

The Environmental Impact of Port Activities at the Manila North Harbor: A Qualitative Investigation

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Isaiah O. Omotosho, ORCID No. 0009-0008-7982-506X

Master in Maritime Administration, Asian Institute of Maritime Studies, Pasay City, Philippines

Abstract

The study assessed the environmental impact of port activities in Manila North Harbor Port and provided insights to contribute in the enhancement of environmental protection policies and practices in the Philippines. Employing descriptive-qualitative design, five (5) purposively selected participants from each department involved in port activities at Manila North Harbor were selected as participants of the study. Using a semi-structured questionnaire, interview was done to gather narrative data from the participants with thematic analysis as method in analyzing the data. The findings highlight that, activities such as oil transport, waste pollution, and ship deballasting have a significant detrimental effect on the environment, leading to pollution and degradation of the marine ecosystem. Conversely, activities like noise pollution, cargo handling, and passenger transportation have a relatively lesser impact. Participants observed these harmful practices persisting since the establishment of the port, resulting in negative alterations in water quality and weather conditions over time. Implementing stringent waste management regulations, reducing the use of hazardous substances, conducting regular water quality monitoring and ecosystem health assessments, fostering collaboration between port authorities, environmental agencies, and local communities, allocating resources for research and development, and utilizing the research findings for sustainable solutions are ways to lessen these impacts. Striking a balance between economic development and environmental conservation is crucial for the port's long-term prosperity and the preservation of the surrounding environment.

Keywords: maritime safety, casualty investigation, qualification, competency, training, enhancement



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INTRODUCTION

On a note of the laws by the congress of the Republic of the Philippines regarding environmental protection, Environmental Management Bureau (EMB) of the Philippines is mandated to “provide research and laboratory services and serve as secretariat in the adjudication of pollution cases.” According to Section 34 of the Philippine Clean Air Act of 1999, the EMB is a line bureau (RA 8749). The agency is tasked with putting into effect the following six (6) significant environmental legislation on a national level: Environmental Impact Assessment Law (PD 1586); Toxic Substances and Hazardous Waste Management Act (RA 6969); Clean Air Act of 1999 (RA 8749); Ecological Solid Waste Management Act (RA 9003); Clean Water Act (RA 9275); and Environmental Awareness and Education Act of 2009 (RA 9512). Its mission is to “Restore, Protect and Enhance Environmental Quality towards Good Public Health, Environmental Integrity and Economic Viability.”

In this context, the Philippines has more than 7,107 islands, and a coastline of around 36,289 kilometers (Philippines Environment Monitor, 2015). Most people opt to reside in large cities and progressive towns because of the higher employment prospects, educational opportunities, and overall quality of life. Additionally, shipping is essential for transferring products and people between the islands, particularly in the nation's center and south (Dimailig et al., 2017), and with its structure and organization, this led to an environmental damage (Lang et al., 2018; Sharma & Das, 2020).

The Organization for Economic Cooperation and Development (OECD) divides the effects of ports on the environment into three groups: emissions from different transportation networks that serve the port region, problems caused by port activities, and problems at sea caused by ships that stop at the port.

Furthermore, according to an analysis conducted by Daniil and Boviatsis (2022),

untreated ballast discharge and harmful air pollution are two instances of how the shipping industry contributes to environmental degradation. It is widely known that ballast discharge is a significant problem that affects marine life on a global basis. It also poses a severe threat to the variety of life in the area where it lives.

Air pollution from ships is another thing that significantly affects human health and the environment, both locally and worldwide. Pollutants like sulfur oxide (SO_x), nitrogen oxide (NO_x), and particulate matter (PM) all affect people and are primarily released into the air by ships. One of the most significant contributors to climate change is the shipping industry, responsible for approximately three percent of the world's total greenhouse gas emissions. As of 2020, the global sulfur emission cap for fuel composition will be lowered from 3.5% to 0.5%, as determined by the International Maritime Organization (IMO). This modification became effective straight away. In response to the worsening state of the environment, the International Maritime Organization (IMO) decided to implement this new worldwide limit on the sulfur content of fuel emissions. Due to this change, ships release less harmful pollution (Daniil & Boviatsis, 2022).

In light of this concern, the present undertakings will delve into the effect that activities associated with ports, particularly the Manila North Harbor Port, have on the surrounding environment. In this context, Northport is responsible for the operation, management, and maintenance of the 64-hectare complex. As a result of Northport's ongoing port expansion, the port now has a total of 5,758 berth lengths, which is designated for both Terminal 1 Vessel operations and Terminal 2 Multi-Purpose and RORO-passenger operations. This is possible because the port now has a total of 5,758 total berth lengths. It is the primary service provider for the domestic freight trade in Manila. The Northport port, which can handle 1.2 million twenty-foot equivalent units (TEUs) annually, is big enough to hold many different ships (About Northport | Northport, n.d.). Moreover, Northport is a

cutting-edge domestic terminal in the Philippines that makes significant investments in a fleet of equipment that includes an increasing number of quay cranes and berths. In addition to providing the most advanced technology and up-to-date machinery, Northport is also distinguished by its commitment to remaining at the forefront of technological innovation. It is the first and highest commendation ever given to rubber-tired gantry cranes (RTGs) utilized in container yard operations around the country. Northport is proud of its operational efficiencies, which have made the port more competitive worldwide and made shipping goods faster and safer. This leading domestic gateway's maritime port management experience is utilized chiefly to support container shipping or transshipment services. The practical and efficient operation of modern terminals reduces the time spent waiting for ships, increasing the amount of cargo that can be shipped. Finally, in 2010, Northport's commercial operations in Manila North Harbor in Tondo got off the ground and started making money. Also, the passenger terminal at the airport opened in 2013 (About Northport, n.d.).

In a 2021 study, Deloitte Norway evaluated the ports of Batangas, Cagayan de Oro, and Manila North Harbor for the project "Clean Ports, Clean Oceans: Improving Port Waste Management in the Philippines." Norway asserts that Manila North Harbor is the only one of the three ports included in their analysis with a resident community. Because Manila North Harbor is located in such a congested city, the City of Manila enforces the Anti-Littering Law, which prohibits littering, unlawful dumping, illegal garbage disposal, piling waste outside buildings, and public utility vehicles spilling, dispersing, and littering junk.

