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### Emission and Discharges Contents of Pollutant from Ships Calling the Qua-Iboe Terminal

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#### Abstract

The study focuses on the emission and discharges contents of pollutant from ships calling, and the environmental impact of shipping activities in the Qua-Iboe Terminal, located in the Ibeno Estuary of Akwa Ibom State, Nigeria. Through an exploratory research design, the study examines the levels of pollutants emitted by ships calling at the terminal, analyzing both air and water quality. 1,128 vessels constitute the population of the study. The sample for the study is made up of one hundred and twenty-four 124 (124) vessels would select from the population of 238 vessels that operated in the terminal in the last one year. The study employs descriptive and inferential statistics, including

Spearman's Rank Correlation and t-tests, to assess the significance of these emissions. Results indicate a significant increase in pollutant discharge over the past year, with current mitigation measures proving insufficient. The findings underscore the need for stronger regulatory measures to reduce the environmental impact of shipping, particularly in coastal and port regions, which serve as major receptors for ship emissions. The study contributes to existing literature on environmental management and provides valuable insights for policy-makers aiming to protect the marine and coastal environment while supporting economic development in Nigeria.

**Keywords:** Emission, Discharges, Pollutant, Ships, Terminal, Coastal Environment

#### Introduction

Over the past decades, growing international trade resulted in a corresponding growth in the tonnage of merchandise carried by ships. The merchant shipping industry and the development of the world economy are closely related. Maritime transportation is considered to be the most energy efficient cargo transportation mode, which has the potential to make a significant contribution to the efficiency of the transport system. The growing number of shipping movements and the related release of air pollutants have drawn attention onto this emission source. Shipping activities are one of major air pollution sources as the ships that have high powered main engines often use heavy fuels. More than 95% of the world's shipping fleet is powered by diesel engines, since the shipping emissions have not been controlled tightly, there is some difficulties to achieve progress in improving environmental performance, (Soni and Kodali, 2012). Because their air pollutant emissions remain comparatively unregulated, ships are now among the world's most polluting combustion sources per ton of fuel consumed.

The bunker oil used in oceangoing ships has been estimated to produce over 100 times compared to on-road diesel per unit volume. Ship emissions have remarkable global, regional, and local adverse impacts on the air quality on sea and land. The most important pollutants emitted from ships are nitrogen oxide (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), hydrocarbons (HC), and particulate matter (PM). Shipping emissions are easily transferred long distances in the atmosphere from the sea to the land and between the continents. Also, the effects of shipping emissions can increase in the domestic seas, narrow channels, straits, gulfs, and port areas specially including dense maritime traffic, sensitive ecosystem and the presence of populations. The health effects of air pollution at ports may include asthma, other respiratory diseases, cardiovascular disease, lung cancer, and premature death, (Onigbide I.O., 2014).

Ship emissions have remarkable global, regional, and local adverse impacts on the air, aquatic and marine environment. The most important pollutants emitted from ships are nitrogen oxide (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), carbon dioxide (CO<sub>2</sub>), hydrocarbons (HC), and particulate matter (PM). Shipping emissions are easily transferred long distances in the atmosphere from the sea to the land and between the continents.

Emissions from marine mode of transportation, especially, ships and coastal vessels, are on the rise as the demand and activities of these mode of transport expands. Shipping transportation is one of the most efficient and cost-effective mode of transporting people and goods around the globe. It is commonly supported by upland vessel and port activities which are equally important to the efficiency of the marine mode of transport industry and in contribution to the environmental pollution.

Shipping transportation takes different forms in the Nigerian water ways. The most predominant includes tugs and barges which move people and essential goods and service to the oil industry, fishing trawlers, and large vessels engage in oil exploration activities in the gulf region. Thus, shipping transportation is strategically important to the economic and social development of the Nigerian economy. It provides employment, income, and revenue to the people and the government of Nigerian and serves as a backbone to the oil industry and commercial activities. (*Lloyd's Register of Shipping (LR)*, 1995).

As important as shipping transportation is to the social – economic development of the Nigerian economy, it has some important impact on the aquatic and coastal environment. For example,

Vessels and port operations affect coastal air and water quality; ballast exchange can lead to the spread of invasive species. In addition, oil and chemical discharge are dominant issues in marine mode of transportation. Vessel discharges and upland maritime support operations introduce pollution from toxins, nutrients, bacteria, pathogens, pharmaceuticals, and plastics directly into waterways. Vessels, vessel support operations, and port operations also directly and indirectly pollute waterways through a variety of sources that include the following: Gray or used water, bilge water or excess fluids in the hull, black or sewage water, ballast water from onboard tanks; antifouling paints and their leachates, Hazardous materials, and Garbage and other wastes, (Spalding & Grenfeel, 1997) <sup>[22]</sup>.

