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Clarion University of Pennsylvania, Clarion, Pennsylvania

ECOLOGICAL RESTORATION OF OIL SPILL SITES IN THE NIGER DELTA, NIGERIA

By

Tunde OT Imoobe & Tanshi Iroro

Department of Animal and Environmental Biology, University of Benin, West Africa.

ABSTRACT

The Niger Delta region of Nigeria, famous for its rich oil deposits, is one of the most productive ecosystems in the world. Paradoxically, since the discovery of oil in Nigeria in 1956, the country has suffered environmental degradation from oil spillage. Ecological restoration of oil spill sites involves passive restoration (natural attenuation and secondary succession) or interventionist restoration (clean up/removal of oil, bioremediation of the site, introduction of desired species, and ecosystem management). The paper reviews relevant literature and examines the process of ecological restoration in the Niger Delta. Although oil companies and regulatory officials suggest that some form of restoration, which usually involves planting seeds, is carried out in the mangroves, there are little documented materials of restoration activities on oil spill sites in the Niger Delta. The paper concludes that the legislations on the practice of restoration are shallow and need to be revised and that the practice of ecological restoration is needed in the devastated region, as it will go a long way in solving the fundamental socioeconomic problems of the region.

Key words: Ecological, Restoration, Oil, Spill, Niger Delta

INTRODUCTION

Nigeria is the largest oil producer in Africa and is now rated the tenth largest producer of crude oil in the world (ICG, 2006), averaging 2.7 million barrels per day (bbl/d) in 2006. Since the discovery of oil in Nigeria in 1956, the country has suffered environmental degradation from oil spillage. Nigeria's Niger Delta, has been identified as one of the world's most severely petroleum-impacted ecosystems (Annon, 2006). Oil spillage arises from routine, accidental, and illegal discharges into both terrestrial and aquatic environments. An estimated 9 to 13 million barrels (1.5 million tons) of oil has spilled in the Niger Delta ecosystem over the past 53 years, representing about 50 times the estimated volume spilled in the Exxon Valdez Oil Spill in Alaska in 1989 (Leschine,et al., 1993; Weiner et al., 1997).

The consequences of this have been enormous financial loss, extensive habitat degradation, and poverty leading to the continuous crises in the Niger Delta Area, that have recently culminated into kidnapping of oil workers, and even children.

Oil spillage occurs through leaking pipelines and storage tankers due to lack of regular maintenance. Some of these facilities have been in use for decades without replacement; fifty percent (50%) of oil spills are due to corrosion. Sabotage and piracy account for 28% of oil spills, oil production operations with 21%, and 1% of the spilled oil is due to inadequate or non-functional production equipment (Wikipedia, 2008).

Natural resources in need of restoration include forest habitats (mangroves, lowland rainforests, swamp forests, agricultural sites, and barrier island forests degraded by oil spill) where significant spills have occurred, marine ecosystems, and wildlife populations. Direct clean-up needs to occur on severely polluted sites, and a restoration program should include both direct and indirect initiatives. In order to sustain mangrove-dependent economies of rural coastal communities and to ensuring their food security and return peace and security to life and property in the region, there is the need to restore the mangrove forest and the coastal water bodies. This paper examines the various restoration practices in the Niger Delta, which aims at re-establishing the full function, structure, and ecological character of the region.

THE STUDY AREA

Nigeria has a coastline of approximately 853 kilometers facing the Atlantic Ocean and lying between latitude 4^o 10' to 6^o 20'N and longitude 2^o 45' to 8^o 35' E (Figure 1). The Niger Delta area is low lying, not more than 3.0 meters above sea level (Dublin- Green *et al*, 1999) and is a complex landscape of sensitive ecosystems which include; fresh water swamp forest, mangrove forest, brackish swamp forests, barrier island forest, and lowland rainforest (Ogbe, 2003). The zone experiences a tropical climate consisting of a rainy season (April to November) and a dry season (December to March), with an annual rainfall ranging between 1,500 and 4,000 mm (Kuruk, 2004). The mean monthly temperature varies between 24^o C and 32^o C throughout the year.

In the 70,000 square kilometres of the Niger Delta, it contains 7,400 square kilometres of mangroves, and is one of the 10 most important wetlands and marine ecosystems in the world. The region is famous for its rich oil deposits; the mangroves in the region offer ecological and socio-economic benefits to coastline inhabitants.

