



Working towards an integrated land contamination management framework for Nigeria

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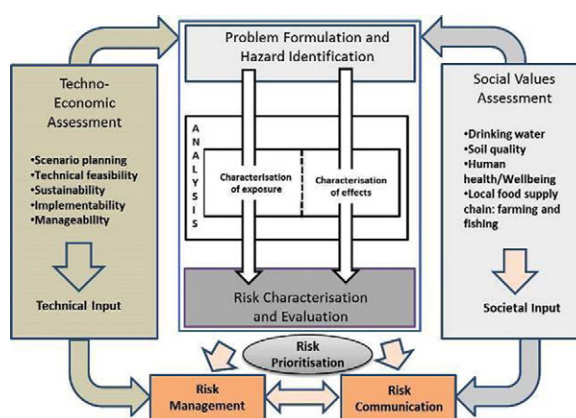
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HIGHLIGHTS

- Contaminated land management in Nigeria is *ad hoc*, lacks transparency and stakeholder input.
- Principles of sustainability and stakeholder engagement are integrated into the risk framework.
- Key challenges to framework implementation include funding, information sharing, and stakeholder engagement.

GRAPHICAL ABSTRACT



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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 exists elements of risk assessment and risk-based corrective action. Despite this progress, we argue 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.

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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 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 better integration and implementation of an environmental management strategy that reflects current science and societal expectations (UNEP, 2011; Ambituuni et al., 2014; Rim-rukeh, 2015); two elements that are considered vital to land contamination management in the region (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 an 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 (Sojину et al., 2010; UNEP, 2011; Adekola et al., 2015). 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, integration of contamination issues into land use planning, 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.

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 posed by a hazard (Defra, 2011; Prpich et al., 2015). Risk assessments are 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, and societal values 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. (Fig. 1).

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).

The quality of outputs derived from stakeholder engagement processes will depend on the nature and relevance of the approach taken (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 US technology (e.g. emails, text messaging, online surveys, and other forms of social media) is often used to inform stakeholder groups about the engagement process, venue location, and aims, as well as support facilitation of meetings and seminars, and question and answer sessions (Smith and Gallicano, 2015). In regions where these types of technologies are not as accessible, 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 by advocating for the use of direct and physical contact with stakeholders (Department of Environmental Affairs and Tourism, 2002; Department of Water Affairs, 2012; Obasi and Lekorwe, 2014). In Nigeria, stakeholder

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