the opportunity to participate and contribute in decision making during the characterisation of socio-economic and environmental impacts of oil spills which will encourage the inclusion of local knowledge in the final decision and thus a reflection of societal expectation (Sam et al., 2016). Such approach will pave the way for sustainable decisions about land contamination management because it provides a mechanism for the coordinated exchange of information, the sharing of assumptions and data between stakeholders, and the inclusion of local knowledge. For example, local communities can better characterise different pathways through which they might be exposed because of their local knowledge (Reed, 2008; Bardos et al., 2016). While advanced regimes have shifted focus to sustainable contaminated land management e.g. UK (Bardos et al., 2016) and USA (Hou et al., 2014), available studies in Nigeria have delved on the impacts of oil spill on receptors (Nwilo and Badejo, 2006; Umukoro, 2012; Pegg and Zabbey, 2013) and the inefficiency of

the regulatory agencies (Ambituuni et al., 2014; Könnet, 2014; Rim-rukeh, 2015), to the knowledge of the researcher, this is the first attempt to explore the significance of sustainable oil contaminated land management in Nigeria. By integrating different viewpoints from all stakeholders on environmental, economic and socio-cultural values into the generic risk assessment of contaminated land, the framework considers the principle of sustainability (Sam et al., 2016). This provision is intended to garner wider consultation and consideration, which should translate into trust, consensus building among stakeholder groups, and an improved and efficient assessment process (Garmendia and Stagl, 2010; Sardinha et al., 2013; Bardos et al., 2016).

Further to this, Chapter 4 proposed a way forward for incorporating sustainability into contaminated land management decision-making in Nigeria and provided a roadmap, as practiced in advanced regimes (Wilks et al., 2015), for addressing the gaps identified in Chapter 2. Specifically, in the short term (within a year), the study recommended that attention should be given to two activities which included a statutory definition for contaminated land and a funding mechanism for contaminated land to alleviate the suffering of the people. In the medium term (2-3 years), guidance on the roles and responsibilities of regulatory agencies, integration of sustainability, contaminated land information centre and standards for protection of human and environmental health were recommended. In the long term (5 years) the study recommended a comprehensive legislation on contaminated land management in Nigeria. This is new to Nigeria as to date there are no published framework for integrated risk assessment and management of contaminated land.

In Chapter 5, a multi criteria decision analysis framework was proposed to take into account conflicting attributes and conditions to be considered for prioritising oil contaminated sites. This was the first attempt to prioritise contaminated sites in Nigeria, however the approach adopted is similar to the works of Stefanopoulos et al., (2014), Zabeo et al., (2011) and Pizzol et al., (2016). The study selected attributes that covered the socio-economic and environmental values that are impacted by oil contaminated sites in the Niger Delta region identified by the

stakeholders and from literature in Chapter 3. Attributes including contaminant levels, surrounding communities and proximity of contaminated site to farmland, residential area, and rivers were weighted to reflect the importance placed on the attributes by the stakeholders. Results indicated that the MCDA framework provided a systematic approach to prioritise contaminated sites in the face of limited data. For example, the approach prioritised Peeteeh-K.Dere as the site that pose the highest risk to human receptors. This ranking agrees with other studies in the region which has identified this site as one of the notorious polluted site in Ogoniland (Tanee and Albert, 2011; UNEP, 2011). In the face of limited funds for management of oil contaminated sites in Nigeria (Könnet, 2014; UNEP, 2011) and the renewed desire by the Nigerian government to begin the remediation of UNEP investigated oil contaminated sites in Ogoniland (UNEP, 2016), the prioritisation framework proposed here is not only timely but provides a working tool for effective and efficient resource allocation to sites that pose highest risk to human receptors. The framework is flexible, thus, other regions can adjust the parameters based on context for prioritisation of complicated environmental problems e.g. drinking water aquifer, even in the face of limited data.

6.2 Research implications

The Niger Delta region has experienced extensive land contamination which has severely impacted local economy and destroyed regional livelihoods. Thus, this study is not only timely but significant at a period when Government is demonstrating interest in remediating land contamination in the Niger Delta particularly Ogoniland. This study provides insights into effective contaminated land management and will benefit all stakeholders as follows:

6.2.1 Government and regulators

This research points the Nigerian Government to areas where policy changes and opportunities for improvements exist in the current contaminated land

management regulation in Nigeria, e.g. statutory definition for contaminated land and development of standards for protection of human and environmental health. The study also provided a pathway for policy improvement in Nigeria – this is significant as it would consider the contextual social values in Nigeria to improve in the future.

