

# Background to Environmental Degradation in Ogoniland

*An Ogoni woman draws water  
from an open well. With a rich  
and diverse culture, the Ogoni  
have lived in the Niger Delta  
for hundreds of years*

© UNEP



## Background to Environmental Degradation in Ogoniland

Ogoniland is characterized by typically deltaic features: uneven terrain, numerous creeks, shallow brackish water bodies and a variety of vegetation types including swamp forest. The following section describes in detail Ogoniland's environmental setting and oil industry operations.

### 2.1 Environmental setting in Ogoniland and the Niger Delta

#### Geology

The Niger Delta is the product of both fluvial and marine sediment build-up since the upper Cretaceous period, some 50 million years ago. Over time, up to 12,000 metres of shallow marine sediments and deltaic sediments have accumulated, contributed mainly by the Niger River and its tributaries. The main upper geological layers consist of Benin Formation,

Agbada Formation and Akata Formation. The Benin Formation is comprised of multiple layers of clay, sand, conglomerate, peat and/or lignite, all of variable thickness and texture and covered by overburden soil. Clay beds are discontinuous and groundwater is therefore present both as localized aquifers or in hydraulically interconnected aquifers. The ground characteristics are consistent with deltaic environments, where erosion and deposition of sediments constantly shift the course of channels, tributaries and creeks.

#### Groundwater

Ogoniland's aquifers are a crucial resource upon which the region's entire population depends for drinking water. The protection of these aquifers is therefore vital. These aquifers are very shallow, with the top-most groundwater levels occurring anywhere between close to the surface and a depth of 10 metres. To tap the aquifers, Ogoni communities typically construct open, hand-dug wells about 60 cm in diameter and water is abstracted either manually or with pumps. In some areas affected by localized pollution of water closer to the surface, wells can be up to 50 metres deep. In such cases, immersible pumps are used to draw water. Water levels in these aquifers are highly seasonal.



*An Ogoni fisherman*

Map 3. Ogoniland is marked by numerous deltaic creeks



Fresh groundwater can also be found in the shallow, sandy and unconfined aquifers of the coastal beach ridges, river bars and islands in the mangrove belt, as well as at varying depths in confined aquifers. A large number of wells drilled in the coastal area produce brackish (salty) water which is not fit for drinking. In some areas, brackish groundwater can be found at depths greater than 200 metres below ground level.

### Surface water

The Rivers State region is drained by the Bonny and New Calabar river systems and numerous associated creeks and streams. Ogoniland itself is bounded to the east by the Imo River and to the west by a series of creeks (Map 3). The Imo receives freshwater inflow during the rainy season but is also influenced by tidal variations. The

width and velocity of freshwater creeks increase downstream to form meandering or braided channels in the delta.

Tidal systems are confined to the southern part of the UNEP study area and comprise saline and brackish mangrove swamps with meandering tidal creeks.

## Vegetation

The coastal area comprises three vegetation zones: (i) beach ridge zone, (ii) saltwater zone and (iii) freshwater zone. The beach ridge zone is vegetated by mangroves on the tidal flats and by swamp trees, palms and shrubs on the sandy ridges. The saltwater zone is mainly vegetated by red mangrove (*Rhizophora mangle*). The coastal plain and freshwater zone is vegetated by forest tree species and oil palm. The Niger River floodplains are covered by rainforest trees, oil palm, raffia palms, shrubs, lianas, ferns and floating grasses and reeds.

Mangroves have traditionally provided a variety of ecosystem services and products to the community, including fishing grounds, timber for housing, and fuelwood. Tree and shrub cover remains important in uncultivated areas. Other non-timber forest products which are important, especially for poorer households, include grass cutters, bamboo for staking of yam (edible perennial herbaceous vines), medicinal plants, vegetables, fruits and snails.

An agriculture-based economy and an increasing population have meant that most of the rainforest that once covered Ogoniland has been cleared for farming. In many places the practice of integrating farming and forestry remains, covering large areas of land and consisting mainly of oil palm and rubber plantations. The farm animal population too has increased with population density, with the animals also involved in nutrient recycling [5].

In Ogoniland, only small-sized sacred forests (shrines) of usually less than 1 ha remain in a relatively undisturbed state, while most of the remaining vegetation is highly degraded. Original vegetation consists mainly of mangroves.

## Local communities

The Ogoni are a distinct people who have lived in the Niger Delta for hundreds of years.

They live in close-knit rural communities, their livelihoods based on agriculture and fishing. The total population of the four local government areas (LGAs) – Eleme, Gokana, Khana and Tai – according to the 2006 National Census was approximately 832,000 (Table 2).

Within Ogoniland, four main languages are spoken, which although related are mutually exclusive: Eleme, Gokana, Khana and Tai. Linguistic experts classify Eleme, Gokana and Khana as a distinct group within the Beneu-Congo branch of African languages or, more specifically, as a branch in the New Benue-Congo family.

Table 2. Number of inhabitants by local government area (LGA), 2006 [6]

LGA	Inhabitants
Eleme	190,884
Gokana	228,828
Khana	294,217
Tai	117,797
<b>Total</b>	<b>831,726</b>



Ogoni women carrying wood and produce



*Ogoniland is home to an estimated 832,000 people*



*The creeks in Ogoniland also form important transportation routes*

**Eleme LGA** occupies the western end of Ogoniland. It has 10 clans within two administrative political blocs or units: the Nchia bloc with six clans (Akpajo, Aleto, Alesa, Alode, Ogale and Agbonchia) and the Odido bloc with four clans (Onne, Ebubu, Eteo and Ekporo). Each clan has numerous sub-communities; the Ebubu clan for example includes the Ejamah, Ochani, Obollo, Egbalor and Agbeta communities.

