Eco. Env. & Cons. 28 (1) : 2022; pp. (86-90)
Copyright@ EM International
ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2022.v28i01.012

Ballast Water Management in Indonesian Port Based on Environmental Risk Assessment

Minto Basuki[1], Lukmandono[2] and Maria Margareta Zau Beu[1]

[1]Department of Marine Engineering, Faculty of Mineral and Marine Technology, Adhi Tama Institute of Technology Surabaya, Indonesia
[2]Department of Industrial Engineering, Faculty of Industrial Technology, Adhi Tama Institute of Technology Surabaya, Indonesia

(Received 15 June, 2021; Accepted 12 July, 2021)

ABSTRACT

The purpose of this study was conducting a risk assessment of the environment due to the implementation of ballast water management on vessel operations. Environmental risk assessment was based on the pertaining laws and regulations of the government of Indonesia Republic and international laws, as well as the sample comprising vessels operating in Indonesian waters. The data used for the analysis were based on the visits of the vessels operating in the operation territory of Inaport I - Inaport IV. The analysis was carried out based on the number of vessels that unload the ballast water at the port and IMO regulation MEPC 56/23 ANNEX 2. The amount of ballast water unloaded measurement used statistical method to determine the probability of risk occurrence. Using a risk matrix, the ranking of environmental risk due to the implementation of ballast water management would be achieved. In 2016, the numbers of ship visited in International route were 30.843 ships and the assumption was the ships conducted deballasting was 60% from the ship numbers in each time throwing ballast water around 25 tons, so, the total water discharged was 450.000 tons.

Key words: *Ballast water, Environmental risk assessment, Inaport, IMO regulation*

Introduction

In the world, sea transportation of trade and economic activities are 2/3. It indicates that sea transportation plays an essential role. According to Basuki *et al.* (2014), while the pulse of trade in the world is still beating, the sea will continue to live for the transportation of goods and services between islands, countries, and even continents. The shipping industries have been instrumental of the transporting goods, playing a role in the world economy, and supporting world industrialization. However, transport is one of causes of environmental problems. One of examples is transferring of microorganisms from one place to another. When a vessel voyaged from one area to another, the vessel cargo must be full capacities. Therefore, it gives benefit for the vessel owner and the vessel must be kept in optimal performance. Optimal performance will be obtained when the vessel sails with maximum cargo, so the propeller can work optimally to produce thrust. Vessels need to be ballasted using counterweight water when the vessel cargo is not fully loaded. Vessel voyage to the port destination must be maintained to safe operational condition, but it can only be carried out with the technological system of ballast water, which is seawater (instead of fresh water). Ship balancer pumped into vessel hull is seawater.

Loading and unloading activities of seawater into and from a vessel seem to be activities which pose no problem and do no harm. Vessel ballasting is crucial to maintain a safe and efficient vessel operation. Many people are not aware if ballasting can cause changes in the marine ecosystem, raise economic problems, and pose serious health repercussions on marine and human life. This condition occurs due to the arrival of the abundant predatory marine species brought by ballast water. One of the important elements of ballast water management is the process of risk assessment, which is conducted to identify and determine the risk rating (David and Gollasch, 2018). Basuki *et al* (2016) explained that an environmental risk assessment of vessel repair used a risk matrix to determine the risk rating. As a country in which most of its territory consists of seas and as a part of international voyage routes, Indonesia has immense threats to the marine environment. One of the threats is resulted by vessel ballasting; especially ballast water unloading in the port of destination. Vessel operational activities with ballasting, intentionally or not, will transfer of harmful aquatic organisms and pathogens through the ballast water and related sediments. The ballasting process brings predatory species which will invade the local environment, then it causes of degrades and extinction of local species. In the vessel ballast tank, ballast water management could be carried out using mechanical-physical and chemical methods (Werschkun *et al*., 2014).

Ballasting activities have been regulated in an international convention by IMO (International Maritime Organization), which was born from the London Protocol and London Convention. The regulation was on the Prevention of Marine Pollution due to the Disposal of Waste and other materials. This convention, known as the Convention of London, was established in 1972. The convention has been force since 1975. The purpose of the London Convention was introducing effective pollution control ordinances, covering all types of marine pollution sources, and taking practical measures to prevent marine pollution due to the disposal of waste and other materials. Thus, there have already been 87 IMO member states; all of them signed the convention. The London Protocol entered into force on March 24th, 2006 and it has been effective since September 2017. According to Castro *et al.* (2017), since 2005, Brazil has implemented a regulation related to ballast water management. This regulation has been adopted and implemented in 39 ports in Brazil. After 5 years, regulation implementation rate by the existing maritime industry grew up to 97%. Indonesia has ratified the convention on ballast water management on November 24th, 2015. In line with the ratification, Indonesia has put ballast water management regulation in the Government Regulation. The enforced regulation was Presidential Regulation No. 132 of 2015 on the ratification of the 2004 International Convention for the control and management of vessel ballast water and sediments.

