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"Educating for a Sustainable Future: Navigating the Impacts of Land Reclamation on Fishing Communities". Case Study: Pantai Robina, Pulau Pinang, Malaysia

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Abstract

This study explores the intertwining of sustainability and education in fostering a society capable of preserving ecological resources, with a focus on the environmental impacts of coastal land reclamation on local communities. In Malaysia, particularly on Penang Island, land reclamation has surged over the past two decades to support commercial, industrial, residential, and tourism development. While these projects enhance urban capacity, they raise significant environmental concerns, particularly regarding marine ecosystems and local livelihoods. This research investigates the sustainable implications of land reclamation on Robina Beach in Penang, emphasizing its effects on the local fishing community. Through structured questionnaires targeting fishermen, segmented into demographics, professional background, and a Likert scale for nuanced responses, along with discussions with the Head of the Fishery Association in Bagan Ajam, Pulau Pinang, the study captures the community's experiences and concerns regarding reclamation projects. Findings reveal that all respondents recognize the negative environmental impact of reclamation, which threatens marine life breeding grounds and disrupts their livelihoods. While fishermen do not oppose development, they urge the state government to consider all aspects of reclamation to prevent adverse outcomes. The study advocates integrating sustainability into reclamation practices to safeguard environmental integrity and protect the livelihoods of affected communities.

Keywords. Land Reclamation, Environment, Sustainability, Impact, Fishermen Society

Introduction

The phrase "Navigating the Impacts of Land Reclamation" refers to the process of understanding, addressing, and managing the various effects that the practice of land reclamation has on the environment, society, and economies. Land reclamation involves the creation of new land from ocean, rivers, or lake beds, often for agricultural use, industrial,

residential, or commercial development. Navigating its impacts involves assessing both the positive outcomes, such as increased land availability, and the negative consequences, such as environmental degradation, loss of habitats, and potentially adverse effects on local communities and economies. It encompasses strategies, policies, and actions aimed at mitigating negative effects while maximizing the potential benefits of newly reclaimed lands (Tu, & Huang, 2023).

In Malaysia, developed coastal areas projects for reclamation land have increased over the last decades for commercial, industrial, residential, and tourism development (Kaparawi & Latif, 1996). Development of land reclamation without proper environmental management will have a long-term impact on the environment, aqua life, and also fishing industry (Feola et al., 2016). Reclamation projects are built for many reasons in order to expand the land area. This occurs as a result of economic growth, and it can now be used as dry land for all economic activities. Land reclamation is no longer an uncommon and rare activity. It has become a common activity, especially in Penang, Malaysia. Penang has grown rapidly as a result of positive economic growth. According to DOSM, in 2019, Seberang Perai Utara (SPU) had a population of 340,600 people with a population density of 1272 people per km. The requirement for urban growth and infrastructure has risen in line with the increase in population development (Ramly, 2008). This will give the opportunity to stakeholders in order to develop the reclamation. The fact that reclamation can have an impact on the environment cannot be ignored. The indirect impacts on the environment can involve geological changes, coastal morphology, hydro-oceanography, and lots more. That leads to a decrease in the quality of the coastal, the extinction of animals and plants, habitat in coastal areas, water pollution, reduced capability of coastal disaster and more (Pincetti, 2023).

Pantai Robina in Penang has been taken as the study area for the land reclamation project's impact on the fishermen. Back then, a mega project of reclamation project on an undersea tunnel was proposed by stakeholders in this study area that links the island with the mainland in Penang, which took 12 years to complete the project (TSD, 2018). The stakeholders involved have submitted a feasibility study to the state government and improved all the comments given by the government and authorities involved in 2019, but due to some reasons, the project is not to be done (The Edge Market, 2021). Currently, in that area, the proposed land reclamation project for over 407 hectares is in discussion, and the stakeholder has already submitted their Environmental Impact Assessment (EIA) to the Department of Environment (DOE) (Dermawan, 2021). The project is still being discussed with the government and authorities involved. During that time, it turned out that most of the people did not agree with the project. In this study area, Datuk Yusoff Mohd Noor has submitted a protest letter regarding the proposed RM2 billion reclamation project that involves 407 hectares to DOE, requesting that the DOE consider cancelling the project due to its socioeconomic and environmental consequences (TSD, 2021). Due to that, the Penang Fishermen Association handed over a memorandum expressing their concerns about the project, stating that more than 5000 fishermen, as well as the shores area and people who live there, will be affected (Sekaran, 2019).

