

# Employing naturally-occurring organisms to combat the Ijegun pipeline oil spill: A case study

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## ABSTRACT

A large-scale oil spill perpetrated by oil vandals affected the community of Ijegun, Nigeria in January, 2014. This oil spill caused significant contamination of the local water supply as well as devastation of crops and aquacultures. These detrimental effects have greatly impacted the lives of the people living in the Ijegun community. The devastation of the crops and aquacultures has limited the available food for the people of Ijegun. In an effort to mitigate these ruinous environmental effects, bioremediation is proposed as a viable solution. This process uses microorganisms to accelerate oil degradation. This process is projected to yield effective results, while helping to keep the resolution process within a limited budget. Bioremediation has shown positive results when used as a mediation effort in battling both land and water contaminants. Though it has been used in response to previous incidents, further field testing is required to determine the efficacy of new organisms in the specific case of Ijegun.

## LOCATION MAP



Figure 1: (left) Map detailing location of Nigeria on the African continent. Adopted from www.worldatlas.com. (center) Map detailing location of the city of Lagos within Nigeria. Adopted from www.bbc.co.uk. (right) Map detailing location of the province of Ijegun within Lagos. Adopted from Google Maps.

## CHALLENGES



Figure 2: The current state of oil contamination in Ijegun waters following the January, 2014 pipeline explosion. Adopted from Sweet Crude Reports.

Among the challenges that could hinder progress towards the goal of cleaning up this oil spill are the difficulty of gaining cooperation from the native residents, the underdeveloped transportation, and the translation barrier between workers and native inhabitants. Gaining cooperation from the residents of the area presents a potential challenge to the process because this is a region with an extensive history of conflict and gang activity. With such a violent past, it will be difficult to convince the people of Ijegun that this process of remediation will be beneficial to them and will not cause more violence in the area. This issue is compounded by the fact that the area has been greatly exploited for its oil, so the residents may be skeptical of whether the remediation efforts are truly well-intentioned. Second among the challenges to resolving this oil spill is how to maneuver the region. The roads in Ijegun are mostly unpaved, which limits the vehicles that can be used for transportation through the area. The unpaved roads also lead to heavy traffic, which makes travel times unreasonably long. A third possible challenge to cleaning up the Ijegun pipeline oil spill is the interaction with the native people of the area. The people of the area speak over 300 dialects, which will hinder the ability to relate to the community on a more personal level in order to gain their trust and support.

## PUBLIC HEALTH DATA

2015 Health Impact Review concerning oil transportation found that exposure to oil spills, crude oil, and oil byproducts causes:

- Mental Health Impacts
- Nausea
- Headaches
- Dizziness
- Eye Irritation
- Acute and Chronic Respiratory Symptoms

Risk of these health effects is compounded in low-income communities and communities of low-level education attainment.

## EFFORTS TO DATE

- Biological remediation efforts have been implemented along the Nigerian coast following similar oil spills.
  - This process uses the plant species of *Hibiscus cannabinus* and *Vetiveria zizaniodes* to combat the oil spill.
  - These plants are characterized by deep root systems that are able to absorb the spilled oil naturally and detoxify the soil.
  - This practice is effective, but has many drawbacks such as: long time commitment, growth limitations based on level of pollution, and required surveillance to ensure that humans and wildlife do not consume the contaminated vegetation.
- In Alaska, following the Exxon Valdez oil spill, slightly different methods were used in an effort to clean up the oil.
  - After this spill, dispersants, surfactants, and solvent solutions were implemented in an effort to biodegrade the oil.
  - However, the use of dispersants is not very efficient due to the fact that the chemicals disperse, rather than actually degrade the oil.
  - Due to the fact that dispersants are chemicals, rather than biological agents, they add slight toxicity to the already contaminated water.



Figure 3: A Nigerian worker collects a sample of contaminated water before introducing *Hibiscus cannabinus*. Adopted from Erik Larson, Bloomberg Business.



Figure 4: Workers pressure clean rocks in the intertidal zone following the Exxon Valdez oil spill. Adopted from Jim Brickett, "Clean-up of Exxon Valdez Oil Spill."

