

## **MOMBASA COUNTY**

Mombasa County is one of the 47 Counties of Kenya. It's located at coordinates 4.0396° S, 39.6534° E. It is the smallest county in Kenya, covering an area of 229.7 km<sup>2</sup> excluding 65 km<sup>2</sup> of water mass. The county is situated in the South Eastern part of the former Coast Province. It borders Kilifi County to the North, Kwale County to the South West and the Indian Ocean to the East. According to the 2009 Kenya Population and Housing Census, its population was 939,370 people comprising of 486,924 males and 452,446 females with a population density of 4,292 people per Km<sup>2</sup>. The county's literacy levels have been greatly affected by drug abuse and the al shabab radicalization of youth. A majority of youth have not made it beyond standard eight. Despite this fact, Mombasa has several institutions of higher learning most of whose students come from other counties. The county's low literacy levels are at 91% for males and 81% for females (Kenya Economic survey 2013).

## **ECONOMIC ACTIVITIES**

The main economic activity is tourism which contributes to 68% of the wage employment. The County is the centre of tourism in the country. It hosts various tourist attractions which are; Fort Jesus, white sandy Beaches, Water Sports, Mombasa Marine National Park, Nature Trail, Historical and Cultural sites and numerous world class Tourist Hotels. Others are fishing, farming of sisal, sugarcane, cashew nuts, and coconuts and livestock farming. Various manufacturing firms have set up base in the County including Bamburi Cement Company at Bamburi. Other industries include petroleum refining, food processing, salt and sand. There is also minimal extraction of coral blocks and ongoing prospects of seabed mining.

## **AN INVESTIGATION ON USED LEAD-ACID BATTERY (ULAB) RECYCLING IN MOMBASA AND PARTS OF KENYA**

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## **ABBREVIATIONS**

BLL-Blood Lead Levels

ULAB-Used Lead Acid Battery

LAB-Lead-Acid Battery

XRF-X-ray Fluorescence Spectrometer

AAS- Atomic Absorption Spectroscopy

Pb-LEAD

GPS-Global Positioning System

EPZ-Export Processing Zone

BEST- Better Environmental Sustainability Targets

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**TABLE 2:**A table showing the BLL results of selected study participants

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## 1.0 INTRODUCTION

### 1.1 Background Information

The global battery industry is the principal consumer of lead and uses an estimated 80% of annual primary lead (mined) and secondary lead (recycled) production. <sup>(1)</sup> Approximately 50% of global lead production is derived from the recycling of lead batteries. <sup>(2)</sup> These batteries are primarily used in vehicles for starting, lighting, and ignition purposes, but are also used in

photovoltaic solar installations and telecommunications systems to store energy. In Kenya, where the power supplies are often inconsistent, lead batteries are routinely used in homes and businesses to back up computer systems, lights, and appliances when outages occur. Electric vehicles are also becoming an important market for lead batteries.

Lead poisoning remains a significant occupational disease and ubiquitous environmental health threat to children. Lead causes numerous adverse health effects including damage to the nervous system, the kidney, the cardiovascular system, the hematopoietic system and the reproductive system.<sup>(3)</sup> In children, blood lead contamination is associated with a significant decrease in academic performance and lower standardized test scores (including IQ test scores) and is linked with hyper active and violent behavior. It is estimated that high blood lead levels contribute to approximately 600,000 cases of intellectual disability in children annually.<sup>(4)</sup> Occupational and environmental lead exposure may have more profound effects in the developing world compared to developed countries. The Basel Convention, which came into force in 1992, restricts the export of used lead batteries to developing countries where environmentally sound recycling cannot be assured.

A study conducted by the Occupational Knowledge (OK) International concluded that the demand for lead is expected to increase disproportionately in developing countries due to several factors including:

- ❖ Environmentally preferable technologies including solar and wind energy which are currently reliant on lead batteries for backup power
- ❖ Lead batteries are used in nearly every cell phone tower to provide backup power
- ❖ As computers are introduced into the rural areas to narrow the “digital divide”, more lead batteries will be used to back up power
- ❖ Poor manufacturing quality and the tropical climates in many developing countries result in short average life of lead batteries and frequent recycling. Since used batteries are broken and recycled by using rudimentary processes, the lead must be melted a second time to remove impurities before it can be used to manufacture new lead batteries.
- ❖ Many developing countries lack regulations and/or the enforcement capacity to adequately reduce occupational and environmental lead exposures.<sup>(5)</sup>

## 1.2 Problem Statement

Improper lead acid battery recycling presents a significant environmental and health problem in Kenya, violating the right to a clean, healthy and sustainable environment as recognized and protected under article 70 of the Kenyan constitution 2010. The discharge of the battery acid into

the environment and remelting of the lead in open fires (recycling plants lacking up to date technology) are common practice in Kenya and few alternatives have been developed to date.