In recent time, studies on the environmental impact of shipping indicates that this mode of transportation contributes significantly to global emission of Carbon Dioxide (CO<sub>2</sub>), Nitrogen Oxide (NO<sub>x</sub>) and Sulphur Oxides (SO<sub>2</sub>). The port areas are the most recognizable receptors of pollutants emitted from ships. The emissions from ships may threaten the air quality while berthing or maneuvering and in coastal communities while transiting along the coast. Approximately 80% of the world fleet are either harbored or near a coast). This means that ships spend significant portion of the time near land Corbett and Köhler (2003) observed that marine mode of transportation contributes 2-3%, 10-15%, and 4-5% of Carbon Dioxide, Nitrogen Oxide and Sulphur oxides respectively. Exhaust emissions from a ships' diesel engine, the predominant form of power unit in the world fleet, largely comprise of excess carbon dioxide and water vapour with smaller quantities of carbon

monoxide, oxides of sulphur and nitrogen, partially reacted and non-combusted hydrocarbons and particulate material (*Lloyd's Register of Shipping (LR)*, 1995).

There is a need for better analysis and understanding the impacts of marine mode of transportation on the coastal and aquatic environment of the coastal towns. It is against this backdrop that the present study is instituted to examine the impact of marine mode of transportation on the coastal and aquatic environment of the coastal communities in Nigeria.

The expanding demand for marine mode of transportation in Nigerian economy is predicated on the expanding trade and oil exploration activities. As technology improves and it becomes economical to produce oil from deep sea, the need for marine mode of transportation increases. The expanding role of marine transportation has contributed immensely to the economic development of Nigerian economy, especially, the oil and gas sectors. (Thomas and Griffin, 1996). In the same vein, increasing flow of good and service and the movement of people from the coastal communities have contributed to the expanding demand for marine mode of transportation in Nigerian waterways.

The maritime industry has responded to the growth in demand for its activities by increasing the number of vessels, tugboats, barges, and ferryboat and fishing trawlers in the Nigerian water ways. Data from the Nigerian Maritime and Safety Administration (NIMASA) shows that between 1990 and 2000, the number of vessels plying the Nigerian water ways doubled, and increased by 112 between 2000 and 2015. The data shows that there was marked increase in supply and demand of marine mode of transportation of all types in the last two decades, (Spalding & Grenfeel, 1997) <sup>[22]</sup>.

The increase in marine mode of transport is not without cost. There are range of environmental activities accompanying the expansion and benefits of the marine mode of transportation. The expansion of marine mode of transport service, port operations, and upland maritime support services have pushed vessels and other marine transport facility into the inland waterways and closer to coastal communities than it was two decades ago. Discharges from the vessel and upland support operations introduce pollutants into the water bodies, ambient air of the coastal communities and soil. In addition to this, garbage and other solid waste, and smokestack emission from the marine vessels are directly discharge into the aquatic environment.

There are grave dangers to the negative consequences of expanding shipping activities in Nigerian water ways. The resilience balance between the marine and the coastal system is in danger. The health and the wellbeing of the coastal communities are equally in danger. The absence of empirical studies on the impact of shipping on the marine and coastal environment of this area creates gap in knowledge for protection and mitigation of environmental danger in the marine environment of the coastal communities, especially in the Ibeno estuary. This is the motivation for the present study. Therefore, the problem of the study is to empirically examine the effect of shipping on the marine environment of Qua Iboe terminal in Ibeno local Government area of Akwa-Ibom State.

The aim of this research is to investigate estimate of the emission and discharges contents of pollutant from ships calling the Qua-Iboe terminal. The study will seek for answers to the following questions, what is the estimate of emission and marine vessel effluent from ships calling the

Qua-Iboe oil terminal? The study nominates the following hypothesis for testing;

**H<sub>0</sub>1:** Shipping has no significant contribution to emission and discharge in the Qua-Iboe terminal.

The study examines the impact of shipping on the Qua-Iboe terminal's marine environment, revealing its effects on the Qua-Ibo River and Nigeria. It will guide environmental policy makers on strategies to protect the environment while promoting economic activities, and contribute to existing literature on environmental management.

The study, conducted at the Qua-Iboe terminal in Ibenu Estuary, Akwa-Ibom State, aims to estimate the impact of shipping on marine environment, focusing on air and water pollution.

