Training Of Rural Conservationists To Carry Out Re-Vegetation Of Mangrove Forest In A Crude Oil Polluted Swamp, In Bara-Nwezor Village, Bodo-City, Ogoni, Rivers State, Nigeria.

A Detailed Narrative Report

By

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Submitted To:
Rufford Small Grant (RSG) for Nature Conservation, London, United Kingdom
&
Global Greengrants Fund (GGF) Boulder, United States of America (USA)
&
PADI Foundation, California, United States of America (USA)

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1. **Full Name of Organization**

Centre for Environment, Human Rights and Development (CEHRD)
(Formerly, **Niger Delta Project for Environment, Human Rights and Development (NDPEHRD))**
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2. **Title of the Project**

Training of Rural Conservationists to Carry out Re-vegetation of Mangrove Forest in a Crude Oil Polluted Swamp in Bara-Nwezor Village, Bodo-City, Ogoni, Rivers State, Nigeria.

3. **Project Committee**

The project team that executed and implemented the activities have experiences and backgrounds in the subject matter. Members of the committee are staff and some volunteers drawn from the project community. Members of the project team are:

i. **Patrick Naagbanton.** He is the coordinator of the organization. His work during project activities involves supervising and strengthening the project activities. His function is more of supervisory. He is a co-signatory to the project account. He is a full time staff of CEHRD.

ii. **Nenibarini Zabbey.** He is a professionally trained hydrobiologist and fisheries Biologist. He heads the Conservation Programme of CEHRD, which is responsible for the execution and implementation of the project. His role during project activities is that of coordinating the project activities. He animates the team and process. He was the trainer during the two-day participatory workshops.

iii. **Kentebe Ebiaridor** is the Project Financial Officer. His work during project implementation and execution was to supervise and advise the team on accounting and management of the project grants. He also keeps financial records of minor and major expenditures during project activities. He works as the team directed. He works on full time for the group.

Other members of the Project Committee from the Community called "Mangrove Restoration and Conservation Committee" (MRCC)
When the team "stormed" the project community, the project idea was widely advertised in the community. Those who became the project support group (MRCC) were those community members who passionately and

enthusiastically embraced the project from its early stage till the end. They are:

iv. **Nkurumah Kiele.** He is a fisherman. He is 45 years old. He acts as a guard to protect the demonstration/protected site from "trespass" by any person. His house is located closer to the site. He earns a small monthly salary for his services. He is a wise man indeed, but never had formal education.

v. **John Gbe.** A young man in his early 30s, he is the leader of MRCC in the community. A hard working, honest and passionate man. He also earns a small monthly allowance for his services during project duration. He is fairly educated.

vi. **Baribefe Bornu.** Is a community youth activist. During project he has the potential of being a great local conservationist if continually trained. He is fairly educated too.

vii. **Peter Nwinkiri.** He is also another community activist. He is a committed local conservationist too. He is a young school leaver.

viii. **Cyprian Tanen.** Fairly educated too, developed much interest in the project right from its inception. He was engaged for 6-months like other members of MRCC above.

4. Description of Project

i. Introduction:

To a coastal community, mangrove ecosystems are synonymous to what taxes are to a government. Mangroves offer ecological and socio-economic benefits to coastline inhabitants. Apart from being the first line of defense of the local people in terms of shoreline protection and flood control, mangroves also provide serene and shaded environment, which supports rich biodiversity (flora and fauna) upon which the livelihood of the people depends. Mangrove trees are logged locally as firewood, providing very cheap and accessible energy for cooking and drying of fish, to mention but a few uses.

The Niger Delta mangrove belt is adjudged the largest expanse in Africa and the fourth largest in the world. Presently, the mangroves of the Niger Delta are under growing anthropogenic induced stress. The threats range from oil and gas activities through pollution from coastal based industrial outfalls to the over-dependence of coastal communities on mangroves for domestic and economic uses etc.

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 spills occur regularly in the Niger Delta region of Nigeria where 80% of the country's crude oil is produced. Unfortunately, many of the oil spillages occur in the sheltered and sensitive

mangrove swamps of the delta. This is because a sizeable number of oil location, platform, flow-station etc are hosted in the mangrove swamps.