The findings of this study will also help regulators and government to plan effectively towards targeted poverty reduction through provision of basic needs in the region. The stakeholder engagement framework for inclusive information collection from stakeholders will help government and other groups to involve everyone in contaminated land decision-making process. When engagement of all stakeholders is achieved, the process will rebuild consensus and trust of stakeholder groups in Government and provide opportunity for better decision making. Considering the present move by Government to start the remediation of contaminated sites in the Niger Delta region, the prioritisation framework will support the project in allocating limited resources to sites that pose highest risk to receptors.

Regionally and more widely, the engagement technique adapted in this study can be used to help developing countries involved in mining or oil exploration activities (e.g. Ghana and Chad) to overcome challenges associated with comprehension and communication of scientific jargons during stakeholder engagement. Additionally, social values identified in this study would help developing countries with similar contextual issues with Nigeria to develop strategies for preventing the Nigerian experience or adopt similar solution for addressing contaminated land impacts on social values.

6.2.2 Industry operators

This research will benefit operators in many ways. First, this study will help operators to plan effectively on how to engage local communities in meeting societal expectations. For example, corporate social responsibility should be

focused on provision of basic needs such as safe drinking water, and training in alternative livelihood to reduce poverty and hunger in the region. Second, conflicts between stakeholder groups that have led to decades of protest and distrust will be addressed through the inclusive engagement process.

6.2.3 Local communities

This research has the potential to empower the local community, provide an opportunity for them to contribute to decision-making and ultimately highlighting their ordeals to national and international audience. The study has developed a process that will ensure local authorities are involved in contaminated land management decision-making, express their views and influence final decisions. Finally, the study also indicated to the Government and other stakeholder groups areas to target help, awareness and education efforts in local communities.

6.2.4 Experts

This research potentially draws the attention of Government to the training and capacity building of experts in contaminated land management. This is significant compared to the works of Ambituuni et al., (2014) and Rim-rukeh, (2015) who identified the need to train regulators of contaminated land in Nigeria. This is because the quality of consultation provided by available experts would depend on the nature of their training and capacity (Sam et al., 2015; Wilks et al., 2015), thus it is essential to train all oil contaminated land practitioners. The study also defined the need for knowledge sharing with experienced and professional organisations and institutions abroad such as SuRF-UK and SuRF-Australia, which in the long-term could lead to the establishment of SuRF-Nigeria and provide a platform for sharing information and improved expertise (Bardos et al., 2016; Coulon et al., 2016).

6.3 Policy transfer audience

This study clearly highlighted that a stark importation of policy from one region to another could be impracticable as identified by the works of (Luo et al., 2009), and thus discouraged. This study builds on this fact by developing an approach to, and identifying the contextual issues that might affect policy transfer in Nigeria.

More significant is the development of a pathway for improving policy through policy transfer. This is very important to the policy transfer debate which has before now focused on abstraction or copying policy from region to another. For example, (Forton et al., 2012) recommended that Cameroon draw lessons including regulatory structure and technical approaches from UK, while Luo et al., (2009) and Brombal et al., (2015), proposed that China could utilise the policy transfer approach to improve existing contaminated land management. However, these studies did not investigate the implications of contextual differences between contexts involved. This study advanced the policy transfer debate by identifying the contextual issue within a developing country such as Nigeria that affect effective and efficient contaminated land management policy transfer from advanced or developed contaminated land regimes.

6.4 Limitations of the research

In the course of this study, the research encountered a number of challenges. First, attribute data to support the prioritisation methodology was limited. Second, insufficient funding affected a number of field trips and stakeholder engagement process that should have been held to provide inclusive inputs at different stages of this study. For example, weights for socio-economic attributes in the Nigerian context required inputs from stakeholders for robust decisions. In addition, the allotted time was practically insufficient for the breadth of issues the research intended to cover. These factors affected the scope of the research. However, the results generated were significant to make reasonable conclusions.