According to Datuk Yusoff Mohd Noor, the division chief of Umno Tasek Gelugor (Mok, 2021), who is also the state opposition leader and a Sungai Dua assemblyman, stated that there is no urgent need to reclaim land to create more land in the study area, citing

the fact that there is no shortage of land in the area. Hence, excessive reclamation will restrict the area of the port, causing the water to flow faster and the instability to increase, which will affect ship navigation. It devastates marine ecosystems and hurts aquatic organisms' lives. These creatures are not only unable to survive, but there are also many tides that will happen. Since fishermen are the sector most affected by reclamation, thus fishermen are taken as a role study for this study. In general, land reclamation impacts marine life, which is why fishermen's resources will be impacted (Al-Madany et al.,1991). All the risks of the project reclamation can be reviewed and determined via the questionnaire that will be provided to the fishermen in this study area. On the other side, this study also can help fisheries industries. The objectives of this study are to review the risk of reclamation activities to the environment in this study area, to determine the environmental impact of reclamation activities in this study area, and to investigate the relationship between the land reclamation activities and environmental impact at coastal areas among the fishermen.

Research Methodology

The data from the respondents in this study area will be collected in a quantitative manner in this study. Quantitative manner is a data type measured on a numerical scale collected by using a survey for this study case. The data will be collected by using a questionnaire, which acts as the primary data to observe the issues, while for secondary data, the information on mitigation will refer to the previous study of the previous reclamation. The survey will be distributed among the fishermen in this study area to know the impact of reclamation. The study will be conducted at Pantai Robina, Pulau Pinang, which is one of the tourist attractions. It is because a land reclamation project is going to develop here. For this study, the questionnaire has been used an on-paper analysis tool, and the analysis items are mainly in level from strongly agree to strongly disagree. Therefore, the questionnaire is an effective method for gathering the data, and hypotheses supporting quantitative research are generated for this study. The data will include issues and problems of the reclamation process as well. The goal of a quantitative study is to gather primary data in order to determine the impact of reclamation operations on the environment for fishermen in the study area.

The survey is divided into demographics, fishing backgrounds, and Likert scale questions. The demographics section asks for the personal details of the respondents, which consist of five questions of multiple choice that are gender, age group, ethnicity, marital status, and income range. For fishing backgrounds, this section provided information about fishermen's backgrounds to know their involvement in fishing activities. The more years a fisher has been fishing and how frequently they go fishing, the more they can be expected to be. This will aid the study in obtaining near-accurate data because they are already aware of the impact of land reclamation. For the Likert scale, the responses of the participants are gathered as data using a Likert scale questionnaire with five scales ranging from 1 to 5, with one being the most strongly disagreed with and five being the most strongly agreed with. Each statement will perform a calculation to determine the value of the mean. If the mean value is close to 5, it means that most respondents strongly agreed with the statement. In contrast, if the mean value is close to 1, it means that most respondents strongly disagreed with the statement. Thus, information about the reclamation can be gathered based on their knowledge and perspective on this reclamation project.

Results and Discussion

Based on the demographic data in **Table 1**, only one woman responded to the survey, and the majority of respondents were men, according to the findings. The majority of the respondents are between the ages of 26 and 50 which is 51%, followed by those aged 50 and above, which account for 33% of the respondents, and those under 25 who make up 16% of the respondents. The most prevalent ethnic groups are Malay (96%), followed by Chinese (3%) and Indian (1%), with 72% of those already married and another 28% single. Approximately ninety percent (90%) of respondents earn incomes between RM1001 and RM3000, seven percent (7)% earn incomes of RM3001 and more, and three percent (3%) have incomes less than RM1000.

