SCENARIO REPORT ON THE LAGOS LAGOON

PREPARED BY SRADev Nigeria
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INTRODUCTION

1.1 Overview of the Lagos Lagoon Profile

The Lagos lagoon, water body is in the heart of the metropolis. Lagos lagoon cuts across the southern part of the metropolis, linking the Atlantic Ocean (in the west and south) and Lekki lagoon (in the east). It is about 6354.708 sq.km in area and 285km in perimeter. The lagoon provides places of abode and recreation, means of livelihood and transport, dumpsite for residential and industrial discharges and a natural shock absorber to balance forces within the natural ecological system. The Lagos lagoon consists of three main segments and they are as follows; Lagos Harbour, the Metropolitan end and Epe Division segment (see Figure1.2).

The Lagos lagoon is linked to important large rivers and creek deeply inland. The water body is particularly vulnerable in having restricted circulation and poor tidal flushing with a low tidal range (0.3 -1m), which exacerbate any pollution problem. The aquatic resource, due to its estuarine location, is of multiple usages. Apart from marine transportation and fisheries, complex mixtures of domestic and industrial effluents enter the Lagos lagoon daily. In addition to wastewater from industries, there are domestic sewage discharges, garbage and wood shavings from saw mill depot along the shores of the lagoon. Sand and gravel extraction for construction purposes and reclamation of wetlands around the lagoon are common features of the landscape.

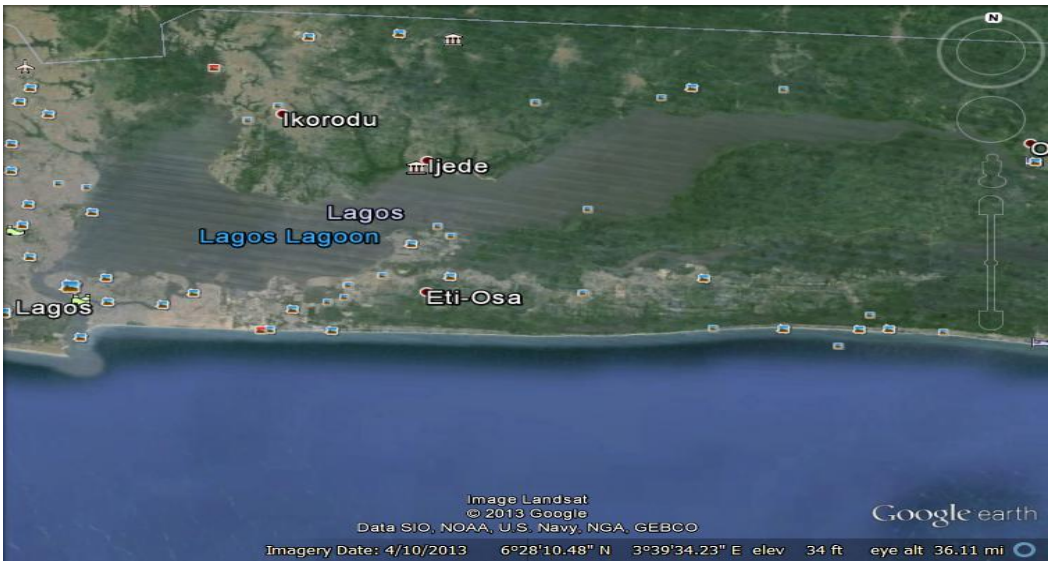

Fig 1.1: A Satellite Map showing the Lagos lagoon and communities along its segments