The oilfields in Eleme LGA, which encompass locations in Ebubu (Ejamah, Agbeta, Obollo, Egbalor), Ogale (Ajioepuori, Nsisioken, Obajeaken, Nsisioken) and Onne (Ekara), were discovered in October 1956. Oil from operations in Eleme was included in the first shipment of 22,000 barrels of crude oil exported from Nigeria to Europe in 1958.

The communities of Eleme host several major national and international establishments.

Eleme's main river is the Imu Ngololo, along which the Nigerian Naval College is based.

**Gokana LGA** was created out of the former Gokana Tai Eleme LGA and came into being on 23 September 1991. It comprises 17 autonomous communities. The Gokana people are mostly fishermen and farmers. Gokana is located within the South East Senatorial Zone and has both riverine and upland communities. It was also one of the major oil-producing areas in Rivers State. It shares boundaries with Tai in the north, Khana in the east, Ogu/Bolo in the west and Bonny in the south. The LGA is situated about 50 km south of Port Harcourt and 30 km from Onne industrial area.

**Khana LGA** is the largest of the four LGAs in Ogoniland, with a total of 106 communities and a population of 294,217 (as at the 2006 census). The people are also predominantly farmers and fishermen. The LGA has four districts: Babbe, Ken-Khana, Nyorkhana and Bori Urban. The Yorla oilfield lies in Khana LGA.

**Tai LGA** was created out of the former Tai-Eleme LGA in 1997, which in turn was a

successor in 1991 to Gokana Tai Eleme LGA. Its administrative headquarters are at Saakpenwa. It is one of the major oil-producing LGAs in Rivers State and is composed of 27 communities and villages inhabited predominantly by farmers and fishermen. The LGA has three districts – Tua-Tua District, Nonwa Area and Kira Central District (Tai Central) – and is bounded by Oyigbo to the north, Gokana to the south, Khana to the east and Eleme to the west. Korokoro Tai, in Tua-Tua district, is one of the Tai LGA's major oil-producing communities, with one flow station and nine oil wells. It was discovered by SPDC in 1968.

### Ogoni interaction with neighbouring regions

Metaphorically and practically speaking, Ogoniland is not an island. This has two implications. The first is that pollution from Ogoniland has the potential to reach and cross its boundaries, as well as entering Ogoniland from external sources. The second is

that the problems of Ogoniland cannot be solved in isolation.

These issues are particularly significant with regard to pollution in creeks. Oil pollution, once it reaches the creeks, can move back and forth with the tides. Consequently, an oil spill, even around Bonny Island at the southern edge of Rivers State, can reach the coast and waters of Ogoniland. Similarly, pollution from Ogoniland can reach downstream villages such as Andoni, and eventually as far as the sea.

Cross-border environmental impacts are also relevant for oil industry infrastructure. While oil production no longer occurs in Ogoniland, crude and refined oil products transit the region via pipelines. The main SPDC oil pipeline, or trunk line, from upstream production areas runs to the export terminal at Bonny, while the pipelines from Bonny terminal to Port Harcourt refinery and from Port Harcourt refinery to Umu Nwa Nwa also pass through Ogoniland.



*Pipelines in neighbouring Okirika LGA. The environmental impacts of oil operations are a shared legacy*



## Institutional framework

The institutional set-up and legislation related to environmental management of the oil and gas industry in Nigeria have evolved over the past 50 years and are very complex.

The Department of Petroleum Resources (DPR) under the Federal Ministry of Petroleum Resources plays a key role in regulating and enforcing environmental law in Nigeria. The DPR regulation 'Environmental Guidelines and Standards for Petroleum Industry in Nigeria' (EGASPIN) [7], first issued in 1992 and reissued in 2002, forms the basis for most environmental regulation of the oil industry.

In 1999, the Federal Ministry of Environment was formed, followed in 2006 by the establishment of the National Oil Spill Detection and Response Agency (NOSDRA). Both of these institutions base their operations on the DPR Environmental Guidelines and Standards.

There are also ministries at the state level; the Rivers State Ministries of Environment and Water Resources both have the management of environmental issues in Ogoniland within their mandates. Local government bodies do not have an official role in either environmental

management or regulation of the oil industry, but have *de facto* involvement with both issues because of their physical presence 'on the ground'.

The long history of environmental problems caused by oil spills also gives the Nigerian judicial system a prominent role as it deals with penalties and punishments for environmental and oil-related offences and crimes, as well as with compensation claims for victims.

## 2.2 Petroleum hydrocarbons: origin and environmental consequences

### Origin and use

'Petroleum' originates from two Latin words: 'petra' meaning rock, and 'elaion' meaning oil. Hydrocarbons refer to chemical substances formed exclusively from carbon and hydrogen. Petroleum hydrocarbons are thus naturally occurring hydrocarbon substances and, depending on the length of the carbon chain, can occur in gas, liquid or solid form. Hydrocarbons are formed by the decay of organic substances trapped within sedimentary rocks. High temperatures and pressure convert the trapped matter into hydrocarbons. Liquid hydrocarbon found in nature is also referred to as crude oil [8].



