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Marine Pollution and Maritime Environment of Shipping Terminals in Onne Port, Rivers State, Nigeria

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Abstract: *This study investigated the relationship between marine pollution and maritime environment of shipping terminals in Port Harcourt. Oily-water was conceptualized as the dimensions of marine pollution while navigation and safety factors were used as measures of maritime environment. The study adopted the cross-sectional survey in its investigation of the variables. Primary source of data was generated through self- administered questionnaire. The population of the study was 84 employees of three (3) selected shipping Terminals in Port Harcourt. There was no need for sampling as the study used a census because the population was small. The research instrument was validated through supervisor's vetting and approval while the reliability of the instrument was achieved by the use of the Cronbach Alpha coefficient with all the items scoring above 0.70. Data generated were analyzed and presented using both descriptive and inferential statistical techniques. The hypotheses were tested using the Spearman's Rank Order Correlation Statistics. The tests were carried out at a 95% confidence interval and a 0.05 level of significance. Empirical findings revealed that marine pollution positively and significantly influences maritime environment of shipping terminals in Port Harcourt, Nigeria. The result of the findings further revealed that oily-water gave rise to navigation and safety factors of shipping terminals in Port Harcourt. The study recommends that management of the Onne Port should avoid as much as possible the release of oily water into the marine environment as it does not give room for oxygen to flow into the water and thereby destroying aquatic lives.*

Keywords: *Marine Pollution, Maritime Environment, Oily-Water, Shipping Terminals*

INTRODUCTION

The incidence of ship generated marine pollution has increasingly engaged the attention of the international maritime community in their effort to promote safe shipping and the protection of the marine environment. The growing concern about pollution centres on the potential for the shipping business to negatively impact the marine environment and the related the safety of mariners/beach goers within the maritime field (Helen, Bloor, Baker & Dahlgren, 2016). Ship-source marine pollutants emanate from cargo carried or waste generated onboard, which usually contains oil or oily mixtures and noxious substances. They accumulate from machinery operation or from the domestic activities of the crew living onboard. Additionally, shipborne pollutants include garbage, solid waste and antifouling paints on ship hulls (Umoh & Nitonye, 2015). Extant studies have documented the effects of ship-based pollution on the marine environment. These include: the introduction of non-indigenous species to the aquatic environment (which threatens the sea animal population) and the negative effects on the economies of countries that depend on commercial fishing. For example, fisheries in the West African ecosystem generate some 500 million Euros annually and over 600,000 men and women depend directly on fishing and fishery related industries (Elenwo & Akankali, 2015).

Against the backdrop of public concern and the need for mitigating policies, the shipping industry has actively sought to curtail the negative environmental effects arising from the shipping The marine environment is affected by a number of human induced stressors and the degradation can be seen not only in coastal areas but has spread to very remote areas in the deep seas and well as in polar areas. Coastal areas are being urbanized throughout the world. Marine operations have been conducted through the whole history of man. Transportation of different cargos along the seaways has also been conducted with great skills and under demanding conditions. Environmental pollution is the pollution of air, land and water in many ways. There are several reasons for environmental pollution, such as from agriculture, industry, and urban sources. Environmental pollution has drastically changed the air, water and terrestrial ecosystems as a result of the industrial (Ainsley, 2008).

Moreover, different types of toxic gases and different forms of carbon components were produced from factories, transport, and energy sectors has resulted in different changes in the global climate and weather patterns, and become a source of contamination of land, as well as the ocean environment where the average temperature and acidity are increasing. The marine environment is affected by a number of human induced stressors and the degradation can be seen not only in coastal areas but has spread to very remote areas in the deep seas and well as in polar areas. Coastal areas are being urbanized throughout the world. There has been a global migration of humans from inland areas to the coastal areas, a phenomenon very obvious in Nigeria and most pronounced in Lagos state and Port Harcourt city of Rivers state. Pollution is spreading via water and air as well through direct dumping. Human induced changes in drainage areas affect the input of sediment into coastal waters leading to erosion, and construction, land filling and dredging also results in affected erosion and sedimentation patterns. Fisheries is a major factor affecting the environment of the seas, both because the balance of the ecosystem is affected by the removal of fish, and through the damage caused by the use of destructive fishing gear.

Maritime industry activities, basically ship operations are the prime factor causing maritime pollution, for example from accidents during oil transportation and ballast water tank transfers of harmful aquatic species between different places in the ocean. In addition, there are the wastes disposed into the sea, especially plastics that remaining for several years without decomposition. Ships and marine platforms also release exhaust gases containing SO_2 and NO_2 as well as green-house gases. Ships also release waste water into the sea. Furthermore, it has been estimated that container ships lose over 10,000 containers at sea each year. In addition to that the discharge of cargo residues from bulk carriers has a potential risk of polluting environmentally highly sensitive areas as well as economically and commercially important strategic locations, like ports, channels and beaches, oil spills can have devastating effects on waterways and oceans. This study therefore examines the effect of marine pollution and maritime environment of shipping terminals in Onne Port, Rivers State, Nigeria.