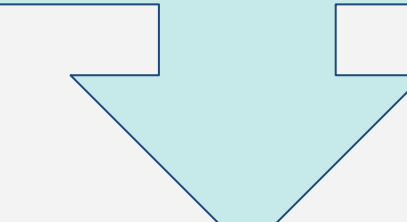
## EQUIPMENT LIST AND BUDGET

- Boom – containment barrier for oil (\$500) – This device will help to keep the oil from spreading further and contaminating more of the region's water supply.
- Skimmers – recover contaminated water and separate from oil (\$3,000) – Skimmers are used to filter the contaminated water in order to separate the oil from the water supply. This will help to clean the already contaminated water.
- Storage devices – store recovered liquids – These storage devices are necessary in order to securely store the recovered liquids from the skimmers for use in field testing and remediation techniques.
- Microorganisms – speed up the process of oil degradation (\$2,000) – These microorganisms will be able to break down the oil naturally, which is preferred to using more expensive technological equipment.
- Satellite imagery technology and GIS – locate and track spilled oil – This technology will be able to show where the spilled oil has spread and project its future patterns of movement.

## ULTIMATE GOALS WITHIN BUDGET

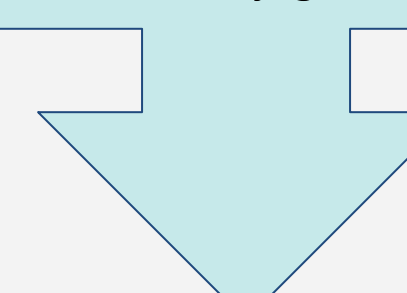
### RAISE AWARENESS

Our first goal is to raise awareness among the public so that it understands the risk associated with the spilled oil and contaminated water. We also aim to bring more attention to this incident to people outside of the Ijegun area, so that more people know about the damage of this spill and can contribute to the cleanup efforts and prevention efforts.



### PERFORM LAB TEST

We would also like to perform a field test using microorganisms to biodegrade the oil. We would like to perform tests on a contaminated Nigerian soil sample, using different species of microorganisms such as fungi, bacteria and archaea. Once we determine which species are the most effective at biodegrading the contaminants in our sample, we would like to implement the use of the microorganisms in the Ijegun cleanup efforts.



### ORGANIZE REGIONAL CLEANUP EFFORTS

Our final goal is to organize regional cleanup efforts. We believe oil companies in the area should contribute to this mission. We would also like to involve the community members themselves. Cleanup would involve implementation of biological agents used in the lab test.