Visible hydrocarbon pollution on surface water in Ogoniland

Crude oil consists of a complex mixture of hydrocarbons of various molecular weights. In addition nitrogen, oxygen and sulphur occurs in small quantities. The hydrocarbons consist of alkanes (paraffins) and cycloalkanes (naphtalenes) that are saturated hydrocarbons with straight or branched chains of hydrocarbon molecules. Alkanes and cycloalkanes which normally constitute the dominating part of the oil, about 80%, have similar properties but cycloalkanes have higher boiling points. The remaining hydrocarbons are aromatic, meaning the molecules are unsaturated made up of benzene-rings. To this group of molecules belongs the polycyclic aromatic hydrocarbons (PAHs – also known as polyaromatic hydrocarbons or polynuclear aromatic hydrocarbons), some of which are known for their carcinogenic properties. One additional group of hydrocarbons that occur in varying amounts up to 10% in crude oil is the asphaltenes, which are molecules with relatively high weight. Oils consisting of a relatively high proportion of asphaltenes tend to be thick almost like asphalt.

The use of crude oil has created at least four major industrial groups:

1. The exploration and production industry, which searches for, finds and then produces crude oil
2. The oil and gas tanker industry, which transports crude oil and refined products around the world
3. The refining sector, which breaks down crude oil into a number of products, including diesel, petrol and specialty oils
4. The petrochemical industry, which takes crude oil-derived hydrocarbons as feedstock and converts them into a range of everyday products used in modern living

### **Environmental consequences of hydrocarbons**

While the economic significance of hydrocarbons as the primary source of fuel and its versatile application in downstream industries are obvious, the product may also have major environmental consequences [9].

Oil exploration, production and processing represent prime sources of exposure to petroleum

hydrocarbons. But there are other possible sources, such as vehicle and generator emissions, burning of vegetation and trash (including domestic waste), food processing and use of cooking fuels. All these activities are commonplace in Ogoniland.

In looking at the environmental consequences of hydrocarbons, it is important to remember that 'hydrocarbons' is an umbrella term used for hundreds of different organic compounds. Secondly, hydrocarbons can cause environmental consequences due to their chemical properties (e.g. toxicity) or physical properties (e.g. smothering). And lastly, owing to the very large number of hydrocarbons present in crude oil, the environmental and health impacts of all the constituent parts have not yet been fully studied or understood.

### **Impacts on soil**

Hydrocarbon pollution of soil can occur in several ways, from natural seepage of hydrocarbons in areas where petroleum is found in shallow reservoirs, to accidental spillage of crude oil on the ground. Regardless of the source of contamination, once hydrocarbons come into contact with the soil, they alter its physical and chemical properties. The degree of alteration depends on the soil type, the specific composition of the hydrocarbon spilled and the quantity spilled. In the least damaging scenario, such as a small spill of a volatile hydrocarbon onto dry sand, the hydrocarbons evaporate fast, causing no chemical or physical damage to the soil. In other situations, for example a spill of heavy crude oil onto clay soil, the chemicals can remain within the soil for decades, altering its permeability, causing toxicity and lowering or destroying the quality of the soil. In such circumstances, the soil itself will become a source of pollution.

Contaminated soil can affect the health of organisms through direct contact or via ingestion or inhalation of soil contaminants which have been vaporized. Soil also acts as a reservoir of residual pollution, releasing contaminants into groundwater or air over extended periods of time, often after the original source of pollution has been removed [13].

### **Impacts on water**

Hydrocarbons can enter water through direct spills or from a spill originally occurring on land



*UNEP expert examining vegetation*

and subsequently reaching water bodies through the effects of wind, rain, surface or sub-surface flow. Regardless of the means of entry, there will be adverse impacts though the nature and severity of such impacts is dependent on the specific chemical composition and physical characteristics of the hydrocarbon involved and the degree of concentration/dilution. Hydrocarbons can cause both physical and chemical effects in water; even very small quantities of hydrocarbon can prevent oxygen transfer in the water column, thus affecting aquatic life-support systems. The presence of mere traces of a highly toxic hydrocarbon, such as benzene, may render water unfit for human consumption [10].

### **Impacts on vegetation**

Hydrocarbons can come into direct contact with vegetation in many ways: through spillage onto roots, stems or leaves; through spillage onto soil; through dissolved hydrocarbons in the groundwater in the root zone of the vegetation; or via air surrounding the vegetation [11]. Impacts on vegetation depend on a range of factors, from

the type and quantity of the chemical(s) involved, to the life-cycle development stage of the plants concerned, and the means through which the plants came into contact with the hydrocarbon. Different vegetation types also have varying sensitivity to hydrocarbons.

In the case of Nigeria, where spillages are not immediately attended to, oil spills often lead to fires, causing total or partial destruction of vegetation. While such fires tend to be localized, more extensive fires, especially in forested regions, have the capacity to change species diversity over significant areas.

### **Impacts on aquatic and terrestrial wildlife**

Oil spills can affect wildlife, both aquatic and terrestrial, in many ways. The severity of damage will depend on the type(s) of hydrocarbon involved, the quantity spilled, the temperature at the time of the incident, and the season. Dissolved or emulsified oil in the water column can contaminate plankton, algae, fish eggs and invertebrate larvae [12].

Intertidal benthic invertebrates located in sediments subjected to tidal variations are particularly at risk, due more to the smothering effects of thick, weathered oil reaching the coastline. Sediments often become reservoirs of hydrocarbon contamination. Meanwhile, fish can be affected via their gills or by ingesting oil or oil-contaminated prey. Fish larvae are equally at risk, particularly when oil enters nursery areas such as mangroves or other wetlands.

Physical contact with oil destroys the insulation properties of fur and feathers, causing various effects in birds and fur-bearing mammals. Heavily oiled birds can also lose their ability to fly, as well as their buoyancy, causing drowning. In efforts to clean themselves, birds often ingest oil, which may have lethal or sub-lethal impacts through, for example, liver and kidney damage.