Furthermore**,** this study was guided by the following research question:

i. To what extent does oily-water affect maritime environment of shipping terminals in Onne Port, Rivers State.

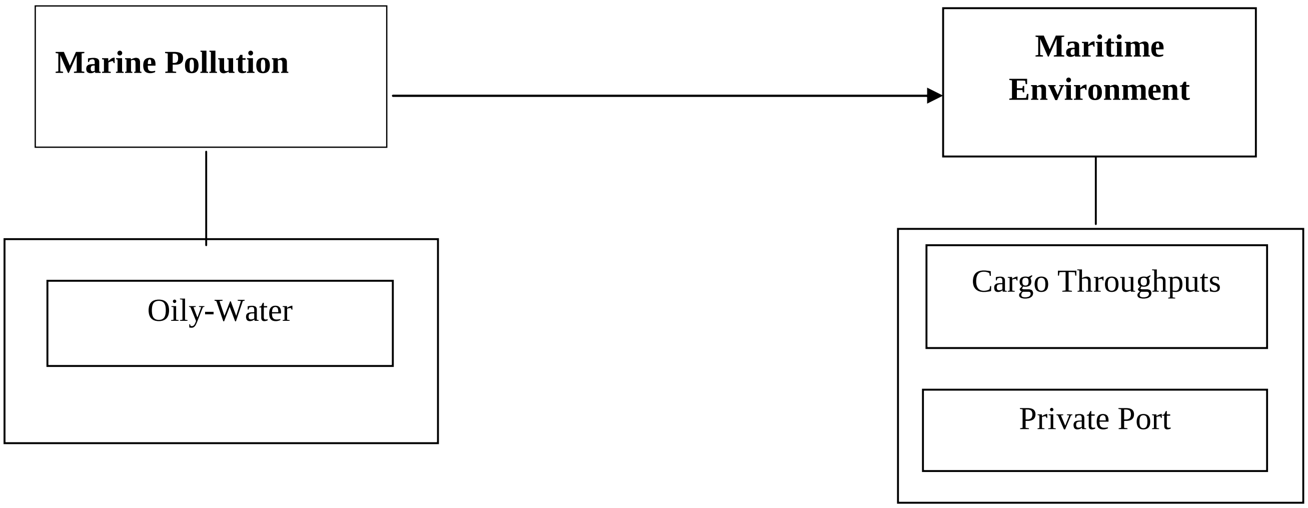

Figure 1.1: Conceptual framework of the relationship between marine Pollution and maritime environment

Source: Desk Research (2019).

LITERATURE REVIEW

Theoretical Framework

The theoretical framework for this dissertation will be hinged on two schools of economics views, the classical and neo-classical economics proponents. One of the orthodoxies, in the person of Ricardo (1772-1823), as cited in Liu and Maes (2017), posited in his "Law of Comparative Advantage", that countries engaging in international trade should specialize in producing and exporting goods that can be produced at a lower relative cost than other countries. In his views, he stressed that advantages of international trade are influenced, relatively, by what he described as "cost differences". Ostensibly, it can be surmised that trade has been responsible for environmental degradation, since most economic agents would like to explore and exploit environmental resources, for profit motives in trade, with little or no regard to the impact their trade has caused on the environment negatively.

Say (1900), in his text on political economy published in the early 19th century (Kloff & Wicks, 2004).), opined that, "Supply creates its own demand", which is often referred as 'Say's law of market.' Say (1900) was trying to typify the importance of production that is clearly determined or influenced by demand, interestingly, one would concur with the views of Say, empirically, that businesses exist to produce goods or services that are demanded for by the consumers, at profit goal, and that this is the exact purpose of capitalism and capitalistic interest.

In the views of Fisher (2004) and Mohammed (2009), there is little reason to expect natural resource development if people are indifferent to the products or services which the resource can contribute. Momoh (2013) stated in his dissertation presentation titled "Development planning for problems of Resource Development", by saying that, "The value of a resource depends upon its usefulness and its usefulness is changing all the time through changes in tastes, techniques or new discovery (Elenwo & Akankali, 2015).

The views of Ekhaise and Anyasi (2005) are quite analogous, and this informs the views of the presenter in this dissertation that, environmental degradation is predicated upon trade and profits making motives, which are pure economic propensities to maximize personal and social welfare in a 'dual optimization' goals. A review of the submissions of both Fisher and Lewis, indicated that the producers of economic goods are capitalizing on the demand for their products to exploit the natural resources in the environment to the chagrin of the people who are directly influence by its deterioration, for the producers' selfish economic goals (Fisher, 2004). On the contrast view, the people who reside in the environment where these resources are massively exploited to fan the whims and caprices of the producers are indifferent to the products of the natural resources as are developed. How could one imagine when the people are indifferent and absolutely ignorant of the values of the natural resources developed in their environment, such that they could jealously preserve them from undue exploitation and abuse which could be to their detriment, taking a peculiar case, the Niger-Delta Regions of Nigeria as a case study, among others.