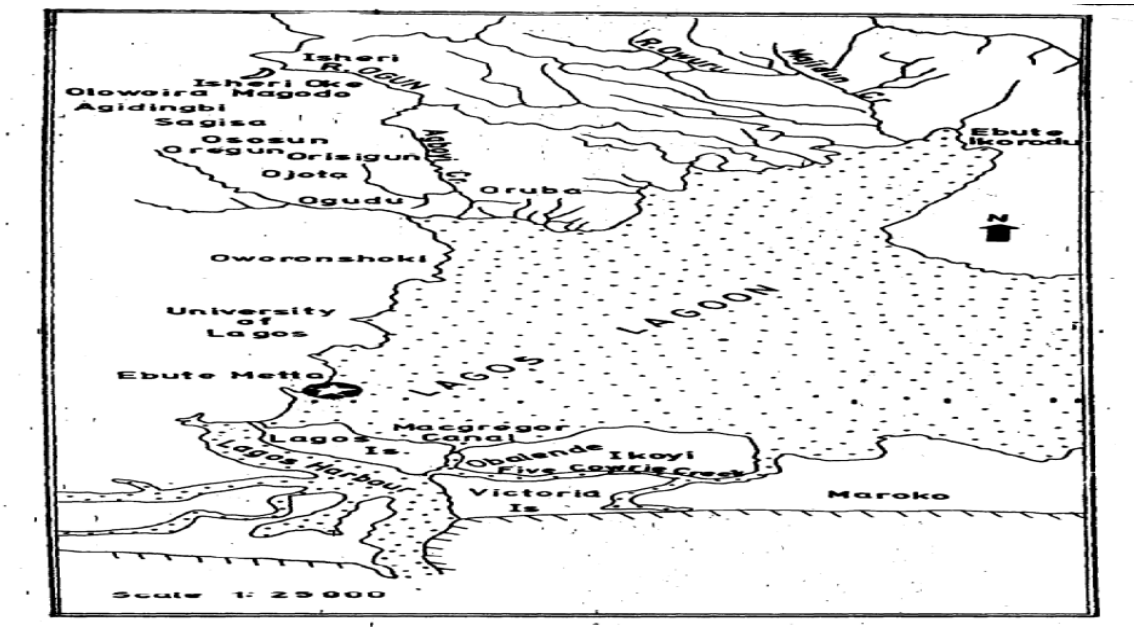

Fig 1.2: A Map showing the three segments of Lagos lagoon

"The bottom water of the lagoon has high temperatures which were relatively constant throughout the year. The temperature varied between 32.7ºC in December 2002 at the entrance of Ogun River near Ikorodu and 27ºC in October 2003. The temperatures range was only 7ºC. During the rains (May to November) the influx of riverine water and the heavy cloud cover in the sky resulted in a gradual fall of the temperature to a minimum of 26ºC."(Oyenekan, J. 1988).

There is differential salinity in the lagoon due to the effect of Atlantic Ocean and fluctuates both seasonal and semi-diurnally. Seasonal and diurnal salinity fluctuations are greatest in the Lagos Harbour segment of the lagoon because of the influx of water from Atlantic Ocean and the Lagoon. At different time of the day and year, the salinity decreases as distance increases from Atlantic Ocean. For instance, owing to seasonal distribution of rainfall, the lagoon system and creeks experience seasonal flooding which introduces a lot of detritus, nutrients as well as pollutants from land. Such pollutant arising from land based activities include domestic and industrial effluents, urban storm run-off; agricultural land run-off,

shipping activities; coastal habitat modification coupled with contaminants from garbage and solid waste dump (Portmann et al, 1989).

The pollution level of the Lagos lagoon is greatest in the Lagos harbor segment and decreases in the metropolitan end of the lagoon, while Epe segment records the least level of pollution. Though, the actual level of pollution varies even within the segments but there are correlations in the values recorded.

The bottom deposits ranged from coarse Shelly and around the mouth of Lagos harbor through various grades of muddy sand to mud. Sandy mud or muddy deposits occurred in the central areas with muddy sand or sand towards the shoreline. The coarse sand of the harbor entrance could be attributed to the fast water currents in the area. The seabed of Lagos lagoon has been described phenomenal because of the nature of continuous deposits and sporadic dredging in the harbor area. The seabed in the metropolitan area is relatively higher and increases toward Epe segment of the lagoon. Semi and large scale mining especially Tin Can area towards Ikorodu area of the lagoon have distorted the seabed.

The greater proportions of two communities (Makoko and Ilaje in Bariga) with a combined population of about 37,598 over an area of about 0.25 sq.km live on the lagoon. The lagoon provides place of abode for the Ilajes and Ijaws (stilt housing) and impacts the lives of Lagosians (inhabitants of Lagos metropolis) generally.

1.2 Activities along the Lagos Coastline

The proliferation of urban and industrial establishments along the shores of the Lagoon has meant additional anthropogenic inputs of a complex mixture of domestic and industrial wastes. Some of these activities/industries are shown in Table 1.1. Other human activities associated with the lagoon are fishing, aquaculture, sand mining, and recreational activities such as boating clubs. It also provides a good platform for inland waterways transportation, which has potentialities of reducing heavy road traffic in Lagos metropolis.

S/No	Establishment	Types	Pollutants
1	Atlas Cove	Tank farm for refined petroleum products	Oil and grease
2	Lagos Wharf	Shipping lane, regularly dredged	Oil and grease various spillage, and ship garbage
3	Ibafon Depot Oil Tank farm	Tank farm for refined petroleum products	Oil and grease
4	Bordpak	Packaging plant	Mainly organic matter pollutant
5	Naval Western command	Naval oil spillages	Oil and grease
6	National Oil and Agip Depot	Refined petrol/gasoline, diesel oil	Oil and grease
7	Fisheries Services Company Ijora	Fish trash, diesel oil, trawler garbage	Oil and grease, Fish trash, organic pollutants, biodegradable
8	Seven Up		
9	Nigeria Breweries Iganmu	Malt fermentation spillages, spent brew	Organic biodegradable pollutants
10	Afprint Textile Mill	Printing, dyeing and gray finishing plant	Various inorganic and organic pollutants. Heavy metals-Cr, Cu, Zn, Fe etc. Coloration (Dyes), inorganic matter (starch), some oil and grease from diesel plant
11	NEPA Ijora	Electric power generating plant	Cooling water (high temp.)
12	NEPA, Thermal Plant, & AES Independent Power Project Egbin	Electric power generating plant	Cooling water (high temp.)
13	Iddo Municipal sewage dump	Major domestic sewage discharges	Biodegradable organic
14	Iddo Market garbage input	Miscellaneous organic wastes etc	Biodegradable, organic matter
15	Oko-Baba Sawmill industry	Logging, sawdust input	Biodegradable organic wastes

Table 1.1: Sources, Types and Pollutant load in the Lagos Lagoon

1.3 Environmental Pollution Sources to the Lagoon

The major environmental pollution sources to Lagos lagoon may be ranked based on their environmental, human health and economic significance (Table 1.2).