More so, tidal regime spread oil scum to distant areas beyond the spill site. Spreading of the crude exacerbates the extent of toxicity of the hydro-carbons.

Worst still, the action of Transnational Oil Corporations (TOC) does not help matters. TOC's consistently blame oil leakages in the delta on "sabotage" without having any recourse to their old pipelines, some of which have outlived their shelf-life.

Although "well-conceived" environmental laws exist in Nigeria, implementation is a little above zero. Capitalizing on negligence on the part of government to enforce laws and regulations to the letter, TOCs often times do not do oil spill cleanup, ecosystem restoration and payment of 'reasonable' compensation to affected communities. Granted, some contaminated environments are left in ruins, perhaps, tied to the monolithic fate of natural recovery. Recovery of devastated habitats through natural processes takes long time and the recovery may be disrupted by another form of devastating incidence.

In order to sustain mangrove dependent economies of rural coastal communities and to ensuring their food security, there is the need to teach rural people the technique of mangrove forest rehabilitation and reforestation by simple and cost effective means.
This report discusses the intervention project of the **Centre for Environment, Human Rights and Development (CEHRD)** (formerly Niger Delta Project for Environment, Human Rights and Development NDPEHRD) in the above regards. It specifically highlights the processes preceding the establishment of a pilot plot at Kiele water front in Bodo, Ogoni, through fertilizer mediated biological recovery of the crude oil polluted swamp to re-vegetation and a participatory training workshop organized by CEHRD for the local folks.

ii. **Project Area/Community**

The project was conducted at a water front locally called Numuu Kiele in Bara-Nwezor. Bara-Nwezor is one of the myriad of 36 villages that make up Bodo-City in the Gokana Local Government Area of Ogoni, Rivers State in Nigeria.
Kiele water front is an integral part of the extensive coastal edge of Bodo town located on the upper reaches of the Bonny River. The low-lying estuarine wetlands of Bodo receive tidal salt waters from Opobo channel and Bonny River toward the Atlantic Ocean.

Prior to an oil spill incidence, which much shall be talked about in this project, there use to be thick mangrove vegetation at the high, mid inter-tidal flat at *Numuu Kiele*. Such mangal community is characteristic of this type of ecological zone in a tropical setting.

Bodo is generally subjected to frequent precipitation (rainfall) that spans the long rainy season (March – November) in the Niger Delta. The creek channel that leads to what becomes *Numuu Kiele* and other neighbouring waterfronts is a tributary of a larger water channel (*Kpador* channel) from Bonny River, though, the water mixes with the waters from Opobo within the creek complexes. The adjunct gradually decreases in water dimension (depth and width) as it approaches a tropical rainforest (the *Zorkpa* forest) where a freshwater stream debouches into it.

iii. **The Problem: Oil Again!**

The Bodo creek complex is vulnerable to crude oil pollution. Besides tidal inflow of chronic oil sleek from surrounding areas, the web of oil pipelines connecting Bodo West (code name for Shell Petroleum Development Company, SPDC Flow station) located in the mangrove swampland of Bodo are sources of oil leakages to the environment.

Between 1970 - 2003, four reported oil spillages impacted Bodo creek. These occurred as follows:

- 1979 (450 barrels)
- 1981 (1,400 barrels)
- 1986 ((10 barrels)[1], all arising from Bodo West field.
- In August, 2003, oil spilled in a nearby swamp belonging to K-Dere community and carried by tide into Bodo creek. It islikely that the leaked pipe is one of the numerous pipes linking the well cherished SPDC Bomu field.

The August 2003 oil spillage is the brain behind the project herein reported. It resulted in the death of endemic biota (flora and fauna alike). Consequently, about 120m long of mangrove fringing Bodo (specifically, between the *Lelasibookpo* jetty and *Kekpaban*, and a relatively small patch at *Numuu Kiele*) died out. Interestingly, no post-spill Ecological Assessment Studies or cleanup was carried out in the area, not to mention the “luxurious” ecosystem restoration intervention.