Dimensions of Maritime Pollution

Oily Water (Oily-water discharge from ship)

Industrial growth has accelerated the emission of various oily-waste from the sources such as petrochemical and metallurgical industries. These oily wastes are one of the major pollutants of the aquatic environment. The special attention has been focused on the discharge of waste water & oily water & its regulatory restriction has become stricter. Oil water separation processes using polymeric or inorganic membranes have been proposed as effective & cost competitive alternative to conventional oil removal technologies but in present the commercial use of membrane in waste water treatment is currently limited by their low efficiency as well as high capital & operating cost (Borunoun & Nabbout, 2016). This problem of separation of oil from water is widely faced in the industries especially in petroleum industry effluent plants and in sewage treatment Industrial waste contains nearly 70% free oil. 25% emulsified oil & 5% soluble soil. Separation of oil from water is necessary of the following reason. Oil slick on surface of water can prevent oxygen transfer from atmosphere to water and lead to over low dissolved oxygen level due to microbial & oxidative attack on the hydrocarbon molecules. The Recycling of water it is necessary to remove oil because it may hinder the process.

• Oil in boiler feed causes foaming & so treatment is required

• Oil & waxes solidify at low temperature & cause clogging in pipes & sewer line.

• Oil slick is responsible for the death of birds.

• The oil penetrates in the feathers there by affecting their insulation & buoyancy.

• Birds become colder & more susceptible to diseases & experience difficulty in floating & flying. The dissertation uses elaborate techniques to purify contaminated areas in different environments after oil spills. Rather than discarding of the human hair it can be used to help cleanse the affected area, absorb the oil then utilized as an effective fuel derivation. The oil absorption of potential wasted hair fibres could produce valuable slot for us prevent & modern society. Investigation have shown the ability of the human hair to absorb a variety of potential hazardous oils; including motor oils, bilge oils & crude oils that have the possibility of being spilled in terrestrial or aquatic environments. Current increased demand for refined crude oil products such as heating oils, lubricant oils, gasoline & jet fuel & other such related products necessitated transportation of rushing products over greater distances when environments any serious accident resulting in spills. We have tried different hair colors & feel that overall black gave the best results for adsorbing the most oil. We are also using hair pellets as fuel that can be help reduce global warming which has also been prevent to provide the cleanest burn of any solid fuel. Thousands of tones of human hair are cue everyday & thrown into landfills as a waste produces which no direct benefits. Hair is not an easily degradable substance these are instances of hair. Our project looked at the possibility of finding a use for waste hair could be used to clean up oil spills & that the oil could be recovered or converted in fuel pellets. Also, the separation results obey Freundlich's isotherm. Thus, confirming that the oil removal is due to selective adsorption.

The operation of ships' power plants often results in spills of lubricating oil, fuel oil, grease and water into bilges. The resulting emulsified water and oil, if pumped into the sea or river when oily-water separator is not fitted or if fitted and is faulty becomes a source of marine pollution from ships. An-other source of oily-water pollution is ballast water pumped into oil cargo tanks. Such water usually contains some quantities of oil residues and foreign species that would have to be pumped overboard before fresh crude oil is loaded. Also, the cleaning process of crude oil tanks of these vessels contributes to marine pollution because the oily-water from the cleaning process contains detergent, solid matters, rusty scales from corrosion which are discharged overboard

Maritime Environment

The marine environment can be described or characterized at a number of different scales, ranging from ocean-level processes through to those that occur at species and genetic level. The scales of relevance here are marine landscapes, habitats and species; their inter-relationship can be expressed as: Species provide the globally accepted original classification of biological diversity, with well-established rules of taxonomy to distinguish between different types. Their classification is arranged in a hierarchy of genera, families, orders, classes and phyla. Habitats comprise suites of species (communities or assemblages) that consistently occur together, but which are derived from different parts of the taxonomic hierarchy (e.g. kelps, mollusks and fish in a kelp forest habitat). Their classification can also be structured in a hierarchy (biotopes, biotope complexes, broad habitats), reflecting degrees of similarity. Marine Landscapes comprise suites of habitats that consistently occur together, but which are often derived from different parts of the habitat classification hierarchy (e.g. salt marsh, intertidal mudflats, rocky shores and sub-tidal mussel beds in an estuary) (Berger, Horvat, Simongáti, 2014).

The International Maritime Organisation (IMO) considers marine environment management as one of the major aspects of maritime that will engender sustainable shipping. In order to ensure that a proactive stance is taken to protect and safeguard the interests of the marine environment and the ecosystem, the IMO established the Marine Environment Protection Committee (MEPC) to deal with issues regarding the environment and proffer solutions that will be adopted by member states to ensure environmentally friendly shipping.

In 2008, Nigerian Maritime Administration and Safety Agency (NIMASA) in her bid to ensure a cleaner and safer marine environment created a specialized Marine Environment Management Department to perform the functions of MEPC in Nigeria. This department was charged with the responsibility of ensuring the protection of the marine environment in line with the global best practices. However, over the years, there has been lack of political will, clear cut strategies and a strong missing link which is the buy-in of the past Headship of the Agency on issues relating to protection of the environment. This was two years before President Muhammadu Buhari appointed Dakuku Peterside as NIMASA DG.