Magliæ *et al.* (2015) conducted a study of productivity estimated and processing ballast water cost at ports using barges. It necessary regulation and rules from Taiwan national to anticipate the implementation of IMO international rules, especially ships visited rate disposing of ballast water, discharge ballast water zone (Liu *et al.,* 2019). Ballast water is very detrimental for marine ecosystems to the port destination. So, it necessary to produce to meet internationally ratified standards (Cohen *et al*., 2017). Ballast water risks, especially invasive microorganism, were very detrimental to the creatures/ microorganism (Aliff *et al.,* 2018). Zaman *et al.* (2019) needed to calculate the amount of water ballas discharged by ships and it related with invasive species from origin country at Tanjung Perak Port, Surabaya. It needed implementation of IMO regulations related with ballast water to control harmful invasive spread (Fileman *et al*., 2016). External ballast water treatment necessary to be conducted to increase the number of ships visit in the port of Pelindo IV Makasar Ltd. area (Basuki *et al*., 2019).

The risk assessment in invasive pada species because water exchange was interpreted in 2 probabilities. First, it based on the probability of species ability entered to the port destination. Second, species probability was able to survive when it was disposed in the port destination (new environment) and it was depended to the similarity of new environment (Bouda *et al.,* 2016). Water ballast was becoming a potential factor from comer invasive species globally and it must be anticipated to reduce environmental risks. It must be applied, especially international ship traffic, because water ballas exchange was very dangerous (Darling, 2018).

Materials and Methods

2/3 of the geographical area of indonesia is water area and the country consists of thousand of islands. The effective-

ness of port management in indonesia was divided into 4 management zones based on the geographical location considering the coverage area which must be managed. This study was conducted in the 4 port management zones.

Design of the study

It was a quantitative study using primary and secondary data. The analysis data for were consisted of the data on vessel visits and vessels which have been implemented ballast water management system under the operations of Inaport I, Inaport II, Inaport III, and Inaport IV. To complete the analysis, data related to the local and international laws and regulations were also used.

Area of the study

In Indonesia, port management was divided into 4 management zones. Port management zone I, which was managed by Inaport I, centered in Medan and the operational areas were covering in North Sumatra, Riau islands, and Batam. Inaport II was based in Jakarta with the operational areas were covering West Java, Banten, Jakarta, South Sumatra, and West Borneo. Inaport III was based in Surabaya with the operational areas were covering Central and East Java, Bali, Nusa Tenggara, South Borneo, and Central Borneo. Inaport IV was based in Makasar and the operational area was covering Celebes, East Borneo, North Maluku, and Papua.

Data collection

The data, both primary and secondary, on vessel visits in the area of Inaport I - Inaport IV were collected. The data on vessel visits included the overall number of vessels visiting the port and gross tonnage (GT). The vessel visits and GT data consisted of data on vessels sailing with international as well as domestic routes. These data were collected from 2012 to 2016. The vessel visit data were compared with the primary data of the amount of ballast water discharged by vessels. The data on the amount of ballast water discharged was used as the basis for the calculation of the environmental risk assessment. Data analysis is use the risk matrix method was employed in the data analysis. It used horizontal axis as the impact of risk and the vertical axis as the probability of events. The data were vessel visits, vessel gt, and the amount of ballast water discharged in the port. They were analyzed and it performed using the probabilistic theorem to determine the probability of risk occurrence on the risk matrix model.

Results and Discussion

The laws and regulations related to the maritime environment in Indonesia were implemented based on the regulations of the International Maritime Organization (IMO) and the regulations of the government of the Republic of Indonesia.

Law and Regulation of IMO

The laws and regulations of IMO governing the protection of the environment were found in MARPOL (Marine Pollution). A further regulation pertaining to the ballast water management was IMO of 2004, the International Convention for the Control, and Management of Vessel Ballast Water and Sediments. Then, the convention was derived into the annexes in force. The IMO convention of 2004 has been effective since September 8th, 2017.