Table 1
Demographic Data

About	Sample (N)	Frequency (F)	Percentage (%)
Gender	69		
Male		68	98
Female		1	1
Age Group	69		
Below 25 years		11	16
Between 26 - 50 years		35	51
51 years and above		23	33
Ethnicity	69		
Malay		66	96
Chinese		2	3
Indian		1	1
Others		0	0
Marital Status	69		
Single		19	28
Married		50	72
Income Range	69		
Below RM 1000		2	3
Between RM 1001 - RM 3000		62	90
RM 3001 and above		5	7

According to the data on the number of years as a fisherman in the figure below, it can be stated that most of the respondents have experience, with 87% having three years or more and another 13% having less than two years. As a result, it can be concluded that most respondents know about the reclamation project. Around 75% of the respondents went fishing almost daily, 14% only on weekends, and 10% only a few times. Hence, it can be stated that most respondents are well-informed about what is happening in their surroundings and have heard about the reclamation issues.

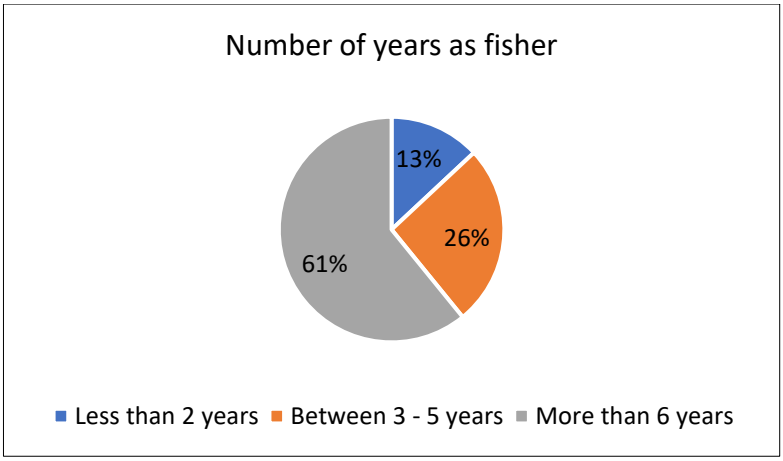

Figure 1. Pie Chart of the (a) respondents' experience as fishers

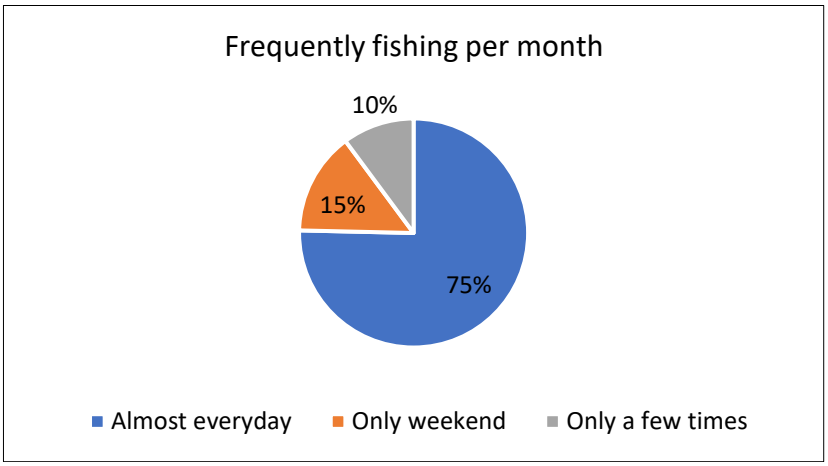

Figure 2. Pie Chart of the respondents' frequently go fishing

Table 2 shows the results of this section of respondents' opinions on a scale of 1 to 5, that is, from strongly agree to disagree strongly. The mean value has been calculated so that the scale of each statement by respondents can be taken whether they agree or do not disagree with the statement. The results for the Likert scale have been answered by 69 fishermen near the study area. According to the Head of the Fishery Association of Bagan Ajam, a few species of marine life are now nearly extinct, as evidenced by the current situation. Skipjacks, prawns, crabs, and other once-common sea life are no longer to be seen or found in this study area since they have gone extinct. Thus, the first and second objectives, which are to review the risk of reclamation activities to the environment in this study area and to determine the environmental impact of reclamation activities in this study area, are met. Some of the reclamation activities that impact the environment include the loss of biodiversity, loss of mudflats, loss of mangroves, reduced ecosystem service value and landscape fragmentation.

