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IMPACTS OF DREDGING AND RECLAMATION PROJECTS

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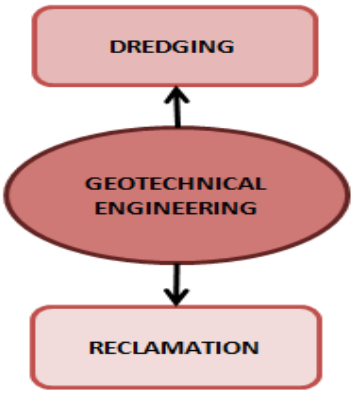
Graphical abstract



Abstract

Dredging works are commonly described as removal of sediments from underwater which involving excavation process. Soil and rocks are excavated for channel and harbor deepening and for land reclamation. Land reclamation is defined as usage of dredged sediments to construct or build new land in the sea. This research aims to investigate the impact of dredging and reclamation projects as dredging and reclamation are one of the geotechnical engineering elements. Human activities such as dredging and reclamation may lead to geo-hazards such as coastal erosion, landslides, flooding and etc. In this research, 157 villagers from Teluk Rampang and Langkah Baik, Pengerang, Kota Tinggi in Malaysia has been selected as respondents to answer the distributed questionnaire. As a result, the analysis shows that villagers become victims due to the reclamation project executed to construct petroleum hub in Pengerang, Kota Tinggi. The impact can be reduced with a proper monitoring and management by the project stakeholders'.

Keywords: Dredging; reclamation; impacts; geo-hazard

1.0 INTRODUCTION

Malaysia is among the rising countries in terms of geotechnical engineering growth and stable economic condition. Geotechnical engineering is a branch of engineering that dealing with earth materials [6]. Dredging and reclamation is also categorized as geotechnical engineering (Figure 1) which gained high demand and attention from various stakeholders. Millions cubic meters of sediments are being dredged for development purposes [3]. The treated dredged sediments will be used in reclamation projects to create new land for development purpose.

Over the last decade, many issues on impacts due to dredging and reclamation activities received and gained concern among construction stakeholders [2]. Dredging and reclamation works that are carried out without a proper environmental management could cause long-term environmental impacts, affect marine environments, and give impact to the fishing industry [7]. Such dredging and reclamation activities often involve management of contaminated sediments, thus suitable decision support and environmental management tools should be taken by the stakeholders [13].

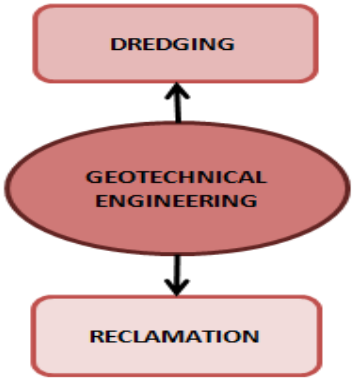


Figure 1 Dredging and Reclamation as Geotechnical Engineering

2.0 DREDGING

Dredging is defined as removal of sediments from the underwater which involving excavation process. Soil and rocks are excavated for channel and harbor deepening and for land reclamation. This is an important activity done in order to keep the waterways navigable for ships and boats [9]. The dredging activity for new construction can be done through mechanically or hydraulically dredges [15].

The purposes of dredging is to construct trench for pipes, flood risk management, beach nourishment, fisheries enhancement, construction of dykes, jetties, port areas and channel deepening [13].

Sediment is the removal from a dredging works that settle at the bottom of a water body. It contained the mixture of soil and rocks and can be categorized as a usable material. Sediments act as habitat for many marine organisms and considered as an important habitat within water ecosystems. The removal and extraction of sediments in dredging process used in construction works and in agriculture industries, wharf expansion, land reclamation, coastal nourishment, flood prevention and for maintenance of underwater pipelines [7]. However, by disturbing the underwater sediments, it may affect the flora and fauna which is found at the bottom of the water. Eventually most of the toxic organic, inorganic chemicals and bacteria that accumulate in sediment will react and affect the surface of waters. Effective sediment management becomes greater challenges faced by many countries including Malaysia [12].

Dredging activities without a proper management and planning will bring negative impacts towards environments [10]. Geological hazards such as soil contamination, water contamination and flooding may occur when dredging activities are not well managed. However, the negative impact on the environment, aquatic species and flora and fauna are high due to the removal of the sediments. Size, characteristics and dredging technique give impacts to the environments. During the dredging process, marine environment will be disturbed and the suspended sediment may cause high turbidity in the water and will increase the sedimentation on the bottom. Many antigenic poisons and microorganisms will bond with the compounds in the water and sink to the sediment. Some of these contaminants may change through oxidation, which changes their solubility [8]. The contaminants will be released to water column if the sediments are disturbed and this will affect marine life. Human health also will be in danger when the contaminant of water consume by the society. The toxic from sediment are poisonous to the human health when mixed with the water column. The poisonous substance lay under the water which also acts as the controller in marine plant growth can release together when the excavation of sediments take place.