Measures of Maritime Environment

Navigation

Navigation is an art, which essentially comprises of two basic principle, firstly determining position and secondly direction. Mankind, since the very beginning of sea transportation has explored various methods for finding position and direction. Along with growth in the world fleet and technological advancements, various additional aspects of navigation have evolved over period of time, which has added new dimensions to navigation (Elenwo & Akankali, 2015). During the medieval age, the Arabic empire contributed significantly in the field of navigation. They used an instrument known as the Kamal. The Kamal was an instrument, simple in construction, used for celestial navigation. It allowed the navigator to find the ship's position with the help of the Polaris (Pole star) and adjust the position accordingly. The principle used was the altitude of the Polaris is approximately equal to the latitude of the observer. The Arabs used the unit of Issabah, which is equal to one degree and thirty-six minutes (Mohammed, 2009; Bonnor, 2012). The Arabs also used a primitive form of magnetic compass that consisted of lodestone (Bruyns & Dunn, 2009).

Another significant instrument used for celestial navigation was the Quadrant, which was first used in the fifteenth century and gained popularity in the mid-eighteenth century. It was used to measure the angles of celestial bodies over the horizon, and enabled the navigators to fix their position. The quadrant was the predecessor of an enhanced nautical equipment, called the Sextant (Suttmeier, 2017). Shen Kou (1031-1095), a scientist in China, wrote about the magnetic needle and concept of the true north; this is the first known written document which mentions the magnetic compass. The compass appeared in the Islamic world and Europe in around 1300 (Bonnor, 2012).

Rabbi Levi ben Gerson (1288-1344) apparently invented the cross staff which was used to measure angular distances of celestial bodies, which assisted navigators to locate their position (Stern, 2003). Hipparchus was born in Asia Minor about 180 BC, and his work on theory of astrolabe projection was credible. It is not known when stereographic projection took the form of the instrument we know as the astrolabe, but it is evident that the astrolabe existed in the seventh century. The astrolabe was introduced to the Islamic world in the mid- eighth century and was widely used in Europe in the Middle-Ages and Renaissance. It helped the mariners to find their position by taking observations of the celestial bodies (The Astrolabe, 2016).

The discovery of the electromagnetic waves in 1864 by James Clerk Maxwell was a major breakthrough, which added a new dimension to maritime field, the wireless communication. It was in 1895 when Guglielmo Marconi was able to send Morse radio signals for over a mile in distance. R.F Matthews was the first ship to request assistance in an emergency in 1899 by the help of the wireless apparatus (Wireless Communication, n.d.) (Massey, Jenkins, Katzdorn, & White, 2003-2004). This was followed by the invention of the radio direction finder and hyperbolic navigation, which assisted in finding position. Electromagnetic waves not only helped in communication and position fixing, but also in the detection of targets by radar. Robert Watson-Watt is credited as the inventor of radar in 1935. 1941-1945 witnessed intensive developments in Radar. The first radar with a plan position indicator was installed in U.S.S. Semmes in 1941 (Suttmeier, 2017). Modern day radars are highly sophisticated and uses improved technology. Automatic radar plotting aid is also used in conjunction with modern radar for collision avoidance.

Global Satellite Navigation Systems (GNSS) is the term used for satellite navigation systems that provide for obtaining a position automatically. 04-October-1957 marked the beginning of a new age, the 'space age', when Sputnik-I was launched. TRANSIT, the first GNSS was developed by the United States; it was declared operational in 1964 and opened for the use of civilians in 1967.

Based on a similar concept the Soviet Union developed 'PARUS' and 'TSIKDA'. The operation of TRANSIT was terminated on 31st December 1996. In 1972, another project of the United States called 'TIMATION' was in operation, but it provided two-dimensional fixes like the TRANSIT. The United States Air Force was studying a project called '621B', which aimed at providing 3-dimensional fixes. On April 1973, these two projects were merged and the 'Navstar Global Positioning System (GPS) Joint Project Office (JPO) was established. The existing systems, GPS (DGPS when GPS is used with correction from GBAS or SBAS) and GLONASS, are named as GNSS-1, while the GNSS-2 will include additional second-generation systems such as Galileo, Compass (CNSS), Indian Regional Navigational Satellite System (IRNSS), and Quasi-Zenith Satellite System (QZSS) (Bonnor, 2012).

The importance of satellites in search and rescue operations was recognized by the IMO in the 1960s. The International Maritime Satellite Organization, which later changed its name to International Mobile Satellite Organization (Inmarsat) was established in 1976. The integrated communication system, the GMDSS, was fully implemented on the1st February 1999. GMDSS required ships to carry equipment like the NAVTEX receivers, EPIRB, Inmarsat ship stations, VHF/MF/HF with DSC etc. to improve safety of life at sea. GMDSS notably reinforced safety of navigation in more than one way. The exchange of meteorological information, navigational warnings, piracy warnings, routine communications etc. was made possible by the inception of GMDSS. The combination of terrestrial and satellite communication makes GMDSS a robust and efficient system (IMO, 2017).