6.5 Further research recommendations

Considering the scope and the constraints of this research, it is imperative to recommend further work in the following areas:

- A comprehensive stakeholder engagement to provide sustainability indicators index is required. This engagement process should be used to develop a weighting scheme for different sustainability indicators based on local context. This would support land contamination management

decision-making and ensure stakeholder views are reflected in decision-making.

- The prioritisation methodology could benefit from the inclusion of more attributes provided data is available. Attributes such as cost of remediation would improve the prioritisation decisions.
- A baseline study of the Niger Delta ecology is required. This will inform contaminated land restoration or remediation projects in the region. It will also support the characterisation of species of fauna and flora that has gone into extinction.
- A methodology for developing fit-for-purpose land use standards for human and environmental protection in Nigeria is required.
- A spatial study of the extent of rural livelihood impacted by oil spills will support planning and allocation of resources.
- A quantification of the extent of oil-related land contamination in the oil producing communities of the Niger Delta is required.
- A quantification of how much of livelihood impacted by oil spill in different communities is required. This will enable the determination of communities suffering the most and inform Government planning and action.

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Appendix A Postcard explanation

The study reviewed the pertinent literature to identify examples of stakeholder values in the Niger Delta region particularly the United Nations Environment Programme (UNEP) report on Ogoniland (UNEP, 2011). This was aimed at providing specific social/stakeholder values relevant to different contaminated land stakeholder groups within the Niger Delta. To achieve this, first, literature search on Google, Google scholar and Science direct used key phrases including "values impacted by oil spills in the Nigeria" and "concerns from contaminated land in the Niger Delta". Following this, telephone interviews with stakeholders (e.g. contaminated land impacted community members, experts, regulator, and operators) were made to validate stakeholder values identified in literature. The validation process led to a selection of 13 different stakeholder values. Identified values provided a means to measure impacts of contaminated sites on livelihoods within the region and a medium to clearly define and characterise how contaminated sites have impacted the population. The 13 stakeholder values include drinking water, soil quality, communal crisis, and health/wellbeing. These postcards were presented to stakeholders during engagement for validation and prioritisation.

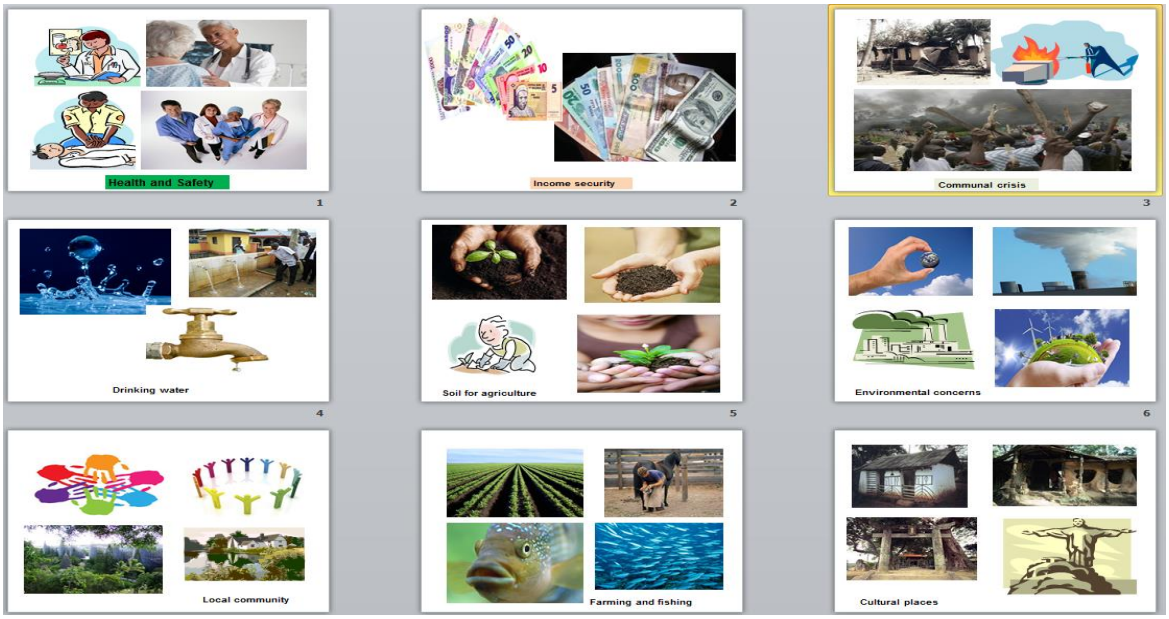

Figure A-1. Example of postcards used.

