

Original article

Negative Environmental Impact Assessment Towards Port Activities [☆]

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Abstract

Seaports are under high-speed developing and booming with the extend of the facilities and equipment to support the port activities and industry's needs. It may bring environment destruction due to the change of the environmental conditions, likes forests, soils, water, and air. Therefore, this paper aimed to analyze the negative environmental impact due to seaport activities in Malaysia. The priority dominant factors are determined through analytic hierarchy process (AHP). Malaysia Port is selected as case study and 20 respondents are selected from virous department based on their expertise. Pari-wise comparison survey is used to collect data. The results shown that the negative environmental impact's main elements are water (0.451), noise (0.262), organism (0.181), and air (0.106). Meanwhile, the toxicity is the prominent negative environmental impact's sub-element of port activities, which scored 0.241, followed by interfering communication (0.142), and smell (0.134). The CR values are less than 0.1 and are considered acceptable. Hence, the outcome of the paper stimulated public awareness toward environmental protection. The development and expansion of seaports must consider environment conservation and preservation, and it cannot bring irreparable sequelae to the earth.

Keywords: Port Activities, Negative Environmental Impact, Analytic Hierarchy Process, Elements, Environmental protection

1. Introduction

Globalization encouraged international trade and transaction of cargoes, and ninety percent of cargoes are carriage by sea. At the same time, seaport became crucial in the cargoes shipping and industrial bases. However, port activities will be giving negative impacts to environment surrounding port areas. Furthermore, the port activities also will be incurring stress among community such as health and ecology. However, many people may not alert yet, but it has been affecting our lives. Since it not yet deteriorated to the point of irreversibility, we need to take necessary step to protect our environment and to raise public awareness towards environmentally friendly. However, how do we stimulate public awareness and promote environmental conservation and preservation? Therefore, the negative environmental impact study is the determinant point to call attention from public.

Thence, this paper desired to study the negative environmental impacts caused by seaport activities in Malaysia. First, it aimed to determine the main elements and sub-elements of the negative environmental impacts toward seaport activities. Then, it has analyzed the priority dominant elements by using analytic hierarchy process (AHP) method. The outcome of the paper will be raising public awareness toward environmental protection. The development of the nation and seaport cannot be neglect environment conservation and preservation.

2. Literature Review

The dynamic growth of the seaport industry has given effect to environment. According to Gupta and Rashmi (2004), the expansion of seaport not only leded benefit to nation economic but also caused destruction to air and marine water in surrounding port areas. According to Trozzi and Vaccaro (2000), port activities caused negative environmental impacts, e.g. noise, odors, volatile organic substances, soil pollution, and water pollution. Sakhi (2019) highlighted that container terminal has bring negative effect on ocean, air, workers, and surrounding areas. Goulielmos (1999) also stressed that port, ship and hinterland caused pollution to the surrounding areas.

Table 1: Summary of negative environmental impacts based on port activities

Main element	Sub-element	Reference
Air	Chemical	Walke and Mackenzie, 2016
	Smog	Walke and Mackenzie, 2016
	Dust	Gary and Heather, 2011
Water	Toxicity	Gary and Heather, 2011
	Smell	Denchak, 2018
	Change in color	Piccard, 2002
Noise	Disturbing brain	Rilind, 2019
	Low hearing power	Rinkesh, 2010
	Interfering communication	Rinkesh, 2010
Organism	Poisoned/diseases	Hamit, 2017
	Death of aquatic	Prashant, 2019
	Disruption marine resources	Caddy and Griffiths, 1995

Several studies have done to generate research framework (figure 1). The main elements and sub-elements of the negative environmental impacts were determined through review studies. Table 1 shown the summary of negative environmental impacts based on port activities. Walke and Mackenzie (2016) stated that burning fossil fuel released chemical and smog into atmosphere. International Association of Ports and Harbors highlighted that port construction activities released dust to air environment. Toxicity also discharged from ships and caused water pollution such as ballast water, oily waste, sewage, garbage, oil spill, lubricant, antifoulant, paint, heavy metal, and other residues from ship. Denchak (2018) highlighted waterborne pathogens is the major sourcing for bacteria and viruses' diseases and smelly water. Piccard (2002) stated that toxic materials released from ships changed the color of water and harmful to biodiversity ecosystems. Besides, Rilind (2019) highlighted that high intensity of sound waves disturbed ear and brain. It is endangering human's memory and reading power. Furthermore, high decibel noise also reduced earing sensitivity towards sound and effected communication between people

(Rinkesh, 2010). Moreover, water polluted can brought diseases to human and organism, e.g. cholera, hepatitis, food poisoning and others (Hamit,2017). Oil spill, chemical release and waste dumping caused marine ecology damage and organism death (Prashant, 2019). It also disrupted the marine resources such as reduce fish produce, coral yield, and seaweed growth (Caddy and Griffiths, 1995).

