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LEVEL OF SHIPPING POLLUTION AND ITS EFFECTS ON LAGOS SEAPORTS ENVIRONMENT, NIGERIA

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Abstract: **The aim of the study is to determine the effects of shipping pollution oil on Lagos seaports environment, while the specific objectives are to examine the trend of shipping pollution from 2006 - 2022 and to determine the shipping pollution level at Lagos seaports. Trend analysis, mean analysis and standard deviation covariance were used to determine the effects of shipping pollution in the Lagos seaports environment. The trend of shipping pollution oil with p – value 0.06 indicates weak impact on water quality. Governance structures do not allow dumping of garbage at Lagos seaports. The 0.87 p – value was the number of garbage handled by the African Circle Limited at Lagos seaports. The shipping pollution level at 0.51 p - value implies significant pollution in the Lagos seaports environment. The study recommended infrastructure upgrades by shipping companies and enforcement of regulations by the government in the Lagos seaports environment, Nigeria.**

Keywords: **Pollution, shipping, environment and seaport**

I. INTRODUCTION

Vikas and Dwarakish, (2015) define marine pollution as the introduction by man, directly or indirectly of substances or energy into marine environment such as estuaries, which has effects on living resources and marine life. It poses hazards to human health, hindrance to marine activities including fishing and other legitimate uses of the sea, impairment of quality for use of sea and reduction of amenities. In order to specifically define marine pollution posed by the shipping operation, the term ship means, a vessel of any type whatsoever, operating in the marine environment and includes hydrofoil boats, air-cushion vehicles, submersibles, floating craft and fixed or floating platforms in accordance with the international convention for prevention of pollution from ships (MARPOL 73/78 convention). Considering a ship as a facility presenting a direct hazard to marine environment, it is appropriate to refer to the definition from the protocol of 1992 on civil liability from oil pollution damage. Ulewicz and Yaroslav (2021) define ship as any sea-going vessel and seaborne craft of any type whatsoever constructed or adapted for the carriage of oil in bulk as cargo. Provided that a ship capable of carrying oil and other cargoes shall be regarded as a ship only when it is actually

carrying oil in bulk as cargo and during any voyage following such carriage, unless it is proved that it has no residues of such carriage of oil in bulk aboard.

Shipping pollution emanates from cargo carried or waste generated on-board, which usually contain oil or oily mixtures and noxious substances. They accumulate from machinery operation or from domestic activities of the crew living on-board. Ship borne pollutants include garbage, solid waste and antifouling paints on ship hulls (Umo & Nitonye, 2015). According to Ismail (2015), 3.2 million tons of oil are discharge per year from all sources into the environment. Ship operations are one of the main sources of oil pollution in the marine environment, especially operating giant oil tanker vessels to transport oil from production regions to consumers. It is not only the risks of catastrophic oil spills when ships ground or collide, the most serious types of oil pollution for the Gulf environment were created as a result of wars in the Arabian Gulf region. For instance, during the Iran-Iraq war, from 1980-1988, at least 80 ships were sunk, many of which were carrying oil and ammunitions, which resulted into chronic sources of pollution in the Arabian Gulf for many years. In 1991, during the second Gulf war, a greater amount of oil spilled into open waters of Arabian Gulf estimated to about 6 million oil barrels were considered the largest spills in history (Poonian, 2003).

The ship generates emissions while maneuvering in and out of ports and at berth. The primary concern with emissions of pollutants by ships while at berth is the release of poisonous gases that can harm the ports environment and the crew on-board the ship. At closer proximities to seaports, the major concern is the quality of water and the negative effects on people's health at seaport's environment and within seaports cities (Cullinane & Cullinane, 2013). Ships generate about 55-57% of the total environmental emissions while at ports (Hulscote & Gon, 2010). Pollution from non-accidental sources continues unabated, and some port authorities have been found wanting regarding the provision of the requisite port waste reception facilities. The implication is that an increase in marine pollution from ship-based discharges will occur in these ports as time goes on. In West and Central African ports, facilities are becoming available at various forms but remains inadequate. Hence, ship waste collection processes at the ports are inefficient and the management remains poor (Barn-Dabban, Koppen & Mol, 2017).

Seaports are characterize by several complex operations when compared with other logistic modes. Environmental pollution assessments from ports and jetties are complicated due to the various types of pollution sources and their different characteristics. Pollution from port areas comes not only from ferries, ships and trade, but also from industrial activities, shipyard activities and auxiliary services. Port pollution can produce negative effects to natural ecosystem and urban population (Kamali, 2017; Mesp, 2017). Effects of ship-based pollution on port environment include introduction of non-indigenous species to the aquatic environment (which threatens the sea animal population) and the negative effects on economies of the countries that depend on commercial fishing. For example, fisheries in the West African ecosystems generate some 500 million euros annually and over 600,000 men depend directly on fishing and fishery-related industries (Kloff & Wicks, 2017).