Table 1.2: Ranking of Environmental Pollution sources to the Lagos lagoon

Category	High priority	Moderate priority	Lower priority
Environmental pollution	Municipal solid waste	Industrial solid waste	Oil pollution
	Sewage discharges	Toxic and hazardous substances	
	Industrial effluents	Industrial air emission	
	Vehicular emissions	Fisheries habitat degradation	

Renewable Resource Degradation	Water hyacinth expansion	Sea level rise	Mangrove degradation
	Flooding/Sea level rise	Coastal erosion	Coastal biodiversity
		Fisheries depletion	

Inadequate municipal solid waste management poses serious health problem to people living in Lagos. When dumped into nearby water bodies like Lagos lagoon, they reduce water quality, further adding to health risk. Municipal solid waste is five times more than industrial solid waste in magnitude. Similarly, the few municipal sewage treatment plants operating in Lagos state are not efficient particularly those in the Federal Housing Estates (Eric Moore, Satellite Town, Festac Town) which drains into the lagoon. Other estates, households and small scale industries utilize commercial sewage collector who dump into the lagoon at Iddo. To compound this most houses still lack sanitary toilet facility.

Health risks associated with improper management of Industrial effluents ranks high and also affect a large proportion of urban population in the state. There are about 2000 industries in Lagos metropolis, the majority of which discharge their effluents into Sasa and Odo Iya Alaro streams in the densely populated and heavily industrialized Ikeja suburb. The water quality of the River based on parameters such as *pH, BOD, turbidity, colour, total suspended solid, oil and grease, pesticides* and *heavy metals* as well as total coliform exceed the standards of WHO and Federal Ministry of Environment. All fresh water bodies in Lagos state and the Ogun River drain into the Lagos Lagoon.

According to the recent industrial database research sponsored by the World Bank in 1996-1997, only 7 industries installed full-scale water treatment facilities out of 534 industries, which answered to the questionnaire among 2000 industries in Lagos state. Most of them utilize a central wastewater treatment plant called WEMABOD constructed in the Ikeja industrial estate in Lagos state, to accept wastewater from several kinds of industries, treat it and discharge into Sasa stream. Since year 2000, WEMABOD have been experiencing epileptic operation.

A similar common treatment plant for about 20 industries was constructed in Agbara Industrial Estate at Agbara between Lagos and Ogun States, which discharges treated water

into Owo River. Wastewater from Iganmu and Apapa Industrial estates are discharged directly into the Lagos lagoon, Port Novo and Ebute-Metta creeks except for the Nigeria Breweries, which carries out physical and biological treatment. Other sources of pollution to the Lagos lagoon include flooding, sand mining, siltation, livestock development, marine transport, vehicular repair workshops, and water hyacinth proliferation.

SECTION TWO

2.0 Description of Industries in Lagos state

The Lagos state industries have been zoned according to industrial estate as can be seen from the table 2.1 below.

*Table 2.1**: Zones and suburbs in Lagos metropolis and the other parts of Lagos state***

Zones	Areas covered in the zones
Zone 1	Ogba, Aguda, Ojodu, Iseri-Oke, Iseri-Olofin, Agindingbi, Adekunle, Ikeja, Oregun, Ikosi-Ketu, Ojota, Ojodu, Ikeja GRA, Maryland, Mendes, Gbagada, Anthony village, Oworonshoki
Zone 2	Abule-Egba, Agege, Iju, Ifako-Agege, Oke-Odo, Magbon, Papa-Ashafa, Alagbado, Dopemu, Alimoso, Ipaja, Akowonjo, Idimu, Egbeda, Isheri-Olofin
Zone 3	Ilupeju, Ikorodu Road, Obanikoro, Pedro, Bariga, Abule-Okuta, Shomolu, Onipanu, Mushin, Palmgrove, Matori, Papa-Ajao, Fadeyi, Igbobi, Idi-Oro, Idi-Araba
Zone 4	Shogunle, Mafoluku, Oshodi, Orile-Oshodi, Ikotun, Egbe, Ejigbo, Isolo Agodo, Isaga-Tedo, Okuta, Ilasamaja, Ijegun, Iseri-Oshun, Festac, Omuwo-Odofin, Kirikiri, Oluti, Satelite Town, Ojo
Zone 5	Eric Moore, Iganmu, Orile-Iganmu, Coker, Amukoko, Ijora, Alaba, Ajegunle, Malu Road, Olodi Apapa, Apapa, Tin-Can Island, Ibafon, Snake Island
Zone 6	Lagos Island, Victoria Island and Annex, Obalende, Ikoyi, Maroko, Lekki, Pennisula, Eti-Osa, Lekki Epe Road
Zone 7	Akoka, Abule-ijesha, Yaba, Onike, Iwaya, Makoko, Ebute-Metta, Alaka, Oyingbo, Oto, Iddo, Surulere, Ikate, Itire, Aguda, Ijesha
Zone 8	All villages, towns and suburbs in ikorodu, Epe, Ibeju-Lekki and Badagry Local Government Areas