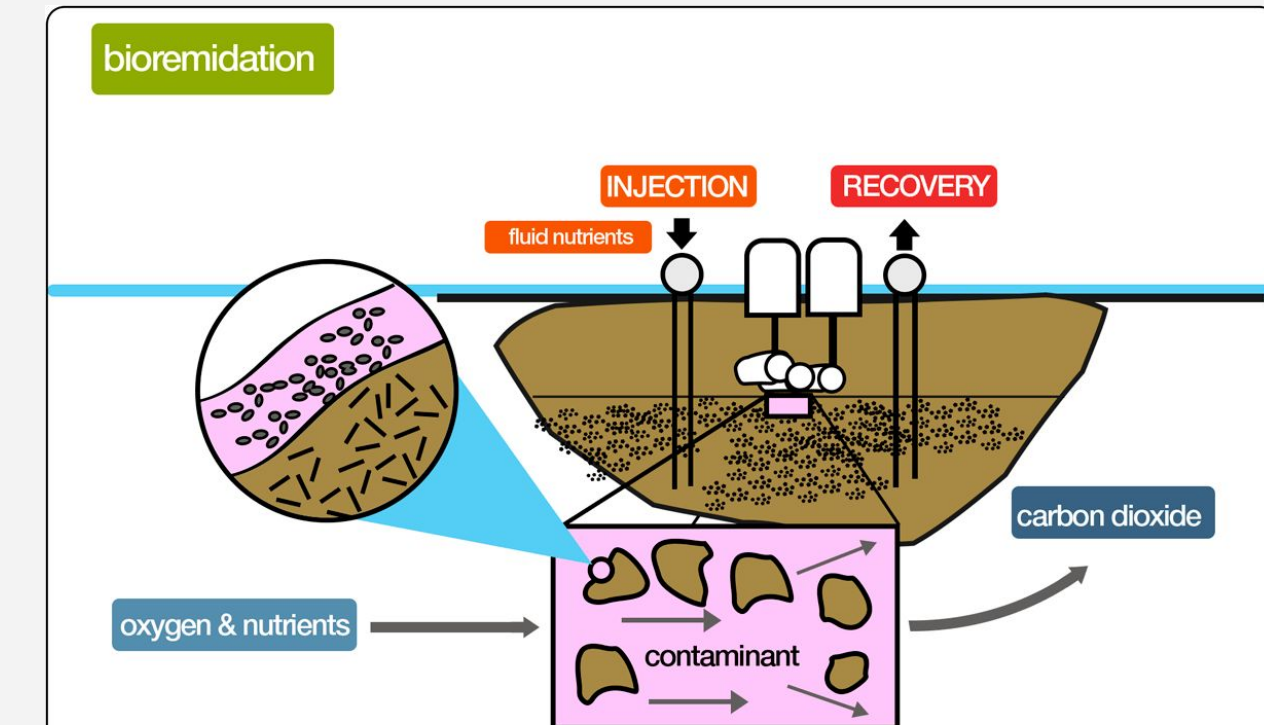


Figure 5: A demonstration of the bioremediation process. Bacteria already existing in the affected soil or water are stimulated by added nutrients. As their growth and activity increase, the contaminants are converted into carbon dioxide. Adopted from Kenneth Buddha Jeans, "Intrinsic Bioremediation."

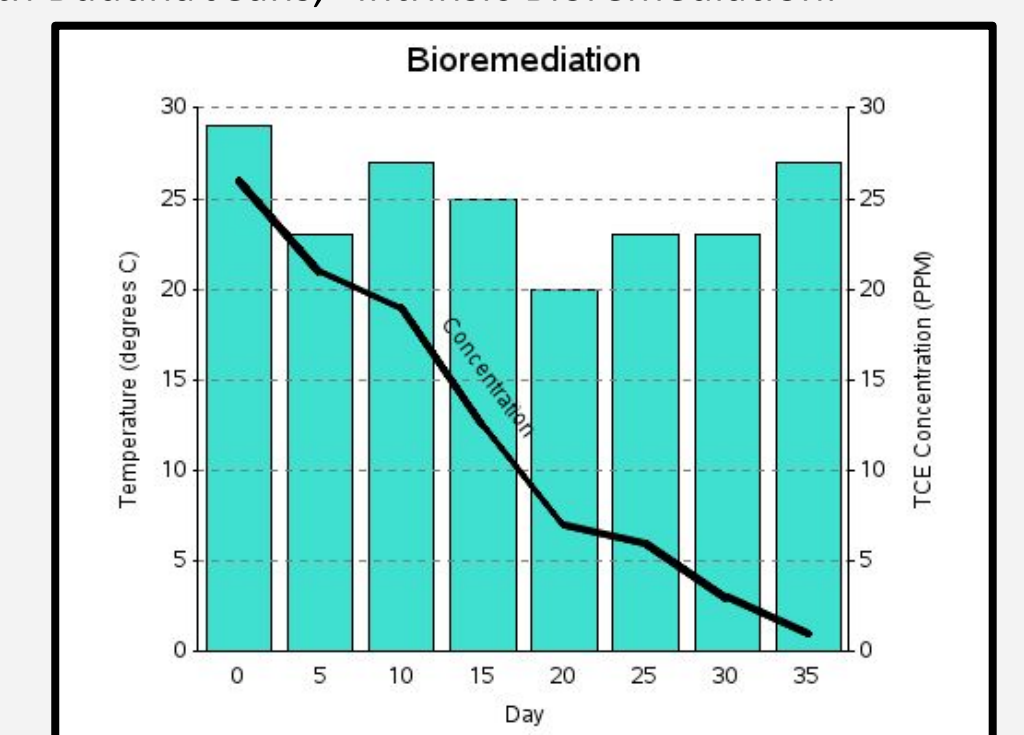


Figure 6: A sample graph indicating the effectiveness of the bioremediation process within a 35-day period. Adopted from Robert Allison, "Bioremediation."

## OPINIONS/RECOMMENDATIONS

- While complete resolution of this oil spill is not within our means, we do recommend a determined effort to raise awareness of the issue of this oil spill and others like it in the area.
- We would also like to enlighten the public of the parties responsible. We believe by raising awareness and identifying the people responsible, we will be able to lessen the likelihood of similar events happening in the future.
- We also recommend that oil companies in the region contribute to the remediation funds. Not only will this benefit the people of Ijegun, but it will also improve each company's image in the eye of the public.
- We also recommend performing field tests and lab studies of Nigerian soil samples using different types of microorganisms and eventually implement the use of bioremediation in regional cleanup efforts. This method of bioremediation is not only inexpensive, but also relatively fast, and releases no harmful toxins into the environment.
- Finally, we recommend increased regulations of oil production in the area. While this incident was caused by oil vandals, others are related to outdated pipes and equipment used to extract the oil.

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