II. STATEMENT OF THE RESEARCH PROBLEMS

Nigeria ports were concession in 2006 for better service delivery and proficiency. The policy aimed at reducing time spent at berth of ships and promotion of efficiency. The implications will result to increase in the number of ships' visits and this invariably will increase the shipping pollution level. For example, between 2008 and 2011, there were 32% and 18% increases in the quantities of garbage and oily waste handled respectively in Nigeria's Tin Can Island port waste reception facilities alone (Momoh, 2017). Despite the existing literatures, no previous study addresses shipping pollution level in the Lagos seaports environment. As such, trend analysis is required to determine the shipping pollution level through mean average and there is need also to carry out impact assessment of water quality standard in the Lagos seaports environment, Nigeria.

III. AIM AND OBJECTIVES OF THE STUDY

The aim of the study is to determine the effects of shipping pollution on Lagos seaports environment with a view to proffering measures for efficient seaports management in Nigeria.

The specific objectives of the study are to:

i. examine the trend of shipping pollution in the Lagos seaports environment, Nigeria;
ii. determine the level of shipping pollution in the study area

IV. RELATED REVIEWS

Marine operations in ports have caused environmental pollution, which affects the normal living conditions of both human and aquatic life. The sources of environmental pollution from ports can be from tanker accidents, noise pollution, marine machinery exhaust, wastewater discharge from ships at ports, oily water discharge from ships, garbage and other solid waste, anti-fouling paints (Umo & Nitonye, 2015). In ports, jetties and harbours, cargo operations can cause accidental discharges and emissions. Handling of dry bulk produces dust, and liquid bulk can cause leaks and spillages, while atmospheric pollution can come from cargo vapour emissions (Sustainable shipping.com, 2008).Any release of cargoes or waste into the marine environment has direct effect on the environment, and may result in oxygen depletion on their breakdown. Most pollution from ports is caused by human error or negligence, either directly or

indirectly through the introduction of substances or energy into the marine environment including estuaries, waste generated by cleaning of port docks, cleaning of ships and leakages of liquid from goods. All these cause harm to living resources, hit on marine life, decline in seafood production, hazard to human health (stem and lungs diseases to port workers), hindrances to marine activities including fishing, impairment of quality for use of sea water and reduction of amenities (FCEC, 2014).

Oil spills can cause a wide range of impacts in the marine environment and are often portray by the media as environmental disasters with dire consequences, predicted for the survival of marine flora and fauna. In a major incident, the short-term environmental impact can be severe, causing serious distress to eco-systems and to the people living near the contaminated coastline, affecting their livelihoods and impairing their quality of life. According to Clark (2001), oil spills into sea through tankers wash and other routing shipping operations cause large harmful effects to marine species, and the surrounding environment. According to Mascarelli (2010), about 75 – 90 percent creatures in the Northern Gulf spend part of their lives on estuary water and water-lands. The creatures can be lost due to spill and therefore results in destruction of the eco-systems. Peterson (2003) stated that a distance event such as burrowing animals or a severe storm can rework the beach and re-introduces the un-weathered oil into the water and eventually affects the marine organism.

Akpomuvie (2011) recorded 1979 Forcados terminal accident in which about 570,000 barrels of oil spilled and the Apoi North spill in 1980, which involved an estimated 280,000 barrels of oil. Oil tanker vessel accidents are one of the most dangerous sources of oil pollution in the marine environment. A major disaster occurred on March 18, 1967. Torrey Canyon was one of the large super tankers and one of the first largest oil spills. The ship was redesign from 60,000 - 120,000 capacity. That was the quantity the ship was carrying when it hits a reef and off the coast of Cornwall (UK).The spill formed an oil slick measuring 270 square miles, polluting 180 miles of coastland with many other catastrophic consequences (Al-Azab, 2005). Amoco Cadiz off the Coast of Brittany (France) spilled 200, 000 tons (1.5 million barrels). Torrey canyon, Barer, Sea Empress and the super tanker Brea off the Coast of Shetland (UK) in 1993, spilled a maximum of 84,000 tons (607, 300 barrels). Exxon Valdez spills in Prince William Sound or Alaska (US) was approximately 36, 224 tons (261, 904 barrels). An accepted average sample of an oil spill is about 700 tons 5, 061 barrels (ITOPF, 1990).