Hence, according to shore reception facility (SRF) service providers, plastics such as PET bottles, cup noodles, and biscuit wrappers make up approximately 50% of the solid waste collected in vessels before COVID-19. This estimate is based on 300–400 cubic meters of solid garbage collected from Manila North Harbor. Consequently, plastic waste is today

one of the most significant issues in Manila North Harbor.

Given the foregoing, the researcher sought to ascertain the current environmental impact of port activities at Manila North Harbor, with the intention to contribute in the enhancement of environmental laws and practices in the Philippines throughout time to alleviate environmental hazards.

LITERATURES

Roles of Government Agencies in the Philippines Maritime Industry. The primary organization in charge of all forms of transportation in the nation is the Department of Transportation (DOTr). All sea-borne carriers and shipping companies, including those involved in logistics, fall under its purview, as does the Maritime Industry Authority (MARINA), the regulatory body for shipping, which is responsible for the supervision, regulation, and rationalization of the organizational management, ownership, and operations of all water transport utilities (MARINA, 2016). The Philippine Coast Guard (PCG) works to protect marine life, resources, and the environment. It also enforces all maritime laws and helps with other seafaring operations. The Philippine Ports Authority and the Cebu Ports Authority (CPA) are the organizations in charge of port operations, development, and regulations.

The Philippine Port Authority (PPA) is in charge of the remaining ports in the nation, while the CPA is in order of all the ports within the authority of Cebu City. The Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA) is responsible for the timely broadcast of weather information.

MARINA was established as the single maritime administration responsible for the implementation and enforcement of the 1978 International Convention on Standards of Training, Certification, and Watch keeping for Seafarers, as amended, and any international agreements or covenants related to it on March 13, 2014, as a result of Republic Act 10635. This

act was signed into law by President Aquino of the Philippines.

Hence, MARINA was given the powers and responsibilities of the Professional Regulation Commission (PRC), the Commission on Higher Education (CHED), the Technical Education and Skills Development Authority (TESDA), the Department of Health (DOH), and the National Telecommunications Commission (NTC). These duties include giving out, validating, verifying, correcting, revoking, or canceling certificates of competency, endorsement, proficiency, and other proofs that all seafarers need. This was in response to the fact that the Philippines remained on the Whitelist.

Specifically for this study, the researcher chose the Manila North Harbor Port. In context, Northport is responsible for the operation, management, and maintenance of the 64-hectare complex. As a result of Northport's ongoing port expansion, the port now has a total of 5,758 berth lengths, which is designated for both Terminal 1 Vessel operations and Terminal 2 Multi-Purpose and RORO-passenger operations. This is possible because the port now has a total of 5,758 total berth lengths. It is the primary service provider for the domestic freight trade in Manila. The port at Northport, which has an annual capacity of 1.2 million twenty-foot equivalent units (TEUs), is large enough to accommodate various vessels.

Moreover, Northport is a cutting-edge domestic terminal in the Philippines that makes significant investments in a fleet of equipment that includes an increasing number of quay cranes and berths. In addition to providing the most advanced technology and up-to-date machinery, Northport is also distinguished by its commitment to remaining at the forefront of technological innovation. It is the first and highest commendation ever given to rubber-tired gantry cranes (RTGs) utilized in container yard operations around the country. Northport is proud of its operational efficiencies, which have made the port more competitive globally and made freight transportation faster and less risky.

A "safe, secure, efficient, profitable, competitive, dependable, integrated, ecologically sustainable, and people-oriented Philippine transport system" is the goal outlined in the Philippine Development Plan (PDP) for 2011 to 2016. According to what is stated in the accompanying document, the plan is to establish a network of intermodal transportation that is both integrated and coordinated, with backbone lines leading to areas of economic expansion. Since the Philippines is an archipelagic country, one cannot ignore maritime transport's significance in achieving this objective.

Regarding achieving inclusive growth and socio-economic advancement, the Philippines emphasizes the maritime industry as an essential component. Presently, shipping is still the principal infrastructure used to connect the Philippines islands. Additionally, it links the nation to international trade and commerce, according to UNESCAP (n.d.).

The integration of the development, promotion, and regulation of the marine sector in the Philippines are within the purview of the MARINA, which is an agency operating under the Department of Transportation and Communication (DOTC). The agency had existed since June 1, 1974, when Philippine Presidential Decree No. 474 was signed into law, and it currently has jurisdiction over four (4) distinct industries: shipping (both domestic and international), ship construction and repair, maritime employment, and maritime transportation.

Moreover, the PPA formulated a policy to ensure that port activities do not cause excessive environmental damage and that all parts of port growth and operation are directed toward safeguarding and maintaining the environment. The PPA's administrative order (AO) no. 05-2018, which contains the Port Environment Policy (PEP), is the organization's tool for institutionalizing environmental preservation and protection as well as its way of "mainstreaming sound practices in all aspects of port management, port operation, port

engineering, and development" on May 27, 2018, the policy took place.

PEP adopts pertinent national and international laws to safeguard and conserve the environment. The International Maritime Organization, the Asia-Pacific Economic Cooperation, the International Association of Ports and Harbor Facilities, and the Permanent International Cooperation of Navigational Congresses have obligations and requirements that must be met. It also complies with these international laws and regulations.

Impact of Ports in the Environment. While effective ports are essential to the economic growth of the communities around them, the associated ship traffic, the processing of the commodities in the ports, and the distribution to the region can have a variety of detrimental environmental effects (Norway, 2021)

Both within ports and in the immediate area around ports, shipping has an influence on the environment. Examples of these impacts are "noise from ship engines and machinery used for loading and unloading, exhausts of particles, CO₂, NO_x and SO₂ from the ship's main and auxiliary engines, and dust from the handling of substances such as grain, sand and coal" says OECD.