Recent developments include AIS, ECDIS, Virtual aids to navigation, INS, e- Navigation etc. The present state of the art will be analysed in order to support a better understanding of the research and the suggested technological developments. Shipping has always been the life blood of global economy. From the age of oars and sails to the age of dual fuel engines, shipping has expanded and brought benefits to people across the world (Miyusov, Koshevoy & Shishkin, 2011). The number and size of ships grew exponentially over time. New types of ships emerged as a result of the demand to transport special cargoes (Låg, 2015). Consequently, efficient navigation became a requisite for the productive shipping of cargo.

The degree of accuracy of a ship's position improved from celestial observations to three-dimensional satellite fixes. This allowed the navigators not only to reduce the uncertainty of running into dangerous navigational hazards, but also improve the efficiency of the voyage. A ship's position is also vital for search and rescue operations, and most importantly the added accuracy gives the navigator confidence to execute plans related to navigation in a more productive way. Direction finding also improved considerably from celestial calculations and magnetic compasses to contemporary gyro-compasses. Modern gyro-compasses allow for the integration with other instruments to add reliability and sophistication to navigation (Axel, 2014).

The improvement in communication technology has helped to save lives, and to exchange information pertaining to safety of navigation and commercial aspects. The human element, an important component of shipping, benefits significantly from modern communication technology, as it allows seafarers to communicate with their families easily and economically. Integration of modern instruments provides multidimensional information to assist decision-making, and enhance situational awareness. Further, the emergence of collision prevention regulations has made navigation standardized, organized and systematic (Axel, 2014).

Automatic Identification System (AIS) is a system used for communication using the VHF maritime mobile band, for exchanging navigational data to enhance safety of navigation. AIS devices, known as stations are identified by their unique Maritime Mobile Service Identity (MMSI), a series of nine digits. The key feature of the system is that the stations operate autonomously. AIS facilitates the exchange of shipboard information automatically from vessels sensors, as well as manually by the operator. The International Convention for the Safety of Life at Sea, 1974 (SOLAS 74), Chapter V, requires all ships of 300 gross tonnage and upwards engaged in international voyages, and cargo ships of 500 gross tonnage and upwards engaged in international voyages, and passenger ships irrespective of size engaged in international voyages to carry AIS. Some administrations require non-SOLAS vessels to carry AIS as well. The purpose of AIS can be broadly classified as follows, firstly, in ship-to -ship mode for collision avoidance, secondly, for littoral States to obtain information, thirdly, as a VTS tool (IALA, 2011).

Automatic Identification System (AIS) system consists of one VHF transmitter, one VHF DSC receiver, two VHF TDMA receivers, and standard marine electronic communications links (IEC 61162/NMEA 0183) to shipboard display and sensor systems. Timing and position information is obtained from an external or integral global navigation system receiver, including a differential global navigation satellite system in coastal and inland waters for a more accurate position. Other information broadcasted by the AIS is fed manually or obtained from various sensors using standard marine data connection. Transmissions use 9.6 kb GMSK FM modulation over 25 or 12.5 kHz channels using HDLC packet protocols. Each Station determines its own transmission schedule (slot), based on the knowledge of other stations' future actions. Position report from one station fits into one of the 2250 time slots that are repeated every 60 seconds, there are two frequencies used, AIS 1(Channel 87B) and AIS 2(Channel 88 B), which is divided into 2250 time slots as mentioned (Axel, 2014).

Safety Factors

The safety of the marine environment mainly includes the protection of the marine natural environment, the resources development environment, and the safeguarding of the environment (Zacharias, 2014). Marine dynamic disasters include storm surges, giant waves, and sea ice. Marine ecological disasters include brassica and red tides. Marine emergencies include marine oil spills, leakage of hazardous chemicals, and leakage of radioactive substances. Marine rights protection incidents include the invasion of illegal ships and the occupation of islands and reefs (UNEP, 2016).

There is no doubt that inadequate infrastructure is one of the biggest challenges to marine safety in those places. Despite the provisions of the law and, of course, the presence of government officials, boats are generally overloaded and overcrowded (Nnadi, 2014). Except in Lau and Donga where there were attempts to introduce lifejackets on rent by private initiatives, passengers were carried for short and long distances without lifejackets. Ironically, in Lokoja and other places, boats were stopped in the middle of the rivers to check cases of overload and overcrowding instead of doing it before the boat commences its voyage. Often, boats develop engine faults due to poor maintenance, water penetrate inside it because of overweight and eventually sink thereby drowning the passengers. There is no boat with load line in all those places (Borunoun & Nabbout, 2016). The marine police lack the motivation and capacity to move swiftly when accidents occur. Apart from those who passed out from technical colleges, boat building is being carried out largely by artisans who inherit the skills from their parents. While there is only one mechanic in major areas, spare parts were either of low quality or not readily available at the time of need (Elenwo & Akankali, 2015).