Poor management of lead wastes and smelting residues is a potent risk to the environment and to the surrounding populations. Left untreated lead wastes in arid and semi-arid areas can be full of lead bearing dusts for years, which is detrimental to humans, animals and the entire ecosystem. These effects include but not limited to still births, anemia, poor muscle coordination, effect on central nervous system, kidneys and miscarriages<sup>(4)</sup>

### **1.3 Goal**

This study mainly aims at creating awareness about the situation of lead recycling in Kenya with the long term intention of developing solutions for the environmentally sound recycling of lead-acid batteries and the protection of human health.

#### **1.3.1 Specific Objectives**

- i. To identify various lead smelting industries in Kenya
- ii. To assess the environmental and public health standards of the physical features of lead smelting industries
- iii. To assess the environmental, safety and health standards of the workers of the lead smelting industries
- iv. To compile a comprehensive report of the situation of lead recycling in Kenya

## **2.0 METHODOLOGY**

### **2.1 STUDY AREA**

So far, several recycling industries in Kenya deal with scrap metals and lead acid battery recycling has been identified with complaints from workers and community members. However, most of the major lead-acid battery recyclers have been shut down following the passing a law on export of lead. The law by the East Africa community parliament was as a result of advocacy

and policy work by the Center for Justice Governance and Environmental Action (CJGEA) in a bid to stop pollution in Owino Uhuru slums. However, this law after being enforced ensured the closure of most of the smelters that were licensed to operate in Kenya.

This therefore, has led to smelting of lead on open and backyard smelting that highly exposes individuals to severe public health related diseases and dangerous pollution levels. Some of the smelters used in this study are described below.

### **2.1.1 Metal Refinery Ltd**

Metal refinery EPZ is located within an informal settlement in Mombasa county, on the coast of Kenya GPS coordinates S04°00.438 ' E039°36.957' in 2007. In 2009, an activist raised the concern of the factory's operations that was causing lead poisoning. A year later three children were tested for lead poisoning and the results came back positive and these agitated the Owino Uhuru community who rose up and demanded the shutting down of the smelter.



Figure 1: A photo of the Metal Refinery EPZ taken from the community side

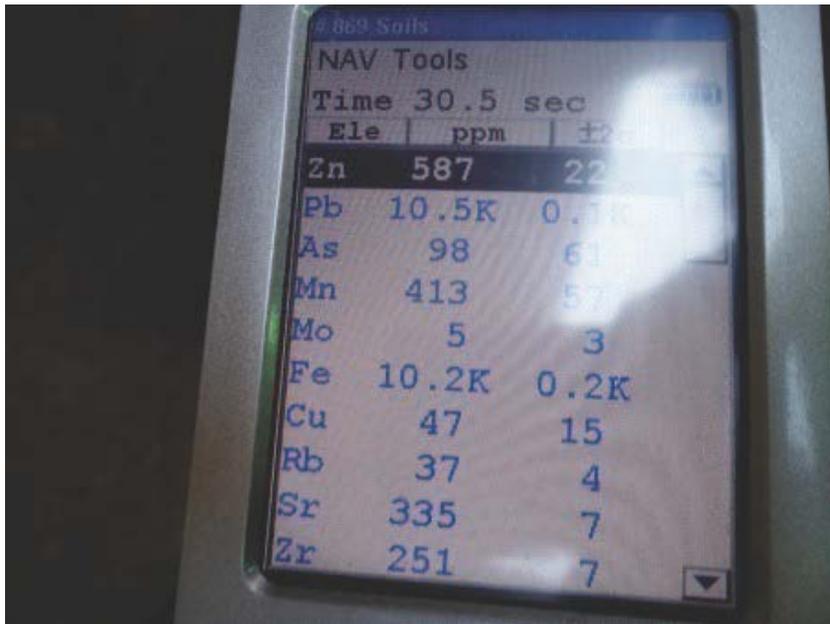


Figure 2: An XRF reading of 10,500 ppm of soil next to the base of the smelter

### 2.1.2 Kenya Metal Refinery

Kenya metal refinery is located at the coastal parts of Kenya at GPS Coordinates S04°00.778 ' E039°36.627. The refinery has been in operation for a long time and has been a source of lead for five years before it was shutdown in 2014. The smelter was later converted into a garment Export Processing Zone with most of the working areas were barely renovated from recycling batteries to making garments. Lead still exists in the dust of the new business premises.