Source: World Environmental System (WES) report 1997

Of particular interest are zones 1, 3, 4 and 5, which have drainage, link to the Lagos lagoon while the other zones empty into the Atlantic via other rivers and streams. The industries

in the zones are characterized into sectoral groups and sub-sectors according to Manufacturer's Association of Nigeria (MAN) as indicated below in Table 2.2

Industry sector	SIC No	Number of Industries										
		Zone 1	*Zone 2*	*Zone 3*	*Zone 4*	*Zone 5*	*Zone 6*	*Zone 7*	*Zone 8*	*Zone 9*	*Zone 10*	*Total*
Vegetable Oil mill	3115	1	0	2	10	0	0	0	2	0	0	15
Food processing	3121	33	16	11	13	21	10	9	16	7	7	143
Distilleries	3131	4	0	0	0	0	0	1	0	0	0	5
Breweries (Malt & Liquor)	3133	1	0	0	0	1	0	0	0	0	1	3
Soft drinks	3134	5	0	2	6	3	0	0	2	0	2	20
Textiles	3210	10	0	26	23	9	0	0	5	4	3	80
Pulp &Paper	3411	15	1	13	2	6	0	0	1	5	3	46
Printing & Publishing	3420	27	13	58	12	1	8	21	1	3	1	145
Industrial Chemicals	3511	12	2	5	20	7	0	3	2	7	10	68
Tubes and Tyres	3551	1	0	1	1	0	0	0	0	0	0	3
Plastics	3513	29	13	23	32	20	0	5	5	3	12	142
Foam	3513	7	2	2	2	0	0	0	1	0	0	14
Polymer Packaging	3513	3	1	5	1	4	0	0	1	0	0	15
Paint	3521	12	4	1	5	4	0	0	0	0	0	26
Pharmaceuticals	3522		8	13	9	5	0	4	0	4	5	71
Soap & Detergents	3523	18	5	10	10	6	1	2	1	3	3	59
Glass	3620	1	0	3	0	1	0	0	0	1	0	6
Cement Bagging	3692	0	0	0	0	2	0	0	0	0	0	2
Steel works	3710	7	3	6	5	2	0	0	0	5	4	32
Metal fabrication	3819	56	16	15	26	9	1	5	4	4	11	147
Petroleum product Retail & Tank farms	6200	26	49	35	29	40	20	38	24	5	8	274
Total		294	153	231	207	144	40	88	66	51	70	1316

Table 2.2: Distribution of Medium and Large-scale industries in Lagos as at 2003/2004

Source : World Environmental System Report, 1997

Table 2.3: List of Industrial Estates in Lagos State with the number of Medium-Large Scale Chemical and Related Industries

Industrial Estates	Fertilizer	Refinery	Plastic & Rubber	Paints/Dyes	Textiles	Tanneries	Foods	Metallurgical	Manufacturing	Pharmaceutical Chemicals
Ikeja	-	-	7	3	4	-	10	2	4	6
Apapa	-	-	6	2	3	-	8	5	2	1
Ilupeju	-	-	3	1	1	-	2	3	2	6
Iganmu	-	-	2	2	5	-	2	2		
Oshodi	-	-	2		1	-	2	1		

Source: Ajao (1989)

2.1 Industrial Effluents and Waste Water

Industrial effluents and waste water are the liquid forms of industrial waste discharge stream. The level of industrial effluent and waste water generation has been estimated using the WHO (1989) model, which has been effective in many countries for the rapid estimation of industrial pollution load, particularly where primary data is lacking.

There are about 2000 industries in Lagos Metropolis, the majority of which discharge their effluents into Sasa and Odo Iya Alaro streams in the densely populated and heavily industrialized Ikeja suburb. The water quality of the rivers based on parameters such as pH, BOD, turbidity, colour, total suspended solid, oil and grease, pesticides and heavy metal as well as total coliform exceed the standards of WHO and Federal Ministry of Environment. All fresh water bodies in Lagos state and the Ogun River drain into the Lagos lagoon. Over 60 percent of Nigeria's industrial activity, including 300 industries on 12 industrial estates is located in Lagos. The major polluters in the city are textile, food processing, metallurgical (electroplating), rubber and plastic, pharmaceutical and chemical, and paint facilities. Five of the industrial estates, Ikeja, Apapa, Ilupeju, Iganmu, and Oshodi, contain the majority of large- and medium-sized industries (see Table 2.3).