Search and rescue operations were still undertaken through communal efforts. In virtually all the places, there are families popularly known as *Gidan Sakin rafi* that are in-charge of rivers and provides search and rescue operations. These families are reputed for their ability to rescue people and recover properties as well as dead bodies. Consequently, search and rescue skill are transferred from generation to generation in *Gidan Sarkin rafi (*Zacharias, 2014). However, there were times when search and rescue operations were carried out by volunteers such as in *Jimeta*. Over 90% of world trade is carried out by the international shipping industry. As of January 2017, there were 52,183 ships in the world's merchant fleets. General cargo ships are ranked as the most common type of ship in the global merchant fleet, accounting for about a third of the fleet (Vouker, 2014).

The world fleet is registered in over 150 nations, and manned by over a million seafarers of virtually every nationality. The worldwide population of seafarers serving on internationally trading merchant ships is estimated at 1,647,500 seafarers, of which 774,000 are officers and 873,500 are ratings. These figures are self-explanatory, in terms of contribution and significance of shipping industry to world trade. So, providing a safe maritime environment to the men and women working on the vessels, and the cargo they escort, naturally becomes priority of the first order for the shipping industry.

Ship security measures are often the first and only measures preventing criminal acts at sea. At the same time ship operators have had problems defending the quality of their ship security analysis when it is challenged. The basic objectives of 'ship security' are – To effectively reduce the security risk to acceptable levels; and to create a security culture in the organisation that supports effective ship operation on an everyday basis (Borunoun & Nabbout, 2016). Without shipping, the import and export of goods on the scale necessary for the modern world would not be possible. As the world realizes that piracy cannot be effectively checked by ships designed to ferry cargo and crew, regional and private solutions, including deployment of armed Marshalls is indispensable (Nnadi, 2014). Civil war-ridden nations, failed States like Somalia, treacherous passages like the Gulf of Aden will continue to pose threat to the innocent seafarers and goods worth trillions of dollars, waiting to get unloaded at their respective destinations. As the shipping industry is all set to embark on a busy and expensive journey over 2020-2030, each ship owner or operator must make a self-assessment based on risk, propose and deploy the most conducive security strategy to safeguard their vessels and men (Elenwo & Akankali, 2015).

In the risk assessment of marine environmental security incidents, comprehensive assessment should be conducted from the three dimensions of incident risk, vulnerability of disaster-bearing vehicles, and emergency management. In addition, the above-mentioned parts of the marine environment security incidents often appear as associated and secondary derivatives. Therefore, to study the risk assessment of marine environmental safety incidents, we must consider multi-factors and multi- event equivalences to comprehensively assess the degree of damage to marine environmental safety incidents (Vouker, 2014).

Historical case data based on typical marine environmental security incidents such as storm surge, Brassica mosses, red tides, and oil spills, the actual business needs for risk prevention and control, and the development process of the marine environmental safety event chain, from the hazards of the incident, the vulnerability of the disaster-bearing entity and the emergency (Nnadi, 2014). Three aspects of the distribution of rescue capabilities are used to screen indicators for marine environmental safety risk assessment. Based on the mutual influence and conversion relationship between indicators, a comprehensive risk assessment index system covering the event's own risks and impacts is constructed; a threshold for the classification of risk assessment indicators for marine environmental safety events is established and constructed (Borunoun & Nabbout, 2016).

Marine Pollution and Maritime Environment

Few dissertations specifically examine the effects of marine pollution on marine resources in West African coastal regions, particularly Nigeria's ports and inland waters. Some of these studies concentrated on the identification of sources and their potential effects on the marine environment. Examples include Liu and Maes (2017) who identify sewage, industrial effluents, plastics that float on water and abandoned objects other than vessel-based ones, as sources. According to them, the specific effects of these sources on the marine environment include: degradation and thermal pollution which adversely affects the ecosystem. Others include: eutrophication arising from untreated waste which can kill sea animals, plants and cause the depletion of dissolved oxygen which affects Biochemical Oxygen Demand (BOD). These findings are consistent with Momoh (2013). A similar study by Ware (2009) identified additional marine pollutants namely: oily water discharge from tanker accidents, accidental oil discharge during routine operations, wastewater, garbage and solid waste from vessels. Additional sources also include: ballast water or that from machinery spaces, exhausts and antifouling paints from vessel hulls.

However, other studies focused more on the examination of legislations and frameworks for enforcement of applicable conventions for the control of marine pollution. Notable ones include: Ekhaise and Anyasi (2005), who studied the organizational and institutional framework of oil spillage and pollution management in Nigeria. Specifically, they appraised the relevant laws (including international agreements) enacted by the government of Nigeria since 1963 which aim to mitigate the incidence of oil pollution. In addition, they also examined the relevant agencies established to implement procedures on oil pollution and management during oil prospecting/production activities.