Effects of shipping pollution on ports environment include the introduction of non-indigenous species to the aquatic environment (which threatens the sea animal population) and have negative effects on the economies of countries that depend on them. For example, fisheries in West African eco-system generate 500 million euros annually, and over 600,000 men depend directly on fishing and fishery related industries (Elenwo & Akankali, 2015).The industry that is worst hit by pollution of marine environment is the fishing industry. Oil spills from ships on ports and jetties cover the fishes. As they swallow this poisonous water, some die, others become weak and endanger the life of anything that consume them. The economic impact of this pollution is far-reaching since it affects population of seafood. The local economy that depends on these industries can devastate by a large-scale disaster (IMO, 2014; Elenwo & Akankali, 2015). Another industry that can be affected and suffer due to marine pollution is the Tourist industry. Holi - cruise tourist resort at Isaka town between Port Harcourt portand Okrika Jetty stop operating mainly due to environmental pollution. If spilled oil reaches the shore, it contaminates the inter-tidal zone and the beaches. The local tourist industry suffers aesthetic beauty due to oil slick. Industries that rely on clean seawater for routine operations have to stop when water is clean. The harmful effects of oil spill on the environment kill plants and animals in the estuarine zone. Oil settles on beaches and kills the organisms that live there. It also settles on oceans floor and kill the benthic (bottom dwelling) organisms such as crabs. Oil poisons, disrupt major food chains and decreases the yield of edible crustaceans. It also coats birds, impair their flight or reduce the isolative property of their feathers, thus making the birds more vulnerable to cold. Oil endangers fish hatcheries and contaminates the flesh of commercially valuable fish. It is evident that the impact of oil on eco-systems is largely dependent on exposure concentration (Almeda, 2013; Fulfordl, 2014). Thus, the risk of exposure to toxic concentration is a critical element in the evaluation of environmental risk. Fingas (2001) indicates that spread of oil spill into marine environment is through spreading, movement, evaporation, dissolution, natural dispersion, emulsification, photo-oxidation, sedimentation, shoreline, stranding and biodegradation.

Ndubisi and Asia (2007) indicate that toxicity cause human respiratory illness leading to kidney disease, neurological disease and potential death. According to Ukoli (2006), oil-film floating on water surface prevents natural aeration and leads to the death of fresh water or marine life and retardation of vegetation growth on land and soil infertility for a long time. According to Twumasi and Merem (2006), the adverse effects of oil spill on marine habitat contaminate and poses enormous human health risk from consumption of contaminated seafood. According to Adegoke (2013), the quantity of oil spilled over 50 years was at least 9 – 13 million barrels, which is equivalent to 50 Exxon Valdez spills.

4.1Empirical Review

In consonance with the trend of shipping pollution in the Lagos seaports environment, the study reviewed the work of Umo and Nitonye (2015) titled “The Effects and Solutions

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of Marine Pollution from Ships in the Nigeria's Waterways". The study identified the causes of marine pollution on human health, determined the effects of IMO regulations in controlling marine pollution through shipping activities and assessed the effects of marine pollution on fishing activities. In achieving the set objectives, researchers adopted the method of questionnaire/descriptive to find out the effects and solution to marine pollution from ships in the Nigeria's waterways. Sampling method used were not probability as the researchers formulated research questions and picked respondents who in their opinion were likely to possess the deserved set of information. About 50 copies of questionnaire were administered for the research.

According to the study, 97.3% of the respondents submitted that marine pollution had adverse effects on marine environment, marine life and human life. The result also indicated that a greater percentage of the respondents believed that laid down regulations by IMO can save our marine environment if adhere to. Result obtained in monitoring, control and prevention of marine pollution was in alignment with the standard practice laid down by the IMO. After analysis, 84.7% of the respondents indicated that pollution of marine environment and aquatic life affected the economy and the health of such community. Solution to prevention of pollution of aquatic environment was an enforcement of necessary laws by the government in line with IMO regulations. There was need to ensure full compliance by the operators within the industry in order to conserve and protect the aquatic resources, provide safe sea food for human consumption and protect means of livelihood. Sampling method adopted was subjective to the researchers' opinion in the selection of respondents. The method was bias since it was not scientific. The study provided helpful information in prevention of marine pollution from shipping activities on Nigeria's waterways.

V. METHODOLOGY

5.1 Research Design

The study adopted ex-post facto method to examine the trend of shipping pollution and level of shipping pollution in the Lagos seaports environment, Nigeria. Secondary data were obtained from the Nigeria Maritime Administration and Safety Agency (NIMASA), and Nigeria Port Authority (NPA), which include the trend of shipping pollution and the level of shipping pollution in the Lagos seaports environment, Nigeria. The secondary data sourced from the Nigeria Port Authority NPA (2023) include shipping pollution oil and garbage between 2006 and 2022. Trend analysis, standard deviation covariance and correlation coefficient were the methods adopted to examine the trend of shipping pollution. Mean analysis and standard deviation were the methods used to determine the level of shipping pollution.