*For a more comprehensive discussion of the biological impacts of oil pollution, refer to the Guidelines on Biological Impacts of Oil Pollution prepared by the International Petroleum Industry Environmental Conservation Association (IPIECA) [13].*



*An Ogoni farmer harvesting plantain*

### Impacts on people

Petroleum hydrocarbons can enter people's bodies when they breathe air, bathe, eat fish, drink water or accidentally eat or touch soil or sediment that is contaminated with oil (Figure 2).

Crude oil contains many compounds, primarily volatile and semi-volatile organic compounds (VOCs and SVOCs), including some PAHs, as well as some other sulphur- and nitrogen-containing compounds and metals. When oil is burned, additional PAHs can be formed as combustion by-products along with inhalable fraction  $PM_{10}$  (particles measuring less than 10 microns), and respirable fraction  $PM_{2.5}$  (particles measuring less than 2.5 microns). Petroleum hydrocarbons differ with respect to their behaviour in the environment and it is this behaviour that defines whether they are more likely to be in air, water, soil, sediment, food or other media that people might come in contact with.

Petroleum products can contain hundreds or even thousands of individual compounds that differ with respect to their potential impacts on people with regard to both exposure and degree of toxicity. The dose and duration of exposure has a direct influence on the effects that may follow. Some petroleum hydrocarbons are soluble in water, while others might be present in water as a separate phase of oil. People of all ages might be exposed to petroleum-contaminated surface water or groundwater when used for bathing, washing, cooking and drinking. People of all ages can also be exposed to petroleum that evaporates into the air. Members of fishing communities risk exposure to petroleum if they drink, bathe or collect shellfish in contaminated water, or if they come into contact with or accidentally ingest contaminated sediment while engaged in any of these activities.

Petroleum hydrocarbons are not efficiently taken up by plants or animals, and finfish – unlike shellfish – metabolize PAHs, preventing accumulation in edible tissue. While most foods are therefore unlikely to be important sources of exposure to petroleum hydrocarbons, farmers can suffer direct exposure from contaminated soil during their day-to-day work.

The types of chemical present in crude and refined oils and released during its combustion may lead to short-term respiratory problems and skin and eye irritation if concentrations are sufficiently high. Acute health effects of exposure to petroleum are reasonably well understood: dermal exposure can lead to skin redness, oedema, dermatitis, rashes and blisters; inhalation exposure can lead to red, watery and itchy eyes, coughing, throat irritation, shortness of breath, headache and confusion; and ingestion of hydrocarbons can lead to nausea and diarrhoea [14, 15, 16]. In addition, environmental contamination associated with oil spills and its effect on livelihoods and general quality of life could reasonably be expected to cause stress among members of affected communities, and stress alone can adversely affect health [17, 18].

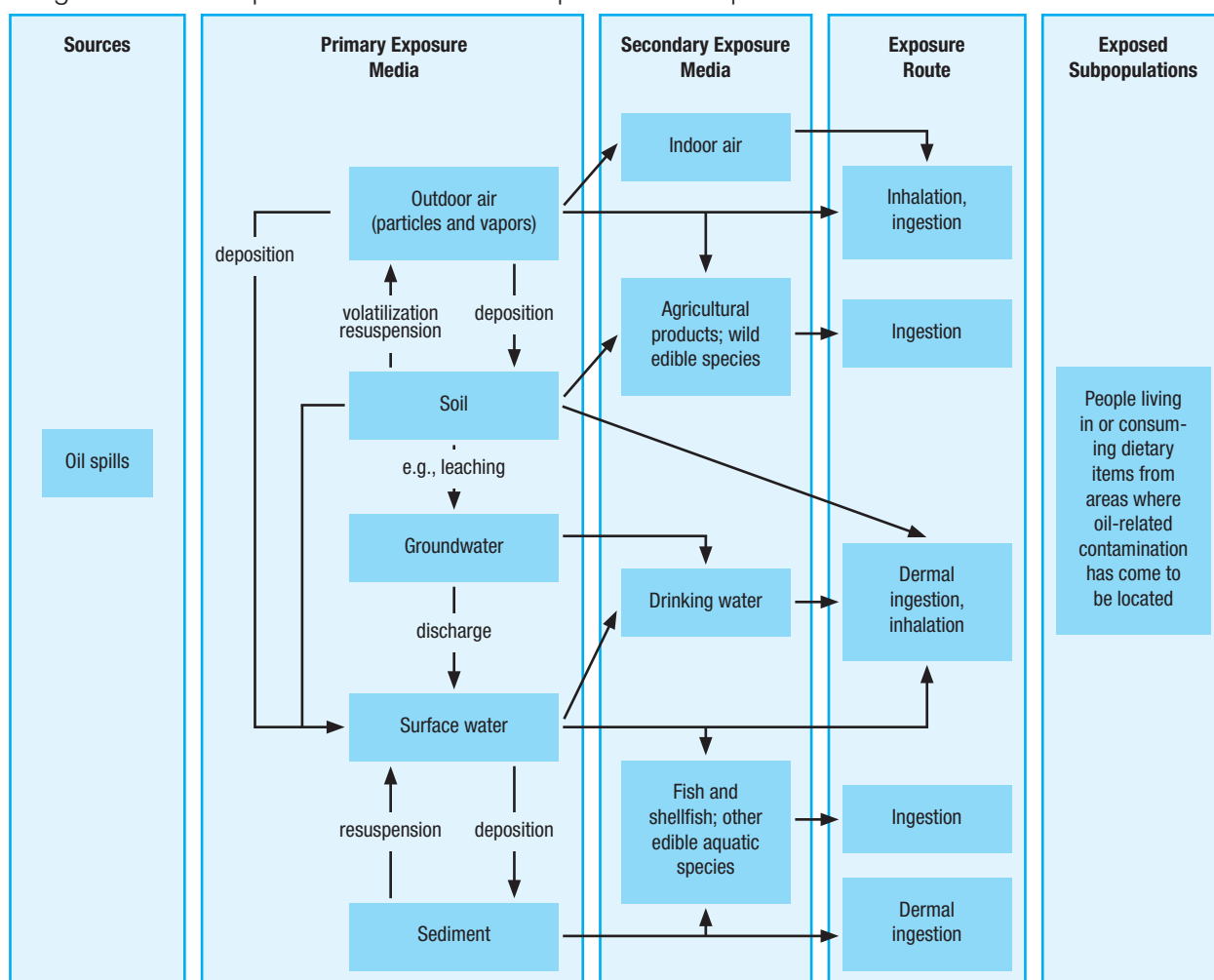
Chronic effects from comparatively low-level exposure are not so well understood and