The effects on the ecosystem, however, vary depending on a number of circumstances, including as port size, activity type, traffic volume, as well as the hydrology and topography of the area. Therefore, creating a framework for environmentally friendly port operations is difficult.

Plastic Pollution in the Philippines. In a 2021 study, Deloitte Norway evaluated the ports of Batangas, Cagayan de Oro, and Manila North Harbor for the project "Clean Ports, Clean Oceans: Improving Port Waste Management in the Philippines."

Norway asserts that Manila North Harbor is the only one of the three ports included in their analysis with a resident community. Because Manila North Harbor is located in such a

congested city, the City of Manila enforces the Anti-Littering Law, which prohibits littering, unlawful dumping, illegal garbage disposal, piling waste outside buildings, and public utility vehicles spilling, dispersing, and littering junk.

Hence, according to shore reception facility (SRF) service providers, plastics such as PET bottles, cup noodles, and biscuit wrappers make up approximately 50% of the solid waste collected in vessels before COVID-19. This estimate is based on 300–400 cubic meters of solid garbage collected from Manila North Harbor (Norway, 2021).

Consequently, plastic waste is today one of the most significant issues in Manila North Harbor. Plastic pollution is one of the most urgent problems facing the globe, endangering human and planetary health. According to a recent EPR research from WWF, Filipinos consume 2.15 million tons of plastic annually. Of this entire trash, only 9% is recycled, and 35% may leak into the environment. Additionally, a recent study reveals that, on average, people may be eating 5 grams of plastic per week—the weight of a credit card (WWF-Philippines, 2022).

WWF-Philippines and PPA are working with the Port Management Offices (PMOs) of Manila North Harbor, Port of Batangas, and Port of Cagayan de Oro to establish a baseline for the quantity of plastic waste created by ports, ships, and the local people near ports. With this as a starting point, WWF-Philippines partners with relevant parties to build a plan and devise strategies to reduce plastic waste leakage in the three aforementioned ports by 50 percent by 2023 (WWF-Philippines, 2022).

Presently, the Philippine Ports Authority (PPA) is reiterating its prohibition on all single-use plastics at all ports under its jurisdiction in order to support sustainable port operations. Plastic coffee stirrers, drinking straws, spoons, forks, knives, and labo and thin film sando bags that are thinner or lighter than 15 microns are all prohibited (PPA, 2022).

Both members of the Department of Transportation's three-pronged marine sector,

the Maritime Industry Authority (MARINA) and the Philippine Coast Guard (PCG), have shown their willingness to carry out comparable programs in their respective jurisdictions (PPA, 2022).

Impact of Maritime Trade on the Environment. Through maritime trade and commerce, ports and the shipping sector today play a critical part in the growth of the global economy. For the movement of huge volumes and heavy cargo, such as minerals, metals, ores, steel coils, etc., which would be hard to move by air, ocean freight is a preferred means of transportation (Carnarius, 2018).

International organizations and pacts have encouraged ports to take on environmental responsibility and utilize sustainable practices to protect the environment. The port and shipping industry's environmental impact had been controlled by major international organizations such as the International Maritime Organization (IMO) and the Marine Environment Protection Committee. These organizations have stepped in to control the environmental impact of the port and shipping industry through ongoing agreements, accords, industry standards, and recommendations. The MARPOL Convention was initially introduced in 1973, and further additions were made between 1978 and 1997. The London Convention (1978), the International Convention on Oil Pollution Preparedness, Response, and Cooperation (OPRC) (1995), and the Tanker Safety Pollution Prevention (TSPP) have all stimulated discussion and prompted extensive action against the numerous ways in which ports have contributed to rising levels of pollution. In light of the deterioration of the environment, numerous legal proceedings have been filed against the shipping industry, particularly in Europe. By passing laws encouraging energy efficiency and limiting greenhouse gas emissions, the European Union has made it possible for ports to run responsibly and suitably for the environment (Di Vaio & Varriale, 2018).

Routine monitoring assessments include waterproofing the soil to prevent

contamination, restricting the parameters around storage tanks, and performing regular, timely maintenance to reduce the risk of unintentional spills, leaks, or explosions. These measures are implemented as part of the routine rotation of ship and port equipment (Ferreira et al., 2017).

Furthermore, Lang et al. (2018) examined the issue of microplastic pollution in both freshwater and coastal ecosystems in their study. The said research discovered significant amounts of microplastics and fibers in the water and the sediments. This was caused by many factors, especially with the most significant waste from the shipping industry.

As stated by the Organization for Economic Cooperation and Development (OECD), the environment is impacted by maritime activity in ports and the surrounding areas. These effects include noise from ship engines and loading and unloading equipment; particle exhausts; CO₂, NO_x, and SO₂ from the ship's main and auxiliary engines; and dust from processing materials such as grain, sand, and coal. Furthermore, the OECD divides the effects of ports on the environment into three different groups: emissions from different transportation networks that serve the port region; problems caused by port activities; and problems at sea caused by ships that stop at the port.

Furthermore, according to an analysis conducted by Daniil & Boviatsis (2022), untreated ballast discharge and harmful air pollution are two instances of how the shipping industry contributes to environmental degradation. It is widely known that ballast discharge is a significant problem that affects marine life on a global basis. It also poses a severe threat to the variety of life in the area where it lives.

Air pollution from ships is another thing that significantly affects human health and the environment, both locally and worldwide. Ship emissions are a substantial source of gaseous and particle pollution. As a result of the expansion of shipping activities during the past few decades, this type of pollution has assumed

a greater significance. The annual NO_x, SO₂, and PM_{2.5} emissions from ship-based sources are estimated to be 2x10⁷, 9.7x10⁶, and 1.5x10⁷ kilograms, respectively (Johansson et al., 2017). The most polluted regions surround the South China Sea and the East China Sea.

Pollutants like sulfur oxide (SO_x), nitrogen oxide (NO_x), and particulate matter (PM) all affect people and are primarily released into the air by ships. One of the most significant contributors to climate change is the shipping industry, which is responsible for approximately three percent of the world's total greenhouse gas emissions. As of 2020, the global sulfur emission cap for fuel composition will be lowered from 3.5% to 0.5%, as determined by the International Maritime Organization (IMO). This modification became effective straight away.