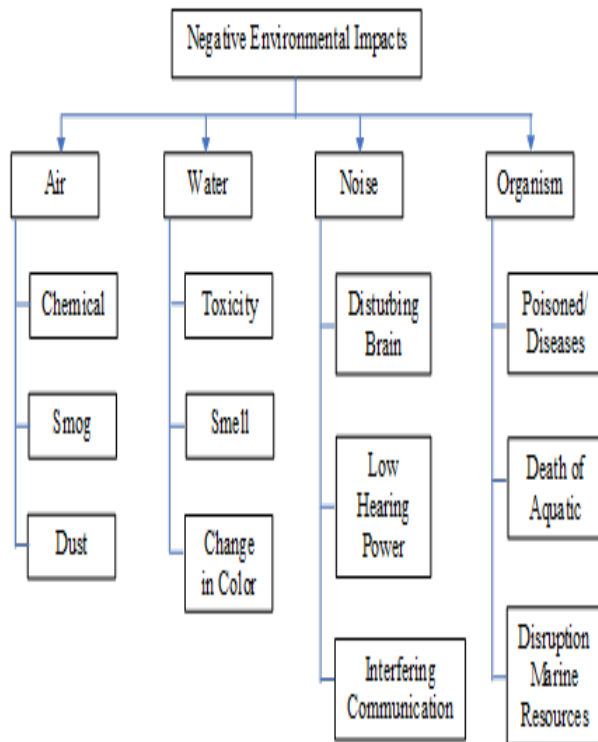


Figure 1: Research framework

3. Methodology

Malaysia Port has been selected as cases study and 20 responders are chose from managerial level that had more than 5-year industry experience and involve in port operation activities. Pari-wise comparison questionnaires have been generated based on dependent and independent variables that filter from literature review. After that, pilot study has been conducted to verified the questionnaires. Then, analytic hierarchy process (AHP) was used for data analysis. Whereas, AHP is a useful tool based on expert judgments and the expert judgments from even one single qualified expert is also considered representative (Golden et al. 1989; Abudayyeh et al. 2007; Tavares et al. 2008). Therefore, AHP does not required large sample size to achieve statistically significant. AHP is used to rank the priority factors

among the alternatives and select the best factor during decision making (Taylor, 2004; Özdağoğlu and Özdağoğlu, 2007). After the survey activities have conducted, the data were put into Analytic Hierarchy Process Software to run and generate the research outcomes.

There are several steps to conduct the AHP method. First, alternatives that need to evaluate is determined through literature review. Second, the criteria and sub-criteria are selected according to research objective. For this study, the criteria selected are air, water, noise, and organism. Then, the criteria are breaking into a related set of sub-criteria. The sub-criteria for air are chemical, smog, and dust. The sub-criteria for water are toxicity, smell, and change of color. The sub-criteria for noise are disturbing brain, low hearing power, and interfering communication. The sub-criteria for organism are poisoned/diseases, death of aquatic, and disruption marine resources. Third, using pairwise comparison to create matrix and to weight the relative importance in between those criteria. Four, the data put into AHP software to check for the consistency level. Last, the software also will calculate the data and assign the relative weighted to each criterion.

4. Results and Discussions

4.1 Negative Environmental Impact’s Toward Port Activities (Main Elements)

Table 2: Ranking for negative environmental impact’s main elements toward port activities

Rank	Main Elements	Weights
1	Water	0.451
2	Noise	0.262
3	Organism	0.181
4	Air	0.106
CR		0.098

Seaport operations and activities led to negative environmental impacts. So, the communities surrounding port areas and environmentalist concerned about the environment and health issues. Therefore, this paper aimed to answer the inquiry about the impacts. Table 2 shown the main negative

impacts towards seaport activities. Water is the first priority negative impact, it scored 0.451 compared with other elements. Besides, noise is the second priority negative impact (0.262), followed by organism (0.181) and air (0.106). The consistency ratio (CR) is 0.098, whereas below 0.1 is considered acceptable (Saaty, 1980; Rahman and Najib, 2017).

4.2 Local Weight Ranking for Negative Environmental Impact’s Sub-Elements

4.2.1 Water

Table 3 shown the local weight ranking for water towards port activities. For water element, the first priority sub-element is toxicity (0.539), the second priority sub-element is smell (0.298) and last priority sub-element is change in color (0.163). The consistency ratio (CR) is 0.000, whereas below 0.1 is considered acceptable (Saaty, 1980; Rahman and Najib, 2017).