*Figure 3: Recently renovated Kenya Metal Refinery that was a former smelter*

### **2.1.3 AclaraEPZ Ltd.**

Alclara EPZ Ltd is located on the coastal parts of Kenya at GPS coordinates S04°00.046 ' E039°36.104 ' .The refinery h  
for four years.

After it was shut down in late 2014, it was converted into a syringe, garment and other homeware materials processing area. The area still had the dumped solid waste and open effluent tank from the smelter that continued to expose the new industry and neighboring residents to risk of lead contamination especially the nearby river.

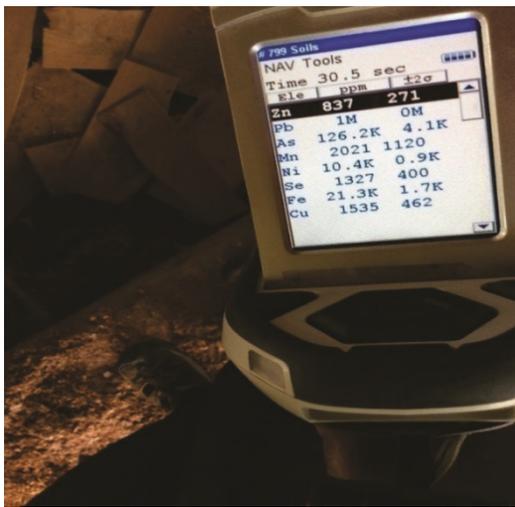


*Figure 4 and 5: Animals feeding from a dumpsite at Alcara EPZ LTD (left), An effluent tank left open even after the shutdown of the factory (right)*

#### **2.1.4 Xiangui International Ltd.**

Xiangui international is a former smelter located in the rift valley section of the country that has currently been converted into a timber yard with all the smelting equipment still intact.

Though we were not allowed to speak to any management persons we tested the soils inside the premises with an XRF machine and were shocked by the results. This was where the people worked daily ignorant of the potent risk in their environment. Outside the gate of the smelter near a vegetable farm, the machine detected up to 800ppm. This indicates that considerable amount of lead pollution in the area after ceasing the operations.



*Figure 6: An XRF reading of soil sample of up to Pb=1million ppm inside the now timber yard*



*Figure 7: Equipment left intact even after shutdown of smelter*

### **2.1.5 Ganesh Eco-Solutions Ltd.**

Ganesh Eco-solutions is located in Nyamathi area in Naivasha sub-county in Nakuru County in the rift valley part of Kenya. The smelter operated for four years and was shut down in 2015 after residents complained of the pollution that was going on. This smelter is located in a highly populated residential area and attracted major state and non-state actors through the complaints from the area residents. Blood, water and biotic material tests were carried out by interested parties that showed quite alarming levels of lead content with seven out of the thirteen tested being positive.

## **2.2 New Lead scrap exporters in Kenya**

There is a new amount of unscrupulous exporters dealing with Lead scrap in the market place. They buy ULABs from Scrap Metal Dealers and simply empty the batteries, remove the plastic coverings and compress the lead plates into blocks that are tied with strips of wire and loaded into containers for export. (This is illegal because the law bars exports of lead scrap in any form from Kenya). They include:

### **2.2.1 Shivam Metal Ltd**

They are operating from Magongo, Refinery Road Mombasa, Kenya. They seem to have a connection with the Scrap Metals Dealers in Nairobi. They then export to Mumbai India: Shivam Metal Industries, 39, 41 1<sup>st</sup> Floor 10, Kumbharwada, Mumbai India.

### **2.2.2 Aloh Investment**

This company is based in both Nairobi and Mombasa and claims to be doing recycling metals it has several businesses that include Scrap Metal Division. They deal with all kinds of scrap metals, load these metals in the containers to camouflage the lead exports.