2.2 Estimate effluent discharge (Classification of industrial waste discharge stream)

Liquid waste arising from industries is of different nature/component. The primary component of liquid waste generated by industries is waste water which accounts for more than 99.95% by volume of the total amount generated while the remaining 0.05% is a variety of materials such as spent lubricants, paint, solvents, etc, which may be held in solid containers for awhile before disposal or are indiscriminately discharged through the drainage channels. Industrial waste water is of significant environmental concern because most are polluting in nature and greatly impair the quality of receiving environments into which they are discharged. Such environments include aquatic systems and open land surfaces. The characteristic of waste water usually reflects the nature of the inputs and outputs of the industry. Thus industries that utilize hazardous materials tend to discharge

some of these wastes along with the waste water. Typical characteristics of waste water and the estimated volume of waste water generated by industries in an untreated state are shown below in *Table 2.4.*

Table 2.4: Estimated Volume of Wastewater (m^3/yr) generated by Industries

Industry Sector	Total	%
Bulk fuel Terminal	*120,000*	*0.37*
Cement bagging	*100,000*	*0.31*
Dairy	*70,000*	*0.22*
Distilleries	*100,000*	*0.31*
Food processing	*160,000*	*4.98*
Glass	*180,000*	*0.56*
Grain milling	*28,000*	*0.09*
Industrial Chemicals	*612,000*	*19.07*
Malt and Liquor (Breweries)	*600,000*	*18.09*
Metal Fabrication	*147,000*	*4.58*
Paints	*80,000*	*0.25*
Pharmaceuticals	*200,000*	*6.23*
Plastics	*140,000*	*4.36*
Printing and Publications	*144,000*	*4.49*
Pulp and Paper	*86,000*	*2.68*
Soap and Detergent	*177,000*	*5.51*
Soft Drinks	*720,000*	*2.24*
Steel Works	*160,000*	*0.50*
Textiles	*736,000*	*23.93*
Tubes and Tyres	*30,000*	*0.09*
Vegetable oil Mills	*22,000*	*0.69*
Total	***3,182,800***	***100***

Source: Ogungbuyi, Onyekwelu & Jinadu, 2003

The contamination of water bodies through wastewater discharge from industries is the most common source of pollution of streams and rivers in urban center. The attendant impairment of the physical quality of such water bodies ultimately impacts on the food chain and general ecological systems.

Table 2.5 Analysis of Environmental Audit Report from Industries Year 2000 -2003

S/N	Industry Sector	Average Wastewater Volume M^3/yr	% With Primary Wastewater Treatment Facility & Type	Wastewater discharge path
1	Food Beverages & Tobacco	9025000	50	Sewers, drain and Water course
2	Textile apparel & Footwear	3360000	48	Sewers, drain and canals

3	Wood & Wood Product	No data	No data	Water course
4	Pulp, Paper, Publishing	3260000	30-primary	Sewers, drain and Water course
5	Chemical & Pharmaceutical	10090000	50	Sewers, drain and Water course
6	Non-metallic & Mineral Products	280000	20	Sewers, drain and Water course
7	Domestic/Industrial Plastic rubber	1400000	35	Sewers, drain and Water course
8	Electrical & Electronics	No data	No data	Water course
9	Basic metal, Iron & Steel	1630000	20	Water course
10	Motor Vehicle & Miscellaneous Assembly	No data	No data	Water course

Source: Ogungbuyi, Onyekwelu & Jinadu

Source of Wastewater

There are four sources from which wastewater can arise. These include:

- Excess process water, which has been used for solution-making, reactions, mixing, etc. This is often laden with dissolved solutes of the industrial raw materials and products and has characteristics, which are typical of the nature of the specific industry.
- Water used for washing reaction vessels in industry. These also have characteristic similar to those of process water.
- Water used for washing factory floor and general facilities. These are not often strongly polluting in nature if channeled out differently from the process and wash water.
- Wastewater derived from the use of conveniences such as factory kitchens, bathroom and toilet. In some cases, kitchen and bathroom wastewater are channeled along with the toilet wastewater into the sewerage systems.

2.2.1 Estimate of total industrial load for the Lagos lagoon

According to Ogungbuyi *et al* (2003), the water pollution load derivable from each industry inventories calculated using the rapid pollution load estimation of the World Health Organisation (WHO, 1989). The total wastewater pollution load estimated to about 39,350 metric tones per annum, of which about 20,000 tonnes and 10,300 tonnes are derived from BOD and oil respectively (*See Table 2.7*). Five major industries contributed about 92% of this total load, these include textile (53.5%), Vegetable oil milling (19.7%), Foam production (11.6%), Brewery (5.8%) and Industrial chemicals (2.2%). The remaining 7.7% is contributed by the other sectors.

From the available data, it can only be inferred that the numbers of companies in Lagos state complying with effluent limitation standard is low despite the installation of effluent treatment plant in some of the companies. In addition, the pollution load from non-point sources such as sewage and urban runoff is unabated despite economic downturn and is yet to be quantified.

2.3 Analysis of responses on mode of channeling of wastewater

Additional to water emanating from factory activities is the contribution of rain water runoff to the total load of wastewater from the factory. The characteristic of a sample effluent wastewater around a given factory depends on the extent of combination of these various sources of wastewater in most cases; the various sources of wastewater are combined and discharged through one outlet. Few industries, however, have more than one outlet for the different wastewater sources. *Table 2.6* indicates the analysis of response of the various industries on mode of channeling their wastewater.