might include cancer and neurotoxicity [19]. Aguilera *et al.* (2010) reviewed human health evaluations associated with oil spills around the world and found that most provided evidence of a relationship between exposure to spilled oils and acute physical and psychological effects, as well as possible genotoxic and endocrine effects [17]. Effects of oil exposure on the developing foetus are also not well understood, although adverse effects have been observed in studies involving individual petroleum hydrocarbons, including benzene and some PAHs [19, 20].

### Impacts of specific hydrocarbons on environment and health

Given that there are many hundreds of different hydrocarbons, which may occur individually or in combination, their impacts on the natural

Figure 2. Conceptual model of human exposure to oil spills



environment and health of organisms are not fully understood. However, there are certain groups of hydrocarbons that are known to have adverse impacts and which are therefore dealt with selectively in oil-spill assessment and clean-up work. The most important of these groups are BTEX (benzene, toluene, ethylbenzene and xylenes) and PAHs. There are many published documents worldwide that provide comprehensive information on these groups. The following gives a brief overview.

BTEX compounds contain one aromatic carbon (benzene) ring. They have low molecular weight, high volatility and are comparatively highly soluble in groundwater. BTEX is naturally present in crude oil, often in small quantities. The concentration of these substances is increased during petroleum cracking (the breaking down of high-molecular weight hydrocarbons into low-molecular weight compounds) [21, 22].

BTEX substances are highly mobile and able to find their way into human beings through air or water relatively quickly. In addition, their toxicity also makes them more potent. Benzene, for example, is a known carcinogen, in addition to having numerous other short-term effects.

PAHs are potent pollutants that occur in crude oil, as well as in wood or coal. They are also produced as by-products of fuel burning particularly at low temperatures leading to incomplete combustion (whether fossil fuel or biomass). As pollutants, they are of concern because some compounds have been identified as causing cancer, changing genetic structures and affecting embryos and foetuses [23, 24, 25].

### **Non-hydrocarbon environmental issues related to the oil industry**

In addition to chemical pollution by hydrocarbons, there are other environmental concerns linked with oil industry operations. These range from clearance of land for oilfield facilities, hydrological changes due to construction of roads and pipelines, and contamination from chemicals other than hydrocarbons (three of which are discussed below). Table 3 summarizes the typical impacts of oil industry operations on the environment.

### **Barium**

Barium is a heavy metal and excessive uptake of water-soluble barium may cause a person to experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness [26]. Barium chemicals are used by the oil industry in drilling mud, which is then often left in the mud pits around wellheads or dumped offshore [27]. In the past, no particular effort was made either to transport the mud away from the drilling location or to handle it in an environmentally appropriate manner. Consequently, it is not uncommon to find high concentrations of barium in the drilling pits.

### **Naturally occurring radioactive materials**

Naturally occurring radioactive material (NORM) includes all radioactive elements or isotopes found naturally in the environment. Long-lived radioactive elements, such as uranium, thorium and any of their decay products, including radium and radon but also the radioisotope potassium-40, are examples of NORM. These elements have always been present in the Earth's crust and within the tissues of all organisms.

NORM encountered in oil and gas exploration, development and production operations originates in subsurface formations. It can be brought to the surface by the oil or gas itself, or by formation water, which is the by-product of the formation of oil and gas in the ground.

NORM concentrations in crude oil and natural gas are known to be low and therefore do not pose a radiological problem. Oil and gas production and processing operations sometimes cause NORM to accumulate at elevated concentrations in by-product waste streams [28]. An accumulation of NORM, such as in pigging wastes, can be problematic and must be avoided, something that the oil industry is now well aware of. As an example, radium isotopes have a tendency to co-precipitate from water phases through temperature and pressure changes in the presence of other elements such as barium. Precipitates can then be found on the surface of equipment and in sludge and ashes. The decay product of radium is radon gas which, if inhaled may pose radiological problems. NORM generally occurs as radon gas in the natural gas stream.

Workers employed in the area of cutting and reaming oilfield pipes, removing solids from tanks and pits, and refurbishing gas processing equipment may be exposed to NORM, hence posing health risks if inhaled or ingested.

### Hydrogen sulphide

Since hydrocarbons are formed by anaerobic decomposition of organic matter, hydrocarbon deposits (of both crude oil and natural gas) are often found in association with hydrogen sulphide gases[29] . Hydrogen sulphide is a foul-smelling

gas that can cause odour nuisance even at very small concentrations. At higher concentrations it is lethal.

### Produced water

Water is often produced along with hydrocarbons [30]. More often than not it is salty, the salt concentration often exceeding that of sea water. Disposal of produced water, even after removal of hydrocarbons, onto either land or water can cause adverse environmental impacts due to its high salinity.