5.2Study Area

The study area comprises Apapa port, the oldest and the biggest port in Nigeria and Tin Can Island port. Both of them are located at close proximity within the commercial hub of the city of Lagos, Nigeria. Apapa port also known as Lagos port established in 1913, located in Apapa Local Government Area of broad western branch, off the main channel of the harbour on latitude 6.45528^{o}north and on longitude 3.364084^{o} east. Tin Can Island port is located on latitude 6.435316^{o} north and longitude 3.334329^{o} east and located at a close proximity to Apapa port in Apapa Local Government Area of Lagos State, Nigeria.

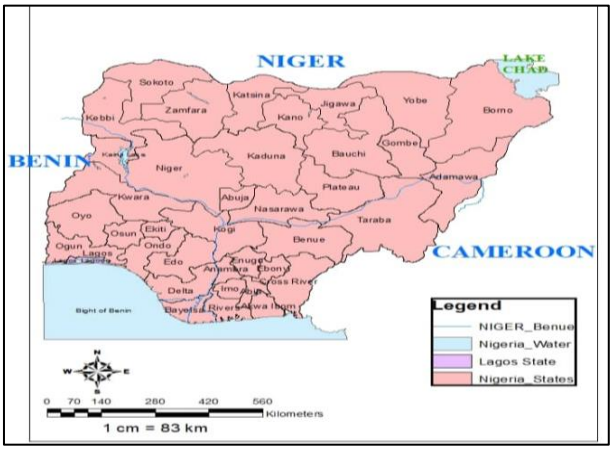

Figure 3.1: Map of Nigeria showing Lagos State
Source: Warnock-Smith et al. (2016)

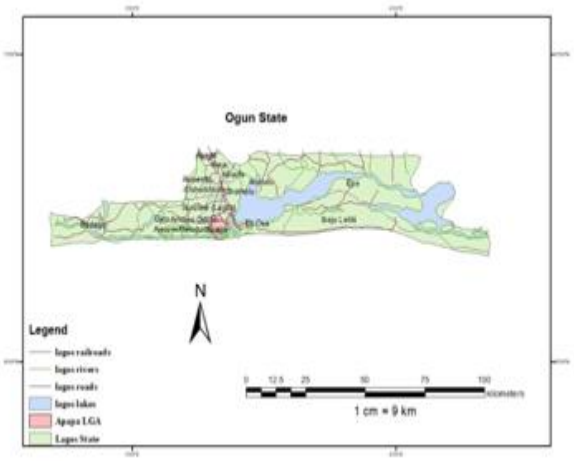

Figure 3.2: Map of Lagos State showing Apapa Local Government Area
Source: Mapbox (2023)

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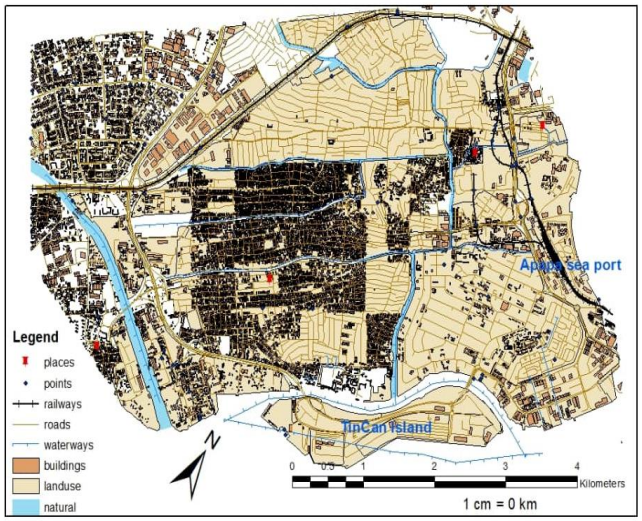

Figure 3.3: Map showing the study area, (Apapa and Tin Can Ports, Lagos)
Source: Mapbox (2023)

5.3Model Specification
This model explains the trend of shipping pollution and the level of shipping pollution in the Lagos seaports environment. The trend value for each year represents as Xi, while the total value for all the years represents as Xn. Summation of all the values (number of occurrences) divided by the number of years will determine the mean average. The mean average is the shipping pollution level in the Lagos seaports environment.
Using the summation sign ∑, we can represent mean analysis as:

$$\sum_{i=1}^{n} Xi$$

If n is taken to be the number of items under x column, and mean is represented as $\bar{x}$, we can represent this as: $\bar{x} = \frac{\sum_{i=1}^{n} xi}{n}$
Xi = individual values making up the series of data in column x (Total quantity of shipping pollution)
$\bar{x}$ = the average or the mean
N = the number of items in column X under consideration (32 years from 1990-2021)

$$\sum_{i=1}^{n} Xi = \text{the summation of all values of x from the first (i} = 1)\text{to the last (i} = n)\text{in the data set.}$$

$$\bar{x} = \frac{\text{Total quantity of shipping pollution}}{\text{Number of occurences}}$$