IMPACT OF OIL SPILLS IN THE ENVIRONMENT

The harmful effects of oil spills on the environment are many. Pelagic organisms are oftentimes worse hit by the effects of oil spills on the aquatic environment, as the oil poison algae and disrupt major food chains. Benthic (bottom-dwelling) organisms are also killed if stranded oil accumulate and sink to the bottom, with possible tainting of commercial species. The low oxygen that characterises mangrove ecosystems makes the oil that penetrates root systems to persist for long periods (NCF, 2003; IMO, 2005; ITOPF, 1985). Vegetation on cultivated land is also vulnerable to oil spills; many forests and agricultural land have been damaged. Common food crops like *Musa spp* (plantain) *Discorea spp* (yam), *Manihot esculenta* (cassava), and *Saccharum officinarum* (sugar cane) have been reported to be affected by oil spills (Daniel-Kalio and Braide, 2004). Of all the factors suppressing the mangroves of the Niger Delta, oil spillage constitutes the most potent threat, given its extensive and all inclusive defoliation and mortality effect on the mangrove communities.

Oil spilt into the environment results in a number of changes, which may include covering of valuable spawning ground by oil. The presence of oil in the water column of a stream channel alters the chemistry of that water body. Toxicity of oil components increases mortality and, thus, the decline in population of the affected species. Displacement of species, for example, intertidal organisms that are attached in rocky shores, can become dislodged as the oil slick makes the rock surface slippery (IMO, 2005). Pollution impacts heavily on the health of humans and their

socioeconomic status. Youth restiveness, hostage taking, and vandalization of oil facilities are now the other of the day. The current situation is very delicate, as the communities are bitter, angry, and distrust the oil companies and the Nigerian government. There is high unemployment (over 50% of youths) as fishing, which is the basic employment and income source, is being damaged.

ECOLOGICAL RESTORATION

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded or destroyed using the processes of remediation, reclamation, rehabilitation, and restoration (SER, 2004; Clewell and Aronson, 2007). Ecological restoration of oil spill sites involves passive restoration (natural attenuation and secondary succession) or interventionist restoration (clean up/removal of oil, bioremediation of the site, introduction of desired species, and ecosystem management).

Restoration ensures that sustainable economic development takes root especially in poor regions of the world, as well as for biodiversity preservation (Clewell and Aronson, 2007). Although a restoration project may affect different people in different ways, the people who are affected by it need to understand the reason for restoration and appreciate its value. Thus, the decision to restore should involve all parties and stakeholders, financiers and the public (especially the affected community), government and non-governmental organisations (NGOs).

PROCESS OF RESTORING AN OIL SPILL SITE

A site that has been damaged or destroyed by an oil spill calls for immediate restoration response and efforts. The decision to restore a site is made after the sensitivity index of the site has been determined. This sensitivity index will help to determine cleanup methods and possible remediation strategies. If any available cleanup methods will increase the impact on the site as determined by the sensitivity index, then “passive restoration” is advised as the best option. However, if the site is adjudged to need and be able to withstand available cleanup methods and subsequent restoration options, then the “interventionist approach” is employed.

It is important to note that the biological agents of restoration include plants, animals, and microorganisms. Plants function in a restoration project to aid the return of structure and some other functions, like substrate/soil stability (Clewell and Aronson, 2007; Kangas, 2004). Animals generally migrate to a site with favourable characteristics. However, certain key species or functional groups are necessary for the total restoration of a damaged ecosystem. Groups like the pollinators (insects and birds in most cases), dispersals and borrow animals aerate the soil, etc. Microorganisms are often

the invisible part of an ecosystem's structure. Key microbial groups, like the nitrogen fixers, are required and may be introduced; others may include Mychorrhizal fungi. Their role in nutrient recycling is invaluable to an ecosystems development and stability (SER, 2004; Clewell and Aronson, 2007).

RESTORATION ACTIVITIES IN THE NIGER DELTA

Regulatory framework, put in place by the Federal Environmental Protection Agency (FEPA, 1992) and the Department of Petroleum Resources (DPR) in Environmental Guidelines and Standards for the Petroleum Industry in Nigeria (EGASPIN, 2002), provides for the restoration of impacted sites in various sections of it's regulation; for instance, mention is made of the spiller being responsible to clean up the site and restore it to its original state. However, there is seemingly no comprehensive or defined pattern of restoration. The statements are vague and often end with "…it shall be restored to its original state". Inasmuch as restoration is to the previous state of the ecosystem, the return of ecosystem processes and function is often the intention of restoration. A statement that does not define the likely process of return, and whether a reference model is to be used or not, as well as the determination of prior states, is too vague to achieve what restoration attempts to achieve.