3.0 RECLAMATION

Land reclamation is defined as usage of dredged sediments to construct or build new land in the sea. Land reclamation has played an important role in the metropolitan development in many developing countries due to the demand from high population. Singapore, Hong Kong and Japan solve insufficiency of land by doing more reclamation projects [5].

Reclamation projects are carried out for various purposes. Reclamation increase land area. Dry land for agriculture, industry, housing, recreation, and airport can be constructed on reclaimed land. Coastal reclamation provides the benefits of increased land availability. Reclamation works also may produce drainage system, this have proven by the Romans who is the first to construct sea banks and waterways. Reclamation is increasingly executed in Asia to provide additional land in cities to provide new city spaces for the public. Reclamation helps to prevent erosion in reclaimed areas [11]. This is because, certain area that has to be reclaimed, vulnerable to erosion so by implementing reclamation work in particular area, it may reduce the risk of erosions.

However, reclamation works may lead to loss of shores, seabed, flora and fauna within the reclaimed areas. Due to the reclamation work, West Africa is facing the over-development and degradation of marine resources. Large areas of intertidal habitation have been lost around the Yellow Sea, China. Besides this, reclamation work have give more pressure on natural resources such as forests and more pressure on fishery resources. This is because pollutants that discharged into river or sea affect the fishery resources and marine environment [4]. For example in Indonesia reclamation had caused mangrove forest and coral reefs function became deteriorated. Apart from this, reclamation would have caused the flow outside the channel to slow, seawater purification declines, frequency and

intensity of algae bloom increase which would also affect fisheries activities [1]. The aim of this study was to investigate the effects of dredging and reclamation projects and to identify what are the impacts that faced by local people in their area when there are dredging and reclamation projects.

4.0 METHODS

In this research, questionnaire has been used as a method to obtain results on the impact of dredging and reclamation. People from two villages who are the victims of reclamation project that being held since 2014 has been selected as respondents to answer the distributed the questionnaire [16]. The reclamation works are performed to construct petroleum hub in Pengerang, Johor. The two villages are Kampung Teluk Empang and Kampung Langkah Baik from Pengerang, Kota Tinggi, Johor in Malaysia. With the reference of the Krejcie & Morgan Table, 157 of respondents have been asked to fill up the questionnaires. The questionnaires have been done to receive feedback on what are the impacts they are facing due to this project.

The questionnaire has been divided into part A and Part B. Part A covers questions on demographic while part B covered opinion and feedback of local people regarding the dredging and reclamation projects at their place. The questionnaire have been analyzed by using *Statistical Package for Social Science (SPSS)*, Version 20 software to analyze mean value.

5.0 RESULTS AND DISCUSSION

In this chapter, the data obtained from the questionnaires are graphed and analysed. The results will show the opinion and the feedback of the village peoples regarding the dredging and reclamation works in their area. Demography analysis has been performed to study the human populations in Kampung Teluk Empang and Kampung Langkah Baik. According to the results, it can be summarized that the local people consists more males than female gender and the percentages are 57.1% and 42.9% respectively. Most of them are fishermen and some are doing small business. The local peoples are mostly in between 45 to 54 years old with 30.4% which is highest percentage compared to other age groups. From the questionnaire, it can be concluded that the percentage of Kampung Teluk Empang people are higher than Kampung Langkah Baik and the differences are 18%. Most of the local peoples are Malays with population of 98%.

Part B in questionnaire was performed to answer the first objective and second objective. First objective is to find out the local peoples' opinion on the dredging and reclamation projects in Pengerang, Johor. The second objective is to investigate the impacts that have been faced by the local people. The scale of measurement used in section B is likert scale which is effective and easiest method to get the data. The higher the average index, the impacts are much higher.

The data obtained from the questionnaire have been graphed and analysed. Figure 2 represents the answer to the question "do you believe dredging and reclamation projects done to increase the acreage of land to overcome shortages of land", a total of 16.1 % of respondents said "yes" with a frequency of 9 and 83.9 % responded "no" with a frequency of 47. This indicates that most people disagree that dredging and reclamation projects done to overcome shortages of land.

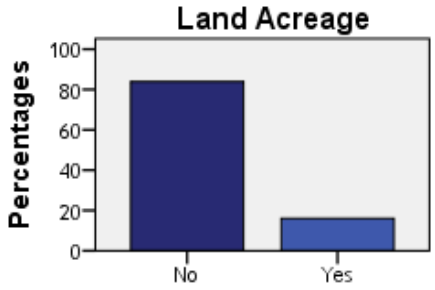


Figure 2 The impacts on land acreage

Figure 3 below shows the result from analysis of the question "does reclamation process in Pengerang adversely affect living organism and plants". The result shows that all respondents said "yes". Percentage shows 100% with a frequency of 56. Therefore, it is undeniable that the dredging and reclamation projects conducted bring a major impact on living organism and plants. The amount of marine species reduced and the fishermen unable to increase their income because the fisheries resources reduced.