Table 3. Summary of the environmental impacts of oil exploration and production

Exploration and production activity	Physical activity	Impacts
<b>Seismic activity</b>		
	Setting up base camps	Land clearance Access creation Abstraction of groundwater Hydrological changes Sewage Solid wastes Light and noise pollution Introduction of alien and invasive species
	Cutting lines	Removal of vegetation Access Creation
	Seismic operation	Vibration Noise
<b>Drilling operations</b>		
	Setting up base camps	Land clearance Access creation Abstraction of water Hydrological changes Sewage Solid wastes Light and noise pollution Introduction of alien and invasive species
	Setting up drilling pads	Land clearance Access creation Hydrological changes
	Drilling operations	Noise Drill cuttings and drilling wastes Spills and leaks Light and noise pollution Nuisance odours
<b>Production operations</b>		
	Facility installation	Land clearance Access creation Abstraction of water Hydrological changes Introduction of alien and invasive species
	Pipeline installation	Land clearance Access creation Hydrological changes Spillages and leaks Fires Nuisance odours Pigging wastes
	Facility operation	Noise Discharge of water Waste, e.g. from tank bottoms Spillages and leaks Fires Nuisance odours

### 2.3 Oil industry-related infrastructure in Ogoniland

As previously mentioned, oil industry operations in Ogoniland have been going on for more than half a century. Activities involve both upstream (exploration, production) and downstream (processing and distribution) operations. As in oil operations worldwide, these processes are managed by different entities. The two key companies with operational facilities in Ogoniland are the Shell Petroleum Development Corporation (Nigeria), which manages the upstream activities, and the Nigerian National Petroleum Company, which deals with the downstream activities.

#### SPDC facilities in Ogoniland

Oil production in Ogoniland ran from 1958 until 1993 when it was shut down in the face of a massive campaign of public protest against the company's operations in Ogoniland. SPDC has not produced oil in Ogoniland since.

The company's technical installations in Ogoniland comprise oil wells, flow lines, flow stations, manifolds (junctions of pipes) and a number

of trunk lines that pass through the region. According to SPDC the oil wells are capped and currently not producing. As a consequence, flow lines, flow stations and some of the manifolds are also not operational. Map 4 shows the extent of oil industry infrastructure in Ogoniland.

The study area for UNEP's environmental assessment contained 116 oil wells which were constructed between 1955 and 1992, as well as five flow stations and 12 manifolds. Potential sources of contamination remain, such as disused technical installations and infrastructure that was damaged or completely destroyed during the Biafran War.

#### Oil wells

Waste streams potentially generated by well drilling operations are drilling fluids, cuttings/tailings, formation waters and sanitary waste. Drill tailings were stored in pits which can still be identified in the wellhead areas.

Typical infrastructure of a well drilling site in Ogoniland as it appears today is shown in the image below; the tailings pit and water reservoirs are still visible. At other sites, water reservoirs were



Typical well Infrastructure (009-002 Well Korokoro 10, Tai LGA)