The fishermen understand the consequences of reclamation because they have taken lessons due to the reclamation project at Jelutong, which has had a negative influence on them. As indicated by the current situation, the risk of reclamation in this study area is that a few species of marine life are currently on the verge of extinction. Since going extinct,

skipjacks, prawns, crabs, and other once-common sea life are no longer discovered there. The reclamation project will no longer be safe for this species of marine life if it is still carried out without proper care for this habitat. Reclamation projects are common in Pulau Pinang because of the island's growing economy and the contractor's desire to produce additional new land for tourism-related purposes. However, it is believed that there is no shortage of land in the study area. The reclamation will have a lot of impacts that influence the environment, which will take a long time to recover and recoup the issues. Hence, the last objective to investigate the relationship between land reclamation activities and environmental impact at coastal areas among the fishermen has been accomplished. It can be proven during the process of the reclamation project. Some of it occurs during the piling process, which generates many waves that will cause a loss of habitat because it can run for roughly 50 miles. This is because constructing a piling on land differs from doing one in the ocean, where waves can go considerably farther than on land. Hence, this will impact fishermen, who would find it difficult to catch fish as usual. Additionally, the piling process causes a loss of marine habitats, such as coral reefs, which take roughly 50 years to recover.

Table 2
The results of respondents' opinions on a scale of 1 to 5

The statement	1		2		3		4		5		Mean
Respondents' opinion based on scale	Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		
	F	%	F	%	F	%	F	%	F	%	
The natural environment had been harmed by land reclamation.	0.0	0.0	1.0	0.4	1.0	1.4	24.0	34.8	43.0	62.3	4.6
Due to the whole loss of mudflats, the reclamation project has an impact on the ocean food chain and the fishing industry.	0.0	0.0	1.0	1.4	0.0	0.0	7.0	10.1	51.0	73.9	4.8
Fishermen's income has been impacted by land reclamation activities.	0.0	0.0	0.0	0.0	0.0	0.0	11.0	15.9	58.0	84.1	4.8
The fishermen's income had decreased due to the destruction of marine habitat caused by reclamation activities.	0.0	0.0	0.0	0.0	1.0	1.4	14.0	20.3	54.0	78.3	4.8

Marine life has declined due to water pollution caused by reclamation activities.	0.0	0.0	0.0	0.0	0.0	0.0	21.0	30.4	48.0	69.6	4.7
The ecosystem suffers because of reclamation activities.	0.0	0.0	0.0	0.0	0.0	0.0	8.0	11.6	61.0	88.4	4.9
The reclamation would have an impact on fishermen's livelihoods.	0.0	0.0	0.0	0.0	0.0	0.0	9.0	13.0	60.0	87.0	4.9
Reclamation has a negative impact on the environment.	0.0	0.0	0.0	0.0	0.0	0.0	17.0	24.6	52.0	75.4	4.8
Penang is becoming a high-tech international city as a result of reclamation.	22.0	31.9	12.0	17.4	3.0	4.3	15.0	21.7	17.0	24.6	2.9
The fishing area has been restricted due to reclamation project, and sea production will be severely reduced.	0.0	0.0	1.0	1.4	0.0	0.0	16.0	23.2	52.0	75.4	4.7
In this area, fishermen support with the a reclamation project activities.	41.0	59.4	3.0	4.3	0.0	0.0	7.0	10.1	13.0	18.8	2.1
Coastal construction is affected by land reclamation (for example hotel, condominiums).	6.0	8.7	0.0	0.0	1.0	1.4	11.0	15.9	51.0	73.9	4.4

Based on Likert scale data in Table 2, the mean value for the first statement, “The natural environment had been harmed by land reclamation”, is 4.6, indicating that the respondents agree with that statement. This is because the respondents agree that reclamation can harm the ecosystem, which includes the loss of biodiversity, loss of

mangroves, reduced ecosystem service value and landscape fragmentation. The second statement is "Due to the whole loss of mudflats, the reclamation project has an impact on the ocean food chain and the fishing industry", with a mean value of 4.1, indicating that respondents agree with the statement. Mudflat is home to some habitats such as crabs, fish, and molluscs and is also the main source of food for migrating birds, where mudflats attract a large number of them. It provides important services such as food production, storm production and coastline stabilization. The moment the reclamation project has been developed, it will cause the rise of sea level, coastal erosion, and decreased river sediment fluxes. "Not only that, even the route in the estuary area shifted, which caused the fisherman to become lost on the way back home. This happened at Kuala Muda back then, when a fisherman was lost in Indonesia, taking around 5 years to return home," said En Mazlan, Head of Fishery Association of Bagan Ajam. Respondents agree on the third and fourth statements, which are "Fishermen's income has been impacted by land reclamation activities" and "The fishermen's income had decreased due to the destruction of marine habitat caused by reclamation activities" share the same mean value of 4.8. Both statements are related because fishermen depend on their income from fishing to support themselves.