Laws and Regulations of Indonesia Republic Government As a maritime country, the Indonesia Republic Government has set its water territory in Law Number 6 of 1996 on Indonesian Waters. Law Number 6 of 1996 on Indonesian Waters was inseparable from Law Number 17 of 1985 on the Ratification of the United Nations Convention on the Law of the Sea (United Nations Convention on the Law of the Sea). The government of the Republic of Indonesia had also set up the processes and procedures for vessels operations in Law No. 17 of 2008 on Shipping. Support to Law Number 17 of 2008 on Shipping waws Law Number 43 of 2008 on the Territory of the Country. In line with these regulations, the government was also issued Government Regulation. Government Regulations regulated this matter included (i) Government Regulation Number 19 of1999 on Pollution Control and/or Destruction of the Sea, and (ii) Government Regulation Number 21 of 2010 on the Protection of the Marine Environment. The laws and regulations mentioned above were used in the management of risks to the marine environment, including vessel ballast water management in the waters of Indonesia.

Vessel Visits in Indonesian Ports

The number of vessel visits was utilized as the basis for the calculation of vessel ballast water management. The data on vessel visits were based on the data obtained Inaport I - Inaport IV. The data was

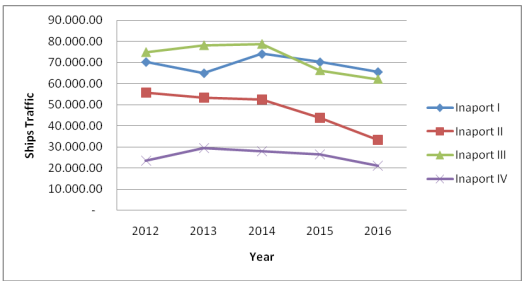

Fig. 1. Inaport Vessel Traffic

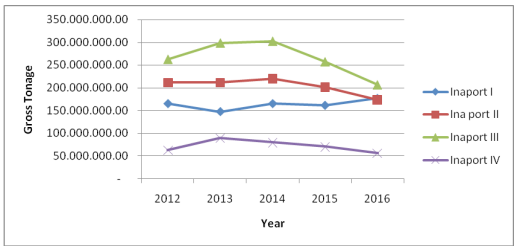

Fig. 2. Inaport Vessel Traffic in GT

presented in the chart below:

Vessel and Volume of Water Discharged

It conducted to MEPC 56/23 ANNEX 2, the overall probability of a successful invasion also depended on part of organism numbers and frequency which they were introduced over the entire period of the exemption. Therefore, it was recommended if a risk assessment should consider estimate at least the following four factors, such as (i) the total volume of water discharged, (ii) the volume of water discharged in any event (voyage), (iii) the total number of discharge events, and (iv) the temporal distribution of discharge events. The researchers used vessel visits data and MEPC 56/23 ANNEX 2 regulation to know the calculation of amount of ballast water discharged by The vessels.

Externality of Ship Ballast Water

The management of Indonesia port had several externalities which must be considered. Externality of ballast water treatment process needed attention. It related to recent environment issues. Seawater damage because of waste dumping from ships, oil splashing from ship operations, and trash disposal from ships both intentional and accidental. The newest issue related to ballast water management. It contributed to the seawater damage and marine ecology. This damage was caused by invasive species presence from ballast water. Externalities were presented in Figure 4.

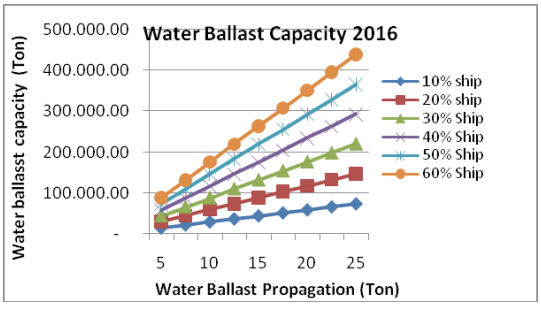

Fig. 3. Water Ballast Capacity

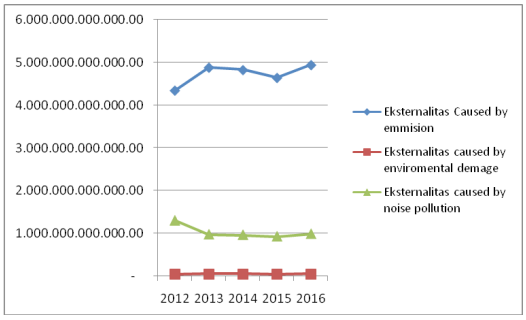

Fig. 4. Externalities of CO_2 Emission, Sea Environment and Noise (Basuki *et al.*, 2021)

Conclusion

The amount of ballast water discharge influenced by: (i) the total volume of ballast water discharge, (ii) the volume of water discharge in any event (voyage), (iii) the total number of discharge events, and (iv) the temporal distribution of discharge events. The amount of ballast water could be used to determine environment risk analysis. Assuming 60% of the ships docked at Inaport I - Inaport IV, there were the potential for ballast water of around 450,000 tons to contaminate ports in Indonesia.