VI. RESULTS AND DISCUSSION

6.1 Trend of oil from shipping pollution in the Lagos seaports environment, Nigeria
Trend of oil from shipping pollution and garbage generated by shipping pollution were examined at Lagos seaports, Nigeria between 2006 and 2022. Trend analysis in Figure 1 shows a steady increase in shipping pollution from 2006 to 2009with a subsequent decrease in 2010. From 2011 to 2013, pollution levels remained relatively stable, followed bya slight increase in 2014. In 2015, there was a decline, but it rose again in 2016. The year 2017 witnessed a sharp drop in pollution levels followed by a slight increase in 2018. The year 2019 stands out as an anomaly with a substantial spike in shipping pollution reaching 204, 964 tonnes. This significant increase was due to the sinking of a vessel, which caused an extensive release of oil products into the marine environment.

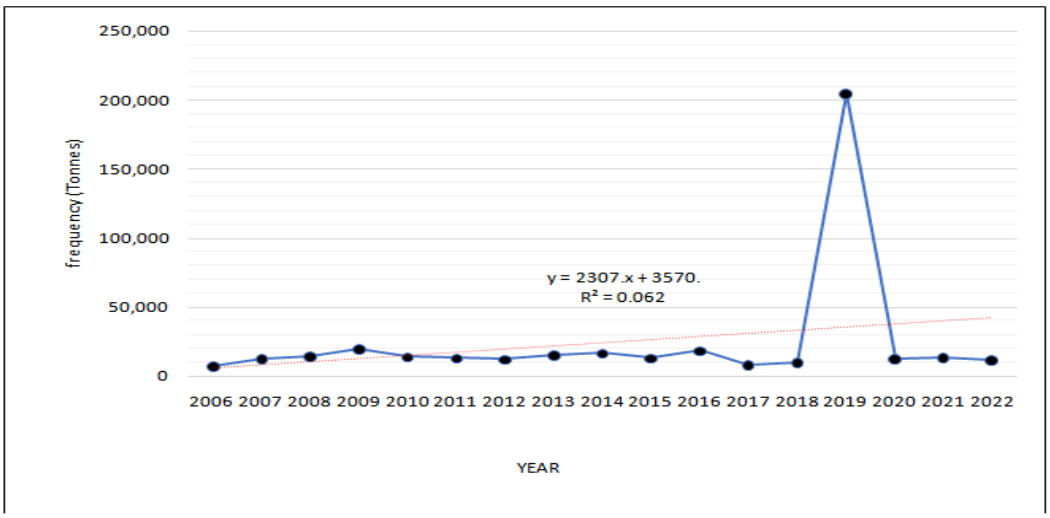

Figure 1: Trend Analysis of Oil Pollution at Lagos Seaports, Nigeria from 2006-2022
Source: NPA Marina Headquarters, Lagos (2023)

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The trendline result shows undulating rise in the quantity of oil pollution over a period of 17 years. The R^2 value of 0.0624 indicated a good fit of the estimated trendline values to the actual data collected between 2006 and 2022. A trendline is most reliable when its R-squared value is at or near 1 or 100%. Hence, R^2 value reliability at 6.2% indicated that oil pollution has a week impact on Lagos seaports environment. The direction and the gentle slope of the trendline helps to clarify the quantity of oil pollution in the Lagos seaports environment at a given time. In 2019, there was a sharp rise in the chart line graph, which indicated a substantial oil pollution in the Lagos seaports environment due to oil spill from MT GLENNSTAR. The vessel sunk without recovering the oil products at the Lagos anchorage charted restricted area at coordinate 06.22.57N, and 00322.37E.The R^2 value of 0.0624 suggests that oil trend contaminates water quality in the Lagos seaports environment, thereby making it toxic for aquatic life. It can lead to reduced oxygen levels, increased turbidity and changes in pH levels. These alterations can disrupt the delicate balance of the aquatic ecosystems thereby affecting the survival and reproduction of marine organisms.

Marine ecosystems are complex and interconnected. Oil pollution can harm various species including fish, shellfish and coral reefs, which rely on the health of their environment for survival. Oil pollution can pose risks to human health particularly for coastal communities that dependent on fishing or recreational activities. Consumption of contaminated seafood can introduce toxic compounds into the human body, thereby leading to various health issues. Contact with oil-contaminated water can also cause skin irritation and respiratory problems. The presence of oil on water surface can hinder sunlight penetration thereby affecting photosynthesis and ultimately reducing oxygen production.