A similar study Crowther, Kay and Wyer (2001), advocate for setting up a uniform system for managing shipborne waste. According to the authors such uniform frameworks would spell out uniform measures for collection and treatment of oil, greasy cargo and other ship waste. In terms of challenges in implementation of prescriptions of relevant pollution control legislations, a companion study by Donau (2010) identifies the constraints in the enforcement of low sulphur marine regulation fuel within the Baltic and North Sea's Emission Control Areas (ECA's) (comprising UK and Sweden in particular). Marine fuel burnt in vessels operating within ECA's is limited to 0.1% sulphur content. Alternatively, sulphur abatement technologies should be employed where high sulphur content marine fuel is used. The study demonstrates the weakness in enforcement measures based on dissertation work only and in the absence of analysis of water quality to confirm compliance. Then Chukwu (2008) who advocates for a regional model of enforcement and provision of waste reception facilities and financing based on the electronic Vignette system. Yet, Elenwo and Akankali (2015) contend that waste handling facilities in West and Central African countries are inadequate. This position is also consistent with.

The study by Kadafa, Zakaria and Othman (2012) however, posits that some developing countries face financial constraints in the provision of adequate waste handling facilities in their ports. From the review, it is established among other challenges that adequate reception facilities and robust monitoring/control mechanisms are lacking in most countries' ports, Nigerian ports inclusive. For example, the study by Nnadi (2014) identifies weakness in the pollution control framework model in place that does not account for prevailing pollution levels. This dissertation attempts to address current research gaps by proposing an integrated model for the management of pollution in marine port environments. The proposed model integrates a process of continuous analysis of water quality in the marine port environment using ship generated wastewater as a proxy. This model envisages an integrated approach that combines laboratory evidence and existing regulations to produce a framework that could be employed by port pollution control administrators.

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1963 which aim to mitigate the incidence of oil pollution. In addition, they also examined the relevant agencies established to implement procedures on oil pollution and management during oil prospecting/production activities. A similar dissertation by Berger (2014), advocates for setting up a uniform system for managing ship borne waste. According to the authors such uniform frameworks would spell out uniform measures for collection and treatment of oil, greasy cargo and other ship waste.

The measures applied so far by IMO in terms of the conventions and their enforcement by flag state, coastal state and port state control have yielded fruitful results, especially in curtailing pollution from accidental spills arising from collisions (Szepes 2013). However, 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 rising levels of marine pollution from ship-based discharges are expected in these ports in the long run. For example, between the years 2008 and 2011, there were around 32% and 18% increases in the quantities of garbage and oily waste handled respectively in Nigeria's Tin Can Island port reception facilities alone (Helen, Bloor, Baker & Dahlgren, 2016).

From the review, it is established among other challenges that adequate reception facilities and robust monitoring/control mechanisms are lacking in most countries' ports, Nigerian ports inclusive. For example, the study by Kloff and Wicks, (2004), identifies weakness in the pollution control framework model in place that does not account for prevailing pollution levels. This dissertation attempts to address current research gaps by proposing an integrated model for the management of pollution in marine port environments. The proposed model integrates a process of continuous analysis of water quality in the marine port environment using ship generated wastewater as a proxy. This model envisages an integrated approach that combines laboratory evidence and existing regulations to produce a framework that could be employed by port pollution control administrators. Resulting from the empirical studies, the following hypotheses relating to the purpose and problems of the study have been:

Ho_1: There is no significant relationship between oily-water and navigation of shipping terminals in Onne Port, Rivers State.

Ho_2: There is no significant relationship between oily-water and the safety of mariners/beach goers of shipping terminals in Onne Port, Rivers State.

METHODOLOGY

The study adopted the cross-sectional survey in its investigation of the variables. Primary source of data was generated through self- administered questionnaire. The population of the study was 84 employees of three (3) selected shipping Terminals in Port Harcourt. There was no need for sampling as the study used a census because the population was small. The research instrument was validated through supervisor's vetting and approval while the reliability of the instrument was achieved by the use of the Cronbach Alpha coefficient with all the items scoring above 0.70. Data generated were analyzed and presented using both descriptive and inferential statistical techniques. The hypotheses were tested using the Spearman's Rank Order Correlation Statistics. The tests were carried out at a 95% confidence interval and a 0.05 level of significance.

The Cronbach alpha that indicated the only result of 0.7 and above were considered as reliable while any result below 0.7 was painstaking taken as unreliable.

Table 1: Reliability Coefficients of variable measures

S/No	Dimensions/Measures of the study variable	Number of items	Number of cases	Cronbach's Alpha
1	Oily Water	5	62	0.732
2.	Navigation	5	62	0.761
3	Safety Factors	5	62	0.700

Source: Research data output, 2019

DATA ANALYSIS AND RESULTS

The level of significance 0.05 was adopted as a criterion for the probability of accepting the null hypothesis in ($p > 0.05$) or rejecting the null hypothesis in ($p < 0.05$).