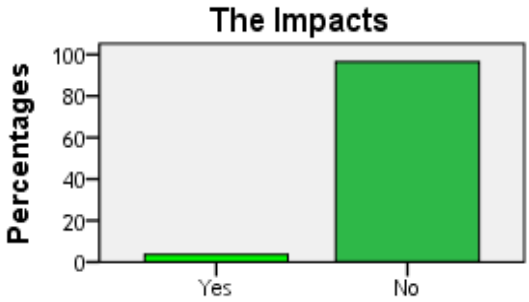


Figure 3 The impact of reclamation to living organisms and plants

For the question "Is the implementation of dredging and reclamation projects in Pengerang can create an economic growth" represented by Figure 4. Percentage of respondents who answered "yes" was 98.2 and its frequency is 55. Percentage of people

who said "no" is 1.8 with a frequency of 1. This may be caused by the fact that new development in a particular area may create job opportunities for the local people. This can increase their living standards at the same time will lead to economic growth.

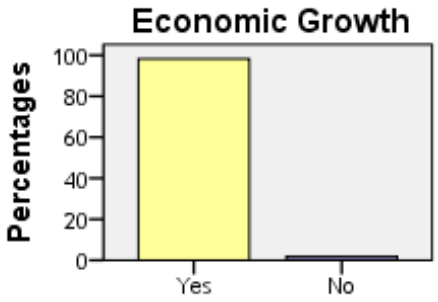


Figure 4 The reclamation project to improve the economic growth

When the questionnaire was distributed, some of the impacts are found by the local peoples due to dredging and reclamation projects in their area. This data has been analysed by using *Statistical Package for Social Science (SPSS),* version 20.0. The mean value obtained for each impact has been prepared in accordance with the highest mean value to the lowest mean value. The scale of measurement used is likert scale (Table 1) which is effective and easiest method to get the data and to find the mean analysis. The mean analysis for each effect has been sorted in accordance with the highest mean value to the lowest min.

Table 1 Average Index (AI) for likert scale

Scale	Item	Average Index (AI)
1	Strongly disagree	0.00<AI<1.50
2	Disagree	1.50<AI<2.50
3	Neutral	2.50<AI<3.50
4	Agree	3.50<AI<4.50
5	Strongly agree	4.50<AI<5.00

The results obtained have been summarized in Table 2. The result shows that the highest mean achieved due to the impact of the dredging and reclamation projects is the 'income of local peoples reduced' is 4.66. Based on the analysis, the project stakeholders are tend to do the development without considering the welfare of the local people. This is due to the lack of proper planning before the construction works started.

While second highest impact is 'business of local peoples affected' because of the dredging and reclamation projects with 4.64 mean. Most businesses in Kampung Teluk Empang and Kampung Langkah Baik were closed and have to move to other places. This shows that before projects are to be done in area that surrounded by people, the projects stakeholders should do a proper monitoring planning and gather all the information on geotechnical engineering and socio-economic so that the society will not be affected.

The third impact with the mean of 4.57 is the local people had to move to other places. The people have to leave their houses and move to the other places which provided by the project's stakeholders. Apart from that the local people also had big loses such as on fixed assets and temporary assets.

Analysis showed that there were several impacts that have the same mean, which are 4.55. The local people experiencing sound and air pollution that disrupting the serenity of their life. The impact of people's health and the amount of fisheries resources reduced also have the same mean number which is 4.54. The project undertaken believed that the fishermen could not go to the sea. This is because the process of dredging, reclamation and construction disturbed the habitat of the marine life.

The impact that have lowest mean is 4.51. The impact is the fishermen and other residents in Kampung Teluk Empang and Kampung Langkah Baik were unable to find other jobs. This is because most of them are low educated and do not have skills in other areas but just rely on the catches and also small businesses that carried out around the village. Therefore, all professionals and the project's stakeholders should cooperate in solving the issue that rose and to overcome these major impacts.

Table 2 Mean analysis on the impact of reclamation works

Impacts Of Dredging And Reclamation Projects	Mean Value
[1] Income of the local peoples reduced	4.66
[2] Affect local people's business	4.64
[3] Local people had to move to other place	4.57
[4] Big loses	4.55
[5] Sound and water pollution	4.55
[6] Affect human health	4.54
[7] Fishery resources reduced	4.54
[8] The fishermen were unable to find another job	4.51

6.0 CONCLUSION

The aim of this study was to investigate the effects of dredging and reclamation projects and to identify what are the impacts that faced by local people in their area when there are dredging and reclamation projects. In conclusion, dredging and reclamation works that are carried out without a proper integrated environmental management could cause long-term environmental impacts, affect marine environments, affect welfare of local peoples and also give impact to the fishing industry. The results also showed that dredging and reclamation projects

should be done in proper management so that adverse impact can be reduced. Project contractor should take necessary steps such as survey in project areas and survey on people feedback regarding the project before carrying out the activities. Thus suitable decision support and environmental management tools should be used by the stakeholders. Evaluation and monitoring should be carried out before the project starts, during and after the projects ended.

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