In an attempt to restore damaged mangroves, the following should be considered: hydrology, ecology, water quality, and soil characteristics. The present level of degradation in the region seems to agree with the general assumption that there are no restoration activities in the region. The need to restore the Niger Delta therefore cannot be overemphasized. However, reports of Shell Petroleum Development Company (SPDC, 2006), Chevron Nigeria Ltd., other oil companies, and regulatory officials suggest that some form of restoration, which usually involves planting seeds, is being carried out in the mangroves (NCF, 2003). Evidence on ground is not enough to enable one to deduce the level of restoration, while Chevron Nigeria Ltd., for instance, do physical replacement of destroyed material. The Shell Petroleum Development Company (SPDC) is involved in rehabilitation, which is not necessarily restoration but rather a replacement, of physical material without considering a reference model or ecosystem trajectory.

As a complimentary role to the efforts of oil companies to restore the degraded mangroves and damaged creeks, some NGO's are in the forefront of restoration in the region. They include: the National Conservation Foundation (NCF), the Centre for Environment, Human Rights, and Development (CEHRD), and the Niger Delta Conservation and Sustainable Development Project. The Niger Delta Conservation and Sustainable Development Project, an initiative of the John D. and

Catherine T. Mac-Arthur Foundation a project that was aimed at biodiversity conservation and sustainable development in the Niger Delta, choose three states (Bayelsa, Delta, and Rivers states) for the pilot phase of the project. The pilot project site of Delta state was located at Otonyesare, near Sapele, and it focused on the regeneration of a degraded forest (NCF, 2006).

The Conservation Programme, Centre for Environment, Human Rights, and Development (CEHRD), formerly the Niger Delta Project for Environment, Human Rights, and Development (NDPEHRD), in cooperation with the local people was involved in the restoration of a pilot plot at Kiele water front in Bodo, Ogoni, through fertilizer mediated biological recovery of the crude oil polluted swamp. It involved a preliminary phase of field treatment - i.e. stump removal, pre-treatment assessment of the physical and chemical conditions of the water and sediment, which was followed by soil tillage, fertilizer application, nursery preparation, planting, and post-planting evaluation (CEHRD, 2006).

CHALLENGES OF RESTORING THE NIGER DELTA

Despite the huge benefits of restoration and the promise it holds for ecosystem conservation and sustainable development, there are quite a number of challenges that militate against the effective restoration of oil spill sites in the region. These include:

1. Few and unspecific laws on restoration - the regulations that ensure restoration of oil spill sites are vague and seemingly not tailored towards the return of ecosystem processes and functionality. The key points, like trajectory and reference ecosystem, are not spelt out. This negligence is capitalised upon by the oil companies and any other spillers of oil, as restoration from the point of view of the regulations is merely a replacement of physical material (CEHRD, 2006).
2. Poor implementation of existing laws - a number of regulatory guidelines provide for the restoration of oil spill sites in the Niger Delta. However, these laws are not implemented and, thus, the desired results are not achieved.
3. Lack of regulatory agencies established specifically for restoration - the regulation and monitoring of restoration is left in the hands of agencies like the Department for Petroleum Resources. Such agencies are too large to be effective with the enforcement of restoration regulations, as well as monitoring of restoration projects.
4. Poor understanding of the benefits of restoration by local people who demand “access fees” - Kuruk (2004) reports that the host communities often demand fees before

remediation teams are allowed access into sites that require restoration. Thus, if such fees are not paid, a site that is marked for restoration is left unattended to.

5. Poor restoration mentality of oil industry - generally there is a poor restoration mentality among oil companies.
6. Political instability of the region.

RECOMMENDATIONS / CONCLUSION

The following recommendations are made to support the restoration of oil spill sites in the Niger Delta:

1. Specific laws on ecological restoration of oil spill sites should be developed - the practice of ecological restoration cannot be effective without laws to back it. The regulatory guidelines should be revised to include procedural guidelines and possible trends of the different ecosystem types that occur within the Nigerian landscape.
2. The practice of ecological restoration should be developed in Nigeria - this will require good expertise to achieve the recovery of damaged and degraded ecosystems. Thus, practitioners need to be encouraged by the Government, research institutions, and the general public. Ecological restoration needs to be recognised as a very important service in present day Nigeria. Funding should also be made available to aid restoration research projects, as the decision to restore translates into a long term commitment to land and funding.
3. There is the need for massive awareness on the importance of restoration projects and what they seek to achieve - the government, environmental action groups, and media should engage in campaigns to promote the understanding of the benefits of restoration in the Niger Delta.
4. Oil companies should develop restoration protocols - a general restoration mentality should be encouraged within the oil and gas industry to remedy the harmful effects of the oil spills.
5. Curbing the political instability of the region will greatly aid the practice of restoration, as the present state of things scare practitioners and environmental managers from the region.