Figure 2 indicates the trend line results from 2006 – 2022, which shows a steady increase in collection of garbage in kilogram over 17 years. R^2 value of 0.8726 indicates a good fit of the estimated trendline values to the actual data collected. A trendline is most reliable when R-square value is at or near 1 or 100%. R^2 value reliability at 87.26% shows the directions of relationship between the time and the quantity of garbage handled by the African Circle Limited at the Lagos seaports environment. The trend line indicates a constant rise in the kilograms of garbage at the Lagos seaports environment. The rising number of garbage collected suggests increases in waste generation in the area, which can have adverse effects on the local environment if not properly managed. It can pollute the seaports and impair marine life and ecosystems. Accumulation of garbage can pose health risks to workers at the seaports and nearby residents. Improper waste management can attract pests, promote the spread of diseases and create unpleasant odors in the surrounding areas. Dealing with increasing number of garbage can put a strain on waste management infrastructure at the seaports. It may require additional resources such as personnel, equipment and facilities to handle and efficiently dispose the waste.

Increasing garbage collection may raise concerns about compliance with environmental regulations and standards. It is essential for African Circle Limited and other stakeholders at the Lagos seaports to ensure that waste disposal practices meet regulatory requirements to avoid potential fines and penalties. The trend of rising garbage collection would have underscored the importance of implementing sustainable waste management practices at the seaports if not the initiatives of African Circle Limited that collect waste from ships at berths and recycle the waste in order to mitigate the impacts of increasing waste generation

6.2 Trend of Garbage Generated by Shipping Pollution in the Lagos Seaports Environment, Nigeria

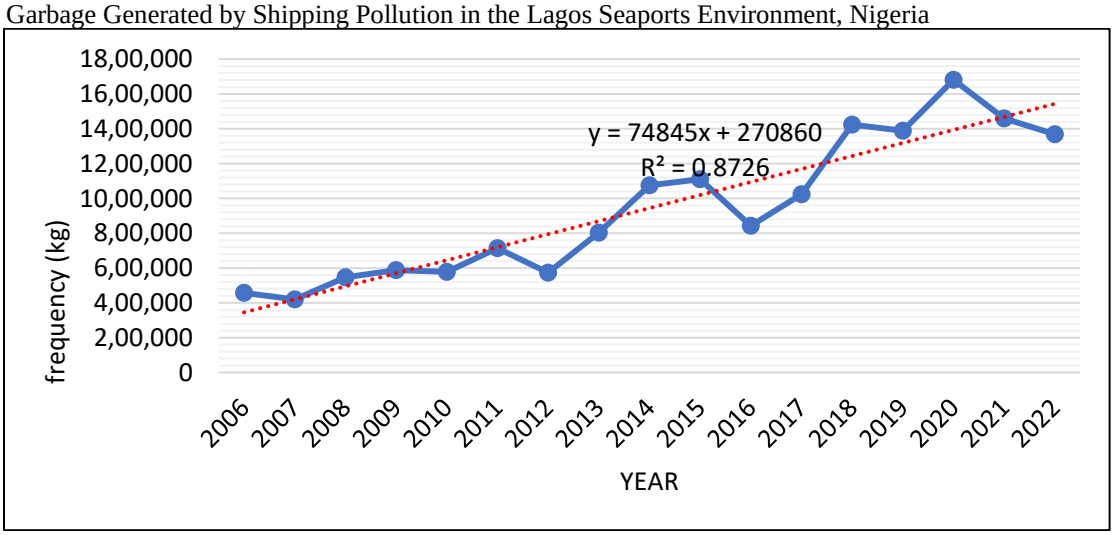

Figure 2 Trend Analysis of Garbage Handled by African Circle in the Lagos Seaports Environment, Nigeria from 2006 – 2022

Source: NPA Marina Headquarters, Lagos (2023)

6.3 Determine the Shipping Pollution Level in the Lagos Seaports Environment, Nigeria

Table 1**:**The mean value of 24,336.471 represents the average shipping pollution level in the Lagos seaports environment, Nigeria. It provides a measure of central tendency, indicating the typical level of shipping pollution observed. The data of 204,964 in 2019 due to sinking vessel appears higher than the rest, which had a significant impact on the mean value. Shipping pollution levels vary significantly from year to year, ranging from as low as 6,915 in 2006 to a peak of 204,964 in 2019. This indicates that shipping pollution level in the Lagos seaports observed fluctuations over time, except in 2019, when shipping pollution level rose to 204,964 due to sinking vessel. Despite the fluctuations, there was relative stability in shipping pollution level from 2006 to 2022, except in 2019. The trend implies effective measures in controlling shipping pollution level in the Lagos seaports environment.

The findings indicate that there has been a significant variation in shipping pollution levels in the Lagos seaports environment over the years. The mean value of 24,336.471 tonnes represents the average shipping pollution level observed during the period from 2006 to 2022. It is important to note that the acceptable standard for shipping pollution is around 700 tonnes (ITOPF, 1990). This is significantly lower than the observed mean value. This suggests that the pollution levels in the Lagos seaports environment are generally high and exceeded the acceptable standards. The implications of these findings are not limited to the immediate vicinity of Tin Can Island and Apapa seaports. Contaminants can often travel through waterways and affect downstream regions, thus potentially affects larger ecosystems and communities.