According to the findings of Sharma and Das (2020), port industry actors need to be indoctrinated with a heightened sense of awareness and accountability toward the environment. Whether they work at a major or a small port, port officials are responsible for paying strict attention to the routine maintenance and repairs of the infrastructure at their respective ports. Those in positions of authority within the government must be held accountable for the state of older ports and the enforcement of regulations controlling the management and disposal of trash. The task should be distributed among smaller ports for more meticulous management of cargo and with proper regard to the protection of the environment. Major ports should not be allowed to operate at total capacity, and the workload should be split among smaller ports.

Therefore, a stricter piece of legislation needs to be made so that it can require the creation of a committee whose primary job will be to make sure that all port activities will still be able to happen in the future. Similar investigations, such as the one conducted in 2021 by Ogbonna et al., which indicated that there have been increasing negative effects on the environment, including the pollution of freshwater habitats, corroborate this. The high concentration of pathogens in the water makes the situation

worse and causes changes in the physiochemical properties of surface water bodies. Consuming fish places the public's health at risk because of the food chain. The species that depend on surface water for habitat or for drinking purposes may also be harmed by these conditions. The bacteria that get into water from human and animal waste are the biggest health risk, and this is mostly because of how wastewater is disposed of.

In response to the worsening state of the environment, the International Maritime Organization (IMO) decided to implement this new worldwide limit on the sulfur content of fuel emissions. Due to this change, ships are now putting out less harmful pollution (Daniil & Boviatsis, 2022).

METHODOLOGY

Research Design. The present study utilized descriptive-qualitative investigation research design (Lambert & Lambert, 2012). It was employed to furnish a holistic comprehension of the ecological ramifications of port operations and the determinants that shaped an organization's practices and policies. The utilization of qualitative descriptive methodologies enabled a comprehensive investigation of the phenomenon at hand, rendering it exceedingly pertinent to the research objectives.

Population, Sample Size, and Sampling Technique. The study aimed to gather qualitative data through interviews and purposive sampling was employed to a minimum of five (5) purposively selected participants from each department involved in port activities at Manila North Harbor. The departments included the Office of the General Managers (GM), the Office of the Assistant General Manager (AGM) for Operations, the Office of the AGM for Engineering, the Office of the AGM for Finance, Legal, and Administration, as well as the (Port Management Offices (PMOs) assigned to the Manila North Harbor Port.

By using purposive sampling, the study aimed to gather data from participants who could

respond thick narratives to the research questions and provide in-depth insights into the environmental impact of port activities at Manila North Harbor. This approach ensured that the collected data were aligned with the research objectives and allowed for a comprehensive exploration of the phenomenon under investigation.

Research Instrument. The primary research instrument for this study was a semi-structured interview questionnaire with guidance from Boyce and Neale (2006). To gather the necessary data, a set of validated semi-structured questions was developed as interview guide. These questions were designed in alignment with the research questions and objectives of the study. The interviews served as the primary method in gathering the data for the study. This is to collect rich and nuanced data directly from the participants, enabling a comprehensive exploration of the research topic and facilitating the achievement of the research objectives. The insights and information obtained were then summarized and analyzed to provide an overall assessment of the environmental impact.

Data Gathering Procedure. The data gathering procedure for this study involved several steps. Firstly, the researcher established contact with Manila North Port Harbor. Once permission was obtained, the researcher proceeded to coordinate with potential participants from different departments within the organization. This coordination involved explaining the study in detail and requesting their voluntary participation. Individual interviews were then scheduled with the participants. The interviews were conducted online and in-person, based on the participants' preferences. During the interviews, the researcher encouraged participants to provide detailed and comprehensive answers.

To maintain an accurate record of the interviews, the entire process was recorded for documentation purposes with the approval and permission of the participants. This recording facilitated the transcription and analysis of the data in the later stages of the research. The

transcriptions were securely stored and organized for efficient data management.

Qualitative Data Analysis. The qualitative data gathered from the interviews underwent a rigorous analysis process to uncover meaningful insights and patterns related to the environmental impact of port activities in Manila North Port Harbor. The researcher followed a systematic approach to analyze the data and draw conclusions.

Employing thematic analysis as technique in analyzing the data, a thorough examination of the interview transcripts, identification of themes, coding of data, and interpretation of the findings were done. This process enabled the researcher to gain a deeper understanding of the environmental impact of port activities in Manila North Port Harbor and shed light on the factors influencing the organization's practices and policies.

Research Ethics. The present study adhered to rigorous ethical standards to ensure the protection and welfare of participants. The researcher followed the Free Prior Informed Consent (FPIC) principle as mandated by the Indigenous Peoples Rights Act of 1997 (R.A. 8371) to ensure that participants had the freedom to provide their consent voluntarily, without external manipulation or coercion. In addition, the Data Privacy Act of 2012 was strictly followed to safeguard the privacy and confidentiality of participants' personal information. Hence, before the data collection process, the researcher ensured that each participant provided informed consent. They were provided with a consent form that outlined the purpose of the study, emphasized the voluntary nature of their participation, assured the confidentiality of their responses, and informed them of their rights as participants.

The researcher also abided by the "AIMS Research Ethics Policies" to ensure ethical conduct throughout the study. These policies encompassed additional guidelines related to informed consent, confidentiality, privacy, and data protection.

RESULTS AND DISCUSSION

Port activities identified as threats to the environment of Manila North Harbor Port. Manila North Harbor is a vibrant center for a variety of vessel operations, ranging from cargo handling and shipping to vessel monitoring and passenger services, as well as customs and immigration. The port's multifaceted operations not only contribute to economic growth but also raise environmental concerns. These specific activities include:

Theme 1. Cargo Handling Operations. Cargo handling, involving domestic cargo, container passengers, and liquid and dry bulk, plays a significant role at Manila North Harbor. Moreover, Manila North Harbor's loading and unloading operations involve the exchange of goods, trading, and passenger vessel transfers.