Map 4. Oil industry infrastructure in Ogoniland

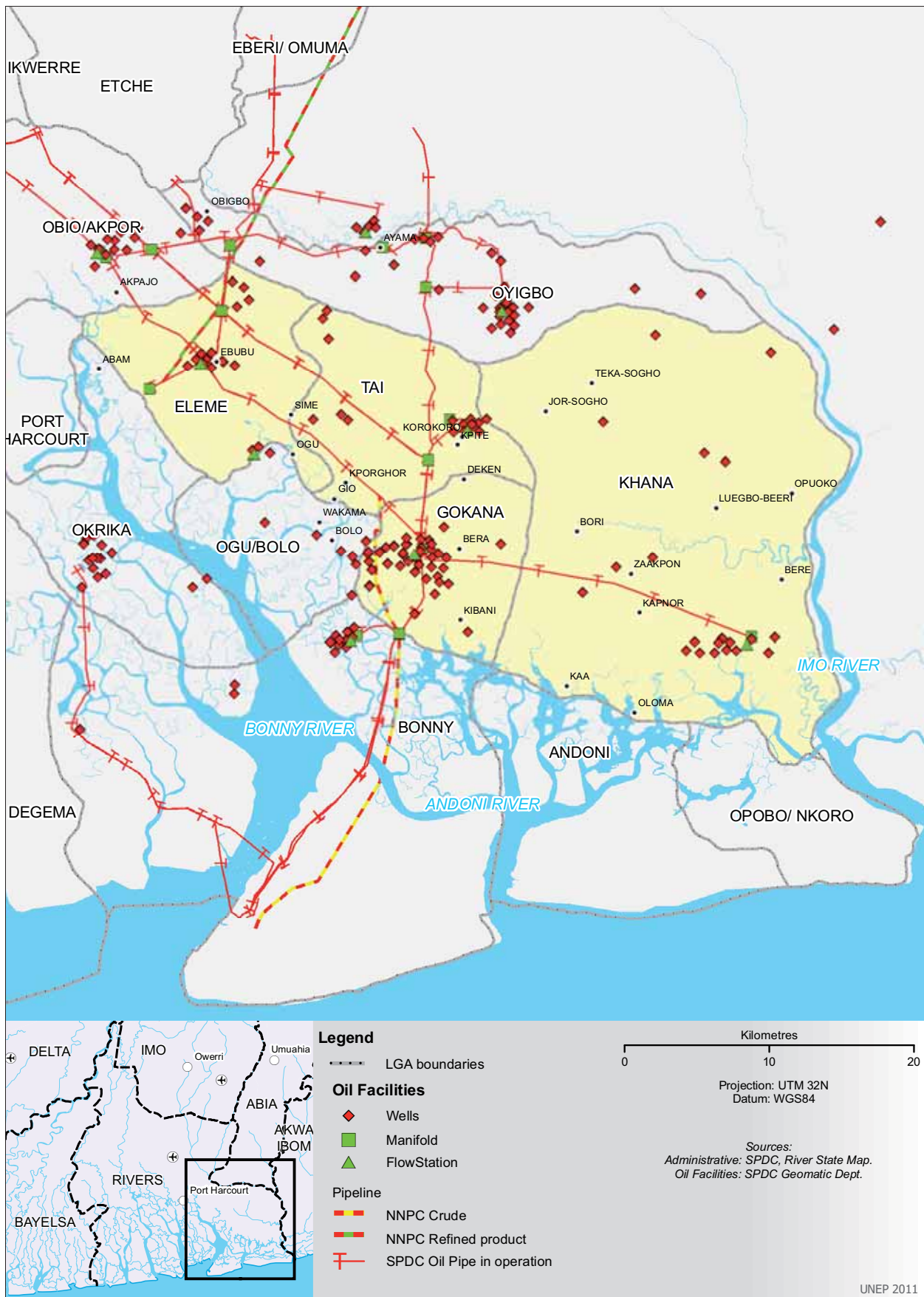


Table 4. Flow stations constructed in Ogoniland by commissioning year

Flow station	Commissioning year	Remarks
Bomu (K-Dere) -1	1958	Legacy infrastructure
Bomu (K-Dere) -2	Not available	Destroyed during Biafran War
Ebubu	1959	Legacy infrastructure
Bodo West	1963	Decommissioned
Korokoro	1965	Legacy infrastructure; 5 spills reported by SPDC
Yorla	1973	Legacy infrastructure; 3 spills reported by SPDC
Onne	Not available	Decommissioned

not present and one or more tailings pits were only visible as shallow rectangular depressions in the ground close to the wellhead.

### Flow stations

Wellheads produce a mixture of crude oil, produced water and produced gas, all of which are transported to a flow station via so-called 'flow lines'. In the flow station, oil, gas and water are separated in order to produce crude oil which is then transported towards a manifold.

The gases consist largely of methane and ethane, other gases including carbon dioxide and hydrogen sulphide, along with organosulphur compounds known as mercaptans. Whereas methane, ethane and similar gases have a commercial value and can be used for energy generation, carbon dioxide and hydrogen sulphide can act as asphyxiants, potentially putting oilfield workers at risk. In addition, hydrogen sulphide and mercaptans have a certain corrosive potential which may reduce the lifespan of pipelines, pumps, etc. if not removed from the system. Since produced water is often saline, it is necessary to separate it from crude oil at the earliest possible stage to reduce its corrosive potential.

According to information supplied by SPDC, the flow stations in Ogoniland were constructed between 1958 and 1973 (Table 4).<sup>1</sup>

Apart from oil and gas separators, the only water treatment facilities observed by the UNEP team were simple gravimetric oil separators which were used to skim oil from the surface and discharge wastewater into neighbouring trenches, wetlands or borrow pits. The gas was reportedly flared during operation of the flow stations.

### Manifolds

Manifolds collect oil streams from flow stations and transmit the flow into one or more pipelines. They consist mainly of inflowing and outflowing bundles of pipelines, as well as pumps, shutters, valves and generators. Given the large amounts of oil that are pumped through these systems, if there is a rupture, the potential for contamination is high.

Ten manifolds were located in the UNEP study area (Table 5). Of these, six were operational and four had been decommissioned. No information was available about commissioning or decommissioning dates.

<sup>1</sup> GIS layers on SPDC-operated infrastructure and rights of way, supplied in 2009.



Typical flow station and associated infrastructure (Ebubu Ejama, Eleme LGA)

Table 5. Operational status of manifolds in the study area (UNEP, 2010)

Manifold	Status	Remarks
Alesa	Operational	Not accessible (in refinery)
Bomu	Operational	Partially operational; seven spills reported by SPDC
Bodo West/Patrick Waterside	Operational	None
Ebubu	Operational	One spill reported by SPDC
New Ebubu I	Operational	One spill reported by SPDC
Elenenwa/New Elenenwa	Operational	None
Bodo West	Decommissioned	None
Botem	Decommissioned	Two spills reported by SPDC
Horo	Decommissioned	None
Yorla	Decommissioned	None

### Non-SPDC oil industry facilities in Ogoniland

The **Nigerian National Petroleum Company (NNPC)**, fully owned by the Federal Government of Nigeria, has interests across Nigeria's entire oil industry. In 1988, NNPC was commercialized into 12 strategic business units covering the full spectrum of oil operations: exploration and production, gas development, refining,

distribution, petrochemicals, engineering and commercial investments.

The **Port Harcourt Refining Company (PHRC)**, a subsidiary of NNPC, is composed of two refineries: one commissioned in 1965 with a current capacity of 65,000 barrels per stream day<sup>2</sup> and the second

<sup>2</sup> The maximum number of barrels of input that a distillation facility can process within a 24-hour period when running at full capacity under optimal conditions.

commissioned in 1989 with a capacity of 150,000 barrels per stream day. The latter has a crude distillation unit (CDU), a vacuum distillation unit (VDU), a fluid catalytic cracking unit (FCCU) and a liquefied petroleum gas (LPG) unit. The refinery has a captive power plant with an installed capacity of 14 MW and four boilers each capable of generating 120 tons of steam per hour [31].