Table 3: Local weight ranking for water towards port activities

Main Elements	Rank	Sub- Elements	Local Weight
Water	1	Toxicity	0.539
	2	Smell	0.298
	3	Change in colour	0.163
	CR		0.000

4.2.2 Noise

Table 4: Local weight ranking for noise towards port activities

Main Elements	Rank	Sub- Elements	Local Weight
Noise	1	Interfering communication	0.540
	2	Disturbing brain	0.350
	3	Low hearing power	0.110
	CR		0.046

Table 4 shown the local weight ranking for noise towards port activities. For noise element, the first

priority sub-element is interfering communication (0.540), the second priority sub-element is disturbing brain (0.350) and the third priority sub-element is low hearing power (0.110). The consistency ratio (CR) is 0.046, whereas below 0.1 is considered acceptable (Saaty, 1980; Rahman and Najib, 2017).

4.2.3 Organism

Table 5 shown the local weight ranking for organism towards port activities. For organism element, the first priority sub-element is poisoned/diseases (0.702), the second sub-element is disruption marine resources (0.227) and last is death of aquatic (0.071). The consistency ratio (CR) is 0.033, whereas below 0.1 is considered acceptable (Saaty, 1980; Rahman and Najib, 2017).

Table 5: Local weight ranking for organism towards port activities

Main Elements	Rank	Sub- Elements	Local Weight
Organism	1	Poisoned/Diseases	0.702
	2	Disruption marine resources	0.227
	3	Death of aquatic	0.071
	CR		0.033

4.2.4 Air

Table 6 shown the local weight ranking for air towards port activities. For air element, the first priority sub-element is smog (0.735), second priority sub-element is dust (0.200) and the third priority sub-element is chemical (0.065). The CR values is lower than 0.1 and is acceptable (Saaty, 1980; Rahman and Najib, 2017).

Table 6: Local weight ranking for air towards port activities

Main Elements	Rank	Sub- Elements	Local Weight
Air	1	Smog	0.735
	2	Dust	0.200
	3	Chemical	0.065
	CR		0.055

4.3 Global Weight Ranking for Negative Environmental Impact’s Sub-Elements

Table 7: Global weight ranking for negative environmental impact’s sub-elements toward port activities

Ranking	Characteristics (sub- elements)	Local weight	Global weight
1	Toxicity	0.539	0.243
2	Interfering communication	0.540	0.142
3	Smell	0.298	0.134
4	Poisoned/Diseases	0.702	0.127
5	Disturbing brain	0.350	0.091
6	Smog	0.735	0.078
7	Change in color	0.163	0.074
8	Disruption marine resources	0.227	0.041
9	Low hearing power	0.110	0.029
10	Dust	0.200	0.021
11	Death of aquatic	0.071	0.013
12	Chemical	0.065	0.007

Table 7 shown the global weight ranking for negative environmental impact’s sub-elements toward port activities. Toxicity is the highest score among the other sub-elements, there is 0.243. The second priority sub-element is interfering communication (0.142). The third priority sub-element is smell (0.134), and the subsequence sub-elements are poisoned/diseases (0.127), disturbing brain (0.091), smog (0.078), change in color (0.074), disruption marine resources (0.041), low hearing power (0.029), dust (0.021), death of aquatic (0.013), chemical (0.007).

Gupta et al. (2005) stated that port activities caused degeneration to air and water quality in surrounding port areas. He suggested that port should have an environmental management plan (EMP) to monitor port activities and operations, to collect data from time to time for prevent, protect and control pollution levels. Waste minimization, waste disposal, waste treatment, and attenuation of residuals are proposed to lower waste degree, and stress on cleaner technologies. Besides, Jeevan et al. (2018) further claimed that maritime sector in Malaysia is under

continues growing stage and giving challenges to ongoing environmentally friendly. They also claimed seaport activities lead to garbage dumping, air pollution, maintenance waste, dust, noise pollution, bilge water, dredging operations and oil spill. They suggested several strategies to reduce environmental issues. Trozzi and Vaccaro (2000) also proposed ballast water should exchange in deep ocean before entering port limits to prevent the spread of harmful aquatic organisms migrating into Malaysia sea waters, to protect the survival of the marine organism.

5. Conclusion

The initial findings indicated that the prominent negative impacts towards the port activities in Malaysia seaport is water with priority (0.451) followed by noise (0.262), organism (0.181) and the last is air (0.105). The consistency ratio (CR) of the main negative impact is 0.093 which is less than 10% and considered acceptable. The findings also expressed that the priority sub-negative impact is toxicity (0.243) followed by interfering communication (0.142), smell (0.134) and the last is chemical (0.007). The CR values for sub-negative impact is below 0.1 and considered acceptable.

The negative environmental impacts are harmful to earth and organism. Consequently, monitoring, controlling, and preventing is required to minimize the environment pollution and negative impacts. It is necessary to preserve the earth and looks for eco-friendly. Eco-friendly can contribute to sustainability, whereas to lead to seaport sustainable expansion and development. People should to go away from conventional thinking to going green, looking on green energies, recycling used materials and green technologies.

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