High shipping pollution level can lead to contamination of the water, thereby making it unsafe for aquatic organisms and potentially endangering human health. The pollutants discharged into the water such as oil spills or chemical waste can have long-lasting effects on water quality and ecosystems. Pollution from ship and its activities can harm marine ecosystems, thereby disrupting the balance of marine life and biodiversity. Toxic substances can accumulate in organisms and affect their reproductive systems, growth and overall survival. This can lead to a decline in fish populations, disruption of food chains and loss of habitat. Shipping pollution can also have adverse effects on human health, particularly for people living in close proximity to the seaports or working in the shipping industry. Exposure to pollutants such as contaminated seafood can cause respiratory problems, skin diseases and other health issues. Oil spills and chemical pollutants can harm coral reefs, sea grasses and other coastal habitats. High shipping pollution level can have far-reaching consequences on the environment and human well-being. The presence of high shipping pollution level can adversely affect the economy, damage the tourism industry and degrade ecosystems. Decline in fish populations and the overall degradation of marine resources can negatively affect the livelihoods of coastal communities that dependent on fishing and related industries. Contaminants can accumulate in the food chain, potentially leading to the consumption of polluted seafood, which may contain harmful substances and pose health hazards.

Table 1: Shipping Pollution Level in the Lagos Seaports Environment, Nigeria

YEAR	OIL (TONNES)
2006	6915.000
2007	12196.000
2008	14017.000
2009	19399.000
2010	13888.000
2011	12849.000
2012	11958.000
2013	15180.000
2014	16423.000
2015	12970.000
2016	18213.000
2017	7749.000
2018	9817.000
2019	204964.000
2020	12232.000

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2021	13358.000
2022	11592.000
TOTAL	**413720.000**
MEAN VALUES (μ)	**24336.471**

Source: NPA Marina Headquarters, Lagos (2023)

Mean analysis of shipping pollution from 2006- 2022 in the Lagos seaports environment, Nigeria.

$\sum oil = 413{,}720$

No of occurrences = 17

$\mu = \sum oil / 17$

$\mu = 24{,}336.471$

Table 2: Deviation = Observed mean average - Acceptable mean average

Deviation = 24336.47- 700

Deviation ≈ 23636.47 tonnes

z = (observed mean - acceptable mean) / standard deviation

z = (24336.47 - 700) / 45264.591

z ≈ 0.51

Table 2: Deviation from the Acceptable Mean Average of Oil Pollution at Lagos Seaports

OIL (TONNES)	MEAN VALUE(μ)	Deviation (OIL - μ)	(OIL - μ)^2
12196.000	24,336.471	- 12,140.471	147,391,036.10
14017.000	24,336.471	- 10,319.471	106,491,481.72
19399.000	24,336.471	- 4,937.471	24,378,619.88
13888.000	24,336.471	- 10,448.471	109,170,546.24
12849.000	24,336.471	- 11,487.471	131,961,989.98
11958.000	24,336.471	- 12,378.471	153,226,544.30
15180.000	24,336.471	- 9,156.471	83,840,961.17
16423.000	24,336.471	- 7,913.471	62,623,023.27
12970.000	24,336.471	- 11,366.471	129,196,662.99
18213.000	24,336.471	- 6,123.471	37,496,897.09
7749.000	24,336.471	- 16,587.471	275,144,194.18
9817.000	24,336.471	- 14,519.471	210,815,038.12
204964.000	24,336.471	180,627.529	32,626,304,232.65
12232.000	24,336.471	- 12,104.471	146,518,218.19
13358.000	24,336.471	- 10,978.471	120,526,825.50
11592.000	24,336.471	- 12,744.471	162,421,541.07
		SUM (OIL - μ)^2	**34,831,015,464.235**
		SUM (OIL - μ)^2/17	**2,048,883,262.602**
	STANDARD DEVIATION σ	**SQRT**	**45,264.591**

Author's Computation (2023)

The z-score or p-value of 0.51 implies a severe case of shipping pollution level above the acceptable limits in the Lagos seaports environment, Nigeria. This indicates that there is significant relationship between shipping pollution level and water quality standard in the Lagos seaports environment, Nigeria.

VII. SUMMARY OF THE FINDINGS

The trend of shipping pollution oil with p – value 0.06 indicates that oil from shipping pollution has a weak impact on water quality in the Lagos seaports environment, Nigeria. The 2019 observed data with 204,964 tonnes of oil has a significant impact on the p – value, which was almost half of the total 413,720 tonnes. The incidence was due to sinking of vessel and the oil products were unrecovered due to high water ingress.