Appendix B Workshop protocol

A number of different research procedures and ethics that were conducted before and during the stakeholder engagement are presented here. This includes the consent letter, introduction letter and the questionnaire that was used to guide the semi-structured interview and workshops.

B.1 Participant consent

Participant number: _____

Date: _____

I, _____ (please print your name in block capitals) confirm that I agreed to participate in the *contaminated land management interview* which has been described to me as:

- *A survey of the likely contextual issues that drive contaminated land management and factors that could influence policy transference in Nigeria*

I understand that all personal information that I provide will be treated with the strictest confidence and I have been provided with a participant number to ensure that all raw data remains anonymous.

I understand that although the information I provide will be used by Cranfield University for research purposes, it will not be possible to identify any specific individual from the data reported as a result of this research.

I understand that the data collected will only be used for research purposes as part of the research thesis. The results will be written up as *a thesis/academic paper to* further understand that my raw data will be accessible only to the researcher and the supervising staff at Cranfield University. All data collected will be stored in accordance with the UK Data Protection Act (1998).

I understand that I am free to withdraw from this project at any stage during the session simply by informing a member of the research team, for whom contact details have been provided. I also understand that I can also withdraw my data for a period of up to 7 days from today, as after this time it will not be possible to identify my individual data from the aggregated results.

I confirm I have read and completely and fully understand the information provided on this form and therefore give my consent to taking part in this research.

B.2 Interview questions

Signature: _____Date: _____

Full name: _____Contact number: _____

Address: _____ Email address_____

_____

Understanding Oil Contaminated Land in Ogoniland, Nigeria.

Hi, my name is Kabari Sam and I am a research student at Cranfield University. Today I will be talking with you about oil contaminated land. The aim of this discussion is to learn from you the issues about oil contaminated land that you feel are most important.

As many of you will be aware, parts of Ogoniland are affected by oil contamination. My research seeks to understand the factors influencing oil contaminated land clean-up and to use this information to develop a support tool to prioritise clean-up activities.

Today I ask for your cooperation and honesty in participating in this fact-finding event. The day's events will consist of both interviews and group work. You will be asked to participate in a team and as an individual. I expect this process to take approximately one to two hours to complete. Your identity will remain anonymous and you can leave the event at any time.

Thank you for your assistance!

Kabari Sam
Researcher, Cranfield University
United Kingdom.

More about you

1. What is your sex?

Please, tick the appropriate answer.

- ☐ Female
- ☐ Male

2. What is your age?

Please, tick the appropriate answer.

- ☐ Under 18
- ☐ Between 18 and 25
- ☐ Between 26 and 39
- ☐ Between 40 and 59
- ☐ Over 60
- ☐ I do not wish to answer this question

3. Have you personal experience dealing or living with oil contaminated land?				
Not at All	A little	Moderate	Somewhat	Considerable

3a. Any other comments you wish to add about the experience?

What are the factors that you feel are important when discussing the issues about oil contaminated land.

1. For this exercise you will be placed into groups and asked to review a set of factors on picture cards. Your task is to pick those cards that most closely represent your concerns about oil contaminated land.

Question to think about while doing the exercise: Why did you choose these cards to represent your concerns about oil contaminated land?

2. For this exercise you are asked to prioritise your selections. Please place the cards in descending order of importance.

Question to think about while doing the exercise: Why did you choose this order of priority?

3. For this exercise you will share with the group your top three priority factors and the reasons why you chose them

4. The final exercise involves the entire group. Please imagine that you are the President of Nigeria and you are speaking to the people of Ogoniland. What will you say to the people of Ogoniland to assure them that oil contaminated land is being managed.