Theme 2. Shipping and Vessel Monitoring. Manila North Harbor facilitates shipping activities, including Roro buses and Breakbulk operations, which involve the transportation of goods and vehicles.

Theme 3. Passenger Operations. Passengers traveling from Manila to other parts of the Philippines are also accommodated in the port.

Theme 4. Customs and Immigration Services

Theme 5. Logistics and Ship Repair and Maintenance

Theme 6. Fuel Product Loading and Unloading

Theme 7. Maritime Patrol, Coastal Cleanup Drive, and Mangrove Planting

Notteboom (2004) states that cargo handling operations at terminals lie at the core of the function of ports. Cargo handling is an important port activity as it generates added value and contributes to efficiency improvements in terms of loading rates and the balance between incoming and outgoing goods flows. Cargo handling also create jobs for terminal and stevedoring companies in the form of dockworkers, management, and

administrative positions. Dock labor needs are very dependent on the cargo flows handled in the port.

In the interviews conducted on the subject of environmental threats, several activities have emerged as major concerns due to their potential harm to the environment. Among the activities mentioned, oil transport or activities involving oil garnered the highest number of responses with seven responses, followed by waste pollution or dumping with five responses, and deballasting of ships with two responses.

Oil transport has been a persistent source of environmental concern, with the extraction, storage, and transportation of crude oil being identified as the most damaging activities to the environment by a majority of respondents. The environmental consequences of oil transport are numerous, including oil spills, water pollution, and air pollution (Arockiaraj & Kankara, 2019). Oil spills can occur as a result of accidents, such as during transportation or offshore drilling operations, or when oil is loaded/unloaded (Kapuściński, 2021). In addition to major spills, water pollution is also caused by routine operations, such as the discharge of bilge water, the discharge of ballast water, and the cleaning of tanks (International Marine Organization, 2019). These activities result in the release of oil residues, chemical substances, and other contaminants, resulting in long-term pollution and environmental damage. Extraction, refining, and transport of crude oil are all associated with significant levels of air pollution. The combustion of fossil gases, such as petroleum, leads to the generation of greenhouse gases, as well as the formation of smog and respiratory ailments (United States Environmental Protection Agency, 2023).

The interviews also highlighted the issue of waste pollution and dumping as two of the most significant environmental threats. Poor waste disposal practices can have a detrimental effect on ecosystems and on human health (Omang et al., 2021). There are several contributing factors to the detrimental effects of waste pollution, such as the indiscriminate disposal of solid waste. This can lead to the accumulation of

hazardous materials, such as plastic, chemicals, and heavy metals, which can cause long-term damage to soil and marine ecosystems (Okunula et al., 2019). Marine animals may be unable to avoid ingesting or becoming entangled in plastic waste, which can lead to injury, as well as suffocation or death (Reddy, 2018). Furthermore, water contamination can be caused by the improper disposal of industrial wastes and untreated sewage, which can contaminate rivers and oceans, posing risks to aquatic life and to human populations that rely on these water bodies (Hojjati-Najafabadi et al., 2022).

An activity with a potential environmental consequence is the practice of deballasting ships, which involves the removal of ballast water (Wankhede, 2021). This process is used to provide weight and balance to ships during voyages and can lead to a variety of environmental issues. The most prominent of these is the introduction of non-native or invasive species, which can contaminate water bodies and have a detrimental effect on human health and aquatic ecosystems (Albeldawi, 2023). Other potential environmental issues include the presence of oil, hazardous metals, chemicals, and excess nutrients in the water, as well as the contamination of receiving water bodies by pollutants. Ballast water can also contain pathogens and diseases that pose risks to human health, aquatic organisms, and marine mammals. Discharged water may contain harmful bacteria, viruses, or parasites, potentially leading to the spread of diseases among marine life or even humans who come into contact with the contaminated water (Kurniawan et al., 2022). The release of ballast water can have physical impacts on the receiving ecosystems. High volumes of water discharged rapidly can cause sediment disturbance, leading to the smothering of benthic habitats and the alteration of shoreline areas (Byrnes & Dunn, 2020). These changes can disrupt the natural habitat and affect the survival of native species. To address these environmental impacts, there have been international efforts to regulate ballast water management. The International Maritime Organization (IMO) developed the Ballast Water

Management Convention in 2004, which sets standards and guidelines for the treatment and discharge of ballast water to minimize the transfer of harmful organisms and pollutants. Shipowners are increasingly adopting ballast water treatment systems to remove or neutralize organisms and pollutants before discharge, reducing the environmental risks associated with deballasting.

As per the data gathered, it is evident that activities causing noise pollution is one of the least harmful port activities. While noise can have some adverse effects on local wildlife and nearby communities, the relatively low count suggests that measures are in place to mitigate and minimize noise levels. Noise-reducing measures are likely implemented to minimize the negative impact on the environment and residents. Moreover, "Participant 1" stated that, "Manila North harbor port can generate a volume of noise level, however, the effect will not be that substantial due to its location. The port is located far from residences."

The interview also identifies cargo activities, including cargo handling, loading, and unloading, as having minimal harm. These activities typically involve the movement of goods and materials, which can lead to potential environmental issues like dust pollution, spills, and emissions. According to the data, passenger transportation exhibits minimal harm to the environment if they are disciplined enough, as verbalized by "Participant 4" in the phrase "proper disposal of their garbage is the last thing the passenger can do but can save our maritime environment.". There is an emphasis on the passengers' cooperation and willingness to avoid dumping their wastes irresponsibly. While the count is relatively low (1 count), the environmental impact can still be significant, underscoring the need to implement sustainable practices. Dry docking, as indicated by the data, has a minimal environmental impact. Dry docking involves the repair and maintenance of vessels, which can potentially generate hazardous waste, contribute to noise pollution, and release pollutants into nearby water bodies. However, the low count suggests that appropriate regulations and

environmentally conscious practices are implemented during such operations (Wankhede, 2023).