### **2.2.3 Haryana Agro Investment**

Haryana Agro Investment is a Kenyan based scrap metal dealer and exporter, specializing in exporting scrap metals products to Middle East, Asian Countries and European countries. Haryana Agro Investments (K) Limited is a scrap metal exporting company based in Mombasa, Kenya with branch offices in Tanzania and Thailand. We were informed that this company does smelting although we could not pin point where the smelting factory is in Mombasa. They export mainly to India, Korea and China.



*Figure 8: New scrap metal dealers who are also exporting lead illegally*

### **2.3 Study Population**

The target population was the workers working in the identified lead acid recycling industries or involved in scrap metal dealing and the community members living on the informal settlements around these industries. The interviews involved both, the men and women. The children were represented by their parents or guardians. The study covered 5 study sites that are characterized by the smelter industries. At least 10 former workers and surrounding residents from each study site participated in the study.

### **2.4 Data collection**

Qualitative data collection methods were used to assess the environmental and health standards of the former workers and the neighboring residents that participated in the study. The researchers used observation, informal conversations for the illiterate and questionnaire based interviews for the literate. There was also photo documentation and soil sample collection in a labeled zip-locked sample bag to be analyzed by SGS labs. A few selected (putting in place all the ethical considerations) former workers/neighboring residents to an existing or former smelter were tested for lead poisoning in a private lab as well.



*Figure 9: A field officer interviewing a neighboring resident (left)*



*Figure 10: A project officer collecting soil samples (right)*



*Figure 11: A community liaison and project officer interacting with LAB recyclers (left) Figure 12: One of the mechanics shops dealing with ULABs (right)*

### **3.0 RESULTS/FINDINGS**

#### **3.1 Soil samples analysis**

The soil samples collected in strategic points were delivered to the SGS laboratories that deal with environmental media to be analyzed for Lead. The soil and dust samples were digested and run into the Atomic Absorption Spectroscopy (AAS) machine to analyze lead element following

the Shimadzu AA6300 standardized analytical method (Shimadzu, 2002).<sup>(6)</sup> The results are illustrated in the table below:

*Table 1: Results of soil sample analysis from specific study sites*

<b>Smelter</b>	<b>Soil sample result</b>	<b>Description</b>
Ganesh Ecosolutions	193 ppm	Dried up water pan
Ganesh Ecosolutions	27000 ppm	50m from the factory chimney
Kenya metal refinery	340.52 mg/kg	Collected after renovation of the factory
Kenya metal refinery	4038.95mg/kg	Collected in a drainage of renovated area
Kenya Metal refinery	3256.52mg/kg	Entrance area
Alcara EPZ	12946.10mg/kg	Behind the building nearest to community
Alclara EPZ	93742.10mg/kg	Collected after years of shutdown
Shabab Area in Nakuru	13491.90mg/kg	Inside a garage
Shabab area	14138.90 mg/kg	A garage next to a vegetable vendor
Metal refinery EPZ	1656.63 ppm	Soil sample a few meters from the smelter

Metal refinery EPZ	23.63 ppm	Drainage water
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As seen from the results above, lead persists for many years before degradation. For instance the metal refinery has been shut down for at least three years now but there are still high levels of Pb. This long term persistence of lead in the environment is what makes it a dangerous heavy metal both in the environment and human body.

### 3.2 Blood Lead Level (BLL) Analysis

The selected participants in BLL analysis with their consent provided their BLL results that they had been tested just a few months back by private laboratories and a few by the government chemist. Most of these had worked in either or all of these three coastal smelters i.e. Metal refinery, Kenya Metal refinery and Alclara EPZ Ltd. Their BLL results are shown in the table below:

*Table 2: BLL results of selected study participants*

<b>Personal Description</b>	<b>BLL Results</b>	<b>Smelter nearby</b>
Nearby resident	124.3 µg/dl	Metal Refinery
Nearby resident	99.3 µg/dl	Metal Refinery
Nearby Resident	24.0 µg/dl	Metal Refinery
Wife to former worker	28.0 µg/dl	Kenya Metal Refinery
Former worker	26.0 µg/dl	Kenya Metal Refinery
Nearby resident	24.0 µg/dl	Metal Refinery
Former worker	10.0 µg/dl	Metal Refinery
Former Worker	8.22 µg/dl	Alclara EPZ
Nearby resident	4.0 µg/dl	Kenya Metal Refinery