Being a sheltered, tidal environment, tidal pumping facilitated the percolation of the oil down the sediments[2], even as tidal flushing would aid in removing oil from the environment.

Mangroves are generally more vulnerable to oil spills than salt marshes because oil on partially submerged roots of mangrove interferes with respiratory activity[3].

[1]Annon 1989: Post-Impact Ecological Studies of Bodo West Field. A report submitted by Consultancy, Research and Development Centre (CORDEC), University of Port Harcourt, to Shell Petroleum Development Company of Nigeria Limited.

[2]Zhu, X., Venosa, A. D., Suidan, M. T., and Lee, K. 2001: Guidelines for the Bioremediation of Marine Shorelines and Freshwater wetlands. Report under a contract with office of Research and Development, U.S. Environmental Project Agency. Available online: http: www.epa..gov/oil spills/pdfs/bioremed.pdf

[3] Evans, C. W. 1985: The effects and implications of oil pollution in mangrove forests. Proceedings of 1985 International Oil Spill Conference. American Petroleum Institute, Washington DC, pp. 367-371.

Although natural recovery of the environment is feasible, natural cleansing processes takes elongated time and there could be another interference(s) before the self-purity is achieved. This calls for human intervention or artificial correctional methods which could be physical, chemical or biological procedures. Of the available remediating measures, bio-remediation seems more promising in view of the low-energy nature and sensitivity of mangrove wetlands[4].

5. CERHD Intervention Project

In October 2004, (barely one year, one month after the August 2003 spillage), CEHRD project team embarked on reconnaissance trips to the affected mangrove swamp (*Numuu Kiele*). After the pre-project assessment exercise, series of consultative meetings were held between the community stakeholders and CEHRD team at Bara-Nwezor. In the meetings, highlights of CEHRD plan to restore and re-vegetate a pilot plot and subsequently train the people were exhaustively discussed.

Some community people who embraced the idea presented to them were constituted into what became known as "Mangrove Restoration and Conservation Committee (MRCC). MRCC members took part in project from start to finish.

FIELD TREATMENT AND ACTIVITIES

Stumps Removal: Field investigation and interviews conducted on the villagers revealed that the devastated pilot swamp was a protected (closed) area. When the giant mangrove trees fell to the toxicity of hydrocarbons, logging of the defoliated tree stands was permitted by the head of the village. Before long, the giant stems of the red mangrove (***Rhizophora racemosa)*** which dominated the area disappeared with only sediment rooted stumps of hanging roots left behind.

As an introductory measure in the rehabilitation process, a demonstration plot of 38 x 46m was marked out. Members of the MRCC were contacted to remove the protruding stumps for easy movement on site and also to aid in natural attenuation via photooxidation. Photooxidation occurs when oxygen under sunlight reacts with oil components[5].

6. PRE-TREATMENT ASSESSMENT

Sampling / Analysis:

Initially four sampling stations were established. The pilot study was marked Station 1. Station 2 is adjacent to Station 1. Moving from upland to the river edge,

[4] Venosa, A. D., Suidan, M. T., Wrenn, B. A., Strohmeier, k. L., Haines, J. R., Eberhart, B. L., King, D. W., and Holder, E. 1996: Bio-remediation of experimental oil spill on the shoreline of Delaware Bay. Environmental Science and Technology, 30, 1764 – 1775.

[5] Floodgate, G. 1984: The fate of petroleum in marine ecosystems. Page 355-398 in Petroleum Microbiology, R. M. Atlas, ed., Macmillan Publishing Company, New York.

Station 2 is to the right of station 1, separated by a narrow creek channel; Station 2 is a little bit elevated vis-à-vis Station 1. The main channel described earlier was tagged Station 3 while an unaffected dense mangrove swamp belt opposite the demonstration plot was marked Station 4. Only water samples were taken from Station 3. On the other hand both sediment and interstitial water samples were obtained from the other Stations (1, 2, and 4).