**Methodology**

The research design adopted for the study is the explorative research design approach. Explorative research design is used to establish a relationship between the cause and effect of a situation. It is a causal research design where the effect caused by the independent variable on the dependent variable is observed. The study area is Iwokpom village on the Ibenu estuary, a of tributary of Qua Iboe River in Akwa Ibom State Ibenu is situated in the hot, humid equatorial rain forest region of Nigeria towards the North Eastern part of Bight of Bonny. The population of the study is the number of shipping vessels operating in the Qua-Ibo River Terminal.

From the port's records, 1,128 vessels used the terminal between June, 2018 and June, 2019. Thus, the 1,128 vessels constitute the population of the study. The sample for the study is made up of one hundred and twenty-four 124 (124) vessels would select from the population of 238 vessels that operated in the terminal in the last one year. The stratified sampling techniques was adopted for selecting the sample for the study. There are naturally three categories of vessels in terms of sizes (large, medium, and small). The study will use descriptive and inferential statistics with SPSS version 22, including Spearman's Rank Correlation Coefficient Analysis and t-test for statistical significance.

**Hypothesis Testing 1**

**H<sub>0</sub>:** Shipping has no significant contribution to emission and discharge in the Qua-Iboe terminal

**H<sub>1</sub>:** Shipping has significant contribution to emission and discharge in the Qua-Iboe terminal

Table 3.1 shows the Spearman's Rank Correlation Coefficient Analysis computed for this stated hypothesis. The result showed that the r value of -.264 indicates a high relationship between the emission and discharge in the Qua-Iboe terminal. The relationship was significant because the level of significance of 0.000 was less than the probability value of 0.05 (95%). Thus, we reject the null hypothesis and accept the alternative hypothesis H<sub>1</sub>.

**Table 3.1:** Correlations of the relationship between emission and discharge in the Qua-Iboe terminal

			I believe that the consumption power of ships calling at the port has increased over the past year	The discharge of pollutant from ships at the port terminal has increased over the past 12 months
Spearman's rho	I believe that the consumption power of ships calling at the port has increased over the past year	Correlation Coefficient	1.000	-.264**
		Sig. (2-tailed)	.	.000
		N	221	221
	The discharge of pollutant from ships at the port terminal has increased over the past 12 months	Correlation Coefficient	-.264**	1.000
		Sig. (2-tailed)	.000	.
		N	221	221

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**Discussion on Finding**

**Estimate the Emission and Discharges Contents of Pollutant from Ships calling the Qua-Iboe Terminal**

Table 4.4 revealed the information on emission and discharges contents of pollutant from ships calling the Qua-Iboe terminal. The study indicated that the emission and discharge of pollutants from ships at the port terminal has increased over the past 12 months, it was also discovered that the measure taken to reduce emissions and discharge by ships calling at the port terminal were not effective. According to the result (43.5%) in Table 4.4, it showed that monitoring of pollutant levels from ships at the port terminal is conducted regularly and transparently. About 70% of ship activity and thus emissions occur within 400 km of the coast, with particularly high ship density in main shipping lanes and near major ports, (Liu *et al.*, 2016; Contini and Merico, 2021). Ship emissions of NOx are estimated to be comparable to terrestrial NOx sources in Europe in 2020 (European Environment Agency, 2013; Karl *et al.*, 2019).

**Conclusion**

The study on the emission and discharge of pollutants from ships calling at the Qua-Iboe Terminal indicates a

significant increase in pollution levels over the past 12 months. Despite efforts to mitigate emissions and discharges, the measures in place have proven ineffective in reducing the environmental impact. Monitoring of pollutant levels, although regular and transparent in 43.5% of cases, has not resulted in meaningful reductions. The findings align with broader research, which shows that a substantial portion of ship-related emissions occurs within coastal regions, particularly in high-density shipping lanes and near major ports. Given that ship emissions of pollutants like NOx are now comparable to those of terrestrial sources in Europe, the study highlights the urgent need for more effective regulatory measures and technological advancements to reduce ship-based pollution, ensuring better environmental management at the Qua-Iboe Terminal.

**Recommendations**

From the findings, the study recommends that:

- Strengthen Emission Controls:** Implement stricter emission reduction measures, such as the use of cleaner fuels and advanced exhaust treatment systems, to reduce pollution from ships at the terminal.
- Improve Monitoring Systems:** Enhance real-time

monitoring of pollutants, ensuring more accurate and consistent data to drive better management decisions.

3. **Adopt Green Technologies:** Encourage the adoption of environmentally friendly technologies, such as energy-efficient ship designs and alternative fuels, to lower emissions.
4. **Collaborate with Shipping Companies:** Work closely with shipping companies to promote sustainable practices and incentivize the use of low-emission vessels.
5. **Develop a Regulatory Framework:** Establish a robust regulatory framework with stricter penalties for non-compliance to ensure effective reduction of ship-based pollution at the terminal.

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