Table 2.6: Analysis of responses on mode of channeling of wastewater from Lagos state industries

Type of Industrial wastewater	Percentage of response
Combined effluent	42.9
Separate process water	26.5
Sewerage	12.2
Rain run off	14.3
Others	4.1

Source: Federal Ministry of Environment, 2002

Table 2.7: Wastewater Pollution Load (mt/yr) for Lagos State Industries

Industry Sector	Standard Industrial Code	Number	Total Product Output	BOD	Suspended solid	Oil	Nitrogen	Phosphorus	Others	Water Pollution Load(total)
Total				20158	8702	10313	4.94	0.8	166	
Textile	3210	92	291870	11100	4210	5553	-	-	Chromium – 144, Phenol – 21.6	21028
Vegetable Oil Mills	3113	15	100000	2490	2450	2810	-	-	-	7750
Foams Production	3513	14	500000	2500	580	1500	-	-	-	4580
Brewery	3133	3	89600	1638	636	-	-	-	-	2274
Industrial Chemicals	3511	68	2176000	816	59.8	-	-	-	-	876
Plastic	3513	142	100630	372	114	302	-	-	-	788
Pulp & Paper	3411	46	48936	269	513	-	-	-	-	782
Food Processing	3121	146	584000	526	52.2	135	2.92	-	-	529
Polymer Packaging	3513	15	45000	18.9	31.0	1.08	-	-	-	206
Steel Works	3710	32	1585390	115	45	4.0	-	-	Phenols – 0.04, Cyanide – 0.14, Fluorine – 0.10	116
Soap & Detergent	3523	59	150000	75.0	5.72	5.4	-	-	-	110
Metal Fabrication	3819	147	7871185	94.1	5.6	2.29	0.88	-	Phenols – 0.3, Cyanide – 0.10, Fluorine – 0.06	95.2
Tube & Tyre	3551	3	45000	18	-	-	-	-	-	68.4
Distilleries	3131	5	166670	62.2	-	-	-	-	-	62.2
Pharmaceuticals	3522	71	5730	47	-	-	1.4	0.8	-	56.9
Soft Drinks	3134	16	8000	16.8	-	-	-	-	-	22.4
Printing / Publishing	3420	145	50000	-	-	-	-	-	-	0.0
Paints	3521	26	105070	-	-	-	-	-	-	0.0
Glass	3620	6	960	-	-	-	-	-	-	0.0
Cement Bagging	3692	2	800000	-	-	-	-	-	-	0.0
Petroleum Products Retail	6200	274	221310M3	-	-	-	-	-	-	0.0

Source: Ogungbuyi, Onyekwelu & Jinadu,2003

Section Three

3.0 Persistent Organic Pollutants (POPs); sources and their impacts on marine environment

Persistent Organic Pollutants (POPs) are a class of chemicals that persist in the environment, capable of long-range transport, bio accumulate in human and animal tissue, and have significant impacts on human health and the environment, even at low concentration. They include such substances as dioxin, PCBs and DDT. POPs can concentrate in living organisms, including humans, to levels that can injure human health and the environment. Most POPs are synthesized substances, including by-products generated as a result of human and natural activity, of which human activity accounts for the major proportion of releases. POPs are very stable compounds that resist chemical and physical degradation in the environment. Consequently, these compounds can persist from months to years in the environment.

POPs exhibit low, but non-negligible, solubility in water but are characterized by high fat solubility. For this reason, they accumulate in fatty tissues of living organisms. POPs reach the greatest magnitudes in predatory birds, mammals and humans. Organisms, such as fish, can absorb POPs directly from the environment with the result that they may have concentrations many thousand times greater than those in their surrounding environment. The first exposure in humans occurs in the foetus, when a percentage of the maternal "burden" of POPs in fatty tissue (POPs accumulated throughout the mother's life) is transported across the placenta. The main human pathway of exposure is through food. Inhalation and dermal contact are also routes of exposure, particularly with regard to pesticide POPs. POPs exposure are often highly pronounced in peoples whose diet include large amount of wild food such as fish, marine mammals or other aquatic foodstuff, especially where such people inhabit.

A number of organochlorine pesticides (OCPs) have been found to have POPs characteristics. Anthropogenic activities provide the primary source of chlorinated hydrocarbons input into the aquatic environment. The OCPs enter the aquatic environment

mainly by deliberate application or accidentally, while the PCBs entry into the aquatic environment is indirect and principally accidental. Ground spraying application of OCPs especially DDT, dieldrin and endosulfan to control vectors for human and livestock diseases are also important source of contamination of the aquatic ecosystems.