Part 2 - Factors that could influence policy transference

1. How would you rate your knowledge about contaminated land?				
Not at All	A little	Moderate	Somewhat	Considerable

2. Are you familiar with the Nigerian oil contaminated land regime?				
Not at all familiar	A little familiar	Moderate familiar	Somewhat familiar	Considerably familiar

3. Are you satisfied with Nigerian approach to contaminated land management?				
Not at all satisfied	A little satisfied	Moderately satisfied	Somewhat satisfied	Considerably satisfied

3a. Please explain why or why you are not satisfied.

Q4. Why do you feel we should manage contaminated land in Nigeria?

Q4a. How do you feel we should manage contaminated land?

Q5. What do you see as the key drivers for developing contaminated land management policies in Nigeria? (e.g. political, environmental economic, socio-cultural, legal)

Q5a. Why did you select these drivers?

Q5b. What do you think are the key drivers from the public's perception?

Q6a.How familiar are you with foreign contaminated land regulation?				
Not at All	A little	Moderate	Somewhat	Considerably

Q6b. Please identify the country or institution you are most familiar with.

Q6c. What elements of these policies might Nigeria want to adopt and why?

Q6d. Do you believe that policy transfer from a foreign country or institution will work in Nigeria?				
Not at All	A little	Moderate	Somewhat	Considerably

Q6e. Please explain why or why not.

Q6f. Do you foresee any barriers preventing policy transfer?. If so, what are they?

Q6g. Do you believe we can overcome those barriers? How can we overcome these barriers?

Thank you for your responses. All information that is collected from this survey is done so with complete anonymity. You are free to opt out of this interview at any point.

B.3 Study protocol

Title: Risk-based Management of Oil-related Contaminated Sites in Ogoniland, Nigeria

1. Project background

The contamination of soil, groundwater, ecological systems with petroleum hydrocarbons and the threats that they posed to human health and ecological systems is a major concern to the Ogoni people and Nigerians in general. Hence, there is need to address contaminated land issues by developing and implementing risk management frameworks to assess, prioritise and mitigate risk to human health and ecological systems. A pre-requisite for this the task is an understanding of the drivers that influence contaminated land management issues which should form the foundation of such frameworks. It is these drivers that this study intends to learn. Also, studies have shown that contaminated land legislative policies are yielding successful results in where they are well developed, United Kingdom and the United States of America for example. Such successful policies could be transferred into Nigeria to achieve successful contaminated land management however; there are contextual issues that could affect its effectiveness. The research intends to assess such factors that could affect transference.

2. Study objectives

The research intends to

- assess the drivers of contaminated land management in Ogoniland
- investigate the factors that could affect policy transference in Nigeria

3. Recruitment and Consent

a. Study population

Oil exploration industry, contaminated land/remediation experts, oil impacted communities; non-oil impacted communities, and contaminated land regulators

b. Specific Inclusion and Exclusion criteria

All participants will be over 18 years of age.
No other inclusion/exclusion criteria necessary as the questionnaire will take this into account.

c. Recruitment process

The research will adopt a workshop approach. Interviewees will be guided in groups to response to the questions. An introductory note will be attached, outlining the reason for the research. A verbal explanation of the rationale and the process of the interview will be given before the workshop/interview. The researcher (Kabari Sam) will guide the respondents with the use of pictures to the end of the process.

d. Consent process

Participants will provide their implied consent by completing the consent form which will be accompanied with an information sheet. The researcher will go through this with the respondents to ensure it is properly signed prior to the interview proper.

4. Study methodology

The researcher will go through the preliminaries (introduction and signing of consent forms) for the first 15 minutes. This will be followed by the workshop proper. First, pictures/posters will be distributed (faced down) to respondents. Having distributed to everyone, they will be asked to go through all the pictures for a few minutes, and then say what the pictures represent. They will then pick pictures that give them concern about contaminated sites, after which they will prioritise; picking top 3 out of the lots (this will inform the key drivers for contaminated land management). This will be followed by distribution of questions relating to political, socio-cultural cultural issues that could hinder policy transference. Again, pictures will be used for this stage. Respondents will pick pictures they feel can influence transference of lessons learned during literature review.