Period of existence of these port activity threats at the Manila North Harbor Port. The respondents believe that port-related harmful practices or activities have been in place since the beginning of the port's existence. This implies that these practices have been in place for a considerable period, possibly for several years or decades. By asserting that these harmful activities have been present since the port's inception, respondents are implying a historical continuation of these practices. Furthermore, they attribute these practices to the port's nature and history, thus suggesting that they have become a part of the port's operations and culture from its inception. This belief may be based on prior knowledge of events, historic records, environmental sensitivities, or personal experience. It is important to note that this statement is from the respondents' perspective and does not necessarily reflect the actual practices or conditions of all ports.

The participants report that they have observed certain detrimental alterations over time which they attribute to the presence of activities or related practices in ports. These alterations are believed to have had a detrimental effect on two aspects: the water quality and the weather.

The participants assert that the presence of activities in ports has harmed the water quality of the surrounding areas, indicating that contaminants, pollutants, or other hazardous substances are being discharged into the water due to the activities taking place in the ports. These pollutants may include chemicals, hazardous waste, and other byproducts related to the port operations, as declared by "Participant 6" that "water contamination is due to leakages, plastics and other trashes can be seen as well". However, "Participant 10" claimed that the majority of waste present in the waters is not generated by port operations or personnel, but rather by external sources that enter the ocean through the waterways. Consequently, it is challenging to determine the

origin of the waste. According to “Participant 1” the turbidity of water in the port has deteriorated. This further means that the water in the port appears to be murky or not clear. Respondents have personally observed or suspected a decrease in water quality, suggesting a fear of the potential environmental consequences. Moreover, “Participant 6”’s statement said that the activities “affect the aquatic ecosystem in the port”.

The statement further implies that participants have experienced changes in weather conditions that they attribute to the practices or activities in the ports. It is not clear from the statement which specific changes in weather they are referencing, however, it is possible that they could be referring to changes in wind patterns, precipitation, or local microclimates due to the presence of the ports. These alterations could be due to land-use alterations, alterations in coastal regions, or changes in atmospheric conditions caused by port-based activities. In conclusion, the respondents’ statement suggests that they believe that the harmful practices and activities in the ports have had an evident effect on the environmental and weather conditions over time.

Impact of the port activities to the environment of Manila North Harbor Port based on the accounts of selected stakeholders. The surrounding waters of Manila North Harbor have undergone significant changes and challenges over time. Sedimentation and dredging activities have altered the natural environment, impacting the water quality. Ports and navigation channels are subject to sedimentation, resulting in fine and uniform muddy beds that require regular maintenance dredging to ensure safe navigation (Samsami et al., 2022). Dredging is the process of excavating or removing sediments and/or rocks from the seafloor. It is a common occurrence in port operations and in the development of coastal and maritime infrastructure (Izah et al., 2022). Additionally, typhoons have caused damage to the port, leading to pollution and contamination of the surrounding area. According to the statements of “Participant 4”, the infrastructure of the ports and nearby buildings have played a

role in contributing to pollution, specifically in the dumping of wastes. Industrial activities within the port area have resulted in waste dumping and pollution runoff, further degrading the water quality. Coastal areas have suffered damage, rendering them unsuitable for swimming and posing health risks to those who come into contact with the contaminated water. Trashes, both from human activities and animals, can also be observed in these waters. This additional waste contributes to the pollution problem, further diminishing the quality of the water. Fish caught in these waters are not safe for consumption due to the contamination. The presence of marine invasive species exacerbates the ecological imbalance in the waters. Poor water quality, harmful algae, and pathogenic microorganisms further complicate the situation, making the waters hostile to native marine life and potentially harmful to human health (Landrigan et al, 2020; National Institute of Environmental Health Sciences, 2023). Furthermore, plastic pollution from offshore and terrestrial sources poses a severe threat to the marine environment (Thushari & Senevirathna, 2020). Plastic debris accumulates in the waters, creating a hazard for both marine life and humans. Waste from industrial areas along Manila Bay also contributes to this pollution, compounding the problem.

As reported by Dela Peña (2021), the Ecowaste Coalition has reported that single-use plastic (SUP) constitutes more than two-thirds of the plastic waste present in the bay, consisting of a total of 8.32 billion pieces weighing 109.298 metric tons and spanning an area of 4.923 square kilometers, with the majority of these SUP composed of various types of plastic waste, including 6.09 billion pieces of HDPE, 1.45 billion pieces of low-density polyethylene, 1.03 billion pieces of polypropylene, and 278 million pieces of polystyrene. Even the internal and external ports are major sources of debris and waste, which cause substantial harm and destruction.

The waters surrounding Manila North Harbor are facing numerous challenges and sources of pollution. From sedimentation and dredging to

poor water quality, invasive species, and plastic pollution, various factors contribute to the degradation of the marine environment.

On the other hand, “Participant 9” and “Participant 10” stated that the Philippines is working towards sustainable development goals, including reducing plastic waste. According to their accounts, the port is collaborating with non-government organizations to reduce its environmental impact, and to reduce plastic waste litter to the ocean by 50%. The government is also working with non-government organizations like the Worldwide Fund and other entities supported by German Foundations. This collaboration aims to help people understand the effects of their practices on the environment and reduce the lack of discipline that negatively affects the environment. The focus of the government is on reducing the environmental impact of their practices, rather than harming the environment. With regards to the informal settlers, “Participant 9” discussed the risks posed by informal sectors staying in the port area. Some projects to relocate these settlers, as it would have a positive impact on waste reduction. She also mentioned the recent administrative order from PPA, which banned single-use plastic use inside the port, as an action taken by PPA to mitigate plastic waste. The project aims to reduce the amount of waste generated by these informal settlers.

In terms of knowledge on how these damages, harms, have affected the environment, the main theme identified is the negative impact of the development and expansion of ports have on coastal habitats and the marine ecosystem. Land reclamation, a common practice in port development, results in the destruction of important habitats such as mangroves, seagrass beds, and wetlands. These habitats play a crucial role in supporting biodiversity, acting as breeding grounds, nurseries, and offering protection against erosion and storms. The destruction of these habitats and the resulting harm to water quality have significant consequences. Some of the threats presented were poor water quality that can lead to fish kills, the stunted growth of seagrasses and

mangroves, and disruption of the life cycles of ocean species.