PHRC produces the following products:

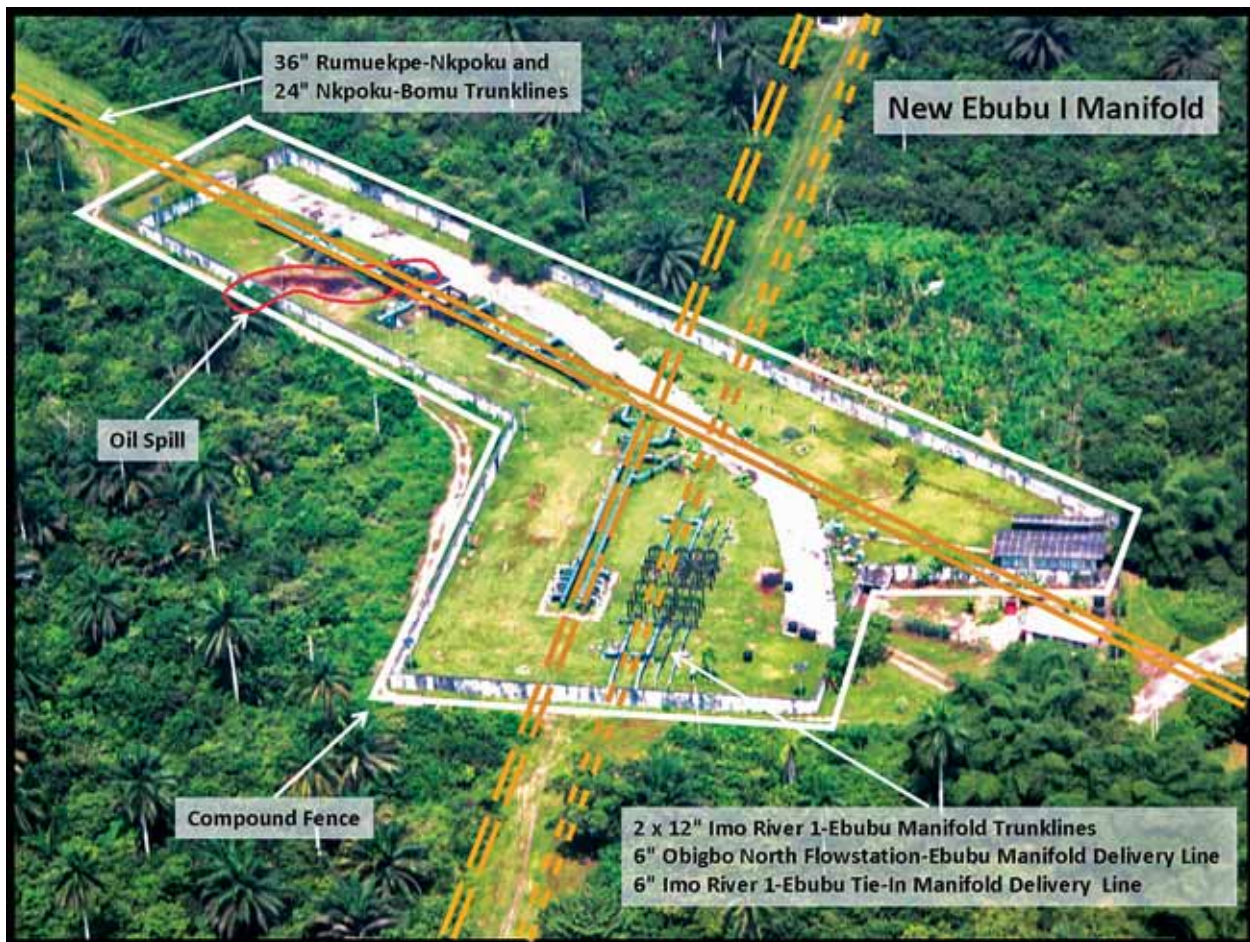
- LPG
- Premium motor spirit
- Kerosene (aviation and domestic)
- Automotive gas oil (diesel)
- Low pour point fuel oil
- High pour point fuel oil
- Unleaded gasoline

**Pipelines and Products Marketing Company (PPMC)**, is also a subsidiary of NNPC. Until Nigeria established its own refinery in 1965, all

the petroleum products used in the country were imported. PPMC was created in 1988, during the reorganization of NNPC, to manage the distribution of refined products to all parts of Nigeria and to ensure they are sold at uniform prices.

**Eleme Petrochemicals Company** is a polyolefin producer located in Eleme, Ogoniland. Established in 1988, the company was a 100 per cent subsidiary of NNPC until, in 2006 as part of a privatization drive, the Indorama Group of Indonesia was declared core investor by the Nigerian Government-sponsored National Council on Privatization [32].

The Eleme complex is designed to produce 240,000 metric tons per year of polyethylene and 95,000 metric tons per year of polypropylene. To produce these resins, natural gas liquids are cracked in an olefin plant. In addition, the complex has the capacity to produce 22,000 metric tons of Butene-1 (a colourless, flammable,



*Manifold at the intersection of pipelines (Ebubu Ejama, Eleme LGA)*



*Oil-related infrastructure in Ogoniland*

liquefied gas) per annum, used as a comonomer in the production of linear low-density polyethylene. Currently occupying 400 ha of land, Indorama is planning to expand the complex to make it the petrochemical hub of Africa.

For the purposes of this report, the key agencies of interest are the Port Harcourt Refining Company, which operates the refinery in Ogoniland, and the Pipeline and Products Marketing Company, which has product pipelines running through Ogoniland.



*Oil industry infrastructure was progressively installed in Ogoniland between the 1950s and 1990s, when oil production in the kingdom was shut down in 1993*