3.1 Identification of discharge streams and emissions related to POPs chemicals

Starting in 1970s country one after the other restricted the use of some of the POPs pesticides inclusive of Nigeria, often with the use of DDT for public health applications (De-ratting ports) as the only exemption in Nigeria. The last known use for each of the POPs pesticides is summarized in *Table 3.1.*

Table 3.1: POP Pesticides and example of last known uses

POP pesticide	Last known Uses	Remarks
Aldrin	Against Termites and other soil pests, termites attacking building materials, in grain storage and for vector control	*Some label still found in local markets in Lagos State*
Toxaphene (Camphechlor)	Control of insects pest in cotton and other crops	*Not available in the market and no cotton growers in Lagos State*
Chlordane	Against termites and other soil pests, termites attacking building materials	
DDT	Control of medical and veterinary vector such as malaria-transmitting mosquitoes, plague-transmitting fleas and trypanosomiasis-transmitting tsetse flies	*Limited use in De-ratting of Ports*
Dieldrin	Control of locust, termite, human disease vectors	*Limited use in De-ratting of Ports*
Endrin	Formerly used against insects and rodents	*No current use are known*
Heptachlor	Against termites and other soil pest, termites attacking building material	
HCB	Formerly used for seed treatment against fungal diseases, as well as for industrial purposes	*No current uses are known*
Mirex	Against leaf cutting ants, termites in buildings and outdoors, and also as a fire retardant and for other industrial process	

For POPs such as the industrial chemical and byproduct mainly Polychlorinated biphenyls (PCB) and dioxins and furans; special attention is given to fossil fuel-fired utility and industrial boilers, waste oil, metallurgical (copper, iron and steel, aluminium and zinc) and chemical industries in Lagos state.

3.2 Some identified industrial sector with POP waste streams in Lagos State

3.2.1 Wood Preserving

Wood preservations are being practiced by the Saw millers at Oko Baba in Lagos state, which involves imparting protective properties to wood to guard against weathering and attacks by pest. Three main types of preservative are used: water based (for example, sodium phenylphenoxide, benzalconium chloride, guazatin, and copper chrome arsenate); organic solvent based (for example, pentachlorophenol and such substitutes as propiconazol, tebuconazzol, lindane, permethrin, triazoles, tributyltin compounds, and copper and zinc naphthenates); borates; and tar oils (such as creosote).

The preservatives are applied, with a pressure or by deluging (mechanical application by flooding or spraying,) and by dipping or immersion and by thermal processing. Any or all of the substances used in wood preserving, such as preservatives and solvents can be found in drips and surface runoff streams. Some of the major pollutants present in drips, surface runoff and contaminated soil include polynuclear aromatic hydrocarbons, pentachlorophenol, pesticides, dioxin, chrome, copper, and arsenic as indicated in *Table 3.2.*

Table 3.2: Effluents (including surface runoff) from the Wood Preserving Industry (milligram per litre, except for PH)

Parameter	**Maximum value**
PH	6-9
TSS	50
COD	150
Oil and Grease	10
Phenol	0.5
Arsenic	0.1
Chromium Hexavalent	0.1
Chromium Total	0.5
Copper	0.5
Fluorides	20
Polynuclear aromatic hydrocarbons	0.05

(PAHs), as benzo-a-pyrene (each)	
Dioxins/furans (total)	0.0005
Pesticides(each)	0.05

Source: World Bank handbook, 1998

3.2.2 Printing

The printing industry in Lagos State is very diverse, as can be seen in a number of different products that bears some forms of printing-books, daily newspapers, periodicals, packaging, cartons, carrier bags, drink containers, signs, forms, brochures, advertisements, wallpaper, textiles, sheeting, metal foils, and so on.

Emission into the air mainly consists of organic solvents and other organic compounds. Some substance may cause unpleasant odours or affect health and the environment. Discharges to water bodies mainly consist of silver, copper, chromium, organic solvents and other toxic organic compounds. Other forms of waste consist of environmentally hazardous waste such as photographic and residual chemicals, metal hydroxide sludge, dyestuff and solvent residues, wiping materials containing dye and solvents and oil spills. There is also bulky waste such as paper that is being generated.

3.2.3 Textiles Industry

The textile industry in Lagos State are enormous, they include Afprint, Nichemtex etc. They use vegetable fibres such as cotton; animal fibres such as wool and silk; and a wide range of synthetic materials such as nylon, polyester and acrylics. The production of natural fibres is approximately equal in amount to the production of synthetic fibres. Polyester accounts for about 50% of synthetics. The stages of textile production are fibre production, fibres processing and spinning, yarn preparation, fabric production, bleaching, dyeing and printing, and finishing. Each stage generates wastes that require proper management.

Textile production involves a lot of wet processes that may use solvents. Large amount of water is being used for their process and these contributed to their high amount of wastewater being discharge into Lagos State by the sector. Emissions of volatile organic

compounds (VOCs) mainly arise from textile finishing, drying processes, and solvent use. VOC concentrations vary from 10 milligrams of carbon per cubic meter (mg/m^3) for the thermo sol process to 350 mg carbon/m^3 for the drying and condensational process.

3.2.4 Power source generation and heating

The thermal power generating plants located in Egbin Thermal Station, Lagos are situated beside the Lagos lagoon. The plants utilize natural gases to generate electricity and fossil fuel to operate their combustion chamber. In addition, the plants also utilize the water body for their water injection process and cooling systems respectively. For instance, the plants utilize the combined cycle units (or barges) that burn fuel in a combustion chamber and the exhaust gases are used to drive a turbine.