5. Data analysis

Responses will be transcribed and then fed into the Nvivo software. This will be able to weigh responses based on themes and provide interconnectivity between subthemes and key themes. It will also code the information to ensure anonymity of respondents. Weightings on key themes will be used to ascertain the responses on key themes. Analysis of responses on key themes will highlight key theories grounded in the data. This will inform the key features of a contaminated land framework in Nigeria and also provide the drivers for contaminated land management which ordinarily should inform the contaminated land management policy goal.

6. Dissemination of information

Responses will be anonymised and analysed, and form part of the final thesis document which will be submitted to Cranfield University. It will also be part of peer reviewed publications in a scientific format which is partly a requirement for the achievement of PhD.

7. Ethical issues arising

This study does involve the collection of any interviewees experience and thoughts, so confidentiality issues will be ensured. Information will be coded and anonymised. Participants will give their implied consent by completing the consent form. No additional harm should come to participants in this project as they will be interviewed in their local area or offices as the case may be.

8. Data protection issues

All data will be anonymised and stored on password protected computers or in locked cabinets for the duration of the research. Following completion of the research the data will be handed over to Dr George Prpich or Cranfield University, who will be responsible for data destruction.

B.4 Ethics approval

Appendix F: Guidance on submitting a Low Risk proposal

Science & Engineering Research Ethics Committee

Low Risk Project Submission Form

This form is to be completed by researchers seeking ethical review and approval of research projects involving human subjects and who consider their project to constitute a low risk to their participants. The form is designed to both collect information about your proposed research activities and screen for projects which might be high risk so please complete it carefully.

This form should be completed in full, saved, and emailed to serec@cranfield.ac.uk . If you are a student then your supervisor should review this form before you submit it. You should both provide electronic signatures at the foot of the form. Your submission will be reviewed by one or more members of the Science & Engineering Research Ethics Committee. You will receive an email confirming you can go ahead with the research if it is accepted as a low risk activity.

- SEREC aims to complete reviews of proposals within seven working days of submission.
- Submissions may be approved conditionally with feedback provided to ensure steps are taken to minimise risk to research participants.

Section A

Please provide the following information about your research:

Title of research project or activity	Risk-based management of Oil-related Contamination in Ogoniland, Nigeria.	
Name of researcher(s) conducting the fieldwork	Kabari Sam	
Email of researcher conducting the fieldwork	k.s.sam@cranfield.ac.uk	
Name and department of staff member responsible for the work (e.g. Principal Investigator / thesis supervisor)	Dr George Prpich and Dr Frederic Coulon	
Email of responsible staff member	g.prpich@cranfield.ac.uk	
Name of research client or sponsor	Niger Delta Development Commission	
Please indicate if the research is part of a:	Taught Masters	☐
	MSc by Research	☐
	MPhil	☐
	PhD	☑

	EngD	☐
	Research Contract	☐
If it is part of a taught Masters programme please give the title of the course		
Intended start date of fieldwork	July 21, 2014	
Intended end date of fieldwork	October 21, 2014	
Who are the intended research participants? (e.g. those who you will be surveying, observing, or speaking to)	Contaminated land experts, stakeholders and regulators	

Will the research client or sponsor be providing access to research participants?		
No	☑	
Yes	☐	If yes, please provide detail as to how you will ensure anonymity and confidentiality for your participants in the box below:

We need to fully understand what information/data is being collected from your participants. Please provide a short description (approximately 150 words) of your research aims, objectives and methodology in the box below.
The contamination of soil, groundwater, ecological systems with petroleum hydrocarbons and the threats that they posed to human health and ecological systems is a major concern to the Ogoni people and Nigerians in general. Hence, there is need to address contaminated land issues by developing and implementing risk management frameworks to assess, prioritise and mitigate risk to human health and ecological systems. A pre-requisite for this the task is an understanding of the drivers that influence contaminated land management issues which should form the foundation of such frameworks. It is these drivers that this study intends to learn. Also, studies have shown that contaminated land legislative policies are yielding successful results in where they are well developed, United Kingdom and the United States of America for example. Such successful policies could be transferred into Nigeria to achieve successful contaminated land management however; there are contextual issues that could affect its effectiveness. The research intends to assess such factors that could affect transference. If you are using questionnaires and/or interview schedules, please ensure that a copy is attached to your research proposal. You will also need to provide a copy of your participant consent form/statement.