The negative effects on water quality and marine life also have indirect consequences for human health. When fish and other seafood species are affected by poor water quality, they may become contaminated with toxins or pollutants (Linderhof et al., 2021). For instance, people who consume this contaminated seafood with microplastics, are at risk of developing health issues, such as food poisoning or diseases related to the accumulation of toxins in their bodies (Bhuyan, 2022). Thus, the impact on the marine ecosystem is of great concern as it disrupts the ecological balance and reduces the availability of fish and other seafood, which are important food sources for both local communities and the wider economy.

The assessment further highlights the wide-ranging impact of the harm caused by port development and expansion. It specifically focuses on the detrimental effects on social development and the health of port workers, particularly stevedores. One of the issues identified is the occurrence of oil spills and maintenance problems, which can lead to the temporary detainment of vessels. The presence of oil and maintenance issues can deter vessels from using the port, leading to economic losses and decreasing the port's overall efficiency and effectiveness.

Moreover, the contaminated water poses health risks to port employees. The employees' health is at risk may be associated with continuous exposure to the contaminated water. They may face various health issues, ranging from waterborne diseases to long-term health complications associated with exposure to pollutants and toxins. The overall health and well-being of port employees are crucial considerations. Their exposure to contaminated water and potential health risks can have implications for their productivity, job satisfaction, and overall quality of life (Shan et al., 2022).

The data collected demonstrates the far-

reaching effects of the port's operations, both in terms of damage and destruction. On the other hand, "Participant 3" and "Participant 7" stated that there are no significant effects in the community.

The assessment reveals that these negative effects mostly go beyond the direct health risks and extend to the wider public life and marine ecosystem. One of the main concerns identified by respondents is the risk of medical disruption and health complications. The port's harmful activities can harm public health, as the release of pollutants and contaminants into the environment can have adverse consequences for human health. Exposure to these hazardous substances can lead to respiratory issues, skin irritation, and other medical issues for those living in the port's vicinity (Manisalidis et al., 2020). Furthermore, the damage of the port activities also has a direct effect on recreational activities, as the poorer the surrounding waters are in terms of quality of life, the less likely people are to take part in water sports and other recreational activities. This, in turn, has a negative impact on tourism and its potential economic benefits. The contamination of the port's waters with garbage and black waters represents another significant concern. Based on the respondents' accounts, this contamination has negative effects on coastal areas, making them unsuitable for swimming or recreational activities. It not only affects the quality of life for local communities but also hampers the potential for tourism and economic development in these areas. This result coincides with the study of Shetye et al. (2021), where it was discovered that anthropogenic activities release nutrients and pathogenic bacteria into coastal ecosystems, causing marine pollution in India. Seafoam, found on Hole Beach in Goa, India was caused by garbage dump yard nutrient release, causing a bloom of *Thalassiosira Pseudonana*. According to the researchers, this could hamper the tourism industry in small states like Goa.

The assessment also highlights the negative consequences on the marine ecosystem. The port's harmful activities, such as pollution and

unchecked development, pose significant threats to the delicate balance of the marine ecosystem. This can result in the decline of fish populations and damage to marine habitats, impacting the livelihoods of fishermen who depend on the bay for their income and sustenance. The decrease in fishing activities not only affects economic stability but also has implications for the health and safety of the fishing community. This coincides with the study of Beaumont et al. (2019) stating that these harms not only the marine ecosystem but also have broader implications for the economy and livelihoods of communities near the affected areas. Many coastal communities rely on fishing and other marine-related activities for their livelihoods (Fabinyi et al., 2022). The decline in fish populations and the degradation of coastal habitats can lead to a loss of income and employment opportunities, exacerbating poverty and inequality in these communities (Arthur et al., 2021).

Furthermore, the environmental threats posed by the port's activities also diminish its visual appeal, particularly during high tide, according to "Participant 9". She further said that these wastes make cleaning the port and surrounding waters challenging for terminal operators during high tides. Trash and debris in the ocean are visible and create an unappealing sight for visitors, including foreign travelers to Singapore, as verbalized by "Participant 10". According to him, this can be embarrassing for the port and the country as a whole, potentially impacting its reputation as a clean and sustainable destination.

The port activities have had a significant impact on the personal lives of the respondents. Some have reported the damage to their shorelines, which were once tourist spots, resulting in economic losses and a decline in recreational opportunities. Others have experienced the inhalation of fumes from oil spills, which negatively affects their health, leading to respiratory problems and other health complications. Some participants do not personally experience any effects but still concern themselves as advocates for marine environmental protection. The impact on

individuals can vary depending on their proximity to the port and their specific circumstances. Some respondents also mention occasional odors in their workplace, which serve as a reminder of the ongoing problem and motivate them to take further action in protecting the marine environment. Additionally, some respondents highlight the potential risks to their health and the impact on their food source, as the damage to marine life could put their health at risk and reduce fish yields, affecting their access to food. Overall, the port activities have had a direct and personal impact on the well-being and livelihood of the respondents.

This finding is not a surprising result as cargo handling is one of the major operations undertaken in all seaports around the world. A vast number of businesses, including manufacturing, retail, agriculture, and the energy industry, depend on cargo handling. For these sectors to remain operational, raw materials, components, and finished goods must be transported in a timely and secure manner. An area or nation's total economic growth is influenced by efficient freight handling. It expands trade possibilities, draws capital, and generates employment opportunities in the logistics and transportation industries.

Oil spills are dangerous and have significant environmental, economic, and social impacts. Crude oil contains toxic substances, including polycyclic aromatic hydrocarbons (PAHs) and heavy metals, which can harm aquatic life, birds, and other wildlife. Oil can smother and damage coral reefs, mangroves, wetlands, and other sensitive habitats, disrupting the balance of ecosystems and causing long-term ecological damage. What makes it the activity that harms the most is cleanup and restoration efforts can be costly, and the loss of livelihoods for those who depend on the affected areas can be significant. Meanwhile, noise pollution and cargo activities present the least damage as it does not show severe impact on the environment.