Food Supplier to factory	2.0 µg/dl	Metal Refinery EPZ
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The ten study participants whose blood was tested for lead poisoning were all positive. Eight out of ten had above the revised WHO standards of 5µg/dl BLL. This weakens their immune system risking ailments related to lead poisoning. Most of them mentioned that they have been treating the common tropical ailments since most of the hospitals in Kenya are not equipped to diagnose chemical diseases. Apart from metal refinery, very few study participants had thought of being tested for lead poisoning. Those that had worked in these smelters or lived closest had higher chances of having higher BLLs than those who had less contact with lead. The alarming thing was that the BLL levels were still this high even after a year of the shutdown of the smelter.

### 3.3 Environmental, safety and health standards of the workers and the physical features of the lead smelting industries

Due to the passing of the law on legality on export of lead by the East African law society, most of the smelters in Kenya have been shut down. Currently, most of the people interacting with lead and lead products are mechanics working in garages and those involved in repairing LABs.

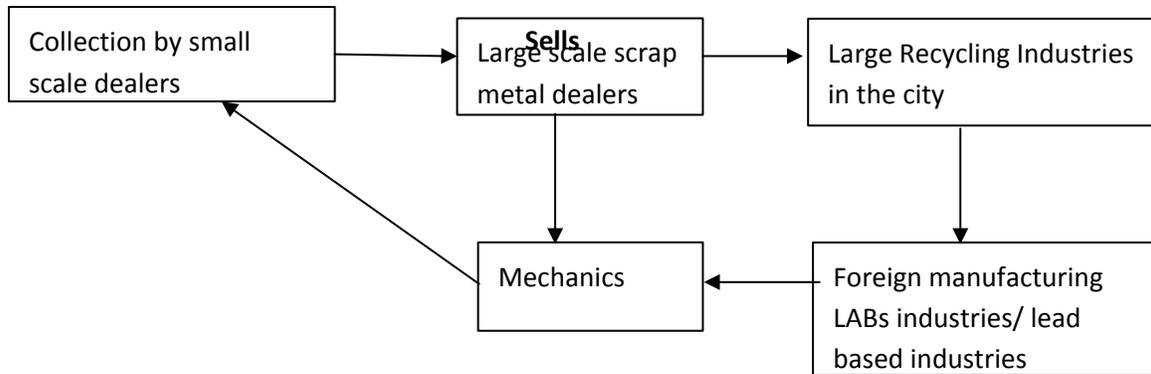
They pointed out that repairing/ recycling of LABs in the country is on the decline in the country due to:

- ✚ The price of a new LAB has become cheap and most people can now afford new batteries.
- ✚ Most of the cars on the road are fairly new and hence do not need battery replacement frequently.
- ✚ The raw material (lead) that they use in repairing ULABs is getting scarce and expensive due to the shutdown of the smelters. This makes repairing expensive and the cost is put on the consumer who prefers having a new battery instead.

#### 3.3.1 Distribution

Commonly small scale scrap dealers collect the Used LABs in small quantities from motor owners and accumulate them and later sells to large scale dealers. The huge quantities are said to be taken to the capital-Nairobi for recycling, no one knew the location. In rare cases, the recyclers and mechanics smelt the cells to collect lead for their use in their work. They also buy new batteries form the distributors/dealers directly. They sell the scrap especially the empty plastic cases to the small plastics dealers. Below there is a flow chart showing the movement of ULABs and how the newly manufactured LABs get back into the system.

*Figure 13: Flow chart showing the general movement of ULABs and LABs in Kenya*



The mechanics/recyclers smelt the cells in small quantities in open fires with barely any Personal Protective Equipment (PPEs). Most of them are on overalls and worn out gloves. They conduct their smelting in open spaces near other businesses such as clothes sellers, cobblers, vegetable vendors etc. Speaking to some of them on the risk they pose to themselves and other people, one said “yeah, I do understand but have been doing this for over 20years and hasn’t affected me”. Another said, “I know how to do it am an expert and can’t affect me.”

A few had separate clothes to change into after work as they had pass through urban center to run errands. But those that lived nearby went home with them same overalls they worked on. During eating times they go to the nearest food joints and eat as they have been working to save on productive hours.