The samples were taken to the laboratory and analyzed for "key" parameters like Total Hydrocarbon Content (THC), Dissolved Oxygen (DO), Biological Oxygen Demand (BOD) and nutrients – Ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen and phosphate. Nutrients especially nitrogen and oxygen are usually the limiting factors in bioremediation process[2, 5]. Microbiological analyses were also done to know the status of microbial degraders, heterotrophic bacteria and fungi present in the area. This normally gives insight into whether Bio-stimulation (nutrient supplementation) or Bio-augmentation (introducing microbial flora) is required. Results of pre-treatment tests are presented in Tables 1 and 2.

Table 1. Results of Pre-treatment Chemical Parameters of Channel Water and Pore Water.

Parameter	Station			
	1	2	3	4
DO (mg/l)	-	-	4.3	-
BOD (mg/l)	NM*	NM	8.0	NM
THC (mg/l)	862	675	-	105
Ammonia-nitrogen (mg/l)	1.0	0.4	2.0	0.8
Nitrite – nitrogen (mg/l)	0.5	0.5	1.5	0.4
Nitrate – nitrogen (mg/l)	ND	ND	ND	ND
Phosphate (mg/l)	0.4	0.4	0.02	0.3

Table 2. Results of Microbiological analysis of water and sediment

Station	Total Heterotrophic Bacteria (CFV/MI/CFV/G)	Hydrocarbon Utilizing Bacteria (CFV/MI/CFV/G)	Total Fungi Counts (CFV/MI/CFV/G)
1	1.60×10^6	4.00×10^5	<3000
2	1.19×10^6	2.65×10^5	<3000
3	9.25×10^3	9.5×10^3	3.00×10^2
4	1.56×10^6	3.20×10^5	<3000

NM* - not measured
ND - not detected

i. **Treatment**

Soil Tillage

Scarifying consolidated or muddy mangrove sediments might be priceless and labour-intensive. The total number of seedlings to be planted was estimated based on the size of the plot. It was decided that an allowance (distance) of 1m between stand and row be given. Spots billed for planting were marked, tilled and pegged.

Since laboratory test revealed DO of pore water as zero, tilling the sediment might be beneficial in a sense. It increases the surface area of sediment for atmospheric oxygen uptake and brings up buried oil to the water-sediment interface. This leads to tidal removal of the oil and enhances photooxidation when the mudflat is exposed during low tide.

ii. **Fertilizer Application**

Coastal marshes are considered high nutrient wetlands[6], but most of the nutrients and nitrogen in particular are present in the form of organic matter and not readily available for microbial or plant uptake[7].

Venosa *et al*[4], stated that when a major oil spill occurs in salt marshes, it is likely that nutrient availability becomes a limiting factor for oil degradation, depending on the type of sediment, the season, and the quantity of oil spilled.

Our laboratory results show that the concentration of nitrogen forms (Ammonia, nitrite and nitrate) range from 0-2mg/l and phosphate values vary from 0.002mg/l to 0.43mg/l.

The threshold concentration range for optimal hydrocarbon biodegradation on marine shorelines is around 2 to 10mgN/l based on field experiences on sandy beaches[4]. Therefore, there was need to boost the nutrient status of the study plot. Dry granular (slow-releasing) N.P.K. fertilizers (25:10:5) were applied directly to the sediment surface at low tide. This method of fertilizer application is cost effective, and it is recommended for low energy beaches, since, washout due to tidal activity alone is relatively low[8].
Fertilizer application actually started in July, 2005 and still on as at the time of filing this report, but, with decreasing regimen. During the first month of fertilizer application, about 1.2 kg of the fertilizer was broadcasted on the surface of the plot every week. Subsequently, the application interval was streamlined to twice every month of the same quantity mentioned above.

iii. **Re-evaluation Test**

Five months into fertilizer application, pore water samples were taken from the demonstration plot (Station 1) to the laboratory to know the present THC concentration. Results show a range of between 500-660mg/l of THC.

7. **NURSERY PREPARATION**

Mature and viable propagules (seeds) of the red mangrove (***Rhizophora racemosa)*** were obtained from the wild to raise the nursery. The nursery plot was established about 1km away from the contaminated swamp to prevent hydrocarbon-induced stress during sprouting. Nursery preparation was concurrently done with the start of fertilization in July.