The wastes generated by the thermal power plants are typical of those from combustion process. The concentrations of their pollutants in the exhaust gases are a function of the firing configuration, operating practices, and fuel consumption. Gas-fired plants generally produce negligible quantities of carbon dioxide, a greenhouse gas. The area of concern is in the fresh water uptake and impact of its wastewater discharge with high heating values and biocides contaminants. However, PCBs have been employed in a multitude of applications, many of which are still in use today in the state, including dielectric fluids in electrical equipment, heat transfer fluids in mechanical operations, Plasticizer, lubricant, inks and surface coatings, of concern is PCB emission that may arise in the course of servicing/repairing and decommissioning or as a result of damaged equipment such as electrical transformers and capacitors which are found in all factories in Lagos because of the need to privately generate electricity for internal usage.

3.3 Ecological impacts of POPs and related substances on environment and human health

POPs are known to bio-accumulate in food chain, and cancerous, also impact negatively on human health. The organochlorine pesticides (OCPs), for example DDT, dieldrin and industrial chemicals like PCBs, their metabolites or conversion products have been

reported to be ecologically harmful and toxic to humans as well, the acute toxicity of OCPs to aquatic organism has been become evident in the past by significant fish kills associated with the accidental release of DDT, toxaphene, dieldrin, aldrin and heptachlor into aquatic environment (Eichelberger and Lichtenberg, 1971; Heydorn, 1970). Nowadays, contamination of water with these recalcitrant chemicals often results in bioaccumulation in fish and other biota, sometimes to biologically active levels. Hence, these chemicals have been suspected to be cancer-causing agents in fish and other aquatic organisms (GESAMP, 1991).

Fish eating birds are at risk of population decrease and even extinction, as a consequence of reproductive failures resulting from eating aquatic organisms contaminated with chemicals. This is because chlorinated hydrocarbons can cause eggshell thinning or impair the process of formation of eggshell of several species of birds by interfering with the deposition of calcium (Trape, 1985; Matthiessen and Roberts, 1982; Koeman et al., 1978).

In Nigeria, Ajao (1989) revealed the effects of domestic and industrial effluents on populations of sessile and benthic organisms in Lagos lagoon. Another study conducted by Oyewo (1998) on the chemical survey effluents from major categories of industries in Lagos metropolis, namely Chemical & Allied Textile, Food & Beverages, Soaps, Detergent and Cosmetics revealed that all of them contained several heavy metals. The predominant metals on the basis of concentration levels were, Fe, Cu, Co, Zn, Mn, Cd, Pb, Cr, Ni and Hg in a descending order. The study showed that the prominent metals in the effluents were also the most abundant in sediments and water columns of the Lagos lagoon as well as a typical drainage channel that receives industrial effluents and empty into the lagoon, thus establishing industrial effluents as a major source of heavy metals found in the Lagos lagoon. It was estimated that a total of 236,000kg of heavy metals were discharged annually from industrial effluents into the recipient channels and rivers, with most eventually entering the Lagos lagoon system.

In a recent report by Ezemonye Lawrence (2004) on the management of Persistence Organic Pollutants (POPs) such as PCBs as contaminants of concern, the report revealed that the health risk posed by industrial POPs, such as PCBs is a major risk to man and other organisms in the environment. Studies with humans who were exposed accidentally or through the consumption of contaminated fish have shown that PCBs alter endocrine, immune and nervous system functions, particularly in developing children (Fischer et al, 2003).

Section Four

4.0 Mitigation measures

There is need for effective management and utilization of the Lagos lagoon resources for sustained ecological and economic development through overcoming key problems areas such as non enforcement of existing legislation and regulations that relate directly or indirectly to environmental degradation and pollution in the coastal zone; non integration of environmental concerns into existing project and economic activities in the zone; non clarification and harmonization of respective responsibilities and functions of the different Government Agencies among the Federal, State and Local Government; existing gap in environmental data base for the Lagos lagoon zone.

An integrated resource management approach is required to address the broad range of social and environmental issues affecting the lagoon towards a sustainable development in which economic and social benefits from the lagoon resources are managed to maximize social welfare and not dissipated by disruptive practices or inappropriate use. It is an ecologically and socially based approach to environmental management that is a significant departure from traditional sectoral approaches which have been proven unable to deal with the complexity that characterizes coastal zone resource problems.

4.1 Government's (State and Federal) effort in POPs management

The following action should be carried by government as priority plan towards mitigating the growing lagoon pollution in Lagos state.

- Review and stream line existing legislation and regulation affecting the Lagos lagoon in order to reduce overlap and conflicts.
- There is also a need to update and bring the various legislation in line with current scientific knowledge.
- Increase the effectiveness of existing regulation. Priority areas should include Environmental Impact Assessment, Pollution Control and coastal setback lines through enforcement of land use policy.
- Enforce guideline and criteria for environmental impact assessment (EIA) and ensure observance.
- Review existing regulations and guidelines for the disposals of hazardous waste (including expired chemicals and POPs) and ensure their implementation.
- Initiate programmes aimed at redressing aquatic resource degradation and rehabilitating degraded coastal habitats such as mangroves, corals and beaches.
- Institute and implement a "Polluter Pays" principle in order to minimize (particularly industrial) pollution.