Most of the area residents and former workers of a smelter that operated for at least three years all had common health ailments including frequent respiratory related ailments, skin diseases, and high rates of miscarriages, affected kidneys, poor muscle coordination, and men erectile dysfunction etc.

The areas that are used for repair/recycling of LABs are shatters or large containers converted into a working space with very poor ventilation with no near source clean water. The sulfuric acid from the LABs is directly poured on the ground or the nearest drainage, which corrodes the pipes leaving the sewage exposed to sight.

#### 4.0 CONCLUSION

Ignorance on the potential risk of being exposed to lead to many is still rampant in the country as observed during the study. Myths and misconception still exists about lead poisoning many viewing it as incurable epidemic commonly comparing it to AIDS, partly due to misinformation delivered. Furthermore, results of interviews established that most workers and the adjacent communities likely to be affected, were neither trained nor informed about occupational exposures to lead and associated adverse health effects during the procedural process (Environmental Impact Assessment) of establishing an industry.

The risk of take-home exposures which many are not aware of is on the rise statistically. Most of the study participants mentioned that they carry their working clothes home for their wives to wash. They expose people between the work place and before they get home and shower. During lunch breaks they eat and interact with other people on their working clothes.

Frequency, in violating procedural rights has been observed especially on the access to information and public participation in decision making in environmental process and which are very well stipulated in the country's constitution. Most of these industries owned by cooperate investors from China and India go through short cut routes to acquire licenses for operation without even informing the neighbors or workers on the dangers of working in such an environment.

In Kenya, we lack regulations and/or the enforcement capacity to adequately reduce occupational and environmental lead exposures. Alternative means to encourage improvements in the industry should be implemented such as Better Environmental Sustainability Targets (BEST) certification standard that is developed with the involvement of key stakeholders outlining performance exposures for workplace exposures, emissions and extended producer responsibility to take back used batteries for proper recycling. Governments of these countries should play a role in controlling the pollution associated with backyard recycling operations in regulating the collection of used LABs. Chelating medication is far much expensive for any low to middle income person to afford and it is barely available in African hospitals. Environmental remediation which focuses on exposure reduction to lead, treatment and capacity building is the solution for various countries and adopting pilot projects such as that in Zamfara, Nigeria.<sup>(7)</sup>

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## **CHALLENGES**

The County is confronted with numerous environmental challenges and needs to invest in environmental governance and management.

- There are problems in sewage disposal resulting in untreated or partially treated effluent being discharged into the ocean. Many hotels release sewerage directly into the ocean.
- The Ocean beaches are being affected by waste oil.
- Quarry operations in some areas of the County such as Bamburi, Ngomeni and Mkomani have left open pits that pose environmental hazards.
- In Changamwe where large numbers of people live, the petroleum refinery contributes to air pollution. Furthermore, the refinery may lead to a disaster of serious proportion. Solid waste collection services cannot cope with the waste generated.
- High levels of poverty. This is caused by landlessness, high and increasing cost of living, inaccessibility to credit facilities, lack of technical and entrepreneurial skills especially among the youth, unemployment, low incomes, HIV AIDS and gender discrimination. The poor are predominantly squatters living on land owned by absentee landlords.
- Lead poisoning in Owino Uhuru. Even after the closure of the metal refinery EPZ in the area its effects are still felt by the people in the area.
- Lead Poisoning in Kwa Jomvu Kuu where the lead smelter Aclara Industries operated. Without decommissioning, the facility has now been turned into a garment storage facility under the EPZ where garment destined for the US market are stored.
- Former Lead smelter Kenya Metal refinery EPZ without proper decommissioning has been turned into a garment factory under the EPZ. Garments are exported to the US Market.

## **INTERVENTIONS**

- Proper sewage disposal. This can be done by ensuring that the sewage plants are treated before being release to the ocean to prevent pollution.
- Enacting of laws that prevent oil refineries from draining their waste oil to the ocean.
- The corporations taking part in the quarry operations should ensure that they refill the open pits so that the land can be reclaimed.
- The people living next to the petroleum refinery should be addressed to ensure their safety and well being.
- The refinery company should collaborate with the waste collection services to ensure that their wastes are properly disposed and also to clean the environment.

- Training services on entrepreneurship should be offered especially to the youth to help them be self sufficient and in the long run improve the standards of living in the county.
- Remediation of the affected areas through excavation of the soil or in situ fixation. This will lead to the community being able to carry out subsistence farming.