The trend of ship garbage at Lagos seaports was 0.87 p – value. This indicates that garbage generated by ships have a significant impact on water quality in the Lagos seaports environment. Despite the high volume of garbage generated by ships at Lagos seaports, it is essential to note that governance structures do not allow dumping of garbage at Lagos seaports environment. Ship generated garbage are being collected by the African Circle Limited at compulsory payment of environmental fees payable to the government.

Shipping pollution level in the Lagos seaports environment was higher than the acceptable standard. According to Tanker Owners Pollution Federation (1990), mean average for shipping pollution oil is 700 tonnes. The observed mean average from shipping pollution oil in the Lagos seaports

environment was 24,336 tonnes. The deviation was 23,636 tonnes above the acceptable standard. The p – value for the observed mean deviation was 0.51. This implies that the observed mean value was higher than the acceptable mean value. This indicates higher level of shipping pollution oil in the Lagos seaports environment, Nigeria.

VIII. CONCLUSION

The incident of shipping pollution oil in 2019 contributes significantly to the increase in p – value in the Lagos seaports environment. Otherwise, the pollution control measures in the Lagos seaports was effective. Governance structures do not allow dumping of garbage at the Lagos seaports environment. Since there is effective measures for shipping pollution oil and garbage, there should be sustainability of port concession and renewal of contract with African Circle Limited by the government for prevention of shipping pollution in the Lagos seaports environment for another twenty years with effect from year 2026.

IX. RECOMMENDATIONS

To mitigate the negative effects of shipping pollution on Lagos seaports environment, it is crucial to implement effective pollution control measures such as:

1. Investing in technology and infrastructure upgrades will reduce shipping pollution oil. Advanced oil spill response equipment such as skimmers and booms should be readily available to respond quickly in the event of shipping oil spill. Upgrading oil storage facilities to prevent leaks and investing in modern oil transportation methods by shipping companies will minimize regulatory framework.
2. There is need for government to establish strict regulations and enforcement to address level of shipping pollution in the Lagos seaports environment. Establishing and implementing comprehensive environmental laws and standards can encourage responsible shipping practices and hold polluters accountable. Regular monitoring, inspections and penalties for non-compliance can help ensure adherence to these regulations.

X. REFERENCES

[1]. Adegoke, O. (2013). Impact of petroleum development on the environment: A case study on the Niger Delta. Retrieved from http://www.scribd.com/doc/16227990/impact-of-petroleum-development-on-the-environment.A-case-study-on-the-Niger-Delta-By-Labode-Adegoke-Esq

[2]. Akpomuvie, O. B. (2011). Tragedy of commons: Analysis of oil spillage, gas flaring and sustainable development. Journal of Sustainable Development, 4(2), 200-210.

[3]. Al-Azab, M., El-Shorbagy, W., & Al-Ghais, S. (2015). Oil pollution and its environmental impact in the Arabian Gulf region. London: Elsevier.

[4]. Almeda, R. (2013). Interactions between zooplankton and crude oil: Toxic effects and bioaccumulation of polycyclic aromatic hydrocarbons. PLOS One, 8(6), e67212.

[5]. Bans-Dabban, H., Koppen, K. V., & Mol, A. (2017). Environmental reform of West and Central Africa ports: The influence of colonial legacies. Maritime Policy & Management, 44(5), 565-583.

[6]. Cullinane K., & Cullinane S.(2013) Atmospheric emissions from shipping:The need for regulation and approaches to compliance.Transport Reviews ,33(4),377-401.

[7]. Elenwo, E. I., & Akankali, J. A. (2015). The effects of marine pollution on Nigerian coastal resources. Journal of Sustainable Development Studies, 8, 209-224.

[8]. International Tanker Owners Pollution Federation Limited (ITOPF). (1990). Response to marine oil spills. London: ITOPF.

[9]. Kamali, W. (2017). Management of environmental sustainability of ports-focus on noise mitigation. In 24th International Congress on Sound and Vibration. London.

[10]. MESP Noise (2017). Managing the environmental stability of ports for durable development.

[11]. Ndubisi, A. L., & Asia, I. O. (2007). Environmental pollution in oil producing areas of the Niger Delta Basin, Nigeria: Empirical assessment of trends and people's perception. Environmental Research Journal, 1, 18-26.

[12]. Poonian, C. (2003). The effects of the 1991 Gulf War in the maritime and coastal environment of Arabian Gulf: Impact, recovery and future prospects.

[13]. Twumasi, J., & Merem, K.(2006). Pouring oil on troubled waters.Lagos Nigeria:Times Magazine.

[14]. Umo,I.,& Nitonye,S.(2015).Effects and solutions of marine pollution from ships in Nigeria waterways. International Journal of Scientific & Engineering Research, 6(12)81-90.

[15]. Vikas,M.A.,& Dwarakish,G.S.(2015).Coastal pollution:A review. In International Conference on Water Resources,Coastal and Ocean Engineering (pp.381-388).