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[6] Mitsch, W. J. and Gosselink, J. G. 1993: Wetlands, Van Nostrand Reinhold, New York.

[7]Cartaxana, P., Cacador, I. Vale, C., Falcao, M., and Catrino, F. 1999: Seasonal variation of inorganic nitrogen and net mineralization in a salt marsh ecosystem. Mangroves and salt Marshes, 3, 127-134.

[8]Zhu, X., Venosa, A. D., Suidan, M. T. and Lee, K. 2004: Guidelines for the bioremediation of oil contaminated salt marshes. EPA/600/R – 04/074 {Hyperlink: "http://www.epa.gov/oilspill/pdfs salt marshbiormd.pdf"}

i. **Planting:**

Nursery bred seedlings were carefully dug out and transported in wooden canoe to the planting site. Caution was exercised not to damage seedling roots during digging and to ensure that ball of nursery sediments is stuck to the rooting system of the seedlings during digging, transportation and planting. Some of the seedlings were also got from the wild. Wild borne plantules were randomly uprooted for planting without being species specific. However, all the wild seedlings are of the Rhizophora stock (***R. mangle, R. harisonii and R. racemosa***).

The admixture of species was meant to simulate natural mangrove floristic pattern of the area characterized by the predominance of ***R. racemosa.*** Planting took place in late November. In addition, the seedlings planted are not of equal heights and age bracket. The variation in height is appreciative in a sense. In nature, mangrove stands are disproportionate in age, height and girth which produce storey-like canopy semblance of tropical rainforest. And the end target of the pilot study is to establish mangrove ecosystem, mimicry of the natural situation.
It has been noted in previous studies that nutrient supplementation could hasten vegetative recovery (Venosa *personal communication*).

ii. **Post Planting Evaluation**

Over one month after planting, the seedlings show sign of good health. Few seedlings stands, which might have had their root system damaged, showed witting signs and were since being replaced with viable stock. Although, the seedlings look very promising in terms of floral outlook and growth as at time of this report, more time is needed to do over-all growth performance assessment.

8. **TRAINING**

To propagate the restoration technique beyond MRCC members, a 2-day participatory training workshop was organized by CEHRD for citizens of Bara-Nwezor village in particular and Bodo City in general.
Pre-workshop consultations were made to village heads, the deputy paramount ruler of Bodo (La bon in Council), Council of Chiefs, Youth organizations and Women groups.

The workshop was held December 28 - 29, 2005 at Numuu Kiele (project site). During the workshop, CEHRD head of Conservation programme (also head of the project team) took time out to explain project steps that led to the emergence of the young and aesthetic mangrove community facing the participants. Practical demonstration was not left out and questions were adequately responded to. Commenting on the success of the project, the spokesperson of Bodo Council of Chiefs (Chief Livinus Korgbara) also thanked CEHRD for embarking on the timely project at Bodo. He described the project as invaluable, stressing that the technique would go a long way in assisting the community people in restoring their lost mangrove ecosystems.

9. PROBLEMS / RECCOMMENDATION

Problems:

- The project takes more time, energy and resources than actually projected.
- CEHRD needs to replicate the project in other nearby communities facing the same problem and there is no funding at hand to do so.
- Women did not participate in the field activities; however they participated actively during the workshop.

Recommendation:

- We are recommending that the funders should put in more grants for similar project in nearby communities.
- That a book or a magazine be published to widely document and publicize the project. This also requires some funding.

10. ACKNOWLEDGEMENT

CEHRD is most grateful to Rufford Small Grant (RSG), London, Global Greengrants Fund (GGF), USA and PADI Foundation, USA for providing financial support for the project. Our united thanks also go to Dr. Albert Venosa (U.S. Environmental Protection Agency) for his invaluable technical advice, comments and observations which led to the neat conclusion of the project. The literature on bioremediation he sent to us were of immense benefit. Nevertheless, we acknowledge the zeal and commitment of members of MRCC who stood beside CEHRD throughout the long period of the project. To Kiele and the entire Bara-Nwezor community, we say many thanks for being the host of the project and for their full participation.

11. CONCLUSION

The project was generally useful and successful.