Acknowledgments

This paper is a part of research based on the environmental risk assessment in the maritime industry. We thank the Indonesian Agency of Research and Development of the Directorate General of Higher Education that has financed this research in the fiscal year of 2020.

References

Aliff, M.N., Reavie, E.D., TenEyck, M.C., Branstrator, D.K., Schwerdt, T., Cangelosi, A.A. and Cai, M. 2018.

Evaluation of a method for ballast water risk–release assessment using a protist surrogate. *Hydrobiologia*. 817(1): 11-22.

Basuki, M., Manfaat, D., Nugroho, S. and Dinariyana, A.A.B. 2014. Probabilistic risk assessment of the shipyard industry using the Bayesian method. *International Journal of Technology*. 5(1) : 88-97.

Basuki, M. and Margareta Zau Beu, M. 2019. Implementation IMO Regulation of Ballast Water Management at Inaport 2 nd Jakarta Based Environmental Risk Assessment. *MS&E*. 462 (1) : 012044.

Basuki, M, Lukmandono, and Basuki, M., Lukmandono, L. and Zau Beu, M. M. 2020. Ballast Water Management at Inaport 4th Makasar Based Environmental Risk Assessment. *Available at SSRN 3512750*.

Basuki, M., Lukmandono, M., Beu, M. Z. and Hidayat, M. J. 2021. Ballast Water Management In The Waters Around Pt. Pelindo I Following The Regulation Of Imo Mepc 56/23 Annex 2 Based on Environmental Risk Mitigation. *Poll Res.* 40 (1) : 67-70.

Bouda, A., Bachari, N. E. I., Bahmed, L. and Boubenia, R. 2016. Design of a risk assessment methodology for the introduction of invasive species from ship ballast waters. *Management of Environmental Quality: An International Journal*.

Castro, M. C. T., Hall-Spencer, J. M., Poggian, C. F. and Fileman, T. W. 2018. Ten years of Brazilian ballast water management. *Journal of Sea Research*. 133 : 36-42.

Cohen, A. N., Dobbs, F. C. and Chapman, P. M. 2017. Revisiting the basis for US ballast water regulations. *Marine Pollution Bulletin*. 118(1-2) : 348-353.

David, M. and Gollasch, S. 2018. How to approach ballast water management in European seas. *Estuarine. Coastal and Shelf Science*. 201. 248-255.

Darling, J. A., Martinson, J., Gong, Y., Okum, S., Pilgrim, E., Lohan, K. M. P. and Ruiz, G. M. 2018. Ballast water exchange and invasion risk posed by intracoastal vessel traffic: an evaluation using high throughput sequencing. *Environmental Science & Technology*. 52(17): 9926-9936.

Fileman, T., Vance, T. and de Mora, S. 2016. Are we at Last Ready to Begin Controlling the Global Spread of Aquatic Invasives. *Int J Marine Sci Ocean Technol*. 3: 1-2.

Liu, T. K., Wang, Y. C. and Su, P. H. 2019. Implementing the ballast water management convention: Taiwan's experience and challenges in the early stage. *Marine Policy*. 109 : 103706.

Magliæ, L., Zec, D. and Franèiæ, V. 2015. Effectiveness of a barge-based ballast water treatment system for multi-terminal ports. *Promet-Traffic & Transportation*. 27(5) : 429-437.

Werschkun, B., Banerji, S., Basurko, O.C., David, M., Fuhr, F., Gollasch, S., Grummt, T., Haarich, M., Jha, A.,N., Kacan, S., Kehrer, A., Linders, J., Mesbahi, E., Pughiuc, D., Richardson, S.D., Schwarz-Schulz, B., Shah, A., Theobald, N., Urs von Gunten, Wieck, S., and Höfer, T. 2014. Emerging risks from ballast water treatment: The run-up to the International Ballast Water Management Convention, *Chemosphere.* 112 : 256–266.

Zaman, M., B., Pitana, T., Fadlilah, A., N. and Semin, 2019. Development of Ballast Water Discharge Profile Estimation, *International Journal of Mechanical Engineering And Technology* (*IJMET*) 10, (2),: 1288-1300