The need to conserve and preserve the biodiversity of the Niger Delta region appears to be contradicting the need to exploit the resource that is the mainstay of the Nigerian economy. The degradation of the ecosystem creates an economic imbalance and subsequently unrest, which is the current state of the region. However, the successful restoration of other oil spill sites, particularly the

much publicised Exxon Valdez oil spill, is a pride to the practice of restoration and helps to establish that the exploitation of crude oil can be achieved in harmony with ecosystem protection.

Since the restoration of an ecosystem ensures the production of natural goods and services for local people, as well as a tool for providing functional ecosystems and solving socioeconomic problems, employing restoration in the Niger Delta will, therefore, be a way of solving a fundamental problem (socioeconomic unrest) which the region is now widely known for.

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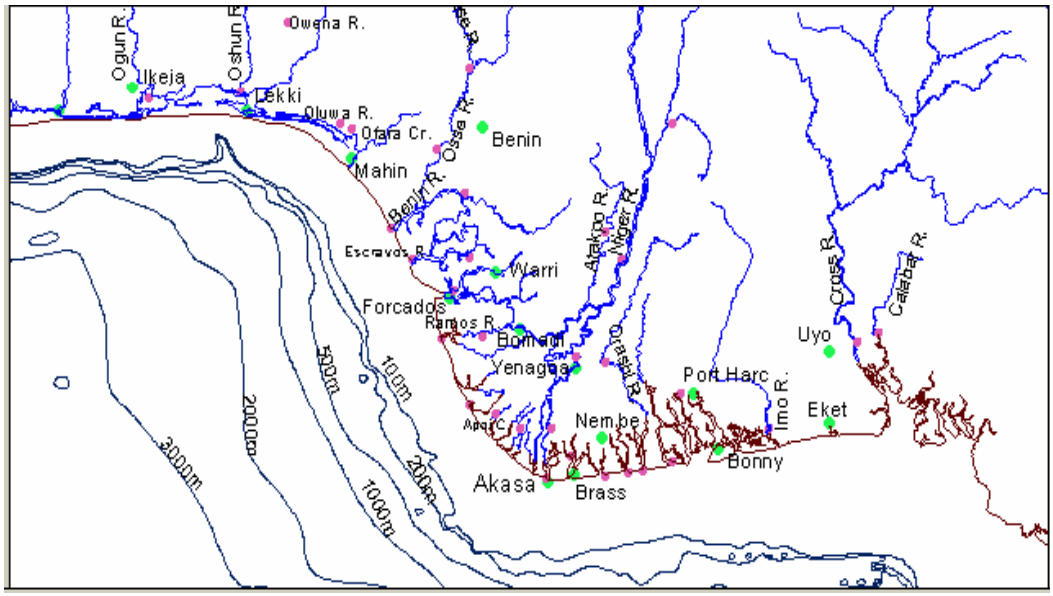
A



B

Figure 1: Map of Nigerian Coastal Areas

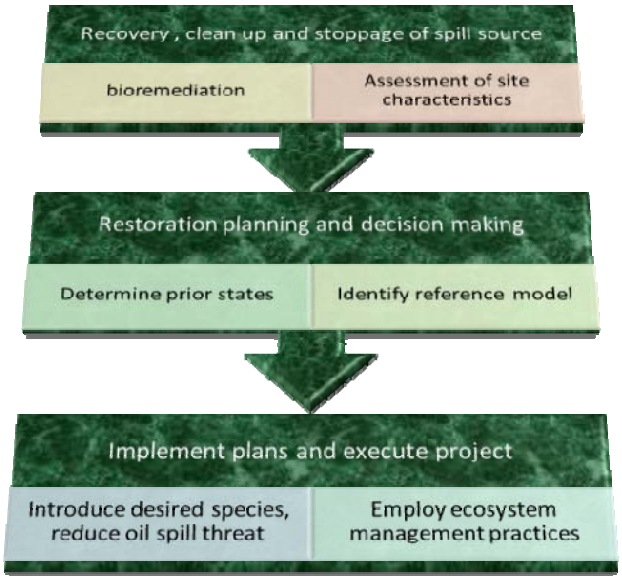


Figure 2: Interventionist Process of Restoring an Oil Spill Site