Table 2: Correlations Matrix for Oily Water and Maritime Environment

		Oily Water	Navigation	Safety Factors
Oily Water	Pearson Correlation	1	.276*	.647**
	Sig. (2-tailed)		.030	.000
	N	62	62	62
Navigation	Pearson Correlation	.276*	1	.481**
	Sig. (2-tailed)	.030		.000
	N	62	62	62
Safety Factors	Pearson Correlation	.647**	.481**	1
	Sig. (2-tailed)	.000	.000	
	N	62	62	62

*. Correlation is significant at the 0.05 level (2-tailed).

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

Source: Research Data 2019 and SPSS output version 23.0

Table 2 illustrates the test for the two previously postulated bivariate hypothetical statements. The results show that for

Ho_1: ***There is no significant relationship between oily-water and navigation of shipping terminals in Onne Port, Rivers State.***

The correlation coefficient (r) shows that there is a significant and positive relationship between oily-water and navigation. The *rho* value 0.276 indicates this relationship and it is significant at p 0.030<0.05. The correlation coefficient represents a low correlation indicating a weak relationship. Therefore, based on empirical findings the null hypothesis earlier stated is hereby rejected and the alternate upheld. Thus, there is a significant relationship between oily-water and navigation of shipping terminals in Onne Port, Rivers State.

Ho_2:*There is no significant relationship between oily-water and the safety of mariners/beach goers of shipping terminals in Onne Port, Rivers State.*

The correlation coefficient (r) shows that there is a significant and positive relationship between oily-water and the safety of mariners/beach goers. The *rho* value 0.647 indicates this relationship and it is significant at p 0.000<0.05. The correlation coefficient represents a high correlation indicating a strong relationship. Therefore, based on empirical findings the null hypothesis earlier stated is hereby rejected and the alternate upheld. Thus, there is a significant relationship between oily-water and the safety of mariners/beach goers of shipping terminals in Onne Port, Rivers State.

DISCUSSION OF FINDINGS

Discussion of Findings

This study using descriptive and inferential statistical methods investigated the relationship between Marine Pollution and Maritime Environment of shipping terminals in Onne Port, Rivers State. The findings revealed that a significant relationship between exists between marine pollution and maritime environment of shipping terminals in Onne Port, Rivers State using the Pearson Product Moment Correlation tool and at a 95% confidence interval. The findings of this study confirmed that marine pollution has an effect on maritime environment of shipping terminals in Onne Port, Rivers.

The finding reinforces previous studies whereby it has been established by scholars and professionals like Liu and Maes (2017) who identify sewage, industrial effluents, plastics that float on water and abandoned objects other than vessel-based ones, as sources. According to them, the specific effects of these sources on the marine environment include: degradation and thermal pollution which adversely affects the ecosystem. Others include: eutrophication arising from untreated waste which can kill sea animals, plants and cause the depletion of dissolved oxygen which affects Biochemical Oxygen Demand (BOD). These findings are consistent with Momoh (2013). A similar study by Ware (2009) identified additional marine pollutants namely: oily water discharge from tanker accidents, accidental oil discharge during routine operations, wastewater, garbage and solid waste from vessels. Additional sources also include: ballast water or that from machinery spaces, exhausts and antifouling paints from vessel hulls.

Significant Relationship between Oily Water and Marine Environment

The first and second hypotheses sought to examine the relationship between Oily Water and Maritime Environment. Hence it was hypothesized that there is no significant relationship between Oily Water and Marine Environment. These hypotheses were tested using the Pearson Product Moment Correlation. The study findings reveal that there is strong positive relationship between oily water and maritime environment of shipping terminals in Onne Port, Rivers. The P-value (0.00) is less than the level of significance at (0.05). This finding agrees with previous findings According to Borunoun & Nabbout (2016) who stated that the special attention has been focused on the discharge of waste water & oily water & its regulatory restriction has become stricter. Oil water separation processes using polymeric or inorganic membranes have been proposed as effective & cost competitive alternative to conventional oil removal technologies but in present the commercial use of membrane in waste water treatment is currently limited by their low efficiency as well as high capital & operating cost. This problem of separation of oil from water is widely faced in the industries especially in petroleum industry effluent plants and in sewage treatment Industrial waste contains nearly 70% free oil. 25% emulsified oil & 5% soluble soil. Separation of oil from water is necessary of the following reason. Oil slick on surface of water can prevent oxygen transfer from atmosphere to water and lead to over low dissolved oxygen level due to microbial & oxidative attack on the hydrocarbon molecules.

CONCLUSION AND RECOMMENDATIONS

Due to the need to consider and ensure the health and safety of maritime workers and those who come around the port, it was necessary to have considered the marine pollution and its effect to the maritime environment in Onne Port. There is a need improve on the health and safety of employees for better productivity. It has been established by scholars and professionals that marine pollution is creates a serious health hazard and problem to the maritime environment around the Onne Port. Due to the health challenges and environmental hazard which the employees are exposed to, there is a need to search for a means of improving their working environment. This therefore brings in the consideration of the effect of marine pollution on the maritime environment. This study therefore concludes that marine pollution significantly affects the maritime environment of shipping terminals in Onne Port, Rivers. Specifically, the study concludes marine pollution significantly affects the maritime environment of shipping terminals in Onne Port, Rivers.

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