Specific harmful changes due to these activities

or practices through time were identified as water quality and the weather. It can be seen that the waters in the port are darker and has pungent smell compared to other bodies of water. According to the respondents, these are caused by sedimentation, dredging, and waste pollution. This just show how much port activities have impacted the environmental waters.

These problems are very important to address as it does not only affect the environments, but also the people working and living around the ports. Certain pollutants in water, such as toxic chemicals and heavy metals, can evaporate and enter the air. Breathing in these pollutants, especially in poorly ventilated areas, can lead to respiratory problems and exacerbate existing respiratory conditions. Some water pollutants, such as arsenic, benzene, and polycyclic aromatic hydrocarbons (PAHs), are known to be carcinogenic. Prolonged exposure to these substances through contaminated water sources may increase the risk of developing various types of cancer, including bladder, liver, and kidney cancer (Omang et al., 2021).

Conclusion. An important environmental problem, water pollution at Philippine ports has far-reaching effects on the economy, public health, and marine ecosystems. Based on the statements of the participants, it can be concluded that Manila ports have serious water pollution problems.

Ports serve as hubs for a variety of commercial and industrial activity, such as oil refineries, cargo handling, and ship repair. These operations have the potential to release contaminants into the water, including heavy metals, oil, chemicals, and wastewater. On the other hand, solid garbage, plastic, and other debris can enter the water as a result of poor waste management and incorrect disposal. Particularly dangerous to marine life is plastic garbage, which may affect a variety of marine animals by remaining in the ecosystem for years. It can also be concluded that since the Manila port is also surrounded by residential areas, this is also a big contributor to the environmental concerns.

Poor urban planning is also a problem. Pollutants include heavy metals, pesticides, fertilizers, and other toxins can enter port waterways as a result of urban runoff from adjacent locations. Development of port infrastructure can disrupt sediment and release contaminants into the ocean. Examples of this include dredging and land reclamation. More so, environmental restrictions that are not adequately enforced and that are not efficient in reducing pollution might worsen the problem of water pollution at ports. There are no serious fines imposed to those who violate environmental laws.

Recommendations. Ship pollution must be reduced in order to conserve marine ecosystems and reduce environmental damage. Here are some efficient methods for reducing ship pollution:

1. Adopt cleaner fuels. Encourage the use of cleaner fuels in place of conventional heavy fuels, such as low-sulfur fuels, liquefied natural gas (LNG), or biofuels. Cleaner fuels provide less nitrogen oxides, sulfur dioxide, and particulate matter emissions, which lowers air pollution (Baxter et al, 2018).
2. Improve engine and vessel efficiency. Enhance ship design and engine performance by implementing cutting-edge technology including energy-efficient propulsion systems and hull configurations. As a result, there may be a decrease in fuel use and greenhouse gas emissions.
3. Use shore power. Ships can link to onshore power networks (shore power) when they are docked at ports rather than operating their engines, greatly decreasing emissions while the ship is in port (Liu et al., 2017).
4. Mandate emission control technologies. Require the use of exhaust gas cleaning devices (scrubbers) to lower sulfur emissions from ships by mandating emission control technology. Before exhaust fumes are discharged into the environment, scrubbers aid in the removal of contaminants from those gases

(Kurniawan et al, 2022).

5. Promote slow steaming. Ships can limit their speed, or "slow steaming," to save fuel and cut pollution. The amount of gasoline saved and the number of pollutants reduced can be considerable with even a little decrease in speed.
6. Tighter restrictions should be put in place: International organizations and national governments should adopt and implement tighter emission limits for ships. This may entail placing limits on toxic chemicals and greenhouse gas emissions.
7. Ballast water management. Carefully control ballast water to limit the spread of noxious aquatic creatures and invasive species, which can devastate marine ecosystems.
8. Reduce plastic waste and litter. Implement steps to avoid the release of plastic waste and litter into the ocean, such as onboard waste management or recycling programs, to reduce plastic waste and other litter.
9. Promote sustainable shipping practices. Encourage the shipping sector to embrace sustainable practices, such as cutting back on single-use plastics onboard, lowering trash production, and promoting eco-friendly products and methods.
10. Support research and innovation. Supporting research and development will help to further reduce ship emissions and pollution. Some examples of this include the use of hydrogen fuel cells, wind-assisted propulsion, and electric-powered ships.

With these in mind, the researcher aims to provide the following recommendations for the stakeholders and future researchers:

1. The implementation of more stringent waste management and disposal regulations should be a top priority. Proper waste treatment and disposal systems can

significantly reduce contamination and enhance water quality.

2. Port activities should be conducted in a manner that minimizes the use of hazardous chemicals and substances, particularly during oil transportation and cargo operations. Utilizing cutting-edge technology and environmentally responsible practices can help to mitigate the environmental impact of such activities.
3. To effectively manage the environmental impact of the port and implement targeted conservation measures, water quality monitoring and ecosystem health assessments should be conducted on a regular basis. This will enable the identification and resolution of emerging issues in a timely manner.
4. Port authorities and environmental agencies, as well as local communities, should collaborate in order to promote environmental protection and sustainable practices. This cooperation should include education and awareness-raising among port personnel and the local communities.
5. It is essential to allocate resources to research and development in order to develop and implement novel solutions to mitigate environmental damage. These solutions may include the exploration of alternatives, the adoption of cleaner technologies and the development of more effective methods of waste management and disposal.
6. The findings of this thesis may be utilized by future researchers and policy makers to develop sustainable and feasible solutions to the negative consequences of the port's operations.
7. More research is recommended as this problem encompasses multifaceted sources and requires different solutions from different sectors.

Manila North Harbor Port can reduce its environmental impact and enhance the sustainability of its operations by implementing these recommendations. Achieving a balance between economic development and environmental conservation is essential for the prosperity of the port and its surrounding environment, as well as for the health and well-being of the employees and local communities.

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