As a result, the moment the marine ecosystem is damaged, their income also decreases. Hence, the fishermen are the most likely to be affected by reclamation. The next statement is agreed by the respondents with a 4.7 mean value, "Marine life had declined due to water pollution caused by reclamation activities". According to the Head of the Fishery Association of Bagan Ajam, a few species of marine life are now nearly extinct, as evidenced by the current situation. Skipjacks, prawns, crabs, and other once-common sea life are no longer to be seen or found in this study area since they have gone extinct. Both statements, "The ecosystem suffers because of reclamation activities" and "The reclamation would have an impact on fishermen's livelihoods", are agreed by the respondents with a mean value of 4.9. "As an example, construct a dumb and then wrap two bottles around it. When the water meets both bottles and the bottles collide, a wave forms, causing the fish to run approximately 50 miles. So, imagine what would happen if a reclamation project were developed, and the quantity of wave that piling would generate as a result of the reclamation." said En. Mazlan, Head of Fishery Association of Bagan Ajam. This is because of the contrast between piling on the ground and in the water, where the waves in the seas can travel much further than the ground. Hence, this will have an impact on fisherman, who would find it difficult to catch fish as usual. Then, the statement "Reclamation has a negative impact on the environment" has a mean value of 4.8, which also lies in the agreeing statement value. One of the respondents said "The coral and reefs will be harmed as a result of the reclamation, which will take around 50 years to recover due to the project.". The mean value of the statement, "Penang is becoming a high-tech international city as a result of reclamation", is 2.9, where it can be concluded that the respondents disagree with the statement. "We are not against the development. Even without reclamation, Penang still can become a high-tech international city." said En. Mazlan, Head of Fishery Association of Bagan Ajam. "The fishing area has been restricted due to reclamation project, and sea production will be severely reduced" mean value 4.7. Most respondents disagree with the statement, "In this area, fishermen support the reclamation project activities", with a mean value of 2.0. This is because the fishermen understand the consequences of reclamation because they have taken lessons as a result of the reclamation project at Jelutong, which has had a negative influence on them. Respondents

agree with the statement “Coastal construction is affected by land reclamation (for example, hotel, condominiums)”, with a mean value of 4.5.

Conclusion

The objectives of this study have been achieved, which are to review the risk of reclamation activities to the environment in this study area, to determine the environmental impact of reclamation activities in this study area and to investigate the relationship between the land reclamation activities and environmental impact at coastal areas among the fishermen. Based on this study, the risk of reclamation activities to the environment in this study area has been attained where the short interview was made with the Head of the Association of Fishermen. It can be concluded that all respondents are aware with the negative impact of reclamation on the environment which will also disrupt their source of income and against the reclamation project. The fishermen claim that they are not opposed to state development for the betterment of the people but require the state government to consider all aspects so that they do not ruin the breeding sites of marine sea life and prevent all the bad impacts of reclamation, which could deprive their income. This is so that fishermen may contribute their fundamental perspectives on experiences to save and protect marine life. In conclusion, the reclamation project in this study area will significantly affect the growth and the population of marine life, thus affecting the environment and fishermen's livelihood. Furthermore, the reclamation will introduce pollutants due to the development that is built there, which will also have a negative impact on marine life and the environment. In short, the reclamation significantly impacts the marine environment, resulting in decreased biodiversity and a shift in community structures. Humans should focus on the ecosystem while gaining social and economic benefits from land reclamation projects. Overall planning from an ecological standpoint should be formed, and the sustainable development of the coastal ecological environment should be maintained. As a result, the impact of reclamation on the environment, marine life, and fishermen's livelihood can be prevented. If the contractor fails to mitigate the impact of land reclamation adequately, it will have a negative impact on the environment where all users will be affected. Upon the successful conclusion of this study, individuals will possess the knowledge to comprehend the impact of land reclamation activities on the environment in coastal regions, particularly their effects on fishermen. This insight will empower us to effectively address and minimize the potential risks and detrimental consequences linked to reclamation projects.

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